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Volume 30, No. 6, November 1987

Injury Scoring
Lithotripsy
Autologous Blood

The Canadian Journal of Surgery

Le journal canadien de chirurgie



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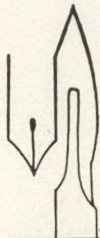
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QUILL ON SCALPEL

This section provides a medium through which Canadian surgeons can declare themselves, briefly and informally, on the day-to-day affairs of surgery.



Pharyngoesophageal Reconstruction With Free Jejunal Grafts

In this issue (pages 436 to 439), Hynes and colleagues have described their experience with the use of free jejunal grafts in the reconstruction of pharyngoesophageal defects. The authors are to be congratulated on their management of these difficult cases. One patient who had an extensive malignant lesion requiring total pharyngectomy presented a particularly difficult management problem.

The low overall cure rate combined with the high morbidity and mortality associated with surgical resection of tumours and reconstruction in the pharyngoesophageal region underlines the importance of a reliable reconstructive technique that will allow rapid postoperative recovery and early discharge. Because life expectancy in the majority of these patients will be less than a year, the "ideal" situation would allow the oncologic principle of wide surgical excision

with tumour-free margins to be followed without hesitation by reconstruction with an easily obtained reliable flap producing little morbidity at the donor site.

Hynes and colleagues give an excellent review of the methods of pharyngoesophageal reconstruction currently available. They present a positive experience with the free jejunal graft. Their discussion of arc length versus cord length is intriguing. The diagrams they present clearly demonstrate the futility of taking a larger piece of jejunum to gain a small amount of length in the neck. The end result of increasing the length of jejunum is obviously to increase the tortuosity of the neopharynx and thus the likelihood of pooling of secretions, stricture formation and difficulty with swallowing rehabilitation postoperatively. I have had problems with such reconstruction that could have been prevented by an appreci-

ation of this feature. The "S" approach is a novel way to overcome the need for increased length, but this further complicates the procedure and increases the possibility of complications because of the need for both a second vascular and bowel anastomosis in the neck. Nevertheless, I think this approach is a valuable addition to our armamentarium when treating a patient who needs pharyngoesophageal reconstruction and in whom all other techniques have been eliminated because of either previous attempts or underlying conditions that prevent their use.

The most notable aspect of Hynes' experience is that to treat these difficult cases a group of surgeons from competing specialties came together to facilitate the use of a reconstructive technique that, by its very design, precludes any one surgeon from being able to perform it.

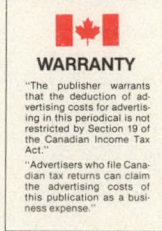
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Detailed instructions to contributors, in English and French, appear on page 41 of the January 1987 issue.

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The combination of an otolaryngologist, plastic surgeon and general surgeon, all with an interest in the head and neck, from both an oncologic and reconstructive point of view is an excellent example that we should all emulate. I think it's important to realize that, regardless of one's specialty, a major reconstructive procedure such as this requires a team approach. Very few centres that I am aware of would have a team of specialists all from one specialty with expertise so wide ranging that they could carry out pharyngeal reconstruction using a free jejunal graft. I think it's equally important to recognize that this is an excellent

technique for reconstruction and for this reason the interdisciplinary approach is essential.

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How I Do It

In this issue, your coeditors inaugurate a new feature — the "How I Do It" sec-

tion. Supervised by Dr. N. Sheiner, this section should provide an opportunity for surgeons to display tricks of the trade that they have tried and found workable. Readers are encouraged to develop and submit descriptions of techniques that may be of benefit to others. A cautionary note is raised, however — words are not enough! Good illustrations are essential to the success of the effort. We hope you enjoy this section and will use it to share thoughts and operative skills.

L.D. MACLEAN, MD, FRCSC

C.B. MUELLER, MD, FRCSC

Coeditors

CORRESPONDENCE

Contributions to the Correspondence section are welcomed.
They should be typewritten and double spaced.

Urinary Stress Incontinence

To the editors.—In his editorial on urinary stress incontinence (*Can J Surg* 1987; 30: 150-151), Taguchi's description of the third author of the classic 1949 paper detailing the Marshall-Marchetti-Krantz (MMK) procedure is inaccurate, incomplete and most assuredly inappropriate for a scientific publication.

Dr. Kermit E. Krantz's "uncertain" specialty is gynecology and obstetrics. He is currently the chairman of the Department of Gynecology and Obstetrics at the University of Kansas, a position he has held for 28 years.

Dr. Krantz's contributions in the areas of stress urinary incontinence are, and continue to be, of the highest order. He has instructed hundreds of physicians in the technique of the MMK and has personally performed more than 4600 of these procedures. Numerous book chapters, articles and teaching films have been produced by Dr. Krantz over the past 35 years, improving the quality and standard of care provided to women plagued by this problem. Furthermore, Dr. Krantz contributed to the knowledge of the anatomy of the female reproductive system. In view of Taguchi's inaccurate description of the "tough fascial lining of the vagina" it is little wonder he is unfamiliar with Dr. Krantz's landmark contributions to this area,^{1,2} which are of such significance that he serves as professor of anatomy at the University of Kansas.

In conclusion, we hope that Dr. Taguchi's evaluation of those patients presenting to him with stress urinary incontinence is much more complete and accurate than his evaluation of the history of the management of this problem. More importantly, may the knowledge that guides his hands in surgery allow for more appropriate and compassionate management than the knowledge that apparently guides his pen.

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2. Idem: The innervation of the human vulva and vagina, a microscopic study. *Obstet Gynecol* 1958; 12: 382-396

To the editors.—Dr. Krantz must be pleased, if not bemused, by the ardour of support from the gynecologic staff in Kansas. So often, as we know, "a prophet is without honour in his own land". I apologize if I insulted Dr. Krantz — it was not meant personally. His expertise is unknown to many urologists as, I suspect, Dr. Marshall's many contributions are unknown to gynecologists. I was admittedly taking a swipe at medicine's passion for acronyms which, too often, bestows excessive credit upon some and not enough on others.

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SURGEONS' UPDATE



What's new in surgery is the subject of this column. The short items are designed to let readers know who's doing what and why. Surgeons are interested in what other surgeons are doing in research, education, practice and administration. Surgery is a vibrant specialty, and, as its practitioners, you must be the source as well as the readers of this column.

Provincial Government Takes Steps Toward Boosting Organ Donation in Ontario

The Walter J. Blackburn Multi-Organ Transplant Unit, a 12-bed centre expected to perform 250 heart, liver, kidney, lung and pancreas transplants each year, was officially opened recently at University Hospital in London, Ont. The Ministry of Health contributed \$4.8 million of the unit's \$7.2 million cost.

While attending the opening, Premier Peterson announced the names of the 13-member board of directors of the province's expanded organ retrieval network. The government will spend \$3 million on the computerized information system that will link transplant hospitals in Ontario, resulting in a single waiting list for all potential transplant recipients in that province.

This is the latest in a series of steps taken by the Action Group on Organ Procurement, established after the 1985 report by the Health Ministry's Task Force on Organ Donation, to improve donation in the province. To achieve this goal, hospitals, medical professionals and the public have been approached and various measures taken. As of January 1987, all hospitals were to have organ donation policies, and a series of videotapes concerning many aspects of donation is being distributed to hospitals. All physicians and active treatment hospitals were sent a brochure from the Ministry of Health summarizing the organ donation process and how to access the province's retrieval system. A pamphlet that answers questions about donation and contains a donor card was circulated to the public.

Robarts Institute Receives Grant

Further to its application for funding (*Can J Surg* 1987; 30: 5), the John P.

Contributions to this column are welcome. Please send your material to: Mrs. Amy Chouinard, *Canadian Journal of Surgery*, PO Box 8650, Ottawa, Ont. K1G 0G8.

Robarts Institute in London, Ont. has been awarded \$20 million by the National Institutes of Health, Bethesda, Md., to study the efficacy of carotid endarterectomy. The investigation will involve 3000 potential stroke patients in 50 hospitals in Canada and the US. Data will be collected and analysed at the Robarts Institute by a team directed by Henry Barnett, FRCPC, and Sydney Peerless, FRCSC (Fig. 1).



FIG. 1—H.J.M. Barnett (left) and S.J. Peerless, directors of study on carotid endarterectomy.

Professional Liability

The numbers are staggering. Premiums for liability insurance have more than quadrupled since 1984. Settlements are in the multi-millions of dollars. Ten years ago, according to one US insurance company, the incidence of suits was one in every 20 physicians; the figure is now one in 8. Although the liability crisis in Canada has not reached the same proportions it has in the US, it is headed in the same direction.

What has caused this problem to esca-

late so dramatically? John O'Brien-Bell, president of the British Columbia Medical Association, addressed this topic at the CMA annual meeting in Charlottetown, PEI, in August. He referred to a comment made by the chairman of the American Medical Association's liability committee that the increase in law suits does not represent a decline in the quality of health care but, instead, the opposite. The quality of care is such that the public now expects the perfect outcome. This, however, is unreasonable since, as the *American Medical News* reports, surgery produces an adverse outcome in about 1 of every 20 cases. And although, according to a 1974 survey, the surgeon is only negligently at fault in 17% of these adverse outcomes, the only way for an injured patient to be compensated is to sue.

The standard by which an accused physician is judged changed in 1980 when the Supreme Court of Canada discontinued the use of professional disclosure — a comparison with what another doctor would have done in similar circumstances — and adopted the American idea of "informed consent". Now, surgeons are required to "fully disclose to their patients the nature of the proposed operation, its gravity and any material risks or special or unusual risks associated with the proposed procedure". Because this is an impossible task, even a competent surgeon can be found at fault.

The effects of litigation have been extensive. There are the obvious high costs of legal fees, settlements and insurance premiums and the hidden, unestimable costs of defensive medicine. As O'Brien-Bell points out, although only 1 skull x-ray in 100 is thought to be of clinical significance "it is a universally held legal maxim that it is an essential investigation of head injury — rash indeed is the doctor who arrives in court not having ordered one...". Perhaps even more devastating to surgeons are the nonmonetary costs. O'Brien-Bell cited a study in which one-third of doctors who had been sued considered early retirement, 19% had lost nerve in clinical situations and

42% had subsequently avoided high-risk cases.

What is the solution? Suggestions have been made, but so far no workable answer has been found. Those who have studied professional liability in the US say that there can be no solution, only management of the situation, and have made such proposals as limiting awards and using pre-trial screening panels to determine if medical care was competent.

The Canadian Association of General Surgeons has formed an *ad hoc* medico-legal committee under Dr. Nis Schmidt to gather data regarding trends and problem areas for general surgeons. It has also been recommended that education on

medical litigation be considered for medical schools.

On the Move

John Wedge, FRCSC, head of surgery at University Hospital in Saskatoon, will be leaving the department on Dec. 31, 1987 and filling the position of head of orthopedics at Toronto's Hospital for Sick Children.

Beginning in the new year, Robert McMurtry, FACS, FRCSC, who is

presently at Sunnybrook Medical Centre in Toronto, will be head of surgery at Foothills Hospital in Calgary.

Two of CJS's Editorial Board members have taken up residence outside Canada. Max Cohen, professor of surgery at the University of Toronto, is now chairman of the Department of Surgery at The Graduate Hospital in Philadelphia, Pa. and Patrick J. Taylor, formerly professor in the Department of Obstetrics and Gynecology at the University of Calgary, has crossed the Atlantic and is now working at the Bourn Hall Clinic in Cambridge, England.

LAUREL WILLIAMSON

BOOK REVIEWS

THE ART OF TOTAL HIP ARTHROPLASTY. Edited by William Thomas Stillwell. 507 pp. Illust. Grune & Stratton Inc., Orlando, Fla.; Academic Press Canada, Don Mills, Ont., 1987. \$306.95. ISBN 0-8089-1813-3.

The author of this book believes that a successful total hip replacement requires a combination of both art and science. Whether or not this proposition, with respect to hip arthroplasty, is true is debatable, but it is my opinion that art and science have been melded together to make a unique orthopedic textbook.

Dr. Stillwell sets out to create a "practical reference for the practising orthopaedic surgeon with a special interest in hip replacement". Since over 400 000 total hip arthroplasties are performed each year world-wide, the appearance of such an encyclopedic text on the subject is timely. The author is not only an accomplished hip surgeon, but also an artist, and over 150 of his drawings illustrate the text. It is the combination of the many superb illustrations and the comprehensive nature of the text, devoted entirely to total hip arthroplasty, that make this book exceptional.

The book is divided into three sections: fundamentals, primary total hip arthroplasty and complex total hip arthroplasty. The chapters, written by the author with 42 contributors are all readable, detailed and current. I particularly enjoyed the chapter on the history of total hip arthroplasty which describes the development of this revolutionary operation with illustrations of literally dozens of the early prostheses. Other chapters cover biomechanics, pathomechanics, finite element analysis and its relationship to arthroplasty design, implant selection, instrumentation and the operating-room environment.

The section on primary total hip arthroplasty discusses in detail the anterior, transtrochan-

teric, lateral and posterior approaches. Many of the author's "surgeon's eye view" illustrations are in these chapters. These chapters should be particularly useful to residents learning a new approach to the hip. There is a rather abbreviated chapter on the differential histology of the bone-cement and bone ingrowth interfaces followed by comprehensive chapters on cementing technique and the technique of both cemented and cementless arthroplasty. Perhaps a criticism should be made that the book is too current — the chapter on cementless arthroplasty goes into great detail on the characteristics and operative technique used for the three most common uncemented arthroplasties in current use. As new developments occur this chapter will become dated; however, the author acknowledges at the end of the book that in the hip arthroplasty field "the only certainty is change". There are chapters on infection thromboembolic disease, heterotopic ossification and rehabilitation as they relate to total hip arthroplasty. These chapters pull together a great deal of information from widely varying sources and provide a fertile resource.

The final section of the book deals in detail with miniature components, arthrodesis, trochanteric problems, long-stem arthroplasty and revision arthroplasty. I was pleased to see that an entire chapter on sciatic neurolysis was included. The author maintains, and I agree, that many sciatic palsies could be avoided by careful neurolysis at the time of revision hip arthroplasty in order to avoid injury to this vital nerve. Once again, the illustrations in this chapter are superb and add greatly to the text. It was a pleasure to review this book, not only for its content, but also for its "art". Although it will find a place in all institutional libraries where total hip arthroplasty is performed and in the library of all hip surgeons, I suspect it will find its way on to many coffee tables as well! Its price is prohibitive for trainees, but

all aspiring hip surgeons should have access to this superb reference.

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CARDIOPULMONARY BYPASS. Principles and Management. Edited by Kenneth M. Taylor. 439 pp. Illust. University Press, Cambridge; Williams & Wilkins, Baltimore, 1986. \$58.95 (US). ISBN 0-683-08105-5.

This book covers an area of great importance to cardiovascular surgeons but about which little has appeared in textbook form. The contributors to this book from Great Britain and the United States include such well-known names as Braimbridge, D. Hill, D.G. Melrose and D. Bregman. The foreword is by Norman Shumway and John Morvin. The book contains excellent contributions in the area of pulsatile perfusion, perfusion techniques for pediatric cardiac surgery, extracorporeal membrane oxygenation, myocardial protection, micropore filtration during cardiopulmonary bypass and blood conservation.

The book is well edited and illustrated with suitable photographs and graphs, and the references at the end of each chapter are up to date.

There are no major flaws in any of the chapters, although the information on cardiac

continued on page 391

STATE OF THE ART

J.W.L. WILSON, MD, FRCSC;* J.C. NICKEL, MD, FRCSC;* R. NOLAN, MD, FRCPC†

Percutaneous Renal Surgery

Percutaneous renal surgery was developed initially to remove renal calculi safely without the attendant morbidity of standard open pyelolithotomy. As familiarity with techniques has been obtained, other intrarenal diseases have been treated using this approach. This report reviews the current applications of percutaneous renal surgery and discusses its relation to extracorporeal shock-wave lithotripsy in the management of renal calculi.

La chirurgie rénale percutanée s'est développée initialement comme moyen d'enlever les calculs rénaux de façon sûre, sans encourir la morbidité reliée à la pyéolithotomie ouverte conventionnelle. A mesure qu'on s'est familiarisé avec les techniques, d'autres maladies rénales ont été traitées par cette voie. Cet article passe en revue les applications courantes de la chirurgie rénale percutanée et commente son apport à la lithotripsie extracorporelle aux ultra-sons dans le traitement des calculs rénaux.

I will not cut persons labouring under the stones but will leave this to be done by practitioners of this work.

OATH OF HIPPOCRATES

For nearly 3000 years, patients who laboured under the stone required cutting by practitioners of the art of open lithotomy. The large and traumatic incision, created to remove relatively small calculi, was associated with morbidity, lost time and cost. Over the last decade,

From the *Department of Urology and †Department of Radiology, Queen's University, Kingston, Ont.

Accepted for publication May 14, 1987

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new techniques have revolutionized the surgical treatment of renal calculi, resulting in much less morbidity, shorter convalescence and lower treatment costs. The aim of this review is to survey percutaneous nephrostolithotomy as one part of the revolution and to examine its wider applications to noncalculous diseases.

Reports of stone removal through existing nephrostomy tracts were published as early as 1941.¹ However, percutaneous intrarenal surgery awaited the development of techniques for safe percutaneous nephrostomy placement, first described simultaneously by Goodwin^{2,3} and Wickbom,⁴ and the availability of instruments that would reliably dilate the nephrostomy tract and manipulate intrarenal calculi. The names Alken,⁵ Fernström and Johansson,⁶ Smith,⁷ Clayman,⁸ Segura⁹ and Wickham¹⁰ all feature in the development and popularization of these procedures. The techniques of percutaneous access and tract dilatation are beyond the scope of this review; however, it should be emphasized that the greatest success has been achieved when a urologist works in close cooperation with a radiologist experienced in the interventional techniques required for the accurate and safe placement of a percutaneous nephrostomy.

Percutaneous Nephrostomy

Most authors agree that there are relatively few contraindications to percutaneous nephrostomy placement.¹¹ The only absolute contraindication is an uncorrected bleeding diathesis. Relative contraindications include uncooperative or confused patients, extreme obesity or severe kyphoscoliosis when visualization is impossible. Untreated obstructive pyelonephritis may indeed be best treated initially by placement of a percutaneous nephrostomy. Horseshoe, solitary, polycystic and transplanted kidneys have all been safely approached using this method.¹² When the collecting system

lies above the 12th rib, supracostal puncture can be carried out with minimal risk of pulmonary injury.¹³ Localization of the collecting system for nephrostomy is usually by fluoroscopy after injection of iodinated contrast agents. In patients allergic to these agents, visualization of the collecting system can be achieved by retrograde injection of contrast through a ureteric catheter or by ultrasonography if there is hydronephrosis. Alternatively, carbon dioxide can be introduced into the collecting system to provide radiologic opacification.¹⁴ Initial needle insertion may traverse the colon, but if the injury is appreciated and the tract not dilated, there seems to be few subsequent problems from the colonic perforation.¹⁵

Ideally, a radiologist places a catheter through the nephrostomy down the ureter to allow adequate stabilization for subsequent tract dilatation. In selected patients, retrograde nephrostomy can be achieved by placing a ureteric catheter in the desired calyx to be punctured and subsequently perforating the kidney, perinephric fat, fascia and flank muscle with a needle guided fluoroscopically through the specially designed catheter. These techniques and appropriate instruments were described by Lawson and associates¹⁶ and Hunter and colleagues.¹⁷

Once the percutaneous nephrostomy has been established, the tract can be dilated to the requisite size (usually no. 24 or 26 French). Initially, fascial dilators were used, but most surgeons now use specially designed systems incorporating a balloon catheter, metal coaxial dilators or the Amplatz renal dilator set, which leaves a working sheath in the tract, into which the various instruments may be introduced or removed without repeated dilatation. The open Amplatz sheath also has the advantage of allowing continuous drainage of an irrigant, thus preventing high intrapelvic pressure; this lessens the risk of retroperitoneal extravasation and absorption of irrigating fluid. The sheath also tamponades tract bleeding.

Percutaneous Nephrostolithotomy

Once access to the kidney has been obtained, various nephroscopes can be inserted to allow inspection of the renal pelvis and calculus if present. Both rigid and flexible instruments are available, the advantage of the former being easy manipulation of calculi and of the latter easy inspection of the whole collecting system. Stones smaller than 1.5 cm diameter can be removed intact, using forceps, graspers or baskets. Larger stones require lithotripsy with the electrohydraulic or, more commonly, the ultrasonic lithotrite. The latter, used only with the rigid nephroscope, is more controlled and likely to be less traumatic than the former. However, with experience, it appears that the electrohydraulic lithotrite, passed through the flexible nephroscope, can be safely used with caution in the narrow confines of calyces or the upper ureter. Tunable-dye pulsed lasers, using a flexible fiberoptic bundle, are currently being assessed.¹⁸ The fragmented calculi can be removed by flushing them into the renal pelvis, using the flexible nephroscope with an attached pulsatile irrigation dental appliance.

The success rate of these techniques has been reported as high as 98% for targeted renal pelvic calculi and 88% for upper ureteric calculi.¹⁹ Concern about damaging the renal tissues with the lithotrite was allayed by the study of Marberger and colleagues²⁰ who showed no long-term mutagenic, mechanical or thermal damage to rabbit kidney subjected to these procedures. The same group also showed that postoperative technetium-labelled dimercaptosuccinic acid (DMSA) scans in 82 patients failed to show scarring at the nephrostomy site; indeed, there was a 7.6% increase in renal function after stone removal.²¹

Intraoperative complications are mainly hemorrhagic. Most venous bleeding is successfully managed by insertion of a nephrostomy tube or a balloon dilator to tamponade this low-pressure oozing. Urine flow ceases, but resumes after a few hours, when the urokinase within urine causes lysis of the clot. Arterial bleeding can also be managed in this fashion, but, rarely, severe bleeding with hypotension may necessitate exploration that usually results in loss of the kidney. Arteriovenous fistula, the most serious postoperative complication, occurs in less than 3% of cases and can be minimized by proper selection of the nephrostomy puncture site into the calyx and the use of small nephrostomy catheters postoperatively. When fistulas do occur, embolization can be effective.²² Other complications include urinomas, when the renal pelvis is injured and there is inadequate postoperative drainage, avulsion of the ureter or stricture formation due to overzealous stone manipulation.

Endoscopic Intrarenal Surgery

Although primarily designed for removal of calculi, endoscopic techniques have been applied to other renal diseases. Calyceal diverticuli or infundibular stenoses can be approached percutaneously with a cutting electrode or cold knife to relieve obstruction or gain access to difficult calculi lodged behind the narrowed segment. Obstruction of the ureteropelvic junction can be dealt with percutaneously using the optical urethrotome to incise the stenotic area down to periureteric fat.²² The area is stented for 4 to 6 weeks and the stent removed at an outpatient cystoscopy. Balloon dilatation can be most useful in cases in which a previous pyeloplasty has failed. Its use in children has not been extensive, but preliminary reports are encouraging.²³ Postoperative ureteric strictures and stenoses at the site of ureterointestinal anastomoses for urinary diversion can be treated effectively with percutaneous balloon dilatation.²⁴

The standard treatment for upper tract transitional cell carcinoma is nephroureterectomy. Recently, more conservative approaches (segmental ureteric resection and partial nephrectomy) have been used with encouraging results. In selected cases — those with suspected low-grade papillary tumours revealed by conventional radiological procedures, in elderly debilitated patients or in those with a solitary kidney — a percutaneous approach may be used. Despite encouraging reports, our experience in such situations is limited; however, we used this technique to resect a low-grade tumour in an elderly, debilitated, but symptomatic patient with gratifying results.

Role of Endourology in the Days of Extracorporeal Shock-Wave Lithotripsy

Simultaneously with the development of percutaneous lithotripsy, Chaussy and colleagues²⁵ were reporting the use of focused shock waves to pulverize renal calculi in situ. This technique, with subsequent passage of stone fragments, now known as extracorporeal shock-wave lithotripsy (ESWL), requires minimal postoperative convalescence and in many cases can be done on an outpatient basis. As experience is gained with both of these modalities it is becoming clear that they are complementary. Extracorporeal lithotripsy deals most effectively with small calculi, and there appears to be no difference whether they are calyceal or pelvic. Percutaneous lithotripsy is effective in both types, but calyceal stones are most difficult to treat, requiring expertise on the part of the radiologist to access the appropriate calyx and of the urologist to locate the stone intraoperatively.

Large calculi (more than 2 cm in

dimension) can be treated with ESWL, but follow-up studies show a significant risk of fragments remaining within the urinary tract that may act as foci for stone growth.²⁶ Also, when large stones are treated by ESWL, the fragment volume may obstruct the ureter ("steinstrasse") leading to further operative intervention. Percutaneous lithotripsy does not deal effectively with very large staghorn calculi, since calyceal extensions may not be accessible without multiple nephrostomies. It is now suggested by many investigators that large stones be debulked initially by percutaneous procedures, with subsequent ESWL treatment of residual calyceal fragments.²⁷

Any obstruction to urinary outflow is an absolute contraindication to ESWL, specifically obstruction at the ureteropelvic junction, ureteric stricture or stones in calyceal diverticuli. Morbidly obese patients and children cannot be treated with current designs of lithotriptors because of size consideration. It is also suggested that patients with previous radiotherapy involving the ureters should not be treated with ESWL. Case reports indicate post-treatment formation of ureteric strictures, perhaps because of the trauma caused by passage of stones.²⁸ All patients have hematuria after ESWL and antithrombotic medications including acetylsalicylic acid need to be discontinued before treatment.

Long-term follow-up studies are necessary for patients treated by ESWL to determine the effect of residual stone fragments in the collecting system. Long-term studies on renal function are necessary, although in the short term no deleterious effect has been documented.

Summary

New techniques for the treatment of renal calculi include percutaneous nephrostolithotomy and extracorporeal shock-wave lithotripsy. Both techniques, which are associated with low morbidity, offer patients rapid, safe procedures to free them of the symptoms of renal calculi. Both procedures are complementary, and patients should now be offered these techniques in the management of their renal calculi.

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BOOK REVIEWS

continued from page 388

anesthesia will be of little practical use to the North American cardiac anesthesiologist because of emphasis on techniques not widely used here. The article on counterpulsation techniques refers to some that are not currently used. There is no mention of left ventricular assist devices or the artificial heart.

This book should be of value to those training in cardiac perfusion, cardiac surgery and cardiac anesthesiology. It is an excellent book and would serve as a useful background reference source. It is recommended for including in the medical libraries of hospitals where open-heart surgery is performed.

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COLOR ATLAS OF COLORECTAL SURGERY. P.E. Jones and R.J.P. Siwek. 199 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1987. Price not stated. ISBN 0-8151-4884-4.

This atlas is divided into three parts: general principles of colorectal surgery, elective operations and emergency surgery for the colon and rectum.

The first part deals with certain common concerns in colorectal surgery. While the book is intended as an atlas, it includes sections on mechanical and antibiotic bowel preparation; notably, the use of standard North American approaches (e.g., magnesium citrate and Golytely solution) are not mentioned. Furthermore, the approach to antibiotic prophylaxis is somewhat unconventional in that the use of parenteral and oral nonabsorbable antibiotics are omitted in favour of intraperitoneal and incisional lavage with antibiotic solution. The section on the anatomy and blood supply of the colon is excellent, and the depiction of colonic mobilization is well demonstrated, being far superior to the comparable section

in standard surgical atlases. Similarly, the section on the author's suggested method of colonic anastomosis is well presented.

The second part deals in an orderly manner with elective surgery for malignant disease, polyps, inflammatory bowel disease, diverticular disease and rectal prolapse. Each chapter is prefaced with a brief discussion of the disease entity, and the authors give a summary of the various operations used. This section deals with the various operations in a complete and thorough manner. It terminates with a presentation of the common procedures for frequently seen benign anal diseases.

The quality of the photographs in this section is far superior to those in the first. One of the weaknesses of the photographs of the intra-abdominal surgery is the lack of definition in the close-up views.

The last part of the atlas deals with the following colorectal emergencies: large-bowel obstruction, perforation, injuries, inflammatory bowel disease, ischemia and massive colonic hemorrhage. Once again, there is usually an introduction with an explanation of the rationale for the various surgical options. This section seems better than the one dealing with elective procedures, as there is more frequently a diagram accompanying the photograph. It features an excellent presentation of two techniques in emergency colorectal surgery — decompression of the colon (with on-table "washout") and intraoperative rigid colonoscopy in colonic hemorrhage.

In summary, our overall impression is that this atlas is very good and presents far greater variety of procedures than those usually used by the general surgeon. Its weaknesses tend to be redundancy (certain concepts are repeated several times) and lack of definition in many of the operative photographs. More diagrammatic accompaniment of certain photographs would be of benefit. Also it must be kept in mind that much of the philosophy of "ancillary care" (e.g., antibiotic use) and the technical detail reflect British views.

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ESSENTIALS OF PLASTIC, MAXILLOFACIAL, AND RECONSTRUCTIVE SURGERY. Edited by Nicholas G. Georgiade, Gregory S. Georgiade, Ronald Riefkohl and William J. Barwick. 1189 pp. Illust. Williams & Wilkins, Baltimore, 1987. Price not stated. ISBN 0-683-03451-0.

This timely textbook on plastic and reconstructive surgery covers most of the areas of this specialty. It is divided into nine sections, beginning with basic principles. The subsequent eight sections cover a number of areas, some of them body regions such as the head and neck, breast, genitalia, trunk and lower extremity; others cover broader topics, such as skin and soft tissues, esthetic surgery and practical concepts of the plastic surgery practice. Altogether, the sections represent 94 chapters, prepared by 140 authors.

Most of the chapters are well done. Unfortunately, some are very much the personal preference of the author and do not provide a balanced presentation of the subject. As plastic surgery covers a multitude of areas, it would be unreasonable to expect all to be covered by a single-volume text. However, one topic that should have been given more than cursory mention is tissue expansion, the most important recent addition to the plastic surgeon's armamentarium.

Although it is not the first time that a multi-authored plastic surgery text has been compiled and bound into one volume, it is a timely addition to the plastic surgeon's library. The individual authors are generally recognized for their excellence.

This book is particularly interesting because it covers a number of unusual areas, including basic science topics, which deal with the principles of skin grafts and flaps and bone, tendon and nerve grafts. There is an interesting section on the psychologic aspects of plastic surgery by an expert in the field.

Technically the book is well produced. Photographs — particularly roentgenograms — are generally of good quality and the illustrations nicely done. One suspects that the editors have been hard pressed to get all of the information between two covers and the print style used on the 1187 pages tends to be a little small for my preference.

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HOW I DO IT

A section on surgical technique, supervised by Dr. N.M. Sheiner

W. ROBERT HARRIS, MD, FRCSC

Below-Knee Amputation: a Technical Note

The classic below-knee amputation, using symmetric "fish-mouth" flaps that may adhere to the tibia and break down, is now outdated. New techniques employ a long posterior flap^{1,2} that wraps around the cut end of the bone, providing better padding. In addition, the suture line is at the front of the stump, above the cut end of the bone, where it cannot become adherent. The prosthesis is made of plastic, moulded on a plaster model of the stump. This permits total contact between stump and socket and greatly increases comfort by better weight distribution. Suspension is also simplified.

In addition to providing a more-easily fitted stump, the long posterior flap has a much better healing rate in vascular disease because blood to the skin of the posterior calf is supplied by vessels within the calf muscles that perforate the fascia.³ In contrast, the blood supply to the anterior skin is supplied by collateral vessels proximally. This supply is feeble and more readily impaired in vascular disease.

Surgical Technique

The commonest technical error is to make the posterior flap too short (Fig. 1). This lessens the soft-tissue padding and puts the suture line opposite the cut end of the tibia. The posterior flap must be long enough to wrap completely around the bone so that the suture line is in front of the tibia, where it will not become adherent.

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Skin Incisions (Fig. 2)

The anterior incision is made 8 to 12 cm below the tibial tubercle depending on the height of the patient. The vertical incision follows the posterior margins of the tibia and the fibula for at least 15 to 20 cm into the lower leg — the posterior flap can easily be shortened if required, but if it is not long enough the bone must be shortened to obtain closure. It is not important whether the vertical and transverse incisions join one another at right angles or by a gentle curve. It is important that the initial incisions go through skin and fat only, and that care be taken not to sever the deep fascia and particularly the periosteum over the tibia.

Previous incisions.—Although incisions from previous vascular surgery may be in a location that could interfere with the healing of amputation flaps, we have seldom encountered this problem, even when the anterior skin incision for an amputation intersects a scar at right angles (Fig. 3). The longitudinal incisions can usually be placed behind the vascular surgery scars. If the resulting posterior flap will not completely cover the cut ends of the bones, the flap should be sutured on its medial side to cover the tibia. If necessary a small gap can be left on the lateral side which, depending on its size, will usually granulate; occasionally, split-thickness skin grafts are required. In either event the resulting scar tissue lies over muscle and does not interfere with prosthetic fitting.

Anterior Flap

The periosteum of the tibia is incised 2 cm distal to the proximal skin. It is not elevated, thus avoiding damage to the bone's blood supply (Fig. 4). The muscles of the anterior compartment are next divided at the level of the periosteal incision, exposing the fibula laterally. The anterior tibial vessels and nerve are iden-

tified where they lie between tibialis anterior and extensor hallucis longus, immediately anterior to the interosseus

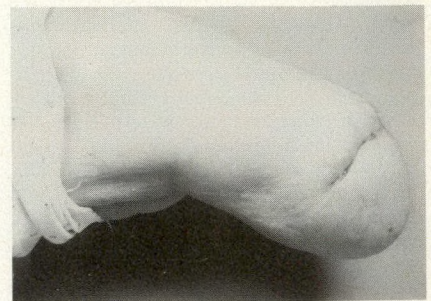


FIG. 1—Short posterior flap resulting in scar adherent to cut end of tibia. Repeated breakdown from prosthetic use required revision to relocate scar to higher level.

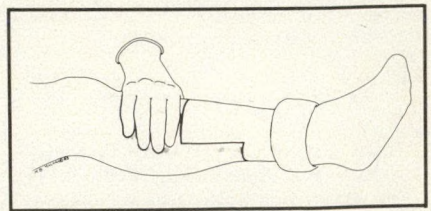


FIG. 2—Location of skin incisions. One hand's breadth below tibia is rough guide for anterior incision.

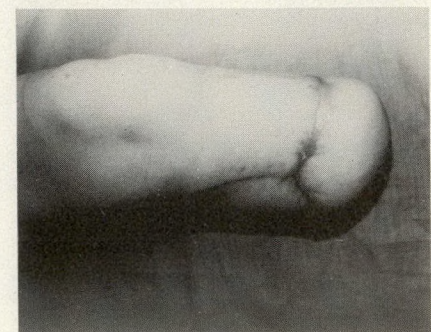


FIG. 3—Healing of below-knee amputation in presence of previous wound for femoropopliteal bypass.

membrane. They should be ligated separately in patients without vascular disease but may be ligated *en masse* in patients with vascular disease when blood flow is minimal.

The tibia is divided transversely with a power saw at the level of the periosteal incision. The saw should be cooled with water to prevent heat necrosis of the bone. The fibula is divided 1 cm proximal to the tibia. The anterior edge of the tibia is bevelled with the saw at 45° through

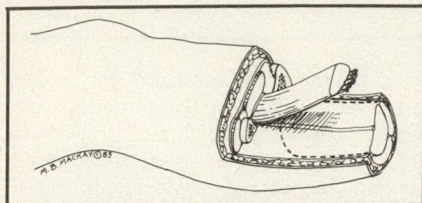


FIG. 4—Amputation completed. Note that tibia is divided *distal* to anterior skin flap. Dotted line indicates area to be bevelled. Muscles in posterior flap are trimmed by excision of deep compartment muscles.

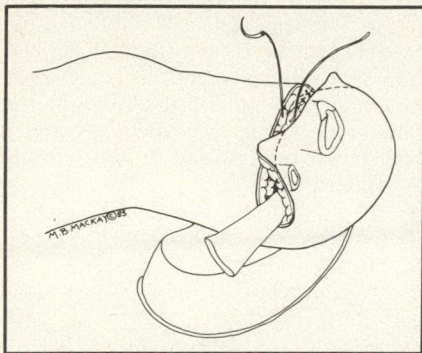


FIG. 5—Excess length of posterior skin is trimmed to match anterior skin. Drain is always used.

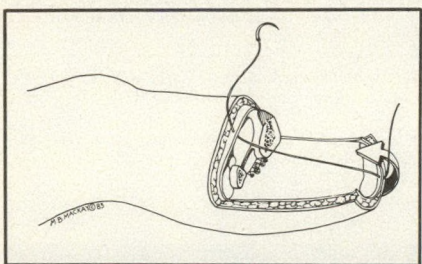


FIG. 6—Flaps are closed by suturing anterior fascia to posterior fascia. Note bevelled of tibia.

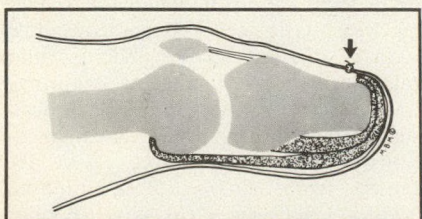


FIG. 7—Diagram of completed amputation. Note posterior muscles padding end of tibia and suture line located in front of stump (arrow), well above cut end of tibia.

the cortex only. Upon completion of this stage, the proximal end of the tibia protrudes 2 cm beyond the anterior skin incision, thus ensuring that the suture line will be well above the cut end of the bone and not adherent to it.

Posterior Flap

A scalpel is inserted to its hilt through the vertical skin incisions and the muscles are separated from the posterior aspects of the tibia and fibula down to the posterior skin incision. A sharp rake is inserted into the medullary canal of the distal tibia and the limb is lifted forward forcefully, pulling the tibia and fibula away from the posterior muscles as close as possible to the interosseous membrane. The posterior muscles are divided from within out at the level of the posterior skin incision. The contained vessels and nerves are also clamped and divided at this level but are not ligated. The muscles in the posterior flap must now be thinned to wrap comfortably around the cut ends of the tibia and fibula. First, the deep muscles (flexor hallucis longus, tibialis posterior and flexor digitorum longus) are separated from the soleus (Fig. 4). In doing so, the posterior tibial and peroneal vessels and nerves remain with the deep muscles and can easily be identified and ligated at the level of the cut ends of the tibia and fibula, following which the deep muscles are excised completely. It is usually necessary also to thin the soleus muscle starting from a point about one-third of the way below the cut ends of the bone. The posterior flap should now wrap comfortably around the bone ends without tension. Excess length of the posterior flap is trimmed to match the anterior skin incision exactly (Fig. 5).

Closure

If a tourniquet was applied, it is now released and any bleeding points are ligated or cauterized. A drain should always be used to allow tissue fluid from the cut surfaces of the muscles to escape. A medium Penrose drain protruding from the lateral end of the incision is sufficient. It does not matter whether the posterior flap folds at its intersection with the longitudinal incisions or posterior to them. Any resulting dog ears need not be trimmed; they shrink rapidly. The flaps are sutured in layers with interrupted stitches (Fig. 6). As the subcutaneous fat of the posterior flap is always thicker than that of the anterior flap, skin closure must be meticulous. Vertical mattress sutures may be required to align the skin edges accurately. In a well-made stump, the bone edges should be covered by well-padded skin under no tension and the suture line should be well above the end

of the tibia (Fig. 7) so as not to become adherent to it. If there is any doubt about this, the anterior flap *must be shortened*.

After Care

We have found a well-padded above-knee plaster cast to be useful. It minimizes postoperative swelling and by preventing knee movement enhances healing, especially in vascular disease, by avoiding "see-sawing" at the suture line. The drain is removed through a window in the cast at 48 hours and the plaster changed at 7 to 10 days. If appropriate facilities are available, a temporary prosthesis may be fitted at that time. If not, it is important to replace the plaster for a further 10 to 14 days to help control swelling. Thereafter, the patient should be taught to shrink the stump with an elastic bandage until admitted to a prosthetic unit.

We no longer use immediate postoperative fitting. Its early promise gave way to disappointment because of disrupted wounds, particularly in vascular disease, and we concluded that a more conservative approach is justified.

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BOOKS RECEIVED

This list is an acknowledgement of books received. It does not preclude review at a later date.

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Surgical Management of Morbid Obesity. Edited by Ward O. Griffen, Jr. and Kenneth J. Printen. 294 pp. Illust. Marcel Dekker, Inc., New York, 1987. \$79.75 (US). ISBN 0-8247-7381-0.

Techniques in Cleft Lip, Nose, and Palate Reconstruction. Donald I. Kapetansky. 200 pp. Illust. J.B. Lippincott Company, Philadelphia, 1987. \$79.00 (US). ISBN 0-397-58302-8.

Vascular Diseases. Current Research and Clinical Applications. Edited by D. Eugene Strandness, Jr., Paul Didisheim, Alexander W. Clowes and John T. Watson. 491 pp. Illust. Grune & Stratton, Inc., Orlando, Fla.; Academic Press Canada, Don Mills, Ont., 1987. \$73.50. ISBN 0-12-794381-1.

Visceral Vascular Surgery. Edited by Alfred V. Persson and Paul A. Skudder, Jr. 291 pp. Illust. Marcel Dekker, Inc., New York, 1987. \$99.75 (US). ISBN 0-8247-7742-5.

Closure of the Mesenteric Gap After Small-Bowel Resection

Resection of a segment of the small intestine leaves a gap in the mesentery that should be closed to prevent internal herniation. A new technique for closing this mesenteric gap is described.

Procedure

Segments of the mesentery are clamped and divided. Tissues on the sides to be retained are transfixed and ligated. One end of each ligature is left long and held by forceps (Fig. 1). When the intestinal anastomosis is complete, the mesenteric gap is closed by tying the long ends of the corresponding ligatures on both sides of the gap (Fig. 2).

Comment

Various methods to close the mesen-

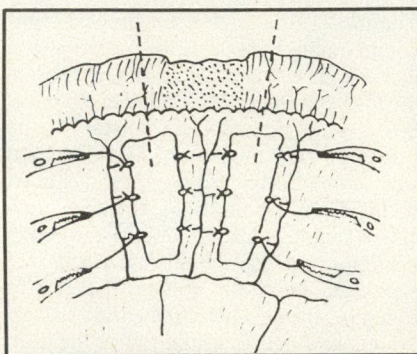


FIG. 1—Ligatures held by forceps after division of mesentery.

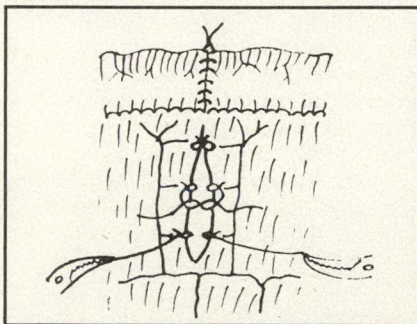


FIG. 2—Ligatures tied to close mesenteric gap.

teric gap have been described. Interrupted or continuous silk or catgut sutures are used.¹⁻³ Occlusion of mesenteric vessels by the sutures has been avoided by taking small bites⁴ and using fine (4-0) sutures.^{2,3} The needle may injure a mesenteric vessel, resulting in a hematoma and possibly ischemia of the bowel segment. To avoid this, the needle may be passed eye first through the tissues.⁴ The edges of the mesentery can be lifted using fine hemostats and the tented tissue brought together with a single ligature if the gap is small.⁵ The new technique we have described for closing the mesenteric gap achieves adequate closure and avoids occlusion of or injury to the mesenteric vessels.

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NOTICES

Canadian AIDS Research Conference

This conference will be held Jan. 26-29, 1988 in Toronto, providing a forum in which delegates can learn about research aspects of AIDS. International experts will address such topics as: detection of AIDS, working with the virus, preparation of vaccines and the functioning of viral proteins. Further information can be obtained from the Conference Office, Suite 4, 1172 Pembina Highway, Winni-

peg, Manitoba R3T 2A4; telephone (204) 474-1565 or 474-1647.

What's New in General Surgery

The Department of Surgery and Office of Continuing Medical Education, UC Davis, School of Medicine are sponsoring a surgical postgraduate course Jan. 15-16, 1988 in Sacramento, Calif. The course is designed to provide general surgeons with a clinical update on surgi-

cal problems and will include the following areas: basic science for surgeons, how I do it, surprises in the abdomen and retroperitoneum, surgical training, trauma management, future of American surgery and managing surgical complications. Further information can be obtained from: Office of Continuing Medical Education, UC Davis, School of Medicine, 2701 Stockton Blvd., Sacramento, Calif. 95817.

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ARNOLD M. NOYEK, MD, FRCSC, FACS;* EDWARD E. KASSEL, DDS, MD, FRCPC†

Contemporary Imaging of Parotid Gland and Parapharyngeal Space

Clinically, the parotid gland and associated parapharyngeal space can be assessed better using selective diagnostic imaging as an adjunct. It increases the effectiveness of management and the pretreatment staging of disease. This paper reviews the available specific imaging modalities (conventional x-ray films, contrast sialography, computed tomography, magnetic resonance imaging, ultrasonography, angiography and radionuclide scanning), their current indications and potential limitations.

Au plan clinique, il est plus facile d'évaluer la parotide et l'espace parapharyngien limitrophe lorsqu'on utilise les techniques radiologiques diagnostiques sélectives. Elles améliorent l'efficacité du traitement et l'évaluation d'avant traitement du stade évolutif de la maladie. Cet article passe en revue les diffé-

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rentes techniques radiologiques (radiographie conventionnelle, sialographie de contraste, tomographie par ordinateur, résonance magnétique nucléaire, échographie, angiographie et scintigraphie isotopique), leurs indications actuelles et leurs limites éventuelles.

The wise head and neck surgeon, for whom parotid gland surgery constitutes a substantial portion of the case load, makes full use of the radiologist and cytologist in arriving at a rational diagnosis. He utilizes the skill of these allied physicians to qualify (by histology) and quantify (by staging), with accuracy, diffuse and mass lesions of the parotid gland (and subjacent parapharyngeal space) in order to evolve an effective surgical, radiation or other treatment plan. He understands the basic principles of diagnostic imaging and applies them to the clinical problem at hand; he minimizes diagnostic and intraoperative "surprises", reduces intraoperative and postoperative complications and generally has a more "informed" patient and family.

The purpose of this article is to suggest a contemporary role for diagnostic imaging in neoplastic (and other) diseases of the parotid gland and subjacent parapharyngeal space. Not all lesions of the parotid gland require imaging, although a clinical photograph, including evidence of facial nerve conduction, is always welcome. Other lesions may need diagnostic imaging, from simple to complex and sophisticated — depending upon the problem. Properly used, effective and selective diagnostic imaging can improve the surgeon's confidence by providing a more realistic provisional diagnosis and a better preoperative staging process and treatment plan, avoiding the surgically unexpected and facilitating prognosis.

General Diagnostic Considerations

Although a variety of inflammatory

and obstructive lesions, as well as systemic disorders, may be better understood using diagnostic imaging, the major indications for its use in parotid gland lesions are as follows:

- Tumour diagnosis (especially extent of lesion).
- Distinguishing focal (and multifocal) from diffuse disease.
- Identifying bilateral and systemic processes.
- Recognizing salivary ductal obstruction and morphologic and physiologic changes within the parotid parenchyma — ranging from minor inflammatory disease and fibrosis to widespread destruction of salivary acini and ultimate sialectasis.
- Recognizing extension of disease into the parapharyngeal space or primary origin within the parapharyngeal space (lymph-node involvement, vascular tumours, neurogenic tumours), and also extension into adjacent parotid structures (facial nerve, trigeminal nerve, muscles of mastication, infratemporal fossa, mandible and skull base).

Specific Imaging Modalities

Conventional Imaging

Conventional imaging has virtually no role in the diagnosis of tumours of the parotid gland and parapharyngeal space. Occasionally, calcific phleboliths would indicate a cavernous hemangioma. Similarly, radiopaque calculi may be evident, although parotid gland stones are notoriously radiolucent.

The contrast sialogram was a major advance in conventional imaging.^{1,2} It still has a role in the assessment of discrete ductal obstruction, whether due to stone or stricture, and end-stage sialectasis but is of limited value in tumour diagnosis, as the findings are nondescript.² A variety of sialographic views does not give as much information as a definitive

axial/coronal computed tomogram with its expanded soft-tissue and bony imaging capability. Contrast sialography carries all the risks of contrast-medium sensitivity and inflammatory response from overdilatation. Finally, the skill of sialography is being lost, as residents are trained on less material and consequently are less motivated to use this technique. Clinicians and surgeons trained more than a decade ago seem to rely unduly on sialography, which was a state-of-the-art examination before the era of computed tomography, digital subtraction angiography and magnetic resonance imaging.

*Computed Tomography*³⁻⁷

Computed tomography of the head and neck has, within the past 10 years, brought about formidable achievements in diagnosis by allowing a full morphologic display of soft tissues and bone. It expands the 16 shades of grey that the human eye can recognize on a conventional x-ray film into the thousands of Hounsfield units numerically recognized on the extended numbers scale. Axial computed tomography of the parotid gland and parapharyngeal space exactly matches the surgical approaches, so the anatomy becomes meaningful to both imager and surgeon. Furthermore, the coronal dimension allows assessment of the skull base in relation to the parotid gland and parapharyngeal space in a way not previously possible.

In order to derive maximal yield, computed tomography must be preceded by an appropriate x-ray film. Then the imager can obtain specific density measurements and recognize specific tissue types. Fat is recognized by being less dense than water; cystic lesions can be specifically delineated — their fluid content is just slightly denser than water — and may be rim-enhanced with contrast if there is some margination; calcific deposits can be recognized; neurogenic tissue (e.g., schwannoma) can be recognized by specific density measurements of 25 to 30 Hounsfield units — matching those of cerebral tissue. All of these possibilities require the skill of an experienced radiologist, who can also measure size or distance by cursor placement. Although the facial nerve cannot be identified by computed tomography, the level of the facial nerve is recognized by the retromandibular vein, which should be seen clearly following intravenous contrast enhancement. This gives a depth perspective to the imaging study.

Initially, computed tomography was combined with sialography.³⁻⁵ This allowed the detection of focal lesions within the parotid gland not assessable by sialography alone. The margins of the lesions, however, may remain obscure and within the parotid gland may not

identify early invasion. With further advances in image quality, the majority of studies on the parotid gland are now performed with intravenous contrast enhancement only, with "focalization" of the mass lesion and better assessment of its margin. Small isodense lesions may still be diagnosed by the combined computed tomography-sialography technique. However, it is by specifically monitoring the deeper margins of the lesion in relation to the underlying fat planes of the parapharyngeal space and the muscular surfaces of the underlying muscles of mastication that tumour invasion is best identified.^{6,7}

Although computed tomograms in the sagittal plane have little application in parotid imaging, the reader should be aware of any advantages. The images have low resolution and probably are only of value in the study of cystic and multicystic lesions.

At present, 3-D computer imaging is best used for displaying the internal and external perspectives of the skeleton. Soft-tissue programs currently display only surface contour but offer the promise of improved depth perception of the parotid gland. These tissue programs undoubtedly will become more sophisticated and ultimately will lead to improved surgical applications and practical applications in planning radiotherapy.

*Magnetic Resonance Imaging*⁷

The art of magnetic resonance imaging has learned from the development of computed tomography. It has the expanded capability for imaging soft tissues that it promised initially, perhaps 100 times the capability of computed tomography. However, bone is not imaged directly — it is indicated only by an absence of signal. As magnetic resonance imaging depends upon the orientation of hydrogen ions (primarily) within the cell, and the "mapping" information supplied by received radiofrequency signals when magnetic forces are altered, there is the possibility of several options for soft-tissue imaging by varying pulse sequences. These magnetic fields cannot act on "solid" structures such as cortical bone but provide bright signals from marrow.

Magnetic resonance allows the images to be weighted by altering the pulse sequence in the signals. So-called T-1 weighted images demonstrate subcutaneous fat and other fatty lesions; T-2 weighted images characteristically produce an image of brighter intensity for the structures of the central nervous system and cerebrospinal fluid, highlighting pathologic changes in these structures. A variety of altered pulse sequences and paramagnetic enhancement allows the possible creation of all sorts of soft-tissue information. Unfortunately, extremely

bright signals can be created from lesions of varying tissue types; a Warthin's tumour may give the same signal intensity as a benign mixed tumour. On the other hand, within individual tumours the range of tissue information is wide. Preliminary correlations between magnetic resonance imaging and the disease can indicate the presence of fibrosis, necrosis, hemorrhage and other tissue changes.

The major role for magnetic resonance imaging at the moment is in detecting tumour extension into neurogenic structures or into the marrow and the skull base. Because magnetic resonance allows for multiplane imaging, lesions can be fully imaged in three dimensions. As this imaging modality produces no ionizing radiation, patient hazard is considerably reduced, while the soft-tissue yield is considerably increased. The role for magnetic resonance imaging in assessing lesions of the parapharyngeal space seems unlimited.

Other Imaging Modalities

High-resolution ultrasonography^{8,9}. — At 7.5 MHz or 10.0 MHz this provides high-resolution real-time images of the parotid gland and its related soft tissues. As the parotid gland is superficially located, there is minimal attenuation of the bursts of high-frequency ultrasound so the gland can be well imaged. Images of 5.0 MHz can be carried out axially in a bilateral display that matches computed tomography, giving gross information on the presence of fluid and pus. The major role for high-resolution ultrasonography, however, is in detecting small focal lesions, and allowing ultrasonically needle-guided aspiration for cytologic examination or for drainage of purulent material¹⁰ and bacteriologic sampling. The last application is particularly important in woody inflammatory lesions, where areas of necrosis and pus occur.

Another role for high-resolution ultrasonography is in detecting cystic lesions and determining if they have been effectively aspirated and are not recurring. Furthermore, small focal lesions may be monitored by diagnostic ultrasonography when the patient or surgeon is reluctant to consider surgical intervention. We have seen small lesions remain stable and then disappear without specific diagnosis and larger lesions (0.5 to 1.0 cm), sampled cytologically, found to be benign (for example Godwin's lesion) and monitored, have also disappeared without treatment.

High-resolution ultrasonography can give specific information to experienced technicians. The ultrasonographer participates directly in creating the image; he can detect extension of tumour into underlying muscle. He can use this

modality to direct a more sophisticated computed tomographic examination. Moreover, he can detect vascular abnormalities. This technique is an excellent screening examination for parapharyngeal space aneurysm — a “cystic” image is revealed with its strong back-wall echo. The imager may recognize the presence of an echogenic lesion between the bifurcation of the internal and external carotid arteries — nothing can exist in this area other than a carotid body tumour. More superiorly in the parapharyngeal space this echogenic lesion is most likely a glomus vagale.

Angiography.—Angiography^{6,7} continues to play an important role in assessing parapharyngeal space vascular lesions. Digital subtraction angiography, as an intravenous screening study, can be used whenever a vascular lesion is considered. It is superb for detecting major vascular shunts and larger aneurysms.

The digital subtraction angiogram will give direction to a more supraseductive study. Supraseductive angiography is always needed to assess vascular parapharyngeal space lesions, such as carotid body tumour, glomus vagale or glomus jugulare (with its involvement of the jugular bulb and temporal bone). Here, the study not only defines the vascular distribution of the lesion and its feeding vessels — usually the ascending pharyngeal artery for the glomus jugulare and the occipital and superior thyroid arteries for the lower paragangliomas — but it also allows the option of intra-arterial embolization as a surgical aid. Arteriovenous malformations are recognized by early venous shunting on the digital subtraction angiogram; this invites closer scrutiny through a supraseductive examination.

Radionuclide scanning.—A variety of radionuclide scans provide selective but specific diagnostic information.¹¹

Sodium pertechnetate salivary scanning identifies the parotid gland. The sodium pertechnetate is concentrated by the salivary glands and ultimately excreted. At the same time, the thyroid gland, which is visualized in the anterior image with the parotid and submandibular glands, usually traps, but does not concentrate, pertechnetate in the same quantitative amount as do the normal parotid glands. On radionuclide scanning, with or without computer enhancement, the images are of poor resolution (1.0 cm or slightly less) but of sharp functional display. Although the physiologic information is usually quite obvious in these highly sensitive studies, expertise in interpretation is essential. The pertechnetate scan provides a low yield of information for a nonfunctioning salivary tumour but is more informative in the case of a functioning tumour. In our experience, all of Warthin's tumours were recognized

preoperatively (or before fine-needle aspiration) by salivary scanning. The only other functioning tumour that will give this response is the oncocytoma. The study is of value as it may obviate the need for surgery for the small tumour in a debilitated high-risk patient. Three of the 29 patients did not undergo surgery although the diagnosis was confirmed by salivary scanning supplemented by fine-needle aspiration (with the typical demonstration of oncocytes and lymphocytes). Finally, sodium pertechnetate scanning can image diffuse disease of the salivary glands with hypofunction — such as in Sjögren's syndrome.

Although limited in assessing tumours, the scan has an important role in detecting altered physiology in one or more salivary glands, due to long-term ductal obstruction with sialectasis. When there is poor accumulation of the radioactive tracer and ultimate retention of saliva following administration of a sialogogue, it means that gland function has been permanently deranged and appropriate clinical decisions can be made. As an aside, the administration of a sialogogue provides an enhanced view of a Warthin's tumour, just as it does of salivary retention due to ductal obstruction. However, it is important to recognize that the focal “hot tumour” is a Warthin's tumour, whereas the diffuse “hot saliva” reflects ductal obstruction.

Gallium 67 citrate scanning is useful in detecting certain inflammatory diseases and tumours. It is taken up by rapidly dividing cells, is useful in lymphoma staging and can demonstrate foci of sarcoidosis and malignant melanoma. Once a specific focus of lymphoma takes up gallium citrate, virtually all other foci throughout the body do the same. However, the degree of uptake is not consistent. There is a much higher concentration of gallium in sarcoidosis and melanoma than lymphoma.

Also to be considered is the red-blood-cell scan. Here a lesson has been learned from imaging hemangiomas of the liver. Cold pyrophosphate given intravenously will combine with the patient's erythrocytes as tin is bound to hemoglobin. Thereafter, pertechnetate given as a tracer will bind to the entire complex. The labelled red cells accumulate and percolate within the large vascular spaces of a cavernous hemangioma. The increase in radionuclide emission in the plane of the image is diagnostic of a cavernous hemangioma.

Finally, the bone scan has a limited role in parotid and parapharyngeal space imaging. It may detect subclinical involvement of the mandible by tumour when conventional x-ray films and computed tomograms do not show cancer extension, and it may be invaluable in the early detection of skeletal metastases.

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International Symposium

Paris is the location of a symposium on therapeutic progress in urological cancers scheduled for June 29–July 1, 1988. For details contact: Dr. Gerald P. Murphy, Professor of urology, School of Medicine, State University of New York at Buffalo, 139 Parker Hall, Buffalo, NY 14214; telephone: (716) 831-2338.

Extended Programs in Medical Education

The University of California in San Francisco is sponsoring a course entitled “Ophthalmic Plastic and Reconstructive Surgery — Past, Present and Future” Dec. 10–11. Discussion will focus on the major topics of ptosis, entropion, ectropion, eyelid reconstruction, cosmetic eyelid and facial surgery, lacrimal abnormalities and orbital disease. The University's School of Medicine is also presenting its 4th annual course on “Decisions in Surgery”, scheduled for Jan. 23–29, 1988. A postgraduate course in general surgery is planned for Apr. 14–16, 1988. Further information on these courses can be obtained by writing: Extended Programs in Medical Education, University of California School of Medicine, Room 569-U, San Francisco, California 94143 or calling: (415) 476-4251.

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Symposium on Trauma: Prevention and Treatment — the Odd Couple

D.E. WESSON, MD, FRCSC; L.J. SPENCE, B SC N; J.I. WILLIAMS, PH D;
P.F. ARMSTRONG, MD, FRCSC

1. Injury Scoring Systems in Children

Injury scoring systems are used to describe groups or individuals for purposes of epidemiologic studies, quality assurance or triage. The two most widely used methods are the injury severity score (ISS) and the trauma score (TS). In this paper, the authors describe their experience with these two methods in a group of 175 severely injured children. They found both to be reliable and valid but found the ISS the more useful of the two for various practical reasons.

Les systèmes de cotes pour l'évaluation des blessures servent à décrire des groupes ou des individus pour fins d'études épidémiologiques, de programmes d'assurance de la qualité ou de triage des blessés. Les deux méthodes les plus largement utilisées sont l'index de gravité des blessures (IGB) et l'index traumatique (IT). Dans cet article, on commente l'utilisation de ces deux méthodes chez un groupe de 175 enfants qui avaient subi des blessures graves. Toutes deux ont été trouvées valables et fiables. L'IGB s'est avéré le plus utile des deux pour diverses raisons pratiques.

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Presented as part of the symposium on trauma: prevention and treatment — the odd couple, by the Royal College in cooperation with the Canadian Association of Teachers of Social and Preventive Medicine and the Trauma Association of Canada, at the 54th annual meeting of the Royal College of Physicians and Surgeons of Canada, Vancouver, BC, Sept. 10, 1985

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Several injury scoring systems have been proposed to study both groups and individual victims of accidental injury. In theory, these systems are objective numerical ratings assigned to injured patients to provide statistically reliable and valid means of predicting morbidity and mortality.¹

The scoring systems can be used in various ways.

- To describe groups of injured patients — for example, all those admitted to a given hospital, treated in a specific emergency medical services system or injured in defined circumstances (e.g., motor vehicle accidents or playground injuries).

- To monitor epidemiologic trends in accidental injuries and service requirements for a particular emergency medical services system.

- To compare results of treatment in different emergency medical services systems or hospitals.

- In the care of individual patients for triage to define those who should be treated at designated trauma centres, to predict the likelihood of survival in a given patient and, as a corollary of this, to identify patients with an unexpected outcome.

Types of Scoring Systems

There are two main types of injury scoring systems — anatomic and physiologic (Table 1²⁻⁴).

Anatomic scores are based on anatomical diagnoses, the most familiar being the injury severity score (ISS) described by Baker and colleagues.² The physiologic scores describe the physiologic impact of injury on the patient, and of these the Glasgow coma scale (GCS)³ and the trauma score (TS)⁴ are universally known.

The reliability and validity of these scoring systems as applied to children have been poorly documented in the literature.

The modified injury severity score (MISS) is a combination of anatomical and physiologic scoring methods.⁵ In this system the cerebral component of the ISS is replaced by another numerical score based on the GCS and three other neurologic criteria (surgical mass lesion, pupillary light response and oculocephalic reflexes). The MISS has been studied extensively in one pediatric population and although its reliability has not been well documented, its predictive validity for death and long-term disability in that population has been well established.⁵

Evaluation of Injury Scoring Systems

Gibson¹ has identified three criteria for evaluating injury scoring systems — reliability, validity and data requirements.

Reliability refers to the clarity and objectivity of the scoring system, so that there is good inter- and intra-rater consistency in assigning the scores to a particular case.

Validity is the correlation of score with outcome (morbidity and mortality). It should ideally be determined prospectively and in different populations.

The data should be easily available and clearly defined. For the TS and GCS, the data must be collected at the time the patient is assessed. For the ISS, the data may be collected retrospectively from the patient's medical record.

Reliability and Validity of the ISS and TS in a Pediatric Population

We studied the ISS and TS in a pediatric population for 1 year beginning June 1, 1984. All patients admitted to The Hospital for Sick Children in Toronto, with a single life-threatening injury (abbreviated injury scale [AIS] of 4 or more) or serious injury (AIS of 2 or more) to two or more body systems were eligible for the study.⁶ Of the 1057 injured patients admitted to the hospital during the study period, 175 met the selection criteria.

The reliability of the ISS was tested in 30 consecutive children. Their records were reviewed by three independent observers (two surgeons and one nurse). The scores were assigned after a review of the child's record, including results of radiologic investigations, operative reports and autopsy findings. Using Cohen's⁷ kappa reliability determination for multiple raters, the ISS was found to be highly reliable (Table II). The value of kappa for the ISS was 0.67 and the Z statistic was 19.82. This indicates an extremely low likelihood that any agreements were due to chance alone. Interestingly, some parts of the ISS were more reliable than others. There was complete agreement in assigning scores to chest injuries but much lower agreement for external injuries.

The TS was tested on 23 children with multiple injuries admitted through the emergency department. Each child was scored independently by the trauma team leader, a fellow in general surgery and a trauma nurse who was on the permanent staff of the department. Once again the inter-rater reliability was found to be acceptable with a kappa value of 0.69 (Table III). The value of the Z statistic for the TS was 4.48, indicating that the TS was not quite as reliable as the ISS. However, the probability that the agreements were due to chance alone was less than 0.001.

Both the TS and the ISS were shown to have predictive validity for death rates. The mean TS for the patients who died was 6.9 compared with 14.2 in those who survived ($p < 0.001$). The mean ISS for those who died was 32.5 compared with 21.1 for the survivors ($p < 0.001$).

Practical Considerations

Although both the TS and the ISS were found to be reliable, some components of the scores were more reliable than others. In the case of the TS, the GCS component seemed to be the least reliable, and in the case of the ISS, as previously noted, the assessment of the external injuries was the least reliable. Overall, the TS seemed to have greater inter-observer variability than the ISS.

Both scores had statistically significant predictive validity in our study population.

The data requirements are quite different for the TS and ISS. Approximately 90% of our trauma patients are transferred from other institutions where treatment with intravenous fluid, blood, endotracheal intubation and occasionally mannitol is often begun; this obviously alters the TS. When a patient has been intubated and paralysis effected, it is virtually impossible to complete the TS. Moreover, the data for the components of the TS must be measured when the

patient is in the emergency department, not gathered retrospectively. This requires cooperation and accuracy on the part of those who do the scoring while resuscitating the patient. These two factors probably explain why a complete TS was obtained in only 61 of the 175 patients in the study.

On the other hand the TS can be done early, either in the field or upon arrival at the hospital, and so may be used for triage purposes. Even a preliminary ISS is unavailable until the diagnostic work-

up has been completed, and a final, accurate ISS depends on the findings of all radiologic investigations, surgical treatment and autopsy examination when applicable.

The normal values used to calculate the TS and the GCS (e.g., blood pressure, respiratory rate and verbal response) are not appropriate for all age groups. In fact, in the youngest infants, normal respiratory rates and blood pressure levels may not meet the "normal" standards for the TS. In an attempt to overcome this

Table I—Commonly Used Injury Scoring Systems

Name	Type	Description	Data requirements
Injury severity score ² (ISS)	Anatomic	A measure of overall magnitude of injury or injuries. The sum of squares of the highest abbreviated injury scale scores in each of the three most severely injured body regions. Range from 0 - 75	May be determined retrospectively from medical record or autopsy report
Glasgow coma scale ³ (GCS)	Physiologic	A measure of the effect of the injury or injuries on level of consciousness; scores for eye opening, best verbal and best motor responses are assigned and summed. Range from 3 - 15	Not routinely recorded in all hospitals. Observations must be made and recorded when patient is first seen and serially thereafter. Cannot be determined retrospectively
Trauma score ⁴ (TS)	Physiologic	A measure of the effect of injury or injuries on vital physiologic functions; scores for respiratory rate, respiratory effort, systolic blood pressure, capillary refilling and level of consciousness are assigned and summed. Range from 1 - 16	Same as for GCS

Table II—Cohen's Kappa Reliability:⁷ Multiple Raters for Injury Severity Score (ISS)

Category	Kappa	Z Statistic	p value
Head	0.78	13.21	< 0.001
Face	0.76	9.23	< 0.001
Chest	1.00	11.02	< 0.001
Abdomen	0.86	9.46	< 0.001
External	0.62	8.11	< 0.001
Extremities	0.89	11.76	< 0.001
Total ISS	0.67	19.82	< 0.001

Table III—Cohen's Kappa Reliability:⁷ Two Raters for Trauma Score (TS)

Category	Kappa	Z Statistic	p value
Respiratory rate	0.60	4.15	< 0.001
Respiratory effort	0.71	3.26	< 0.001
Systolic blood pressure	0.84	6.03	< 0.001
Capillary refilling	0.79	4.21	< 0.001
Glasgow coma scale	0.56	4.57	< 0.001
Total TS	0.69	4.48	< 0.001

problem, we have developed a pediatric version of the GCS that can be used in infants. This version of the GCS has not been fully tested for reliability or validity. At present there is no pediatric version of the TS.

Uses of the ISS

We now use the ISS to monitor patient service loads and for quality assurance screening.

We have assigned the ISS to all trauma patients admitted to our hospital from June 1, 1984 and can now study the impact on our hospital service demands of planned changes in our regional emergency medical services system with regard

to the severity of injury of the patients we treat. The hospital administration can benefit from this information in its dealings with government funding agencies.

We have also instituted a quality assurance program for trauma patients. A standard set of screening criteria has been developed for all hospitalized patients; to this we have added some specific criteria for trauma patients that are now being applied to all patients with an ISS of 16 or more.

In summary, we have found both the ISS and TS to be reliable and valid in a pediatric trauma population. In practice, the ISS has been the more useful of these two scoring systems in our hospital, and its data requirements are more easily met.

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BRENDAN J. DOOLEY, MB, BS, FRCS, FRACS

2. Medical Significance of Occupant Restraint on Road-Crash Victims and the Role of the Medical Profession

Compulsory use of seat belts has been the single most important measure in reducing the number of deaths and injuries on the road. Seat belts are most effective in reducing head and facial injuries in frontal impacts, but less so with side collisions and roll-overs. There should be no medical exemptions to the wearing of seat belts. There is little evidence that seat belts, if properly worn, cause serious injury.

The reduction in road deaths and injuries applies only to car occupants: the number of deaths in motorcyclists closely parallels the number of motorcycles in use. Likewise, the pedestrian death rate remains unchanged.

L'usage obligatoire de la ceinture de sécurité est la mesure la plus importante ayant contribué à réduire le nombre de

morts et de blessés dans les accidents de la route. Les ceintures de sécurité sont surtout efficaces pour protéger des blessures à la tête et au visage lors d'une collision frontale. Leur efficacité diminue lors d'une collision latérale ou lorsque la voiture se retourne. Il existe peu de preuves que les ceintures de sécurité, lorsqu'elles sont correctement mises, soient la cause de blessures graves.

La diminution des morts et blessés dans les accidents de la circulation ne s'applique qu'aux occupants d'automobiles: chez les motocyclistes, le nombre de décès est fortement proportionnel au nombre de motocyclettes sur la route. De même, le taux de mortalité chez les piétons demeure inchangé.

Like most professionals, physicians have given freely of their time, in an honorary capacity, to individuals in need, to community groups and society at large. One example of this is the road trauma committee of the Royal Australasian College of Surgeons, formed in 1969 with the aim of reducing the maiming and killing on our roads. As a side effect, our involvement in this area has proved a real antidote to the ever-increasing criticisms of doctors and the denting of our image, mainly by politicians, certain members of the media and left-wing groups. Doctors and laymen alike must be informed on road trauma. They must appreciate the magnitude of the problem, its cause and prevention. Appropriate training and

education should commence at primary school level.

There is now undisputed evidence that (a) seat-belt restraint, when properly used, remains the single most effective measure in protecting vehicle occupants from death and injury in road crashes; (b) maximum benefit is achieved by a maximum wearing rate; and (c) that high wearing rate can only be achieved by laws backed by adequate enforcement, good promotion and readily available, safe, comfortable and easy-to-fit restraints.

Geographically large countries with small populations, Australia and New Zealand have had relatively poor roads compared with other western nations. They have also been affluent countries with young people frequently being able to obtain a car of their own when eligible to drive at the age of 17 years. Alcohol is freely available and the combination of inexperience, alcohol and speed has proven deadly. In the 1950s and 1960s our road-accident record was the world's worst. Twenty percent of the population cause 80% of the accidents, a percentage that contains an unduly high proportion of young people from the lower socioeconomic level, mostly living away from home and hence undisciplined.

Injuries to Restrained (Belted) Occupants

Compulsory seat-belt laws became effective in Victoria in 1970 and quickly spread to other states and to New Zealand so that, within 1 year, for adults and children over the age of 8 years, seat belts

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were compulsory for front-seat passengers. Subsequent studies revealed a 20% reduction in deaths and injury. But it was not until much later (1980) that seat belts also became compulsory for all age groups and for back-seat passengers.

It must be emphasized that at very high speeds with severe vehicle deformation and intrusion by outside objects, no type of occupant restraint can be totally effective.

Seat-belt wearers may be killed or seriously injured if loads are above the injury threshold, if there is excessive movement of the belt, if it is poorly worn or if there is intrusion; none of these factors are directly related to seat-belt design and anchorage. A comparison of victims of motor-vehicle accidents admitted to hospital who used seat belts and those who did not (Table I) showed that the greatest protection was for a front-end impact, particularly with regard to severe facial and eye injuries and for lower limb injuries, mainly fractures of the patella and comminuted fractures of the femur. The seat belt does not give nearly so much protection on side impact, particularly if the door gives way or if there is intrusion into the vehicle. Head injuries are responsible in 50% of victims who die in road crashes and in most of those left with serious permanent damage.

There is only so much that a seat belt can do. I ask the question, "Should we be wearing crash helmets?". To my knowledge, in Australian stock-car racing, with the driver wearing a pilot's harness, a crash helmet and anti-inflammable clothing and with the vehicle protected by roll-bars, there have been no reported deaths to date even though crashes happen at high speed.

In side crashes and roll-overs, the problem, particularly for the belted front-seat occupant, is the narrow distance from the adjacent door and from the roof or support pillars of the roof. Even with minimal excursion in a side collision, the head or one side of the trunk can be heavily impacted. Also, unrestrained back-seat occupants and broken seats can contribute loadings to the back of the front-seat occupant and even effect seat-belt release. Correct seat-belt wearing prevents ejection from the vehicle. Some people even argue that ejection is desirable but figures disprove this. Seat belts can be easily released and, even if the car bursts into flame or is immersed, the victim should be able to escape, although admittedly, they sometimes do not, even when help from outsiders is close at hand.

Exemptions to Seat-Belt Use

It has been proposed that certain people should be exempt from wearing seat belts; they include pregnant women and those with a colostomy or pacemaker. In

most countries with compulsory seat-belt laws, there is no exemption on medical grounds and I agree with this. Some claim nonmedical exemptions relating to reversing and low-speed delivery vehicles. In severe crashes, the maternal death rate from pregnant women not using a seat belt is double that for those who do so. Fetal loss is four times greater if the mother is ejected. Reports of injuries from belts or resulting fetal death are isolated. A baby should never be carried in the front seat of a vehicle, even if the person holding it is wearing a seat belt.

Injuries Caused by Belts

There is little evidence that seat belts, if properly worn, cause serious injury. Abrasions and bruising to the chest and abdomen are the main problems. It is recommended that the belt system be changed approximately every 7 years. Head and neck injuries occur to belt wearers only where there is head contact or if the seat belt is worn incorrectly. There have been isolated case reports of carotid artery injury and neck dislocation or fracture when the sash component is against the neck; it should always be across the trunk and shoulder. The commonest major chest injury directly attributable to the seat belt is a fractured sternum. Rarely are there serious intrathoracic injuries. Incorrect wearing and possibly advanced age of the user are responsible for serious abdominal injuries caused by belts. There is evidence that elderly occupants are less able to withstand crash forces. Surgeons who treat road-crash casualties should be aware of the so-called "seat-belt syndrome" when assessing intra-abdominal injuries. It is possible that the increased intra-abdominal pressure resulting from belt compression in an accident could result in diaphragm and bowel injury. But, on the other hand, if a belt had not been worn in such a situation, death or more serious injury could have resulted.

The effectiveness of seat belts depends on use. In Australia, we have been able to achieve approximately 90% use for the vehicle driver, but less for rear-seat passengers. Efforts to increase the wearing of seat belts should be directed toward young people, rear-seat passengers and rural and night-time travellers.

Medical Commitment and Initiative

The role of the road trauma committees in Australia and New Zealand during the past 15 years has been directed principally toward the following:

- Improved medical care at the crash scene, which involves the training of ambulance officers. Also, improved emergency department, inpatient care and rehabilitation. We do not have trauma units along the lines of those recently established in North America but rather concentrate on improving the trauma units within each major hospital. These hospitals are categorized according to the skills of the surgeons, anesthetists and others treating multiple trauma victims.

- Promotion of measures that reduce death and injury.

- Identification of the major factors causing road accidents; these include alcohol, inexperience and speed. Concentrating on the alcohol aspect, our groups are responsible for introducing compulsory testing of blood alcohol levels in motor vehicle accident victims over the age of 15 years and for the introduction of random breathalyzer tests and rehabilitation programs for intoxicated drivers.

- Collection of medical data on a national basis.

- Education. This has included annual seminars which have been widely reported in the press. Also, we have concentrated on appropriate medical undergraduate and postgraduate teaching.

- Media involvement. The media have conducted particularly effective campaigns.

- Liaison with support groups involved in road safety and with the government, police and ambulance.

I believe the activity of the Royal Australasian College of Surgeons over the past 15 years is an example to be followed in medical involvement and leadership in road safety programs. The college council, in 1970, also committed itself to involvement in major social programs affecting the lives and health of all sectors of the community. These activities, over the years, have resulted in the college being now regarded as the national medical authority on road accidents, and its opinions are frequently sought by government and other authorities.

The committee has published a road-

Table I—Injuries Sustained With and Without Seat Belts, 1970 to 1973 (% of Admitted Patients)

Injury	Front-end impact		Side impact	
	With belt	Without belt	With belt	Without belt
Head/face	23	79	17	47
Chest	—	—	44	37
Lower limb	29	36	22	12
Upper limb	—	—	3	9
Pelvis	—	—	22	12
Spine	—	—	3	7

safety booklet, which has gone to two editions of 20 000 in each, entitled *Road Trauma, the Modern Epidemic*. This booklet contains factual information for doctors and others, enabling the community to be better informed on road safety. Copies have been distributed to all schools and libraries in Australia and New Zealand and to other sections of the community. The project was made possible by a grant of \$100 000 (Aus) from the Life Insurance Federation of Australia.

Conclusions

The resolutions of the Sixth International Accident and Traffic Medicine

Conference, held in Melbourne in early 1977, still holds good today — "This Conference further concludes that Governments and other appropriate authorities which have not enacted legislation making seat belts mandatory are placing the road using population under their administration at needless risk".

Although legislation reducing speed limits, countermeasures against alcohol, improvement in vehicle and road design and better driver education have all played a part in the gradual reduction of the road accident toll, we reiterate that compulsory use of seat belts has been the single most important measure in reduc-

ing the number of deaths and injuries on the road. Some countries have been reticent about introducing seat-belt legislation because of claims of interference with civil liberties or that air bags are better than seat belts. Without question, the best protection would be air bag, seat belt and even a crash helmet. Unfortunately, in the road toll, it is only vehicle occupants who have been helped by countermeasures. The numbers of deaths and injuries in motorcyclists still closely parallel the number of motorcycles in use and, likewise, the number of deaths for pedestrians, again without protection, has not been reduced. ■

ALAIN VERDANT, MD, FRCSC

3. Major Mediastinal Vessel Injury: an Underestimated Lesion

Of patients who sustain traumatic rupture of the aorta, 15% to 20% will reach the hospital alive. Without associated major brain trauma or irreversible abdominal injury, survival depends on early diagnosis and prompt surgical repair by an experienced surgeon. Regardless of whether there is radiologic evidence of rupture or rib fractures, a constant awareness of aortic rupture should be maintained, based on the history of the accident. Among 50 patients in whom a rupture of the thoracic aorta was diagnosed, 47 with traumatic rupture of the descending thoracic aorta were treated by the author. Of 34 involved in motor vehicle accidents and in whom a history of the accident was obtained, 30 (88%) were not wearing seat belts and 11 (33%) were involved in a lateral collision. Six percent of the 50 patients sustained a vertical fall of more than 10 m.

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Presented as part of the symposium on trauma: prevention and treatment — the odd couple, by the Royal College in cooperation with the Canadian Association of Teachers of Social and Preventive Medicine and the Trauma Association of Canada, at the 54th annual meeting of the Royal College of Physicians and Surgeons of Canada, Vancouver, BC, Sept. 10, 1985

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The four most common clinical findings in the 47 patients with rupture of the descending thoracic aorta were: unexplained hypertension (60%), a pseudo-coarctation syndrome (40%), a chest murmur (33%) and an unexplained elevated central venous pressure (20%). Blurring of the aortic knob shadow by a mediastinal hematoma present on a chest x-ray film is sufficient to warrant aortography. A high-quality aortogram is essential to establish precisely the diagnosis and to plan the proper surgical approach. Ninety-four percent of the 50 aortic ruptures involved the isthmus, and the repair necessitated temporary occlusion of blood flow to the descending aorta. One of the most common and serious complications of this maneuver is paraplegia. Most (44) of the author's patients were protected with a temporary external bypass (9-mm Gott shunt), inserted from the ascending to descending aorta. The overall survival using this technique was 95%; two deaths occurred from associated irreversible brain trauma, present before surgery. There was no paraplegia or other spinal cord ischemic deficit.

Environ 15% à 20% des blessés atteints d'une rupture de l'aorte thoracique peuvent espérer arriver vivant à l'hôpital. En l'absence de lésion majeure irréversible (crânienne ou abdominale), leur survie repose sur la promptitude du geste diagnostique, suivi d'une réparation immédiate de la lésion par un chirurgien d'expérience. Même en l'absence de fractures de côtes, le diagnostic doit tou-

jours être soupçonné en se basant sur l'histoire de l'accident.

Quarante-sept des 50 malades chez qui une rupture de l'aorte thoracique a été trouvée avaient leur lésion située au niveau de l'aorte descendante. Parmi les 34 victimes de la route chez qui une histoire exacte de l'accident a pu être obtenue, 30 (88%) ne portaient pas de ceinture de sécurité et 11 (33%) avaient été impliqués dans une collision latérale. Six pourcent des 50 ruptures aortiques trouvées furent secondaires à une chute verticale de plus de 10 m. Les quatre signes cliniques les plus fréquents rencontrés chez 47 malades atteints d'une rupture localisée au niveau de l'aorte descendante furent: une hypertension systolique inexpliquée (60%), un syndrome de pseudo-coarctation (40%), un souffle thoracique systolique (33%), et une pression veineuse centrale élevée sans explication valable (20%). Le simple effacement du bouton aortique dû à un hématome médiastinal visible sur un film simple du poumon justifie une aortographie. Celle-ci demeure à la fois le seul moyen de faire un diagnostic précis et de bien planifier l'approche chirurgicale. La grande majorité (94%) des 50 ruptures aortiques rencontrées étaient localisées à l'isthme aortique. Leur réparation exige une interruption complète du courant aortique au niveau de l'aorte descendante. La paraplégie demeure la complication la plus tragique et la plus fréquente de ce geste. Pour préserver la perfusion de la moelle épinière, nous avons protégé nos malades avec le shunt de Gott no. 9, utilisé comme dérivation externe entre l'aorte ascendante et

l'aorte descendante. Quarante-deux (95%) des 44 malades opérés avec cette technique ont survécu. Les deux décès ont été causés par un dommage cérébral associé, présent bien avant la réparation chirurgicale. Aucun malade n'a développé ni paraplégie, ni autre accident médullaire.

During the past 11 years at the Sacré-Coeur Hospital in Montreal, 56 patients with traumatic injuries have had surgical repair of a ruptured thoracic aorta or its intrathoracic branches. In most cases the lesion involved the thoracic aorta (50 cases) and was situated almost exclusively at the aortic isthmus (47 of 50 cases, 94%). Only 20% of such victims live long enough to benefit from surgical treatment.¹ They survive as long as the aortic adventitia remains intact; this strong vascular layer represents 60% of the tensile strength of the aortic wall and temporarily contains the blood flow. Unfortunately the remaining 80% die of exsanguination secondary to the instantaneous disruption of all aortic layers.

Can On-Site Prevention Change This Gloomy Picture?

Aortic rupture is basically a deceleration injury. The predominance of isthmus rupture (distal to the left subclavian artery) is explained by a gradient of deceleration between the mobile aortic arch and the relatively fixed descending aorta. This exposes the aortic isthmus to excessive stretching, leading to disruption.

Robert Greendyke, in 1966,² concluded from autopsy findings that: "[aortic] rupture was twice as common in ejected occupants as in those not ejected". We found the same trend in our series. A reliable history of the accident was obtained in 34 of the 50 patients with a ruptured thoracic aorta. Thirty (88%) of the 34 were not wearing seat-belts at the time of impact. The wearing of seat-belts could (a) decrease the frequency of aortic rupture by reducing the deceleration forces and (b) allow more patients to reach hospital alive.

Prevention in the Emergency Room

Of the small number (20%) of patients who initially survive, 30% die within 6 hours and 50% within 24 hours of arrival in the emergency room. Thus, delayed or missed diagnosis should be avoided by a constant awareness of this lesion. In our series, 24 patients had surgical repair of a chronic post-traumatic aneurysm, discovered between 3 months and 43 years after the accident. Eight of these patients were hospitalized initially for 0 to 10 days (mean 4.5 days) because of associated

injuries. Obviously, an inaccurate history of the accident and lack of awareness of aortic rupture resulted in premature discharge of these trauma patients. A closer look at the entire series of acute (26 cases) and chronic (24 cases) ruptures is also interesting and explains why the diagnosis could easily be missed.

Twenty-nine (58%) of the 50 patients had neither rib fractures nor external evidence of chest injury at the time of initial examination. Most were polytrauma victims with associated orthopedic (58%), craniofacial (42%) and abdominal trauma (20%). These coexisting injuries are readily diagnosed and their presence can divert the physician's attention from the more lethal aortic rupture. Therefore an accurate history of the accident from ambulance attendants is mandatory.

The following is a summary of the types and circumstances of accidents, as obtained from family or witnesses in the 34 cases in which an accurate history was obtained:

- A death or the total destruction of a vehicle are direct manifestations of the intensity of the accident.

- As mentioned earlier, 88%, not wearing seat-belts, were submitted to some form of ejection.

- Thirty-three percent of our patients were involved in a lateral collision. As observed from car-crash experiences, seat belts used in most cars offer less protection in lateral than in frontal impacts.

- Deceleration from speeds over 100 km/h should alert the physician to possible aortic rupture. Unfortunately this specific detail is usually difficult to obtain.

Less common types of accidents were encountered. A fall from a height (more than 10 m, deltaplane, bridge) was responsible for aortic disruption in 3 of the 50 patients. The aorta is less resistant to vertical deceleration than it is to horizontal deceleration. The aortic injury was caused either by a heavy object (tree) compressing the chest, or by a high-velocity object striking the chest wall in four cases.

Clinical Findings

Despite the severe nature of the injury, clinical findings are usually meagre or inconclusive. Four clinical manifestations were found in our series of 47 patients treated for injury of the descending thoracic aorta, the respective incidence being as follows:

1. Systolic hypertension (60%). Unexplained sudden hypertension in a trauma patient who has been resuscitated should alert the physician. This is due to stretching or stimulation of the aortic plexus located in the vicinity of the isthmus.

2. A pseudocoarctation syndrome

also called the acute coarctation syndrome was found in 40% of our patients. There is hypertension in the upper extremities and a difference in pulse amplitude between them and the lower extremities. This is due to a partial or complete aortic obstruction by the torn intimal and medial layers at the site of the rupture.

3. A harsh systolic murmur over the precordium or the interscapular area was heard in 33% of our patients.

4. In 20% of patients, a central venous pressure higher than 15 to 20 cm H₂O was recorded. This is important when a tension pneumothorax (the first cause of high central venous pressure in closed chest trauma) has been ruled out. This pseudotamponade syndrome is explained by a periaortic hematoma causing external compression of the major mediastinal veins.

Radiologic Findings

Many radiologic signs have been described in the literature but most are

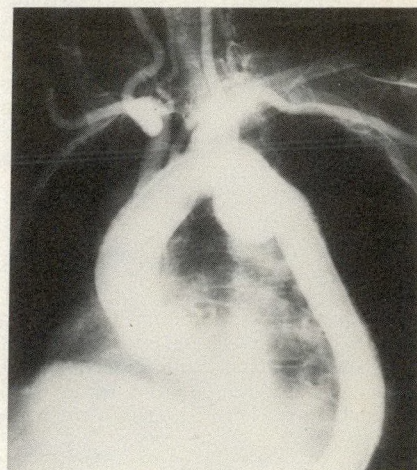


FIG. 1—Aortogram showing classic rupture of descending aorta at isthmus.

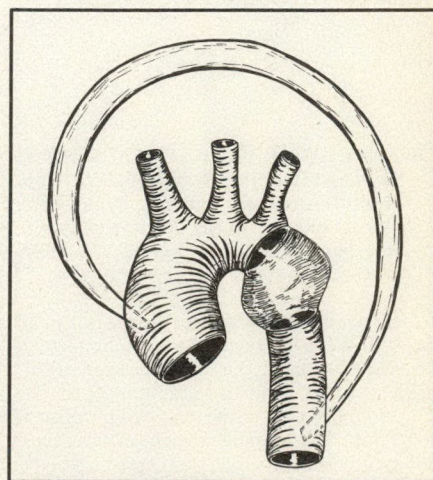


FIG. 2—Position of Gott (9 mm) shunt inserted from ascending to descending aorta.

inconstant. In our experience the presence of a dense mediastinal hematoma causing loss of the aortic knob shadow is constant and highly suggestive, but not diagnostic, of aortic rupture. Its presence is sufficient reason to perform aortography. The mediastinal shadow may not be very wide and was almost normal in one of our patients.

Prevention in the Angiography Room

High-quality aortography is the only definitive means of establishing the diagnosis of aortic rupture (Fig. 1). It should always precede thoracotomy in order to plan the proper surgical approach. In 9 (16%) of the 56 patients with rupture of the thoracic aorta or its branches, studied angiographically because of a mediastinal hematoma, aortography demonstrated rupture at an unusual site: ascending aorta (one), aortic arch (two), innominate artery (one) and right subclavian artery (five).

These lesions should be approached through a median sternotomy not the regular left thoracotomy used for isthmic disruption. Once the diagnosis has been clearly established by aortography, the patient must reach the operating room alive. A premature secondary adventitial

rupture can be prevented by lowering the blood pressure below 100 mm Hg with a solution of nitroglycerin or nitroprusside. The forceful contractions of the hyperdynamic young hearts can be controlled with Inderal.

Prevention at the Operating Room

Once a patient with an aortic rupture reaches the operating room alive, the surgeon faces two major goals: (a) the patient must survive and (b) the surgical technique should not produce any further physiologic damage to surrounding organs.

Since 94% of aortic ruptures involve the isthmus, protection in clamping the descending thoracic aorta will be emphasized.

Direct aortic cross-clamping has a number of well-known deleterious side effects.

- Acute proximal hypertension may result in brain damage or heart distension with sudden arrest.
- Sudden reduction of distal aortic perfusion affects all splanchnic organs, resulting in severe metabolic acidosis and renal dysfunction or failure.
- Paraplegia, a dreadful example of organ deterioration, is reported to be as high as 25%.³

In order to avoid these deleterious effects, we adopted one method of aortic shunting — a 9-mm Gott aneurysm shunt as an external bypass between the ascending and descending aorta (Fig. 2).

Forty-four acute and chronic traumatic aneurysms of the descending thoracic aorta have been operated upon using this procedure. The overall survival was 95% (42 of 44). Two deaths were due to irreversible brain damage present before aortic repair. There were no cases of heart failure, renal failure or dysfunction, and no instances of paraplegia.

Addendum

Since this manuscript was accepted for publication, three other isthmic ruptures were repaired using the Gott aneurysm shunt. All patients survived without paraplegia.

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BOOK REVIEWS

continued from page 391

It is only with the passage of time and use that new textbooks such as this find their niche. Undoubtedly, this text will vie with others for the attention of medical students, residents and surgeons and will likely become a useful reference text.

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ESSENTIALS OF THORACIC SURGERY.

Raymond Hurt and Michael Bates. 270 pp. Illust. Butterworth and Co. (Publishers) Ltd., London; Butterworth Publishers, Stoneham, Mass., 1986. \$59.95 (US). ISBN 0-407-00397-5.

It is difficult to know where to place this small book. It is too abbreviated and incomplete to be of much value to the experienced chest surgeon or to a Canadian "cramming" for the English fellowship — the intended purpose of this book. The training resident in cardiovascular and thoracic surgery at Queen's University commented that the book is too superficial for a candidate sitting the fellowship examination in cardiothoracic surgery — more

depth in every area is required than the book provides.

The illustrations and roentgenograms are excellent and the topics are covered in a clear and concise manner but with little or no mention of alternatives. This book may be of value to an intern or even a junior resident, but cannot be generally recommended.

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KIDNEY TRANSPLANT REJECTION.

Diagnosis and Treatment. Edited by G. Melville Williams, James F. Burdick and Kim Solez. 506 pp. Illust. Marcel Dekker, Inc., New York, 1986. \$79.75 (US). ISBN 0-8247-7496-5.

This superior textbook is a wonderful collection of the most recent developments in allograft rejection. The problem of rejection is important since approximately 3 of 10 renal transplants are lost at 3 years when patients are treated with cyclosporine and prednisone; the majority fail because of rejection. Patients who reject heart or liver transplants face certain death, whereas kidney transplant recipients may return to dialysis.

This textbook is divided into three sections — biology of allograft response, diagnosis of rejection and new immunosuppressive agents. There are 22 chapters, including an excellent review of antibody-mediated rejection by Winn from the Massachusetts General Hospital. Some other chapters are not completely up to date. For example, the latest terminology for the clustering of monoclonal antibodies (CD) is not used. The nomenclature is already terrible and the CD terminology is a major step forward. The chapter on T-cell proteins and T-cell activation has omitted important discussions on T-cell activation by 9.3 (TP44) monoclonal antibody and CD2 pathways of activation, not to mention the TP103 pathway of T-cell activation recently reported. The chapter on lymphokines has not dealt with the existence of IL3, IL4 and IL5. Perhaps being totally up to date is not always good since the IL4A reports have been retracted.

The chapter on anti-idiotypic immunity is excellent, but its clinical relevance may not be as important in light of recent data from the Collaborative Transplant Study based in Heidelberg, which has suggested that transfusions may no longer be required in the cyclosporine era.

The section on diagnosis is an excellent review of immunopathology, and the chapter on cytomegaloviral infections by Colvin and Rubin presents a lucid review as does the review of immunotherapy with polyclonal and monoclonal antibodies and the pitfalls of cyclosporine therapy.

continued on page 420

Symposium on Unexpected Findings at Laparotomy

T. KEITH SCOBIE, M SC, MD, DABS, FACS, FRCSC*

1. General and Vascular Surgery Questions

As part of a symposium, the following cases were presented as examples of surprise findings at laparotomy.

Case 1

Question

At operation on a 66-year-old man with an obvious but asymptomatic abdominal aortic aneurysm (diameter 6 cm), the gallbladder and common duct were seen and appeared normal, but the former contained a number of medium-sized stones.

Which of the following procedures should be performed:

(A) Repair of the aneurysm alone with long-term follow-up for the development of symptomatic gallbladder disease.

(B) Cholecystectomy alone followed by repair of the aneurysm some weeks later.

(C) Combined repair of the aneurysm and cholecystectomy.

(D) Combined repair of the aneurysm and cholecystostomy.

(E) Cholecystectomy, ligation of the aorta above and below the aneurysm and axillobifemoral grafting?

Presented as part of a symposium on unexpected findings at laparotomy at the 9th annual meeting of the Canadian Association of General Surgeons, held in conjunction with the 55th annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Sept. 23, 1986

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Answer (E)

Discussion

The surgeon who discovers unexpected intra-abdominal disease at laparotomy for aortic reconstruction faces a serious dilemma. The risk of adding an operation that involves opening a hollow viscus is still controversial. Because of their concern about the development of acute cholecystitis postoperatively and possible rupture of the aortic aneurysm if cholecystectomy alone is performed, many surgeons would perform a cholecystectomy if indicated after uneventful completion of the aortic surgery and closure of the retroperitoneum. The decision must be based on surgical judgement and a knowledge of the natural history of both untreated cholelithiasis and asymptomatic abdominal aortic aneurysm.

What is the natural life history of silent gallstones?

Gracie and Ransohoff¹ reviewed the natural history of silent gallstones diagnosed by cholecystographic screening of a healthy population. Complete follow-up of 123 patients revealed that none died of gallstone disease and that the 15-year cumulative probability of biliary pain or complications developing was only 18%. They concluded that the innocent gallstone is not a myth.

What is the risk of rupture of an asymptomatic aortic aneurysm after other abdominal surgery?

The incidence of rupture associated with asymptomatic aneurysms increases in proportion to their size — the 5-year risk of rupture of a 4-cm aneurysm is 15%, a 6-cm aneurysm 35% and an 8-cm aneurysm 75%. Patients with symptomatic aneurysms have a much worse prognosis — 33% die within 1 month, 74% within 6 months and 80% within a year, mainly from rupture.²

Does laparotomy precipitate rupture of aortic aneurysms in the immediate postoperative period?

Swanson and colleagues³ reported the rupture of previously asymptomatic aneurysms in 10 patients within 36 days (mean 10 days) of a laparotomy. They suggested that laparotomy and associated intra-abdominal disease may have precipitated rupture by reducing the collagen content of the aneurysm, thus making the wall weaker. Lysis of collagen is enhanced by injury such as laparotomy and by nutritional depletion and local inflammation. The mean diameter of the aneurysms in their report was 9.4 cm, placing them at high risk for rupture even without laparotomy and possible surgical trauma.

How frequently do gallstones occur in patients with abdominal aortic aneurysms and what is the risk of concomitant cholecystectomy and aneurysm repair?

Ouriel and colleagues⁴ detected gallstones in 42 (5%) of 865 patients with abdominal aortic aneurysms, 18 of whom underwent concomitant aneurysm resection and cholecystectomy. There was no significant increase in operative mortality, duration of operation or length of hospital stay with the combined procedure; however, one patient suffered graft infection 26 months postoperatively. Of 11 patients who underwent aneurysmectomy without cholecystectomy, 9 experienced an episode of acute cholecystitis during a mean follow-up of 2.9 years. Two episodes occurred in the immediate postoperative period; biliary sepsis resulted in the death of one of the patients.

String⁵ reported cholelithiasis in 33 (13%) of 250 patients who underwent aortic surgery. Sixteen had a combined procedure without graft infection; 1 died of myocardial infarction. String emphasized the need for careful reperitonealization of the aorta before

cholecystectomy and the avoidance of bile leakage, using Bovie electrocautery to transect the ligated cystic duct. Routine bile cultures gave positive findings in 33%. There was no closure or drainage of the gallbladder bed. Of 17 patients who did not have cholecystectomy, 9 required the procedure at intervals of 2 weeks to 108 months postoperatively.

Ameli and colleagues⁶ have had experience with combined cholecystectomy and abdominal aortic surgery in 56 patients. They reported no increase in morbidity or mortality and no graft infection related to the cholecystectomy in a follow-up of 1 to 125 months. They concluded that cholecystectomy can be safely performed at the time of aortic surgery by a vascular surgeon experienced in biliary tract surgery.

Moir and Litherland⁷ analysed the charts of 1049 patients with abdominal aortic aneurysms seen between 1973 and 1984 at the Vancouver General Hospital, 100 (9.5%) of whom had associated gallbladder disease. They noted the following: 45 patients had symptomatic biliary tract disease; 34 of these had cholecystectomy alone followed by subsequent aneurysm repair (average diameter 6.3 cm) without intervening rupture, 9 had aneurysm repair alone, which was complicated by postoperative cholecystitis in 5 and fatal aortoenteric fistula 11 months after aneurysmectomy in 1, and 2 had combined procedures and suffered bile leakage and biliary sepsis.

Fifty-two patients with asymptomatic cholelithiasis left alone at aneurysmectomy were followed up for a median of 5.4 years; cholecystitis developed in 9, 5 of whom required cholecystectomy. Moir and Litherland concluded that symptomatic biliary disease should be treated before elective aneurysmectomy, but asymptomatic cholelithiasis does not require immediate surgery, and concomitant cholecystectomy may lead to postoperative complications.

In my personal series of 950 aortic grafts, I have followed a similar policy without complications of aneurysm rupture or fatal cholecystitis.

Proponents of combined cholecystectomy and aneurysm repair do recognize the following contraindications: acute cholecystitis, choledocholithiasis, operative problems with the aneurysm repair, serious cardiac complications at the time of surgery, anesthetic problems, and possible acute or ruptured aneurysms.

Case 2

Question

At laparotomy for a gunshot wound to the abdomen, the infrarenal inferior vena cava is seen to be transected with a 3-cm loss of length. There are also associated

colon and small-bowel perforations. The best method of management is:

- (A) Ligation of the vena cava
- (B) Primary repair after mobilization
- (C) Repair with a synthetic graft
- (D) Repair with autogenous vein
- (E) Anastomosis to the portal vein?

Answer (A)

Discussion

Inferior vena caval injuries due to penetrating abdominal trauma occur in 1 of 50 patients with civilian gunshot wounds and 1 of 300 patients with knife wounds. Of these, 36% will die before reaching hospital and 34% to 57% of those who reach hospital alive will also die of their injury, despite efforts at repair.⁸

The major determinants of survival are the level of injury to the inferior vena cava (suprarenal versus infrarenal), the presence of hemorrhagic shock on admission and the speed with which diagnosis is made and treatment instituted.⁹ If the injury is complicated and involves the infrarenal vena cava, ligation is the best procedure and is well tolerated. Suprarenal and especially intrahepatic caval injuries present a much greater problem in management, primarily due to the difficulty of exposure. Repair must be attempted because ligation of the suprarenal inferior vena cava is almost always fatal.

Case 3

Question

A 58-year-old man with known coronary artery disease and atrial fibrillation is seen in the emergency room 2 hours after the sudden onset of severe diffuse abdominal pain. The most productive investigation is:

- (A) Physical examination including rectal examination
- (B) Laboratory investigations including measurement of enzymes and blood gas levels
- (C) X-ray films of the abdomen
- (D) Examination of the stool for occult blood
- (E) Mesenteric angiography?

Answer (E)

Discussion

The classic picture of acute mesenteric insufficiency is severe, visceral, poorly localized, abdominal pain, usually out of proportion to the physical findings and initially not supported by objective data. Peritonitis, when present, is a late finding.¹⁰ The history of severe generalized atherosclerosis, of postprandial pain and

weight loss suggestive of chronic mesenteric insufficiency are important as is a history of heart disease and a potential source for an embolus. Increased leukocyte count, sedimentation rate and inorganic phosphate levels¹¹ are usually late findings as is elevation of the various enzyme levels and the appearance of metabolic acidosis. Because of the presence of fluid in the bowel, x-ray films of the abdomen may show the classic gasless appearance of an acute mesenteric occlusion, in addition to dilated loops of bowel, thickening of the bowel wall and altered mucosal contours. Occult blood is present in the stool in more than half the cases, but again should not delay assessment. Mesenteric angiography is diagnostic, especially in obscure cases. It will confirm the diagnosis in cases of acute arterial occlusion and yield suggestive findings in many cases of ischemic injury of nonocclusive origin. Furthermore, by defining the level of anatomic occlusion, angiography expedites arterial revascularization in superior mesenteric artery embolization and thromboses. Finally, angiographic techniques may play an important part in the management of ischemia by allowing infusion of vasodilating drugs, such as papaverine, directly into the mesenteric circulation.¹²

Angiographic evidence of emboli and thrombosis is usually distinguishable and the absence of their characteristic findings suggests nonocclusive disease as a cause. Angiographically, emboli appear sharply defined early in the course of the disease, but if examination is delayed by several days, secondary thrombosis builds up proximally and distally, obscuring the typical meniscal configuration. The superior mesenteric artery embolus usually lodges 3 to 8 cm away from the aortic origin of the vessel and can be seen on the anteroposterior film. The characteristic angiographic picture is that of a mercury meniscus sign in the mesenteric artery with the proximal branches showing up rapidly, but without visualization of distal jejunal and ileal branches. Superior mesenteric artery thrombosis in contrast occurs in the proximal 3 cm, is easily seen and best demonstrated on the lateral view.

Question

At laparotomy in this 58-year-old man, extensive ischemic changes are seen in the small bowel and right colon, and palpation reveals occlusion of the superior mesenteric artery at the middle colic origin. Treatment should be:

- (A) Primary resection of the involved ischemic bowel alone
- (B) Aorto-superior mesenteric artery bypass with long saphenous vein
- (C) Aorto-superior mesenteric artery bypass with a prosthetic graft

(D) Instillation of papaverine into the superior mesenteric artery combined with a second-look operation 12 to 24 hours later

(E) Embolectomy of the superior mesenteric artery with or without bowel resection?

Answer (E)

Discussion

Primary resection of ischemic bowel without arterial revascularization rarely results in patient survival. Superior mesenteric embolectomy by a Fogarty catheter through a small transverse incision in the superior mesenteric artery is the treatment of choice, having produced the best results.¹³ In acute superior mesenteric artery thrombosis, bypass grafting¹⁴ with a reversed saphenous vein is preferred because of the possibility of subsequent bowel resection causing infection detrimental to a prosthetic graft. Once revascularization is complete, a decision must be made concerning the viability of the bowel and the need for resection.

Question

Which method or methods noted below are satisfactory in assessing bowel viability:

- (A) Clinical assessment
- (B) Doppler ultrasonic flow probe
- (C) Fluorescein ultraviolet fluorescent pattern
- (D) All of the above?

Answer (D)

Discussion

It has been demonstrated that although clinical assessment by an experienced surgeon avoids leaving ischemic bowel behind it probably results in a higher incidence of resection of potentially viable bowel. Fluorescein ultraviolet fluorescent patterns are probably more efficient than Doppler ultrasound flow probe in assessing bowel viability but both have accuracy rates of 80% to 90%.¹⁵

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MICHAEL A. ROBINETTE, MD, FRCS*

2. Urology Questions

Case 1

Question

During a left hemicolectomy for carcinoma of the descending colon performed on a 68-year-old woman, the left ureter was accidentally cut in its middle third.

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Both ends were visualized. Which of the following procedures should be carried out:

- (A) Repair of the ureter with a spatulated anastomosis
- (B) Repair of the ureter with a spatulated anastomosis and insertion of a double J stent up to the kidney and down to the bladder
- (C) Establishment of a cutaneous ureterostomy
- (D) Nephrectomy
- (E) Mobilization of the bladder, establishment of a Boari flap and reimplantation of the proximal ureter into the bladder with ligation of the distal segment of the ureter?

Answer (B)

Discussion

When a ureter is damaged during surgery and the injury recognized at the time, repair should be immediate. Ureteral injuries can be prevented by preoperative

intravenous pyelography and placement of ureteric catheters, especially in procedures expected to be difficult. Ureteral "danger areas" are: the inferior mesenteric vessels (during ligation), the ovarian fossa, the rectovesical pouch, the ureterosacral ligaments during division and during reperitonealization.

Principles in ureteral reconstruction include repair with viable tissue, anastomosis without tension, adequate drainage, placement of a ureteral stent (J), proximal diversion and administration of antibiotics. Factors affecting the choice of repair include the type and extent of injury, involvement of other organ systems, condition (age) of the patient and the status of the urinary tract (the contralateral kidney and ureter, urosepsis, prior irradiation).

Repair of a mid-ureteral transection at operation when the ends are visualized is best accomplished by debriding and spatulating the ends, and anastomosing with 3-0 or 4-0 chromic catgut over a double J stent.

Case 2

Question

During an abdominoperineal resection of the rectum, clear fluid is suddenly visible in the wound. The source of the leak is identified in the posterior urethra. Which procedure should be carried out:

- (A) Completion of the abdominoperineal resection leaving a Foley catheter in the urethra
- (B) Urethroscopy to delineate the injury and repair, leaving a Foley catheter in the urethra
- (C) Urethroscopy to delineate the injury, repair and suprapubic cystostomy
- (D) Complete abdominoperineal resection and drainage of the perineum?

Answer (C)

Discussion

Injury to the posterior urethra occurring during rectal surgery is best treated conservatively with suprapubic diversion of the urine and appropriate drainage of the perineum. Urethroscopy permits identification of the injury and delineates its extent. With a tear in the urethra clearly visible, repair should be performed with interrupted 3-0 chromic catgut when possible. A Foley catheter should not be used. A follow-up urethrogram is required to ensure that healing is complete and there is no residual stricture.

Case 3

Question

A 25-year-old man was admitted to hospital after a motor vehicle accident. Because an abdominal tap yielded blood, laparotomy was performed. A ruptured spleen was removed. A large left-sided retroperitoneal mass was noted with obvious hemorrhage extending into the colonic mesentery. Which of the following procedures should be performed:

- (A) Needle aspiration of the mass
- (B) Reflection of the colon and exploration of the mass
- (C) Intravenous pyelography with or without angiography on the operating table and observation of the hematoma for increase in size
- (D) Closure of the abdomen and monitoring of the patient clinically, assessment with help of a postoperative intravenous pyelogram or angiogram, or both?

Answer (C)

Discussion

With upper abdominal trauma, renal

and intraperitoneal organs can be damaged concurrently. At laparotomy, a retroperitoneal mass over either kidney may be found. It is essential to obtain information on the degree of damage to the affected kidney and the status of the opposite kidney before treatment is considered. The degree of renal injury is more important than the size of the hematoma in deciding on surgical or conservative management.

The value of an intravenous pyelogram obtained intraoperatively is that it determines the status of the contralateral kidney and assesses the extent of damage and if the affected kidney is functioning. The indications for intraoperative angiography include nonvisualization of one or both kidneys on intravenous pyelography or evidence of severe renal injury.

If the kidney is seen to be functioning and the retroperitoneal mass is not increasing in size, conservative management is indicated, even when a small amount of extravasation is seen on the intravenous pyelogram. When exploration is required because of a nonfunctioning kidney, a large amount of extravasation or an increasing retroperitoneal hematoma, control of the renal vascular pedicle is essential before the organ is mobilized. With a vascular clamp tem-

porarily on the renal artery to control blood loss, the damaged kidney is debrided and the parenchymal lacerations are repaired, following which the renal fossa should be drained extraperitoneally.

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SESAF V Question

222. Which of the following statements about aortoenteric fistula — communication between an aortic prosthetic graft and the bowel — is NOT true?

- (A) Such communications generally occur between the proximal suture line and the distal duodenum or proximal jejunum
- (B) Simple suture closure of the defects in bowel and aorta provides satisfactory results
- (C) Among those who survive an initial operation for aortoenteric fistula, the leading cause of death is blow-out of the ligated aortic stump
- (D) Common premonitory symptoms for aortoenteric communication may include fever and malaise, distal microembolization, or minor episodes of gastrointestinal bleeding
- (E) Patients who have placement of aortic prosthetic grafts in emergency circumstances, such as ruptured aneurysm, are at much higher risk for aortoenteric fistula

For the critique of Item 222 see page 413.

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3. General Surgery Questions

Case 1

Question

A 32-year-old man is explored through a McBurney incision because of lower abdominal pain and peritoneal signs maximum to the right of the midline. The appendix appears normal. There is pus in the pelvis and a small perforation of the sigmoid colon that is barely visible.

The correct approach is:

(A) To place two drains in the pelvis and close the incision; administer broad-spectrum antibiotics

(B) To place two drains in the pelvis and carry out a transverse colostomy

(C) To extend the incision across the midline for better exposure and resect the involved portion of sigmoid colon by a Hartmann procedure

(D) To close the McBurney incision, make a vertical midline incision for better exposure and resect the colon by a Hartmann operation

(E) To close the McBurney incision, make a vertical midline incision, resect the sigmoid colon and carry out primary anastomosis?

Answer (D)

Discussion

Peritoneal drainage of an intestinal per-

Presented as part of a symposium on unexpected findings at laparotomy at the 9th annual meeting of the Canadian Association of General Surgeons, held in conjunction with the 55th annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Sept. 23, 1986

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foration is inadequate treatment since soilage is likely to continue.

The classic treatment of perforated sigmoid by drainage and proximal defunctioning colostomy allows continued soilage by colonic contents distal to the colostomy. Most authorities agree that this approach should be used only when technical problems make sigmoid resection hazardous or in patients who are extremely frail or unstable.

A better exposure is necessary to identify the pathologic process in the sigmoid colon. The problem with extending a McBurney incision across the midline is that it transects the rectus muscle which can leave the patient with a weakened lower abdominal wall which, if complicated by wound infection (a common occurrence in the situation described), may produce a hernia that is difficult to repair.

The McBurney incision is inappropriate to treat a sigmoid lesion. It should be closed and a long midline incision made; this gives excellent exposure and heals well. No matter what the cause of the perforation, the ideal treatment at this early stage, in a young, healthy person, is to resect the involved portion of sigmoid colon. Although there have been reports advocating primary anastomosis of the colon for perforation on the left side, most authorities favour end-sigmoid colostomy and closure of the distal end with second-stage reconstruction once recovery is complete and there is no concern about intraperitoneal sepsis.^{1,2}

Case 2

Question

A 50-year-old man is operated on for carcinoma of the right colon. Results of preoperative liver function tests were normal; however, an unexpected metastatic mass (5 cm in dimension) is found in the right hepatic lobe deep to and to the right of the gallbladder fossa.

Management in this situation should be:

(A) Resection of the right colon and the right lobe of the liver

(B) Resection of the right colon, leaving the tumour in place. Placement of a

catheter in the right hepatic artery through the gastroduodenal artery for postoperative infusion chemotherapy

(C) Resection of the right colon, leaving the liver lesion for removal by a right hepatic lobectomy 3 to 6 weeks later after discussion with the patient

(D) No resection of either tumour; systemic chemotherapy

(E) Resection of the right colon. Delay at least 6 months to see if other disease appears before considering liver resection?

Answer (C)

Discussion

The lesion as described would require right hepatic lobectomy without either complete screening for other metastatic disease or discussion of the potential risks of that operation with the patient. A resection of this magnitude is contraindicated. Had the lesion been suitable for simple wedge excision one could proceed simultaneously.

Even in the presence of metastatic disease in the liver, the primary colonic cancer should be removed because of the risk of later complications such as obstruction or bleeding. The use of intra-arterial infusion for unresectable liver cancer is an option, but the benefit in terms of survival is, as yet, unproven. Since resection is the best treatment for isolated liver metastases, it should not be compromised by catheterizing the hepatic artery.

After resection of the primary tumour, postoperative studies should include lung tomography or computed tomography to make certain that there are no pulmonary metastases. The risks and benefits of liver resection should be discussed with the patient, realizing that 5-year survival figures of between 25% and 40% can be expected following resection of solitary metastases from colonic cancer.

Cure is not possible with systemic chemotherapy, nor is it clear what benefit chemotherapy has in prolonging life in this situation.

It has been argued that resecting the primary lesion and waiting for 6 months allows one to identify the biologically

favourable lesions and resect only those. The data comparing 5-year survival in patients having synchronous excision of metastatic tumours and metachronous excision do not clearly show an advantage in survival for the latter patients. Because metastases can arise from liver metastases, most authors now recommend resecting solitary liver metastases at the same time as the primary, if the criteria referred to above have been met.³⁻⁵

Case 3

Question

A 60-year-old taxi driver has been treated for 8 years, off and on, for proven duodenal ulcer disease. He is admitted through the emergency department with a massive gastrointestinal hemorrhage and, because of difficulty in maintaining adequate blood pressure, is taken to the operating room for abdominal exploration. He is found to have marked cirrhosis of the liver, splenomegaly and mild ascites.

Appropriate management would be:

- (A) To close the incision and manage the condition as a variceal hemorrhage
- (B) To perform intraoperative endo-

scopy to determine the source of the bleeding

(C) To do a gastroduodenotomy to determine the source of the bleeding

(D) To carry out an esophageal transection including a vagotomy and pyloroplasty

(E) To perform emergency shunting plus a vagotomy and pyloroplasty?

Answer (C)

Discussion

Bleeding must be controlled surgically and since from the history a bleeding ulcer is a real possibility, conservative management as with a variceal hemorrhage is inadvisable.

Presumably an attempt at endoscopy was made before operation, but even if not it is unlikely that one could adequately assess by intraoperative endoscopy the esophagus, stomach and duodenum in a patient bleeding this rapidly.

Gastroduodenotomy provides an opportunity to locate bleeding from the duodenum, stomach or gastroesophageal regions. It permits the control of bleeding from a duodenal ulcer and can be converted into gastric drainage combined with vagotomy. If the patient's duodenal

ulcer is not actively bleeding, the gastroduodenotomy can be converted to a pyloroplasty with vagotomy and alternative treatment for bleeding varices selected.

Esophageal transection with vagotomy and pyloroplasty is an option when gastroduodenotomy discloses an active ulcer, as well as bleeding from varices. Although esophageal transection may be effective in controlling the immediate hemorrhage, recurrent bleeding is not uncommon.

Emergency shunting should only be considered if gastroduodenotomy discloses no active peptic ulcer and continued hemorrhage from the gastroesophageal region. Prosthetic materials should not be used because the gastrointestinal tract has been opened.

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4. General Surgery Questions

Case 1

Questions

At elective cholecystectomy performed on a 40-year-old obese, hypertensive woman

Presented as part of a symposium on unexpected findings at laparotomy at the 9th annual meeting of the Canadian Association of General Surgeons, held in conjunction with the 55th annual meeting of the Royal College of Physicians and Surgeons of Canada, Toronto, Ont., Sept. 23, 1986

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through a midline incision, a 2-cm, well-demarcated, smooth mass is palpated above the left kidney in the region of the adrenal gland.

1. The most likely diagnosis, assuming an adrenal mass, is:

- (A) Adrenal cortical adenoma
- (B) Metastatic carcinoma
- (C) Pheochromocytoma
- (D) Myelolipoma
- (E) Adrenal cortical carcinoma?

2. The treatment of choice is:

- (A) Removal of the left adrenal gland
- (B) Needle aspiration
- (C) Exposure of the mass and an incisional biopsy if the findings are suspicious
- (D) Intravenous pyelography on the operating table to rule out renal cyst
- (E) None of the above?

3. All of the following can be useful additional preoperative investigations of an adrenal mass discovered incidentally on computed tomography of the abdo-

men performed for other reasons, EXCEPT

- (A) Ultrasonography
- (B) Radioisotope iodobenzylguanidine scanning
- (C) Needle aspiration biopsy
- (D) Hormone studies
- (E) Review of clinical signs and symptoms?

Answers (1A), (2E), (3A)

Discussion

Computed tomography scanners visualize the normal adrenal glands in 95% of patients and can identify adenomas as small as 1 cm in diameter. About 0.6% of upper abdominal computerized tomograms reveal incidental adrenal masses. Of the 95 cases of adrenal incidentalomas described in the literature,¹ 71 were removed surgically with diagnoses as follows: adrenal cortical adenoma 30, metastasis 17, pheochromocytoma

toma 4, cyst 9, myelolipoma 5. No adrenal cortical carcinoma presenting as an incidentaloma was reported.

If the clinical setting suggests the presence of metastatic disease and the primary disease is occult, percutaneous needle biopsy under computed tomographic guidance established the diagnosis in 94% of adrenal tumours in a recent study.² Screening hormonal studies are necessary even when the clinical features of endocrine symptoms are absent, since even occult hormone secretion (Cushing's syndrome, pheochromocytoma, Conn's syndrome) are potentially dangerous. Further investigations are rarely helpful. Ultrasonography and angiography provide little new information. Iodobenzylguanidine scanning can be helpful in suspected pheochromocytoma. When the three main steps have failed to produce a diagnosis, the lesion is likely a benign adenoma, especially if it is less than 5 cm in dimension, round or oval in shape and is clearly delineated from surrounding structures; 90% of carcinomas are larger than 5 cm.³ A conservative approach to the adrenal incidentaloma is recommended. However, clinical follow-up and repeat computed tomography at 6 months and 1 year are necessary to confirm that the disease has not progressed.

Case 2

Question

After returning from a 2-week stay in the Dominican Republic, a 30-year-old man presented to hospital on Mar. 26, 1986 with a 3-day history of crampy abdominal pains. He had eaten many local foods including shellfish. The pains began suddenly and were associated with intermittent nausea and vomiting. There was no hematemesis, melena, fever or chills, but there were a few episodes of watery non-bloody diarrhea. A contact of the patient had similar, but short-lived, symptoms.

His body temperature was 37.5°C, pulse rate 80 beats/min and blood pressure 130/80 mm Hg. He was in moderate distress with abdominal pains. The abdomen was soft and diffusely tender but not distended. Bowel sounds were increased. Rectal examination produced watery brown liquid stools negative for occult blood. On laboratory investigation the leukocyte count was $13.1 \times 10^9/L$, the serum creatinine level 97 $\mu\text{mol/L}$, serum amylase 107.3 U/L and serum electrolyte values were normal.

Emergency room management options were as follows:

- (1) Rehydration, antispasmodics, antiarrhythmic agents and discharge home
- (2) Culture of stools for parasites and bacteria
- (3) Addition of vancomycin with or

without any other option and discharge home

(4) Abdominal x-rays

Which of these options is the correct one:

- (A) 1, 2 and 3
- (B) 1 and 3
- (C) 2 and 4
- (D) 4 only
- (E) All?

Answer (C)

Question

The patient was admitted to the holding unit with a presumptive diagnosis of gastroenteritis. He continued to have crampy intermittent abdominal pain accompanied by nausea and vomiting. Abdominal x-rays showed multiple 1.5 × 3-cm sausage-shaped objects throughout the small bowel with dilatation and air-fluid levels (Fig. 1). The patient was admitted to hospital.

Which of the subsequent treatment options is appropriate:

- (A) Laparotomy within 24 hours
- (B) Administration of mineral oil, cathartics (magnesium citrate) and liquids
- (C) Gastric suction and intravenous fluids with observation on a standard ward
- (D) Intensive care and monitoring
- (E) Nasogastric whole-gut lavage with Ringer's lactate or Go-Lytely solution?

Answer (C)

Question

A nasogastric tube was inserted and during the next 48 hours he continued to have increasing upper abdominal pains with intermittent nausea relieved by

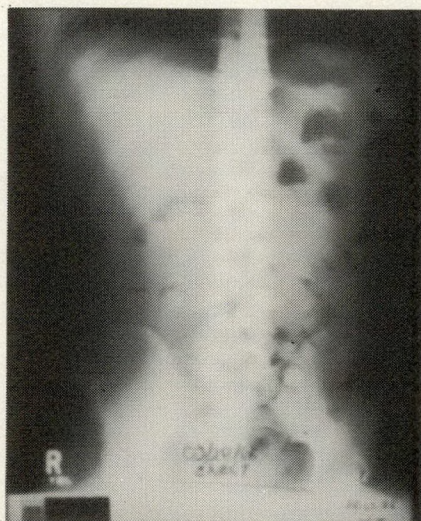


FIG. 1—Packets of cocaine that caused bowel obstruction.

changing position. He continued to pass flatus. Repeat abdominal x-ray films were unchanged. Blood pressure and pulse remained stable with occasional low-grade fever (temperature to 38°C).

All of the following are signs of cocaine toxicity EXCEPT:

- (A) Rising blood pressure
- (B) Bradycardia
- (C) Fever
- (D) Arrhythmias
- (E) Cardiovascular collapse
- (F) Seizures?

Answer (B)

Question

On the evening of Mar. 29, the patient complained of increasing abdominal pain. Examination continued to show hyperactive bowel sounds with marked tenderness and passage of some liquid stool which did not contain blood. On the afternoon of Mar. 30 the patient was taken to the operating room where, at laparotomy, multiple small packets were palpable throughout the large bowel but not in the small bowel.

Which treatment option is now appropriate:

- (A) Closure of the incision, allowing packets to pass spontaneously
- (B) Multiple colotomy as necessary and removal of packets
- (C) Operative colonoscopic extraction, aided by the abdominal surgeon
- (D) Milking of the colon until all packets are retrieved rectally
- (E) None of the above?

Answer (D)

Discussion

The patient was admitted with a classic history of foreign travel, abdominal colic, nausea and vomiting after eating shellfish. The diagnosis of enteropathogenic *Escherichia coli* infection or infection with *Vibrio parahaemolyticus* was correctly entertained. The patient initially refused abdominal roentgenography and it was not until this study was done that it was appreciated he had swallowed packets containing a drug.

There was no evidence of overt obstruction initially and it was elected to observe the patient, as most packets will pass spontaneously.⁴ Close monitoring and repeated abdominal x-ray films are indicated for signs of obstruction, and the patient must be watched carefully for signs of cocaine or hashish toxicity as a result of the packets breaking open. Cocaine overdose is suggested by early evidence of sympathetic overactivity — rising blood pressure, pulse and temperature, cardiovascular and respiratory collapse and arrhythmias. Seizures and

hyperthermia are additional signs. Hashish overdose is of less concern than cocaine; however, respiratory depression can occur. After 3 days of observation, the patient had increasing abdominal pain with marked tenderness and it was decided to do a laparotomy. Probably the packets would have passed spontaneously if the surgeon had waited another day or so.⁴ Having made the decision to operate and finding all the packets in an unprepared large bowel, the surgeon made the correct decision to milk the packets out through the rectum, and this was accomplished successfully. Two of the packets were empty, probably a result of manipulation and milking rather than spontaneous rupture. They had been wrapped, obviously by a professional, with one layer of silver foil and two layers of latex rubber bound with nonabsorbable suture.

Case 3

Question

A 73-year-old man who was in apparent excellent health went to his family physician for a routine check-up. An SMAC biochemical analysis revealed abnormal liver function. He had no history of liver disease and denied excessive alcohol consumption.

Laboratory investigations gave the following serum values: alkaline phosphatase 142 U/L (normal range from 30 to 105 U/L), aspartate aminotransferase (SGOT) 60 U/L (normal range from 0 to 47 U/L), alanine aminotransferase (SGPT) 84 U/L (normal range from 0 to 47 U/L); serum bilirubin and albumin levels were normal. The serum tested positive for hepatitis B surface antigen (Hb_sAg), negative for antibodies to hepatitis B surface antigen and positive for hepatitis B core antigen. A liver scan was performed and a defect 3 cm in dimension was seen in the right lobe. The left lobe was prominent. The spleen appeared normal. Isotope flow studies showed that the defect was vascular but did not have the characteristic appearance of a hemangioma. In view of the patient's well-being, no further investigation or treatment was instituted and the liver scan was repeated 3 months later. The previously described lesion was considerably larger but there were no new defects. The patient was admitted to hospital. The α -fetoprotein value was 5.9 μ g/L (normal less than 15 μ g/L). All other investigations including pulmonary and gastrointestinal ones failed to show a primary tumour. Hepatic arteriography revealed normal vascular anatomy with an 8-cm highly vascular lesion in the right lobe.

At laparotomy, a normal-sized liver was apparent. It contained evidence of severe macronodular cirrhosis of the non-

nutritional variety. The right lobe was large and its central portion felt firm, but no tumour could be seen on the surface and none was palpable within the liver substance itself.

The options are:

- (A) Needle biopsy of the right lobe using a 1.2-mm Menghini needle
- (B) Deep wedge biopsy of the right lobe
- (C) Closure of the incision with a presumptive diagnosis of regenerating cirrhotic nodule
- (D) Intraoperative ultrasonography and guided biopsy
- (E) Closure of the incision because of age and the degree of cirrhosis?

Answer (A)

Question

Several blind needle biopsies were done with a 1.2-mm Menghini needle. Frozen sections were difficult to obtain because the tissue was HB_sAg positive. There was only one cryostat and the pathologists had not been forewarned of contaminated tissue. The specimen was also very fragmented. After a 45-minute delay the pathologist reported evidence of inflammatory cells, fibrosis and necrosis with no indication of carcinoma.

The procedure of choice at this stage is:

- (A) Repeat needle biopsy of the right lobe with 1.9-mm Menghini needle
- (B) Deep wedge biopsy of the right lobe
- (C) Closure of the incision with a presumptive diagnosis of regenerating cirrhotic nodule
- (D) Closure of the incision because of the patient's age and degree of cirrhosis
- (E) Right hepatectomy?

Answer (A)

Discussion

Despite the negative α -fetoprotein value, the preoperative diagnosis was probable hepatoma due to chronic HB_s antigenemia, although some metastatic tumours (e.g., colonic tumours) can be highly vascular. Preoperative percutaneous needle biopsy can be dangerous in vascular hepatomas and probably would not have been helpful. The severity of cirrhosis was surprising as was the lack of a visible or palpable tumour. Hepatomas can lie deeply and often are diffuse without surface visibility and difficult to palpate in a cirrhotic liver. It is essential to have tissue diagnosis before undertaking major hepatic resection. One can argue that a 73-year-old cirrhotic should not be subjected to liver resection. Certainly, all major hepatic resections should be handled at centres with expertise, experience, intensive care and blood bank

support. Aspiration needle biopsy is the diagnostic procedure of choice but is often unsatisfactory in the cirrhotic liver which fragments. Intraoperative hepatic ultrasonography has, in some hands, proved indispensable in the accurate diagnosis and determination of the resectability of hepatocellular carcinomas⁵ and in their safe resection,⁶ but is not yet generally available or widely used in North American institutions. A 1.9-mm needle is the best intraoperatively. While cirrhotic livers do not regenerate, segmental and subsegmental resections can be performed, but fresh plasma is needed preoperatively along with cryoprecipitate, vasopressin infusion and the use of a cell-saver or autotransfused blood.

Case 4

Question

A 70-year-old man had 10 days previously undergone elective triple-vessel coronary bypass, internal mammary artery implantation, free omental grafting and aortic valve replacement for remote myocardial infarction and exertional angina. He was on Coumadin anticoagulation. Convalescence was slow but uncomplicated until day 7 when he complained of anorexia and epigastric discomfort accompanied by a low-grade fever. The serum bilirubin value was 41 μ mol/L. He was known to have had cholelithiasis for many years, now reconfirmed by ultrasonography. The common bile duct measured 9 mm in diameter, but there was no evident choledocholithiasis as detail was obscured by overlying gas. The gallbladder wall was 3 mm thick with no other obvious abnormality. The patient experienced increasing abdominal discomfort, tenderness and fever over the next 48 hours.

The choice of management is:

- (A) Emergency laparotomy
- (B) Endoscopic retrograde cholangiopancreatography, with or without sphincterotomy and nasobiliary drainage if indicated
- (C) Administration of antibiotics, nasogastric suction, parenteral alimentation and conservative management
- (D) Reversal of anticoagulation with vitamin K and fresh frozen plasma followed by laparotomy in 24 hours
- (E) Percutaneous biliary drainage of the gallbladder under computed tomographic guidance (percutaneous cholecystostomy)
- (F) Cholecystostomy under local anaesthesia?

Answer (D)

Question

At laparotomy, an acutely inflamed

gallbladder and slightly dilated common bile duct is found with no frank perforation.

The procedure of choice is:

(A) Cholecystostomy and intraoperative cholangiography by way of the gallbladder

(B) Cholecystectomy and intraoperative cholangiography by way of the cystic duct

(C) Cholecystectomy and insertion of a T tube into the common bile duct

(D) Cholecystectomy and common-bile-duct exploration?

Answer (B)

Question

In the presence of known cholelithiasis, when planning elective cardiac or vascular surgery, in which the abdomen will be opened or could easily be opened (median sternotomy), symptomatic biliary tract disease should be treated:

(A) Before the cardiac or vascular surgery

(B) Concomitant with the cardiac or vascular surgery

(C) After the cardiac or vascular surgery

(D) Ignored?

Answer (B)

Question

Asymptomatic stones should be treated:

(A) Before

(B) Concomitantly

(C) After

(D) Ignored?

Answer (D)

Discussion

The clinical entity of acute cholecystitis occurring after the surgical treatment of unrelated disease was defined in 1947. It is also recognized in association with multiple trauma, burns, prolonged critical illness and sepsis. The condition is commonly referred to as acute acalculous cholecystitis since over 90% of such patients do not have stones.⁷ The presence of stones in 50% of cases of postoperative cholecystitis as distinct from other groups is probably a coincidence related to the patient's age, and the calculi probably play a minor role in causing acute inflammation. Altered bile composition and impaired blood supply (hypoperfusion) are important causative factors, and early necrosis and gangrene of the gallbladder wall make early surgical intervention mandatory. A gallbladder wall thicker than 3.5 mm on ultrasonography is considered diagnostic (in

the absence of ascites) while a thickness of 3 mm is highly suggestive — especially in the appropriate clinical setting. Cholecystectomy and operative cholangiography should be performed when they can be readily accomplished and in patients with extensive gangrenous changes; however, cholecystostomy alone has also been successful.⁷ Gagic and Frey⁸ have emphasized that cholecystostomy without choledochotomy is totally inappropriate when cholangitis is present, and the patency of the common duct must be ensured or the common duct must be decompressed directly. Percutaneous transhepatic needle-catheter drainage of the gallbladder has recently been reported in the high-risk patient⁹ but as yet is unproven.

Asymptomatic stones should be treated in the same way as asymptomatic biliary tract disease discovered incidentally — that is, conservatively; but, in the case of symptomatic stones, cholecystectomy is highly desirable because of the risk of future complications. We favour its performance after the cardiovascular procedure is successfully accomplished, at the same surgery. Others¹⁰ have shown an increase in overall complications and mortality when nonvascular operations are combined with vascular procedures,

especially in the presence of a potentially contaminated prosthesis; however, good operative judgement, careful wound and abdominal packing and judicious use of modern antibiotics and antibiotic lavage make the results of such retrospective studies questionable.

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SESAP V Critique

ITEM 222

Aortoenteric fistula usually develops between a proximal aortic suture line pseudoaneurysm and the small bowel in the region of the ligament of Treitz. Such lesions are the most feared complication of aortic reconstruction, arising much more frequently among patients requiring emergency operation (eg, for ruptured aneurysm). Patients with aortoenteric fistula may have vague constitutional symptoms, septic peripheral emboli, or so-called "herald" bleeds — small, self-limited gastrointestinal bleeding episodes.

Optimal management includes closure of the intestinal defect, graft excision, aortic ligation, and (usually) extra-anatomic bypass grafting to restore lower body perfusion. Less aggressive management, such as simple closure of the fistula, is inevitably accompanied by recurrent hemorrhage. Even among appropriately managed patients who survive initially, the leading cause of death is recurrent bleeding from the ligate aortic stump.

B

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5. General Surgery Questions

Case 1

Question

A 74-year-old man is operated on for a rectosigmoid carcinoma, 13 cm from the anus, through a left paramedian incision. A hard mass, 3 cm in dimension, is noted at the hepatic flexure and you believe this could be a second cancer. There is no ascites and on palpation the liver seems normal.

The preferred management is:

(A) Proceed with the planned anterior resection, allow 3 to 4 weeks for recovery and then do a right hemicolectomy

(B) Proceed with the planned anterior resection, allow 3 to 4 weeks for recovery and then carry out a barium enema examination or colonoscopy, or both, to ascertain the nature of the right colonic mass

(C) Do a total colectomy and ileorectal anastomosis

(D) Carry out an anterior resection and right hemicolectomy with ileotransverse anastomosis

(E) Do an anterior resection, then a colotomy for biopsy of the right colonic mass; if this is malignant, do a right hemicolectomy?

Answer (D)

Discussion

This case illustrates an exception to the usual recommendation to carry out total colectomy for synchronous carcinoma of the large intestine.^{1,2} Here, total colectomy would result in an ileomidrectal anastomosis in a 74-year-old man in whom the risk of a third carcinoma is about 2%.³ Two standard resections and

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colonoscopic follow-up will result in better intestinal function and prevent a metachronous lesion.

Case 2

Question

The patient is a 24-year-old woman with Crohn's disease who has been taking steroids for 6 months and has lost 10 kg in weight. Preoperative examination reveals a tender pelvic mass. X-ray examinations show a narrowed ileum and an irregular area in the distal sigmoid colon. No fistulas are visible. At laparotomy, a thick and inflamed ileum is closely adherent to the sigmoid colon which is likewise affected. There is also an abscess containing 50 ml of pus between the ileum, the sigmoid and the right adnexa.

The preferred management is to:

(A) Drain the abscess

(B) Drain the abscess and establish a proximal ileostomy

(C) Carry out ileal resection and anastomosis and close the sigmoid defect

(D) Perform both ileal and sigmoid resections with immediate anastomosis

(E) Do an ileal resection and terminal ileostomy, sigmoid resection and anastomosis and plan second-stage closure of the ileostomy?

Answer (E)

Discussion

This is an example of the common situation of ileal Crohn's disease with ileosigmoid involvement and fistula. The management is ileal resection and either closure of the sigmoid defect or segmental resection.^{4,5} Here, because of the description of the sigmoid, the only alternative is resection and two anastomoses close to an abscess cavity. The ideal way to deal with this situation is to do the distal anastomosis only and establish an ileostomy and mucous fistula, thus delaying the proximal anastomosis to a second stage.

Case 3

Question

While attempting to define the anterior plane of dissection in a 56-year-old man being operated on for cancer of the rectum, you believe that the base of the bladder and prostate are grossly involved with tumour. There is no metastasis and the

patient is in good general condition but was not informed of the possibility of total pelvic exenteration.

You should:

(A) Carry out total pelvic exenteration

(B) Separate the tumour from the prostate, excise the rectum and advise the patient to undergo total pelvic exenteration within a week

(C) Separate the tumour from the prostate, excise the rectum and advise the patient to undergo total pelvic exenteration in 3 to 4 weeks

(D) Separate the tumour from the prostate, excise the rectum, leave clips on the residual tumour and recommend postoperative radiotherapy

(E) Do nothing, close the abdomen, obtain consent for total pelvic exenteration and reoperate within days?

Answer (E)

Discussion

Several points must be considered.

1. One cannot carry out total excision of the bladder and urostomy without consent.

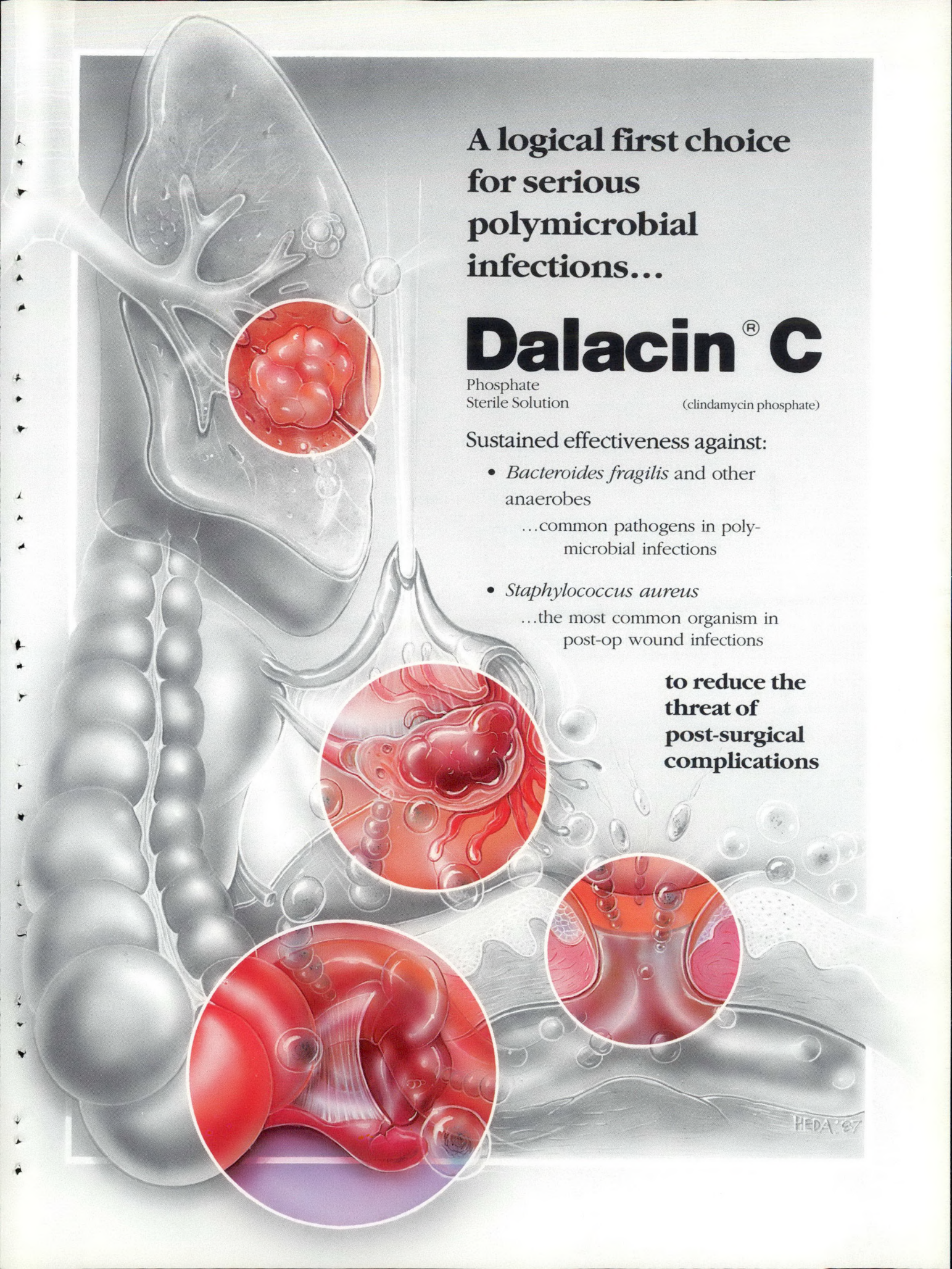
2. Separation of a rectal tumour from its prostatic involvement is tantamount to opening the tumour and spilling cancer cells and guarantees local recurrence.

3. Postoperative radiotherapy for gross residual tumour will not control the disease.

4. Total pelvic exenteration is the procedure of choice for resectable local invasion without distant metastasis.⁶⁻⁸

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Action: Clindamycin exerts its antibacterial effect by causing cessation of protein synthesis and also by causing a reduction in the rate of synthesis of nucleic acids.

Indications: Dalacin C Phosphate (clindamycin phosphate) is indicated for the treatment of infections where the oral route is not indicated or feasible.

Dalacin C Phosphate is indicated in the treatment of serious infections due to sensitive anaerobic bacteria, such as *Bacteroides* species, peptostreptococcus, anaerobic streptococci, *Clostridium* species and micro-aerophilic streptococci.

Dalacin C Phosphate is also indicated in serious infections due to sensitive Gram-positive organisms (staphylococci, including penicillinase-producing staphylococci, streptococci and pneumococci) when the patient is intolerant of, or the organism resistant to other appropriate antibiotics.

Contraindications: The use of Dalacin C Phosphate (clindamycin phosphate) is contraindicated in patients previously found to be hypersensitive to this compound, the parent compound, clindamycin, or clindamycin palmitate. Although cross-sensitization with Lincocin® (lincomycin hydrochloride) has not been demonstrated, it is recommended that Dalacin C Phosphate not be used in patients who have demonstrated lincomycin sensitivity.

Until further clinical experience is obtained, Dalacin C Phosphate is not indicated in the newborn (infants below 30 days of age), or in pregnant women.

Warnings: Some cases of severe and persistent diarrhea have been reported during or after therapy with Dalacin C Phosphate (clindamycin phosphate). This diarrhea has been occasionally associated with blood and mucus in the stools and has at times resulted in acute colitis. When endoscopy has been performed, some of these cases have shown pseudomembrane formation.

If significant diarrhea occurs during therapy, this drug should be discontinued or, if necessary, continued only with close observation. Significant diarrhea occurring up to several weeks post-therapy should be managed as if antibiotic-associated.

If colitis is suspected, endoscopy is recommended. Mild cases showing minimal mucosal changes may respond to simple drug discontinuance. Moderate to severe cases, including those showing ulceration or pseudomembrane formation, should be managed with fluid, electrolyte, and protein supplementation as indicated. Corticoid retention enemas and systemic corticoids may be of help in persistent cases. Anticholinergics and antiperistaltic agents may worsen the condition. Other causes of colitis should be considered.

Studies indicate a toxin(s) produced by *Clostridia* (especially *Clostridium difficile*) may be a principal cause of clindamycin and other antibiotic-associated colitis. These studies also indicate that this toxigenic *Clostridium* is usually sensitive *in-vitro* to vancomycin. When 125 mg to 500 mg of vancomycin were administered orally four times a day for 5 - 10 or more days, there was a rapid observed disappearance of the toxin from faecal samples and a coincidental recovery from the diarrhea.

It should be noted that serious relapses have occurred up to one month after apparently successful treatment. A relatively prolonged period of continuing observation is therefore recommended.

Precautions: Dalacin C Phosphate (clindamycin phosphate), like any drug, should be prescribed with caution in atopic individuals. Dalacin C Phosphate must be diluted for intravenous administration. (See Dosage and Administration)

The use of antibiotics occasionally results in overgrowth of nonsusceptible organisms - particularly yeasts. Should superinfections occur, appropriate measures should be taken as dictated by the clinical situation.

As with all antibiotics, perform culture and sensitivity studies in conjunction with drug therapy.

Since abnormalities of liver function tests have been noted occasionally in animals and man, periodic liver function tests should be performed during prolonged therapy. Blood counts should also be monitored during extended therapy.

Dalacin C Phosphate may be used in anuric patients. Since the serum half-life of clindamycin in patients with impaired hepatic function is greater than that found in normal patients, the dose of Dalacin C Phosphate should be appropriately decreased. Hemodialysis and peritoneal dialysis are not effective means of removing the compound from the blood. Periodic serum levels should be determined in patients with severe hepatic and renal insufficiency.

Adverse Reactions: Local

(a) **Intramuscular Injections:** Of 404 patients treated with Dalacin C Phosphate (clindamycin phosphate) intramuscularly (with a solution containing 150 mg/ml), six (1.5%) demonstrated local reactions as follows: Two complained of pain at the injection site, two demonstrated induration at the injection site and two developed sterile abscesses.

(b) **Intravenous Infusions:** Of 192 patients treated with Dalacin C Phosphate by intravenous infusion, 14 (7.3%) demonstrated local reactions. Eleven patients developed superficial thrombophlebitis and one patient developed both superficial and deep thrombophlebitis. The majority of these cases developed in conjunction with the use of indwelling I.V. catheters and it is difficult to know how much the drug contributed to the irritation. Two patients developed localized erythema, swelling and pain at the site of the infusion.

Systemic Side Effects: Twenty-eight patients of 596 treated with Dalacin C Phosphate (clindamycin phosphate) by either the intramuscular or intravenous routes developed systemic side effects as follows:

	Number of Patients
Rash.....	7
Urticaria.....	1
Pruritus.....	1
Fever, Leucocytosis.....	1
Nausea, with or without vomiting.....	1
Diarrhea (See also under "Warnings").....	4
Hypotension.....	1
Hypertension.....	1
Shortness of Breath.....	1
Superinfection*.....	4
Cardiac arrest**.....	1
Bad or bitter taste in mouth.....	5

* Superinfection is a complication of antibiotic therapy in general and is not necessarily a true side effect of clindamycin phosphate.

** Due to underlying myocarditis in this patient.

Clinical and Laboratory Findings: Patients treated during clinical trials of Dalacin C Phosphate (clindamycin phosphate) were followed with clinical laboratory tests, including complete hematology, urinalysis and liver and kidney function tests. Some of these tests were abnormal initially and returned to normal during therapy with Dalacin C Phosphate, while others were normal initially and became abnormal during therapy. Overall evaluation of clinical laboratory values in these patients does not indicate that Dalacin C Phosphate therapy has a toxic effect on the hematopoietic, hepatic or renal systems. Transient elevations of serum transaminases have occurred in some patients, but other liver function tests (alkaline phosphatase, serum bilirubin) have not shown any tendency to increase and there have not been clinical signs of drug-induced hepatic toxicity.

Symptoms and Treatment of Overdosage: No cases of overdosage have been reported. No specific antidote is known. Doses as high as 1200 mg every six hours (4800 mg/day) by infusion for five days have been given without adverse effects.

DOSAGE AND ADMINISTRATION

Adults

Intramuscular Injection: 600 mg/day in 2 equal doses.

Moderately severe infections: 600 to 1200 mg/day in 2 or 3 equal doses.

Severe infections: 1200 to 2400 mg/day in 2, 3 or 4 equal doses. Intramuscular injections of more than 600 mg into a single site are not recommended.

Intravenous Administration: Dalacin C Phosphate (clindamycin phosphate) must be diluted prior to I.V. administration to a dilution of 300 mg in 50 mL of diluent (6mg/mL) or more, and infused in not less than 10 minutes. Administration of more than 1200 mg in a single 1 hour infusion is not recommended. Dalacin C Phosphate should not be injected intravenously undiluted as a bolus.

Moderately severe infections: 900 to 1800 mg/day by continuous drip or in 2 or 3 equal doses, each infused over 20 minutes or longer.

Severe Infections: 1800 to 2700 mg/day by continuous drip or in 3 or 4 equal doses, each infused over 20 minutes or longer. In life-threatening infections, doses of 2700 to 4800 mg/day by continuous drip or in 3 or 4 equal doses each infused over 20 minutes or longer may be given.

Dilution and infusion rates:

Dose	Diluent	Time
300 mg	50 mL	10 min.
600 mg	100 mL	20 min.
900 mg	150 mL	30 min.
1200 mg	200 mL	45 min.

Alternatively, drug may be administered in the form of a single rapid infusion of the first dose followed by continuous I.V. infusion as follows:

To maintain serum clindamycin levels	Rapid infusion rate	Maintenance infusion rate
Above 4 mcg/mL	10 mg/min. for 30 min.	0.75 mg/min.
Above 5 mcg/mL	15 mg/min. for 30 min.	1.00 mg/min.
Above 6 mcg/mL	20 mg/min. for 30 min.	1.25 mg/min.

Children: (Over one month of age)

Intramuscular injection: 10 to 15 mg/kg/day in 2, 3 or 4 equal doses.

Moderately severe infections: 15 to 20 mg/kg/day in 3 or 4 equal doses.

Severe infections: 20 to 30 mg/kg/day in 3 or 4 equal doses.

Intravenous Administration:

Moderately severe infections: 15 to 25 mg/kg/day by continuous drip or in 3 or 4 equal doses, each infused over 20 minutes or longer.

Severe infections: It is recommended that children be given no less than 300 mg/day regardless of body weight. (Dilute Dalacin C Phosphate Sterile Solution in the same manner as for adults.)

Dilution and Compatibility:

4 mL (600 mg) Dalacin C Phosphate when diluted with 1000 mL of the following commonly used infusion solutions was found to be physically compatible and demonstrated no significant change in pH or antimicrobial potency over a period of 24 hours:

Sodium chloride injection
Dextrose 5% in water
Dextrose 5% in saline
Dextrose 5% in Ringer's Solution
Dextrose 5% in half-strength saline plus 40 mEq potassium chloride
Dextrose 2½% in Lactated Ringer's Solution (Hartmann's Solution)

Dalacin C Phosphate was not stable when added to Dextrose 5% in water plus vitamins. Therefore it is not recommended that Dalacin C Phosphate be mixed with any infusion solution containing B vitamins.

Supplied:

Dalacin C Phosphate contains the following per mL of sterile solution:

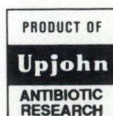
Clindamycin phosphate equivalent to clindamycin base 150 mg
Benzyl alcohol 5 mg
Disodium edetate 0.5 mg
Water for injection q.s.

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Aortoenteric Fistula: Case Review and a New Surgical Technique

The authors describe a new surgical technique for the management of aortoenteric fistula and report on the diagnosis and management of five such cases. The new technique consists of stapling the afferent and efferent loops of bowel as close to the fistula as possible. In a bleeding patient this effectively stops the blood loss into the bowel; when a patient is not actively bleeding, it helps in the retraction of the bowel away from the operative site. The authors propose that this technique be used by a surgeon with limited vascular experience to temporize the blood loss and transport the patient to a vascular unit.

The recommended procedure is total excision of the graft with an axillobifemoral bypass. Acute awareness of the condition and prompt early operation in a patient who has undergone aortic surgery will result in lower death rates.

Les auteurs décrivent une nouvelle technique chirurgicale pour traiter les fistules aorto-entériques. Ils commentent le diagnostic et la marche suivie dans cinq de ces cas. La nouvelle technique consiste à brocher les anses afférente et efférente de l'intestin, aussi près de la fistule qu'il est possible. Chez un patient qui saigne, cela arrête la perte de sang dans l'intestin; quand il n'y a pas d'hémorragie cela contribue à la rétraction de l'intestin à distance du site opératoire. Les auteurs suggèrent que cette technique soit utili-

sée par les chirurgiens ayant une connaissance limitée de la chirurgie vasculaire afin de réduire les pertes de sang en attendant que le patient soit transporté vers une unité de soins vasculaires.

L'opération recommandée consiste en une excision totale du greffon et en une dérivation axillo-bifémorale. Dans les cas de chirurgie aortique, il faut garder cette complication à l'esprit et opérer promptement pour réduire le taux de mortalité.

The frequency of aortoenteric fistula, a dreaded complication of aortic reconstructive surgery, varies from 0.5% to 2% of all patients who have undergone aortic grafting¹ and the death rate ranges from 15% to 85%.²⁻⁴ If surgery is delayed, death by exsanguination is inevitable. Since the first successfully treated case was reported by Heberer⁵ in 1957, more than 250 others have been reported in the English literature. The

pathogenesis of the condition is not clear, but mechanical factors and infection at the suture line contribute to most fistulas.

We present the pathogenesis, clinical findings, diagnosis and management of five cases of aortoenteric fistula seen at our centre. One fistula occurred after thoracoabdominal aortic graft replacement. We believe this is the first such case reported. A new surgical technique to temporarily control the associated exsanguinating hemorrhage is also described.

These fistulas can be divided into two groups — primary and secondary. Primary fistulas are those that develop without the association of previous surgery. These are now rare and will not be discussed. Secondary fistulas (Fig. 1) can be classified into (1) aortoenteric fistula, (2) aortoenteric fistula with pseudoaneurysmal communication and (3) aortoenteric erosion or paraprosthentic-enteric sinus.

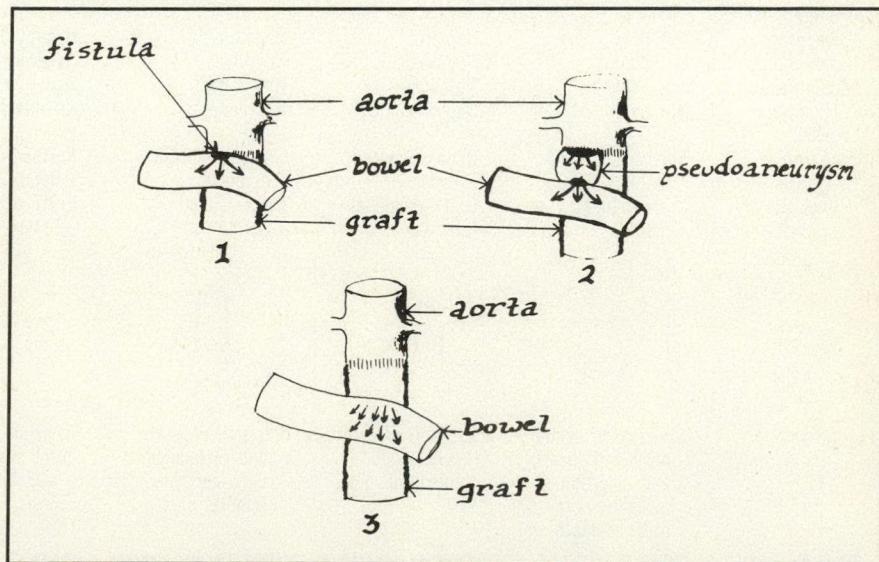


FIG. 1—Types of secondary aortoenteric fistulas. (1) aortoenteric fistula, (2) aortoenteric fistula with pseudoaneurysmal communication, (3) aortoenteric erosion or paraprosthentic-enteric sinus.

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Groups 1 and 2 make up 80% of all cases. In group 3 the graft itself and not the suture line erodes through the bowel wall and the bleeding occurs through the interstices of the graft.⁶

Aortoenteric fistulas communicate with the duodenum in 85% of cases, the small bowel in 10% and with other sites such as esophagus, stomach, appendix and large bowel in the remaining 5%.

The pathogenesis remains controversial. Two factors — mechanical and infective — have been implicated. Constant pulsatile pounding on the wall of the bowel and foreign-body inflammatory response due to the adjacent graft cause erosion of the bowel, leakage of gastrointestinal contents and accumulation of bacteria around the graft. The proteolytic enzymes then erode the aortic suture line causing the fistula. Predisposing causes such as dissection, retroperitoneal infection, foreign-body reaction to silk sutures, failure to re-peritonealize the graft adequately, are associated with a higher risk of aortoenteric fistula.

Clinical Presentation

Gastrointestinal bleeding is the most important symptom in patients with an aortoenteric fistula. The bleeding may

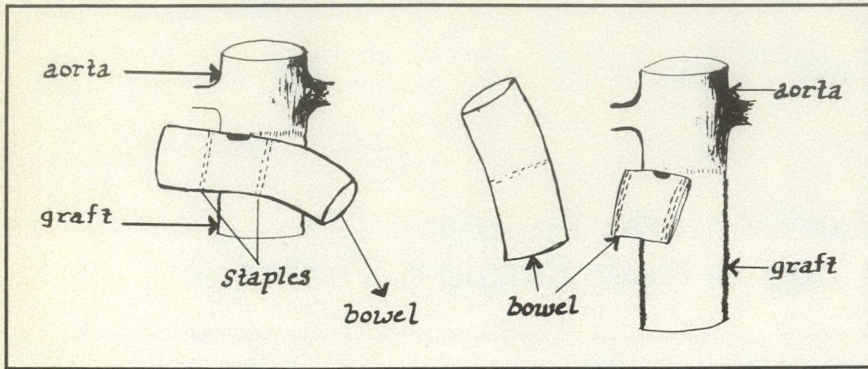


FIG. 2—New stapling technique. Afferent and efferent loops of bowel are stapled as close to fistula as possible and two open ends are anastomosed end-to-end or side-to-side.

Data	Table 1—Details of Patients				
	Patient no.				
	1	2	3	4	5
Age	57	73	70	72	72
Sex	M	M	M	M	M
Initial disease	Aneurysm	Aneurysm	Aneurysm	Arteriosclerosis	Carcinoma, left kidney
Type of surgery	Thoracoabdominal aortoiliac graft	Aortobifemoral graft	Aortic tube graft	Aortobifemoral graft	Left nephrectomy and ligature of renal pedicle
Graft	Dacron	Dacron	Dacron	Dacron	—
Suture material	3-0 Prolene	3-0 Prolene	3-0 Prolene	3-0 Tevdec	Umbilical tape
Complications	Drainage of para-aortic fluid collection 3 mo after surgery	—	—	—	—
Time between initial surgery and fistula, yr	2	5	6	12	1.5
Mode of presentation	Massive GI hemorrhage with hypotension	Massive GI hemorrhage with hypotension	Moderate hemorrhage on admission. Massive hemorrhage 6 h later with hypotension	Claudication both legs. Moderate GI hemorrhage on admission	Melena
Investigations					
Gastroscopy	Not done	Negative	Negative	Negative	Negative
Colonoscopy	Not done	Negative	Negative	Negative	Sigmoid polyp
Angiography	Not done	Not done	Not done	Negative	Not done
GI contrast studies	Not done	Negative	Not done	Negative	Negative
Preoperative diagnosis	Aortoenteric fistula	Duodenal ulcer	Angiodysplasia of colon	Aortoenteric fistula	Peptic ulcer disease
Findings at surgery	Graft-sigmoid fistula	Graft-duodenal fistula	Graft-jejunal fistula	Graft-duodenal fistula	Aortoduodenal fistula
Treatment	Excision infrarenal portion of graft and insertion of axillobifemoral graft; colostomy	Excision of graft with axillobifemoral graft	Excision of graft and replacement with aortobifemoral graft	Excision of graft and insertion of axillobifemoral graft	Excision of bowel and suturing of fistula in aorta
Outcome	Alive, 2 yr	Died at operation	Died 11 mo later of bronchogenic carcinoma with metastasis	Alive, 2 mo	Alive, 10 d

occur any time between 2 days and 14 years after the initial operation.⁷ The classical "herald bleed" — a brief, brisk initial bleed, often accompanied by hypotension, that suddenly ceases — is present in 80% of the cases.² These patients are hemodynamically unstable and require urgent surgery.

Signs of sepsis with unexplained fever are present in three quarters of the patients.⁸ Metastatic abscesses of the lower limbs, septic skin emboli, septic arthritis of the lower limb joints, may occur due to infection. Upper abdominal pain, sometimes accompanied by a palpable mass, is present in 50% of the cases.⁹

There are two types of patient presentation. The first type of patient has chronic blood loss, present for months, causing anemia, with or without signs of sepsis. These patients can be operated on electively.

The second type presents either with exsanguinating hemorrhage or has recently had a substantial "herald bleed" and is still hemodynamically unstable.

Diagnosis

All patients with previous aortic graft surgery who present with gastrointestinal bleeding should be considered to have an aortoenteric fistula, unless proven otherwise.

When presenting hemorrhage is massive, immediate surgery precludes any diagnostic work-up. If time permits, endoscopy, upper gastrointestinal contrast studies, aortography, computed tomography and gallium scanning may be helpful in establishing the diagnosis. With the diagnostic yield of all these tests being only 33%,⁴ exploratory laparotomy is indicated if a diagnosis of aortoenteric fistula is suspected.

An endoscope passed down to the third and fourth parts of the duodenum may visualize the graft protruding into the intestinal lumen. Other suggestive endoscopic findings are punctate ulcerations, petechiae, pulsatile extrinsic mass and bleeding from this site.¹⁰⁻¹² Caution should be exercised in sucking out any clot in the area, since profuse bleeding may result due to unplugging of the fistula. It is important to note that duodenal ulcer disease has been reported in 40% of patients with grafts before the development of an aortoenteric fistula.¹

When endoscopy fails to establish the source of bleeding, the diagnostic yield with other investigations is low.^{1,6}

Demonstrating a leakage of dye or outline of a pseudoaneurysm at angiography can be helpful. Computed tomography may show a pseudoaneurysm or a loop of bowel in close proximity to the aorta. Gallium scanning is helpful in demonstrating retroperitoneal infection.

Blood cultures, preferably taken from the femoral arteries, may be positive, even though the venous blood cultures are negative.¹³ A positive blood culture preoperatively indicates a poor prognosis, usually with no survivors.¹⁴

Treatment

Upon completion of the investigations, all patients should undergo exploratory laparotomy.

Successful management of the condition requires excision of the fistula and control of the graft infection. This is accomplished by total excision of the infected graft and placement of an extra-anatomical bypass graft. Although various techniques, from local repair of the fistula to excision of the graft with replacement in its bed, have been tried, they are seldom successful.¹ Complications, with recurrence of the fistula are frequent and these procedures are therefore not recommended.

Surgical Technique (Fig. 2)

With a GIA stapling device, the afferent and efferent loops of bowel are stapled as close as possible to the fistula. This effectively tamponades the bleeding and gives the surgeon time to dissect the dense scar tissue around the graft and to clamp the infrarenal aorta. With this technique in a patient who is not bleeding, the small bowel can easily be retracted out of the abdomen, thus helping in the dissection. The bowel can then be anastomosed side-to-side with a GIA stapler or end-to-end with an EEA stapler. Using this technique in one of our patients we were able to correct the hypotension before proceeding.

We propose that this new technique be used if a patient operated upon for undiagnosed gastrointestinal bleeding in a hospital with no vascular unit is found to have an aortoenteric fistula. After the bowel is stapled and the abdomen closed, the patient may be transferred to an appropriate institution.

Once the old graft has been removed from its bed, the infrarenal aortic stump should be effectively covered with omentum, psoas muscle flap or an anterior spinous ligament flap to prevent future stump blow-out or a recurrent fistula.²

In stable patients, axillobifemoral grafts have been placed before laparotomy and excision of the infected aortic graft. To us this is not logical since there is a potential danger of the new graft getting infected when the old graft is left in situ.

In fistulas to the sigmoid colon, primary bowel anastomosis is not advised and the colostomy site should be located away from the site of the axillofemoral graft.

Clinical Material (Table I)

Of our five patients, three had massive exsanguinating hemorrhage requiring urgent operation. One had had a previous nephrectomy for carcinoma of the left kidney (patient 5). Although he did not undergo grafting, we included him because we believed that the umbilical tape used to ligate the renal pedicle had eroded into the duodenum and aorta causing a secondary fistula. Even though the patient was not actively bleeding, we found our technique of stapling helpful because of the easier access to the aorta once the bowel loops were out of the abdomen.

Another patient had had a thoracoabdominal aortic replacement. A fistula developed between the sigmoid colon and the left iliac anastomosis. Since it was at the distal anastomotic site, we were fortunate in successfully managing the fistula by excising the infrarenal portion of the original graft. We believe that this is the first reported case of such a fistula occurring after a thoracoabdominal aortic graft replacement.

One patient died on the operating table. He was hypotensive preoperatively and throughout surgery and was bleeding heavily into his intestines. This occurred before we devised our stapling technique which we believe could have stopped his bleeding. This was our only death although another patient died of unrelated causes 11 months after operation.

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Obstructive Jaundice and Cholangitis Due to Choledocholithiasis: Treatment by Extracorporeal Shock-Wave Lithotripsy

Endoscopic shock-wave lithotripsy, although now the standard treatment of urolithiasis, has only recently been applied to cholelithiasis. The authors describe the case of an 88-year-old man, a high-risk patient with choledocholithiasis, in whom endoscopic stone extraction after sphincterotomy failed. Extracorporeal shock-wave lithotripsy was used for noninvasive stone fragmentation and the fragments were passed without complication.

Bien qu'elle soit maintenant la norme dans le traitement de l'urolithiase, la lithotripsie endoscopique par ultrasons n'a que récemment été appliquée à la thérapie de la cholélithiase. Les auteurs décrivent le cas d'une personne à risque, un homme de 88 ans souffrant de cholédocholithiase, chez qui l'extraction endoscopique du calcul après sphinctérotomie, a échoué. La lithotripsie par ultrasons extracorporelle a été utilisée pour provoquer la fragmentation du calcul; les fragments furent éliminés sans complication.

Extracorporeal shock-wave lithotripsy has only recently been used to treat cholelithiasis. We describe the successful management of an elderly high-risk patient with gallstones treated by this method.

Case Report

An 88-year-old man with cholangitis and

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jaundice had several medical risk factors, including ischemic heart disease and Parkinson's disease. A cholecystectomy had been performed 13 years before for cholelithiasis. On admission, he had fever (body temperature 39°C) with a leukocyte count of $21.0 \times 10^9/L$ and jaundice with a total serum bilirubin value of 143.6 $\mu\text{mol/L}$ (normal less than 17.1 $\mu\text{mol/L}$) and an alkaline phosphatase value of 398 U/L (normal from 45 to 125 U/L). Ultrasonography demonstrated a dilated common bile duct and choledocholithiasis. Antibiotic treatment with penicillin (12 million units), metronidazole (1000 mg/d) and gentamicin (400 mg/d) was begun. Endoscopic retrograde cholangiography (ERC) confirmed a single common-duct stone, measuring 12 mm and causing complete obstruction of the common duct. Endoscopic retrograde sphincterotomy was performed and retrograde stone extraction was attempted but was unsuccessful. Because the patient was considered a poor operative risk, we decided, with informed consent, to fragment the common-duct stone using extracorporeal shock-wave lithotripsy. A nasobiliary catheter was placed endoscopically into the common bile duct to allow duct opacification for targeting. Computed tomography demonstrated that there was no lung tissue in the shock-wave path.

Endoscopic shock-wave lithotripsy was performed under epidural anesthesia using the HM-3 lithotripter (Dornier Medical Inc., Marietta, Ga.). With the patient in the supine position, diatrizoate meglumine 30% was injected into the common bile duct through the nasobiliary catheter to identify the stone (Fig. 1). A total of 2605 shock waves generated with 18 kV were administered to the gallstone in two sessions on different days. Metoclopramide (10 mg) was administered intravenously in order to promote the passage of considerable bowel gas which appeared to be interfering with shock-wave transmission to the stone. Satisfactory fragmentation was achieved. The patient's fever resolved immediately after the procedure and the serum alkaline phosphatase and bilirubin levels returned toward normal. All stone fragments passed spontaneously (Fig. 2). The nasobiliary catheter was removed and the patient discharged from hospital 5 days after the first lithotripsy session.

Comment

Extracorporeal shock-wave lithotripsy, which has rapidly become a standard approach for the treatment of urolithia-



FIG. 1—Common bile duct is opacified through endoscopically inserted nasobiliary catheter. Common-bile-duct stone is seen as filling defect.



FIG. 2—Completion cholangiogram after successful endoscopic shock-wave lithotripsy and sphincterotomy. Tiny residual fragment can be seen (arrow) in distal common bile duct. It passed into duodenum spontaneously after catheter was removed.

sis, has only recently been applied to gallstones.¹ The first reported series included five patients with common-duct stones in whom endoscopic stone extraction was not feasible. Surgery was avoided in all but one patient and when, in this case, choledochotomy was performed, no damage to the choledochal wall and surrounding tissues was found. One patient

in the series had obstructive jaundice and two had septic cholangitis. In our patient, both of these complications of choledocholithiasis were present. Additional risk factors included heart disease, advanced age and previous biliary surgery. No complications resulted from the endoscopic shock-wave lithotripsy, which, in this high-risk patient under epidural anesthe-

sia, proved to be a successful noninvasive adjunct to endoscopic retrograde sphincterotomy in the treatment of choledocholithiasis.

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Rectal Duplication in Chronic Large-Bowel Obstruction

Rectal duplication is a rare congenital anomaly. The authors describe the case of a 52-year-old man with this condition, which caused chronic constipation. An unusual sequence of events led to the diagnosis of this anomaly at a repeat laparotomy and its eventual successful management. Awareness of the anomaly would greatly influence its early diagnosis and treatment.

Le dédoublement du rectum est une anomalie congénitale rare. Les auteurs décrivent le cas d'un homme de 52 ans chez qui cette malformation était responsable d'une constipation chronique. Lors d'une deuxième laparotomie, un déroulement inhabituel des événements a conduit au diagnostic, puis à la réussite éventuelle du traitement. Le fait de garder cette anomalie à l'esprit influencera grandement son diagnostic précoce et son traitement.

Duplications of the gastrointestinal tract are relatively rare developmental anomalies that can occur anywhere from the mouth to the anus.¹⁻³ The small bowel is most frequently affected and the rectum is the least common site.^{2,3} Intestinal duplications are congenital, fluid-filled

cysts of the tubular or, more commonly, spherical type, and resemble in structure some part of the gastrointestinal tract.¹⁻⁴ Closed duplications enlarge as secretions from the mucosal lining accumulate, causing local pain from increased tension or mechanical interference with adjacent structures.^{1,2} Duplications communicating with the bowel lumen are often complicated by hemorrhage or perforation from peptic ulceration in an area of ectopic gastric mucosa.^{5,6} In infancy or childhood the usual complications are intestinal obstruction, volvulus, intussusception, infection or hemorrhage. The anomaly is seen less frequently in the adult but with similar manifestations.^{1,4} We describe one of the rare occurrences of this abnormality in an adult and review the sequence of events leading to its diagnosis at surgery.

Case Report

A 52-year-old man was admitted Feb. 24, 1983 to the University of Ife Teaching Hospital, Ile-Ife, Nigeria, with a 10-year history of chronic constipation, alternating with diarrhea. For 3 months before admission the patient could only move his bowels once every 2 weeks. He had progressive abdominal distension and low back pain. He was an emaciated patient with a grossly distended, tympanic, nontender abdomen where peristalsis was visible in its lower aspect. On rectal examination there was a fluctuant, nontender posterior rectal mass, the ampulla being patulous and filled with stool. Plain abdominal x-ray films showed that the entire colon and rectum was filled with stool. The clinical impression was that of chronic large-bowel obstruction with a retrorectal abscess. No ova or parasites were found on laboratory investigations of the stool. The hematocrit, leukocyte count and serum electrolyte, creatinine and liver function values were normal as was an intravenous urogram.

An x-ray film after barium enema revealed a markedly dilated rectum and colon with displacement of the rectum to the right (Fig. 1). A lateral view of the pelvis showed a gap of 5.4 cm between the posterior rectal wall and the sacrum. The appearance was that of acquired megacolon.

One week after admission the patient underwent proctosigmoidoscopy and rectal wall biopsy; exploration of the left ischio-rectal fossa failed to reveal an abscess and because digital rectal examination still confirmed a retrorectal fluctuant mass, the left levator ani was opened. A soft mass, like bowel in appearance, was seen and thought to be a portion of the dilated rectum or an internal hernia. The levator ani was repaired and the wound closed. The rectal biopsy showed normal rectal muscle, mucosa and nerve ganglia. Laparotomy was then carried out. The entire colon and rectum

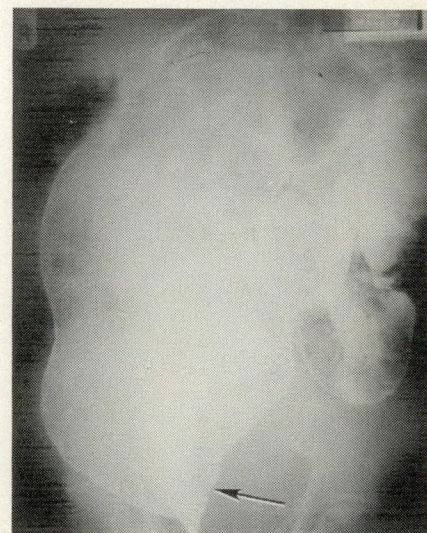


FIG. 1—Distended rectum is full of feces and rectum is displaced to right (arrow) by extrinsic soft-tissue mass.

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were grossly dilated with a rectosigmoid diameter of 25 cm. The stomach, liver, small bowel, bladder and kidneys felt normal. Sigmoid resection and sigmoid end colostomy were performed and the rectal stump was closed as a Hartmann pouch. Histologic examination of the resected colon demonstrated nerve ganglia in the wall. The postoperative course was uncomplicated.

The patient was readmitted in July 1984 for colostomy closure. Digital examination of the rectum revealed the continued presence of the retrorectal mass and preoperative barium study of the rectal pouch demonstrated persistent displacement to the right. At laparotomy a posterior pouch, believed to be the Hartmann pouch, was opened and found to contain a greyish, opalescent, gelatinous material. A rectal tube was passed through the anus into the rectum to define the anatomy. Attempted excision of the retrorectal pouch was abandoned because of dense fibrosis from the previous operation and the fact that the left ureter was

adherent to its upper part. A biopsy of the cyst was taken and its mucosa denuded. The cyst shared a common wall with the rectum but did not communicate with it. The residual cavity was drained with a large rubber tube and an end-to-end rectosigmoid anastomosis performed. Radiologic study done 7 days after operation using barium in the rectum and Urografin in the cyst is shown in Fig. 2. Radiologic study of the rectal duplication 15 days after operation showed a marked decrease in the size of the cyst (Fig. 3). The rubber drain was removed after Urografin demonstrated a complete collapse of the pouch. Microscopic examination of the biopsy specimen showed an outer smooth-muscle wall with an inner lining of columnar epithelium. Two years postoperatively, there was no evidence of a retrorectal mass.

Discussion

Duplication of the rectum is an uncommon congenital anomaly, accounting for only 3.2% of all intestinal duplications.⁷ The diagnosis is often difficult and depends on awareness of the condition.⁸ In our patient, despite the digital finding of a retrorectal mass and anterior displacement of the posterior rectal wall on barium enema examination (Fig. 1), the diagnosis was unexpected and was made only at repeat operation. Being the most common cause of a retrorectal mass in our population, perirectal abscess was considered initially. If there was increased awareness of rectal duplication, the correct diagnosis could have been made earlier when a bowel-like mass was found on exploration of the left ischioanal fossa. As suggested by MacLeod and Purves,⁴ rectal duplication should always be considered in the differential diagnosis of retrorectal masses. Obstruction is more frequently encountered with duplications of the small bowel than the rectum, because of the large capacity of the ampulla, but, as our case demonstrates, rectal duplication can indeed cause partial rectal obstruction which on the x-ray film after a barium enema resembles acquired megacolon. The histologic criteria for the diagnosis of bowel duplication are the presence of gastrointestinal epithelium, a layer of smooth muscle in the wall of the cyst and attachment to the alimentary tract.⁴ The cyst in this case fulfilled all these criteria.

Treatment of a spherical rectal duplication is excision; the tubular type may require correction of the anomaly at its lower end, with or without excision.^{2,4,8} Reports^{9,10} demonstrating malignant degeneration of rectal duplication support the suggestion that early operation be performed. Also, excision of the cyst may reveal other lesions within it — recently a carcinoma was reported in a cyst wall.¹¹ It is noteworthy that when complete surgical excision is impracticable or risky, removal of the mucosal lining may be adequate.¹²

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BOOK REVIEWS

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This book represents a balanced, superior review of the literature with some new information and will appeal to transplant physicians, transplant surgeons, immunologists and pathologists. Any of these individuals could consider this textbook core reading.

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MANAGEMENT OF OVARIAN CANCER.

Edited by G. Blackledge and K.K. Chan.
214 pp. Illust. Butterworth and Co. (Publishers) Ltd., London; Butterworth Publishers, Stoneham, Mass., 1986. \$95.00 (US). ISBN 0-407-003900-8.

This book covers problems of ovarian cancer control. The important aspects of ovarian disease, surgical evaluation and debulking procedures and the indications for and limitations of second-look laparotomy are reviewed. Hormone therapy and new avenues in radiotherapy are also considered with special emphasis on nonepithelial tumours. The five most frequent ovarian epithelial tumours — serous, mucinous, endometrioid, Brenner and clear-cell — are described with their adenomatous, borderline and carcinomatous components.

Analogies of serous tumours with tubal adenocarcinomas, mucinous with intestinal or endocervical tissue, Brenner with Wolffian uroepithelial transitional epithelium, clear-cell

continued on page 433

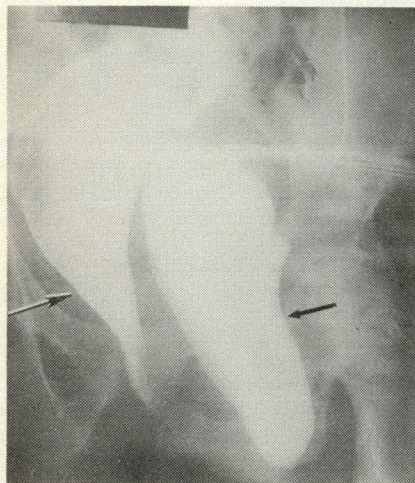


FIG. 2—Postoperative contrast study with barium in rectum (white and black arrow) and Urografin in posterior duplication (black arrow).

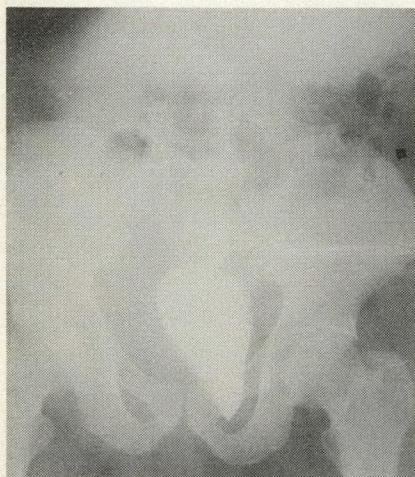


FIG. 3—Urografin contrast study of posterior duplication demonstrating decrease in cyst size 15 days after removal of cyst mucosa.

Risk of Bacteremia With Endoscopic Sphincterotomy

A prospective assessment of the risk of bacteremia with endoscopic sphincterotomy was made in 81 patients who underwent 95 procedures. Blood samples were taken for culture in all patients before and at 5 and 10 minutes after the last incision of the sphincter by the papillotome. An additional blood sample was obtained for culture within 30 seconds of the final incision in 32 of the 95 procedures. The rate of blood-culture positivity before the procedure was not significantly different from the post-incisional rate (1% compared with 3%, $p > 0.05$). No patient suffered from fever or chills during the 24 hours after sphincterotomy.

Cette étude prospective du risque de bactériémie lors de sphinctérotomie par voie endoscopique comprend 81 patients ayant subi 95 interventions. Des hémocultures furent faites avant l'intervention et 5 et 10 minutes après la terminaison de la papillotomie. Un échantillon additionnel fut pris moins de 30 secondes suivant la dernière coupe du papillotôme dans 32 des 95 procédés. L'incidence de cultures positives fut la même dans ces quatre groupes (1% à

3%, $p > 0.05$). Il n'y eut aucun cas de pyrexie ou frissons dans les 24 heures suivant la sphinctérotomie.

Endoscopic sphincterotomy is an accepted method for removing common-bile-duct stones and relieving papillary stenosis in patients who are considered unacceptably high-risk surgical candidates.^{1,2} Even though the risk of bacteremia with endoscopic retrograde cholangiopancreatography is low,³ several authors^{2,4,5} have recommended the prophylactic administration of antibiotics in view of the invasive nature of the technique and the findings that procedures such as simple dental brushing and cleaning can cause bacteremia.⁶⁻⁹ In addition, the committee on rheumatic fever and endocarditis of the American Heart Association has recommended, based on the limited data available, prophylaxis for upper gastrointestinal tract endoscopy with biopsy.¹⁰ To determine if the frequency and type of organisms causing bacteremia following this procedure warrant routine prophylaxis we prospectively investigated patients who were scheduled to undergo endoscopic sphincterotomy.

Patients and Methods

Eighty-one unselected patients who underwent 95 endoscopic sphincterotomy procedures were studied sequentially as referred. All procedures were performed by one of us (A.B.M.). The two indications for sphincterotomy were common-

duct stones and ampullary stenosis as defined radiologically. The only contraindication to the procedure in this study was an abnormal prothrombin time. All patients were investigated at the St. Boniface General Hospital in Winnipeg between May 1982 and March 1985. None of the patients had received antimicrobial agents during the 2 weeks before the procedure.

A side-viewing fiberoptic duodenoscope (Olympus JF-IT; Olympus Corp., Lake Success, NY) was used throughout.

The purpose of the study was explained to all patients and informed consent obtained before entry into the study. All patients had blood samples drawn for culture before endoscopic sphincterotomy and at 5 and 10 minutes after the final incision was made by the papillotome. After preparation of the skin with povidone-iodine and then washing with 70% isopropyl alcohol, 5 ml of venous blood was drawn. Thirty-two patients had additional blood samples obtained within 30 seconds of the final incision made by the papillotome. The samples were inoculated into 45 ml of supplemented peptone broth (Becton Dickinson, Rutherford, NJ) and incubated at 37°C for 7 days. Subcultures were made into sheep's blood agar at 24 hours and 7 days. Plates were incubated aerobically and anaerobically. All isolates were identified by standard microbiologic methods.¹¹

The proportions of procedures with positive blood cultures were compared before and after sphincterotomy by means of a χ^2 test with Yates' correction.

Table 1—Microorganisms Isolated From Blood Cultures Before and After 95 Endoscopic Sphincterotomy Procedures

Procedure no.	After			
	Before	30 s	5 min	10 min
2	—	—	—	<i>Bacillus</i> sp
12	<i>Bacillus</i> sp	—	—	—
54	—	<i>Bacillus</i> sp, <i>Clostridium</i> sp	<i>Bacillus</i> sp	—
85	—	<i>B. fragilis</i>	<i>B. fragilis</i>	<i>B. fragilis</i>
92	—	—	—	<i>S. faecalis</i>

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Results

One of 95 pre-procedural blood cultures was positive, but was negative at 5 and 10 minutes after sphincterotomy (Table I). Seven (3%) of 222 post-procedural blood cultures were positive. These results were not statistically different. In one procedure, blood cultures were positive for *Bacteroides fragilis* at 30 seconds, and again at 5 and 10 minutes. In another procedure, blood cultures were positive at 30 seconds for *Bacillus* sp and *Clostridium* sp and at 5 minutes for *Bacillus* sp only. There were two procedures in which blood cultures were positive only at 10 minutes.

Discussion

The 3% of blood cultures that were positive after endoscopic sphincterotomy is a rate comparable to those reported in the literature for other endoscopic procedures of the upper gastrointestinal tract.^{3,12-15} None of our patients experienced fever or chills during the 24 hours following the procedure.

The source of the organisms grown in the blood cultures may be contamination, either during the collection or processing of the specimen, or may represent true bacteremia. The isolation of *Bacillus* sp likely represents contamination.^{16,17}

Weinstein and colleagues¹⁸ reviewed 500 episodes of bacteremia and fungemia in adults. The isolation of facultative and anaerobic gram-negative bacilli, fungi and gram-positive cocci almost always indicated true bacteremia, whereas the isolation of aerobic and anaerobic gram-positive bacilli, including *Clostridium* sp, often represented contamination. They reported 18 cultures in which *Bacillus* sp were isolated; in 17 the organism was considered clinically to be a contaminant. Reith and Squier¹⁹ drew similar conclusions when they isolated *Bacillus* sp from 20 (17.7%) of 113 blood cultures from healthy people.

The *Streptococcus faecalis*, *B. fragilis* and *Clostridium* spp that were isolated after sphincterotomy in our study (Table I) may represent true asymptomatic bacteremias resulting from the procedure. The *S. faecalis* that grew in the 10-minute sample may have originated from the common bile duct, a recognized source of *S. faecalis* bacteremia.²⁰ The common bile duct may also have been the source of the *B. fragilis* isolated at 30 seconds, 5 minutes and 10 minutes after sphincterotomy and the *Clostridium* sp isolated from the 30-second sample in another patient. Anaerobes have been shown to colonize the common bile duct in patients with biliary tract disease.²¹

The rationale for prophylaxis in

patients with endocarditis as recommended by the American Heart Association is that the risk of endocarditis is increased after traumatic procedures to mucosal surfaces likely to produce bacteremia and that giving antimicrobial therapy to persons at risk for endocarditis in association with these procedures decreases the risk.²² Enterococcal species (*S. faecalis*, *S. faecium*, *S. durans*) are the organisms most frequently responsible for endocarditis occurring after gastrointestinal tract instrumentation. Although gram-negative bacillary bacteremia may follow these procedures, these organisms are only rarely responsible for endocarditis and therefore the American Heart Association does not recommend that prophylaxis be aimed at them.¹⁰ Thus, the association recommends that antibiotic prophylaxis be directed primarily against enterococci. We isolated enterococci after sphincterotomy in only one procedure and in only one of the three post-procedural samples (Table I). Because bacteremia occurs infrequently and there is no evidence of the effectiveness of prophylaxis,²³⁻²⁹ we recommend that antibiotics be given prophylactically only for patients with prosthetic heart valves and those with surgically constructed systemic-pulmonary shunts who are at especially high risk for infective endocarditis.

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Correction

In the September 1987 issue, page 371, the footnote to the article "Penetrating chest wounds: a 10-year review" by S.S. Sett, E. Busse, T. Boyd and J. Burgess should *not* read "From the Department of Surgery, University of Saskatchewan, Saskatoon, Sask." The *correct* wording is "From the Department of Surgery, University of Saskatchewan, Plains Health Centre, Regina, Sask."



Analysis of a Lane-Plate Internal Fixation Device After 64 Years In Vivo

A patient presented for an above-knee amputation 64 years after successful internal fixation of a femoral fracture with a Lane plate. Chemical analyses of the plate and corrosion products were done using atomic absorption spectrophotometry, x-ray energy spectroscopy and x-ray diffraction. Mechanical properties of the fixation devices were measured using Rockwell-type instruments and metallographic analyses were also performed. In addition, pathologic and radiologic investigations of the underlying bone were carried out.

Results disclosed that extensive corrosion had weakened the plate by 50%.

The metallosis of the surrounding soft tissues and abnormal morphologic features of underlying bone were analysed. No appreciable cellular inflammatory or dysplastic reaction of adjacent tissues was identified. The underlying bone showed a persistent lack of mature compact bone and no evidence of remodelling.

The products of corrosion were mainly ferrous carbonate and some ferrous chloride. The mechanism of the corrosion was the formation of a galvanic cell between the iron carbide and surrounding iron, with dissolution of the iron and formation of the corrosion products.

Un patient a été hospitalisé pour une amputation au dessus du genou, 64 ans après la fixation interne réussie d'une fracture fémorale à l'aide d'une plaque

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de Lane. L'analyse chimique de la plaque et des produits de corrosion a fait appel à la spectrophotométrie d'absorption atomique, à la spectroscopie aux rayons x et à la cristallographie par diffraction de rayon x. Les propriétés mécaniques des appareils de fixation ont été mesurées à l'aide d'instruments de type Rockwell et des analyses métallographiques ont aussi été effectuées. De plus, on a pratiqué des examens pathologiques et radiologiques de l'os.

Les résultats ont révélé qu'une corrosion importante avait affaibli la plaque de 50%.

La métallose des tissus mous environnants et les caractéristiques morphologiques anormales de l'os ont été analysées. Aucune réaction cellulaire inflammatoire appréciable ni réaction dysplasique des tissus adjacents n'ont été identifiées. L'os sous-jacent révélait le manque persistant d'os compact à maturité et l'absence de remodelage osseux.

Les principaux produits de corrosion étaient le carbonate ferreux et un peu de chlorure ferreux. La corrosion s'explique par la formation d'une cellule galvanique entre le carbure de fer et le fer environnant, avec dissolution subséquente du fer et formation des produits de corrosion.

A recent case at the Victoria General Hospital in Halifax, Nova Scotia, presented a unique opportunity to analyse a pioneering form of internal fixation — the Lane plate — after 64 years in vivo. Pathological, mechanical and chemical analyses of the corroded internal fixation (uncomplicated by inflammation or infection) was possible with the longest follow-up yet reported in the literature.

Case Report

In 1917 a fisherman, who sustained a frac-

ture left femur in a shipwreck, was treated conservatively for 6 weeks in a small coastal community hospital. Because of shortening and malalignment at the fracture site (junction of proximal two-thirds and distal one-third), he underwent open reduction and internal fixation of the fracture with a Lane plate through an anterior approach. After recuperation in hospital, he was discharged and remained asymptomatic with an excellent functional result.

In 1981 he underwent a left above-knee amputation for severe peripheral vascular disease and the specimen, containing the plate, was obtained for analysis.

Methods

Fine-detail roentgenograms were obtained with a Faxitron using Kodak X-OMAT TL film (Fig. 1).

The plate and screws were removed from the bone and three of the four

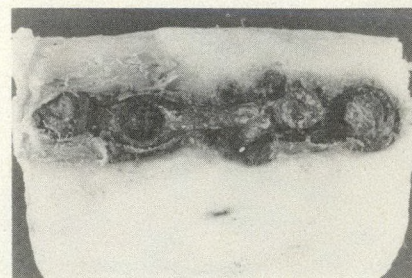


FIG. 1—Lane plate in situ showing metallosis of adjacent tissues (original magnification $\times 2.5$).



FIG. 2—Lane plate and screws after removal from bone (original magnification $\times 2.5$).

screws recovered without breakage (Fig. 2). Histologic sections of bone were made using formic acid decalcification, paraffin processing and hematoxylin and eosin staining. Iron was stained using Perls' test. The greenish-brown loose scale was brushed off the plate and chemically analysed by atomic absorption spectrophotometry.

No changes in the dimensions of the plate were obvious, but closer examination revealed extensive areas of corrosion near the screw holes and in the central tapered region, primarily on the side adjacent to the bone. In these areas the metal had been replaced by a dark-brown, tightly adhering corrosion product, as confirmed by optical microscopy (Fig. 3). Similarly, after removing the loose scale from the screws with weak sulfuric acid, severe areas of corrosion in the region of the threads were observed. The products of corrosion had replaced the original metal, maintaining the thread shape. Samples of the dark-brown corrosion product were broken off from the plate with a sharp instrument and analysed by x-ray energy spectroscopy, x-ray diffrac-

tion and atomic absorption spectrophotometry.

The plate was then divided between two screw holes to provide a cross-section for metallographic examination, chemical analysis and mechanical testing. One screw was mounted in plastic for metallographic and mechanical testing. The optical metallographic microscope was used to study the microstructure of these specimens.

The mechanical properties were determined by taking hardness measurements using a Rockwell-type machine with the B-scale Rockwell indenter. The plate was strained to failure in a tensile testing machine.

Results

Radiologic Findings

Roentgenograms showed that the general shape of the plate and screws was preserved (Fig. 4), but the interface between the metal and tissues was indistinct (Fig. 5).

Histologic sections of the dense fibrous

tissue around the plate showed a heavy iron metallosis in two forms: small brown hemosiderin granules and larger green-yellow, plate-like deposits of different shapes having a crystalline structure (Fig. 6). There was no active phagocytosis of this debris by macrophages or any inflammatory reaction.

The bone supporting the plate was depressed below the marginal cortical contour and exhibited abnormal cortical architecture (Fig. 7). This bone was poorly organized, lacking osteonal organization and any definable stress pattern. Much of the osteoid in the superficial zone of the plate bed lacked osteocytes, also suggesting poorly structured bone. The bone supporting the plate did not show appreciable remodelling (Fig. 8).

Pathological Features

The measurements of the plate revealed a 6 cm × 1.0 cm × 2.5 mm plate typical of the Lane configuration.

Gross inspection revealed black discoloration of the soft tissues around the

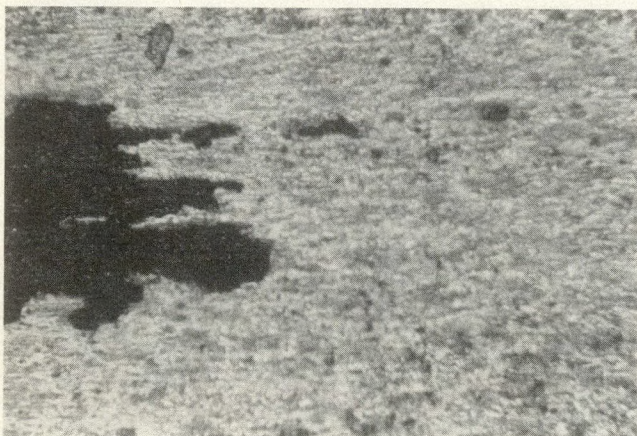


FIG. 3—Optical photomicrograph of corroded region of Lane plate. Dark region is corrosion product, light-coloured region is steel (original magnification × 250).

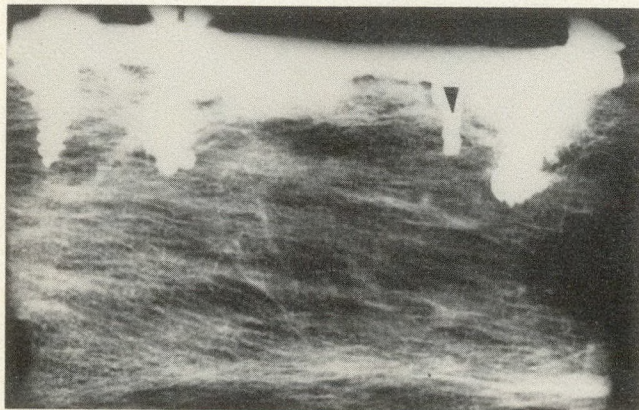


FIG. 5—Lateral fine detail demonstrates indistinct tissue-metal surface and metallosis of nearby tissues. Screw (arrow) seems fractured.

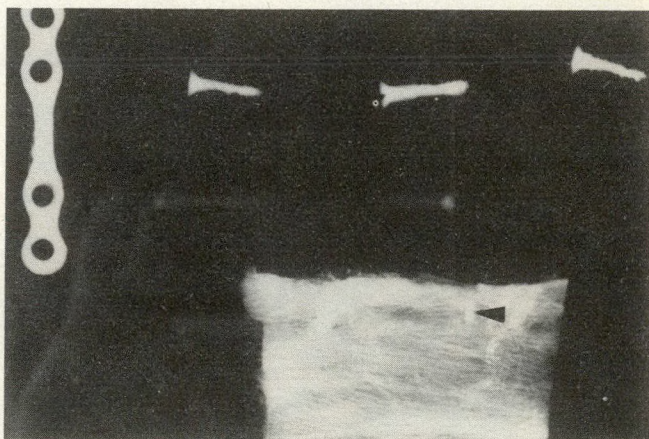


FIG. 4—Fine detail of metallic hardware and femur. Note surface corrosion and metallosis of tissues. Arrow shows deep fragment of fractured screw.

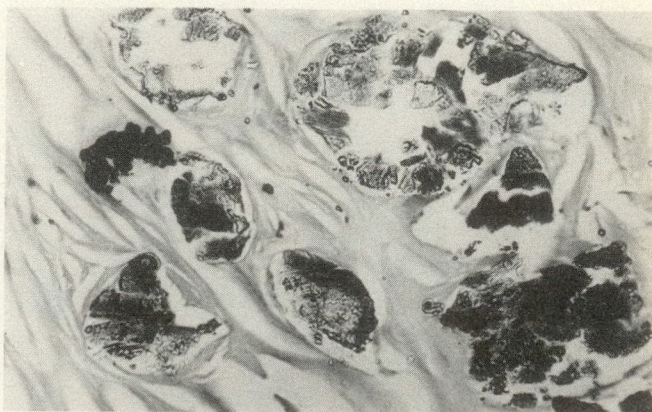


FIG. 6—Photomicrograph of fibrous tissue forming tissue bed of plate. Note two forms of metallosis — dark granular and large crystalline forms (hematoxylin and eosin, original magnification × 400).

plate and plate surface (Fig. 1). Bits of oxidized metal were easily scraped from the surface.

Chemical Findings

The analyses of both corrosion

products (the loose greenish-brown scale and the dark-brown, tightly adhering scale) were performed for sodium, calcium, potassium and iron by atomic absorption spectrophotometry and are reported in Table I.

X-ray energy spectroscopy of the dark-brown, tightly adhering corrosion product showed some variation in chemical composition. One region contained 99.7% iron and 0.3% silicon; another contained 80.7% iron, 19.1% chlorine and 0.2% silicon. The elongated white particles visible in Fig. 2 contained 99.5% iron. Carbon and oxygen are not detected by this method.

X-ray diffraction studies of the dark-brown scale showed crystals of ferrous carbonate (greenish-brown crystals), iron carbide (ferromagnetic), iron percarbide (ferromagnetic) and ferrous chloride (greenish-white crystals). The strongest lines were ferrous carbonate, showing that this was the principal corrosion product. The weakest lines were percarbide and ferrous chloride.

The results of the atomic absorption spectrophotometry and emission spec-

Table I—Atomic Absorption Spectrophotometric Analysis

Element	Greenish-brown loose scale, wt %	Dark-brown tightly adhering scale, wt %
Ca	2.1	0.24
Na	0.7	0.21
K	0.4	0.06
Fe	47.06	58.2
C + O	Balance	Balance

Table II—Chemical Composition of Plate and Screw Alloys

Element	Atomic absorption spectrophotometry		Emission spectroscopy	
	Plate	Screw	Plate	Screw
Fe	Balance	Balance	> 1.0	> 1.0
Mn	0.06	0.33	< 0.1	0.1 - 1.0
Cu	0.029	0.018	< 0.1	< 0.1
Ni	< 0.002	0.003	< 0.1	< 0.1
Cr	< 0.005	< 0.005	< 0.1	< 0.1
Mo	< 0.05	< 0.075	< 0.1	< 0.1
Al	—	—	< 0.1	< 0.1
Mg	—	—	< 0.1	< 0.1
Si	—	—	< 0.2	< 0.2

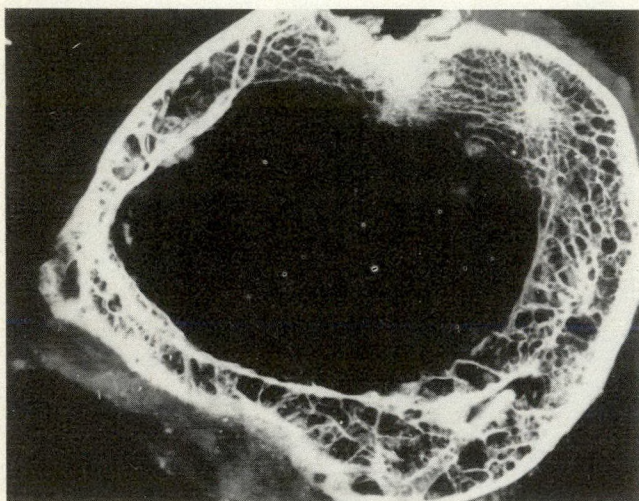


FIG. 7—Fine detail of 5-mm cross-section of femur after removal of plate showing defective cortex deep to plate ($\times 4.5$).



FIG. 8—Photomicrograph of fibrous tissue bed of plate and adjacent fibrous tissue-bone interface. Note metallosis, which was both granular and crystalline; superficial bone is void of osteocytic nuclei (hematoxylin and eosin, original magnification $\times 63$).

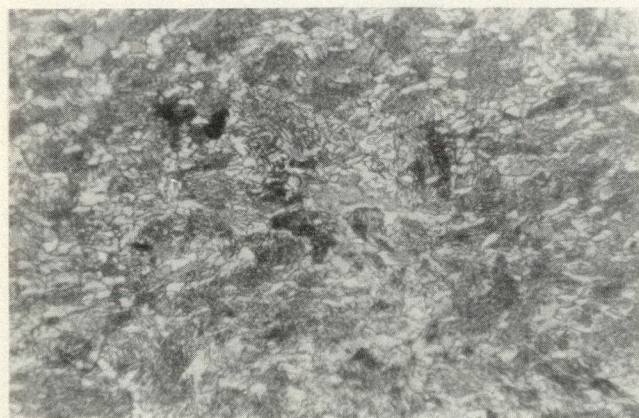


FIG. 9—Optical photomicrograph of microstructure of steel in Lane plate (original magnification $\times 750$).

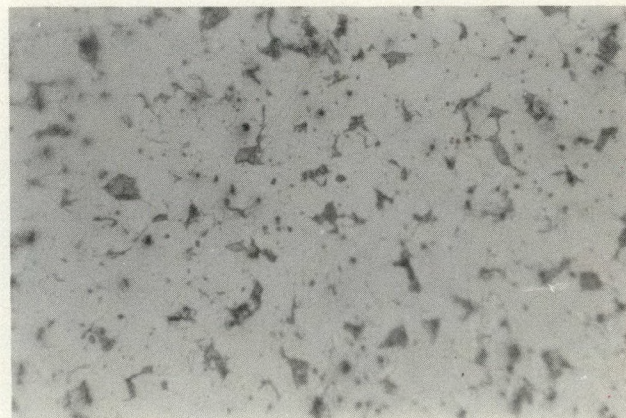


FIG. 10—Optical photomicrograph of microstructure of steel in Lane plate screws (original magnification $\times 750$).

troscopy of the plate and screw alloys are shown in Table II.

Metallographic Findings

The microstructure of the plate (Fig. 9) indicates the material is approximately 0.6% carbon steel in the normalized condition as indicated by the relative amounts of white phase (ferrite) and the dark lamellar constituent (pearlite).

The microstructure of the screw (Fig. 10) revealed approximately 0.2% carbon steel, also in a normalized condition but with some evidence of being cold worked.

Mechanical Findings

Hardness values obtained on the plate and screw are shown in Table III. The tensile strengths are estimated by an empirical relation between hardness and ultimate tensile strength.¹

Based on the measured cross-section of 10 mm² at the centre of the plate, a load of 6550 N (668 kg) would be expected to approach the ultimate tensile strength of the plate if it were wholly 1060 steel. When tested, the plate supported a maximum load of only 3420 N (350 kg).

During the tensile test, the specimen crumbled extensively, lumps of the dark-brown scale spilling off under the tensile machine grips and at the centre of the plate, in each case on the side of the plate adjacent to bone. At the centre, less than 50% of the cross-section was steel.

Discussion

The retrieval of implants has led to many important findings which have resulted in the refinement of internal fixation.

Carbon-steel implants have clearly shown a susceptibility to corrosion, with 62%² to almost universal involvement³ of recovered implants reported. No relation between time and corrosion has been delineated.³ Multiple-component fixation, combinations of differing materials and poor techniques of internal fixation have all been shown to increase corrosion.^{2,3} Crevices in the surfaces are thought to increase corrosion by producing areas of relative hypoxia and acidity. Different materials, when used in proximity to one another, increase corrosion by generating large potentials.²

Despite the corrosion, implant failure is a relatively uncommon reason for

removal compared with sepsis, aseptic inflammatory responses, loosening and migration. There is no evidence that corrosion delays union.⁴ Increased corrosion has been found in implants removed for sepsis or loosening.³

The Lane plate that we retrieved is typical, being made of a plain carbon pearlitic steel, number 1060, which nominally has an ultimate strength and hardness very close to the values found in our analysis.

The screws appeared to be of plain carbon steel containing about 0.2% carbon. The hardness and microstructure found would indicate that the steel had been hardened by cold working.

As mentioned, the plate had corroded to one-half of its original strength. The corrosion was most severe on the side of the plate adjacent to the bone. This is in contrast to other studies⁵ which have shown crevices and metal interfaces more involved. The corrosion products, mainly ferrous carbonate (FeCO₃) and some ferrous chloride (FeCl₂) formed a dark-brown, tightly adhering scale where they replaced the steel crystals. These give evidence of the nature of the corrosion reaction of body fluids with the steel. The iron carbide (Fe₃C) is one of the original phases in the steel of the Lane plate. In the presence of an electrolyte (the body fluids) a galvanic cell is formed between the Fe₃C and the nearly pure iron surrounding it in the lamellar, pearlite structure of the steel. The iron is anodic to the Fe₃C; thus, the former dissolves while the Fe₃C is not corroded and ultimately remains among the corrosion-product crystals (FeCO₃ and FeCl₂) as the elongated white crystals observed in Fig. 2. This scale probably slowed down the rate of corrosion by forming a partially protective layer over the steel.

The iron percarbide, thought to be present in small amounts because of the weak lines observed in the diffraction pattern, is probably not a corrosion product since possible mechanisms for its formation are complicated involving reactions of ammonia and carbon monoxide with iron.⁶

The pathological appearance is also of interest. The evident extensive metallosis was confirmed microscopically. Despite this, there was no evidence of serious inflammation, phagocytosis or other reaction to the foreign material.

In contrast, Danzig and colleagues⁷ reported a plate recovered from a patient after 56 years when aseptic inflammation developed locally. They reported histologic evidence of inflammation and minimal pigmentation. This reinforces the variability of patient response to implants, both in the extent of corrosion and host response to it.

Also of interest is the extensive depression of cortical bone below the plate on cross-section. Despite the age of the

implant, no evidence of mature, compact bone was noted in the plate bed and there was persistently no well-developed stress pattern. The bone did not exhibit appreciable remodelling and was essentially in a dormant, disorganized state largely due, we believe, to the stress relief effect of the plate.

Although the Lane plate is now seldom used because of improved alloys and implant design, our findings certainly suggest that the osteopenia and lack of maturation of bone underlying plates persist as long as the implant remains in place.

It is interesting that these changes and the severe corrosion and metallosis are still compatible with an excellent clinical result.

We are grateful to Dr. L.M. Castelliz for the x-ray diffraction study, Dr. W.F. Caley for the x-ray energy spectroscopy analysis, Mr. A. Ritchie for the tensile testing, Mr. C. Cole for emission spectroscopy and atomic absorption analyses and Mr. W. McManus for technical assistance.

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NOTICES

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Multi-Organ Transplantation

The first Canadian symposium on multi-organ transplantation to be held in London, Ont. at University Hospital Apr. 21-22, 1988, will be presented by the Department of Continuing Medical Education in cooperation with the Department of Surgery. The symposium will include the following topics: organ transplantation, donation, retrieval and preservation, transplant immunobiology, ethical issues, perioperative patient management, and resource requirements. Further information can be obtained by contacting: Continuing Medical Education, Faculty of Medicine, The University of Western Ontario, London, Ont. N6A 5C1; (519) 661-2074 or Dr. David Grant, University Hospital; (519) 663-2926.

Table III—Hardness and Estimated Ultimate Tensile Strength of Alloys

	Rockwell B hardness	Ultimate tensile strength, psi (MPa)
Plate	94	95 000 (655)
Screw	98	104 000 (716)

Autologous Blood for Pleurodesis in Recurrent and Chronic Spontaneous Pneumothorax

Open operation for recurrent pneumothorax may be necessary to resect or oversew a bulla. At the same time, to stimulate adhesions, the pleura may be abraded with gauze, chemicals used to cause inflammation or a partial pleurectomy performed. Operation is necessary to decorticate the lung if it has developed a thick peel, in the presence of gross bleeding (hemopneumothorax) or if a large bulla is present. Occasionally, a chronic pneumothorax is due to a persistent leak caused by an adhesion holding open a bulla. The adhesion may be cut at thoracoscopy, using diathermy, and the leak will close. Many chemical agents have been used to encourage adhesions: iodized talcum powder, silver nitrate, 50% glucose and water, Atabrine, nitrogen mustard and tetracycline. In this series, one to three instillations each of 50 ml of autologous blood were used after the lung was fully expanded, usually after the use of an apical chest tube. This procedure was successful in 21 (85%) of 25 patients with difficult, chronic or recurrent pneumothoraces. It is a practical and easy method of causing a chemical pleurodesis, without serious side effects.

Dans un cas de pneumothorax récidivant, une opération ouverte peut être nécessaire pour réséquer ou recoudre une bulle. Au même moment, dans le but de stimuler la formation d'adhésions, on peut irriter la plèvre au moyen de gaze ou de substances chimiques utilisées pour provoquer l'inflammation ou on peut pratiquer une pleurectomie partielle. Une opération est nécessaire s'il y a lieu de décortiquer un poumon qui se serait couvert d'une pelure

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épaisse, devant une hémorragie importante (hémopneumothorax) ou quand une grosse bulle est présente. À l'occasion, un pneumothorax chronique est attribuable à la persistance d'une fuite causée par une adhésion qui maintient une bulle ouverte. L'adhésion peut être coupée par diathermie lors de la thoracoscopie, permettant la fermeture de la fuite. Plusieurs substances chimiques peuvent être utilisées pour favoriser la formation d'adhésions: poudre de talc iodée, nitrate d'argent, glucose à 50% dans l'eau, Atabrine, moutardes azotées et tétracycline. Dans le groupe faisant l'objet de cet article, de une à trois instillations de 50 ml de sang autologue ont été utilisées après expansion complète du poumon, habituelle après l'utilisation d'un tube thoracique apical. Parmi 25 patients souffrant de pneumothorax chronique ou récidivant, 21 (85%) ont répondu au traitement. Cette intervention est un moyen à la fois pratique et facile de provoquer une pleurodèse chimique sans effets secondaires sérieux.

Spontaneous pneumothorax may occur at any age, with peaks of incidence in neonates, the second and third decades and in later years from chronic obstructive lung disease.

If a pneumothorax is small it does not need treatment and the air is absorbed spontaneously.¹ If it is large, causing shortness of breath, it is customary to treat the first attack by chest-tube drainage until the lung expands. To cause chemical inflammation and stimulate "reaction" and pleural adhesions at its site, the tube is left in place for at least 24 hours after the air leak stops. The incidence of recurrence after tube drainage varies from 20% to 30%.

Recurrent or chronic pneumothorax requires different treatment methods. Some recommend open operation to excise or oversew a bulla or cluster of blebs, thus stopping the air leak. At the same time, physical inflammation of the pleura may be stimulated by abrasion with a dry gauze swab.² Alternatively,

iodized talcum powder or silver nitrate on the pleural surfaces is used to cause a chemical pleurodesis.³⁻⁷ Another method is parietal pleurectomy to encourage pleural adherence,⁸⁻¹⁰ but this method carries a risk of bleeding and infection.

A pneumothorax due to rupture of a bleb or a small bulla does not result in a significant space-occupying lesion and for this it is difficult to justify a major operation. The possible detrimental effect of a thoracotomy will not make the excision of a bleb, *per se*, worthwhile. On the other hand, there are definite, though rare, indications for open operation in patients with chronic or recurrent pneumothorax. If the bulla is large — one-third to one-half the size of a hemithorax — if there is obvious thickening of pleura or peel on the lung or if gross bleeding is associated with the air leak, open operation is necessary.

Without these complications, closed methods of dealing with the problem are desirable and satisfactory. When tube drainage and full expansion of the lung have been achieved, various chemicals, as follows, may be instilled to cause a chemical pleurodesis: 1% iodized talcum powder; 5% silver nitrate (5 to 10 minims);^{11,12} 0.25% camphor in oil; Atabrine;¹³ 50% glucose solution; nitrogen mustard and tetracycline (500 mg).¹⁴ Most are very painful, and iodized talcum powder has been associated with later tumour formation.¹⁵ Nitrogen mustard, while excellent for drying up a malignant pleural effusion, induces nausea and vomiting for 24 hours.

Methods

For several years, autologous blood has been used for pleurodesis after lung expansion with tube drainage. Blood outside its own environment is a strong irritant as is well known to surgeons doing a second operation at any site or in a cavity. Adhesions due mainly to hematoma and serosanguineous reaction from previous handling of tissues and organs can make such procedures quite difficult.

The amount of blood used depends on the degree of persistence of the leak and

extent of lung disease. One to three injections of blood, 50 ml each, are made on different days into the chest tube. Initially, blood was drawn into a syringe containing 5000 units of heparin (the latter to prevent clotting during the short period of withdrawal before injection into the pleura). The heparin is now omitted. The blood is withdrawn quickly into a 50-ml syringe, using a needle size 18 or 19, and injected, before clotting occurs, into the pleura through the chest tube which is clamped before injection. The clamp is left on for 2 hours. The blood is injected with the tube elevated to permit gravity flow over the surface of the pleura.

In most patients with a difficult, recurrent pneumothorax, the tube will have been placed through the first intercostal space posteriorly. This is the highest point in the thoracic cavity, the ideal spot for taking off the last vestige of air that has risen to the top. Alternatively, the tube may be inserted through the second intercostal space anteriorly, the highest spot in the thorax when the patient is supine. Both these sites are advantageous for injections, as the bullae or blebs are usually at the apex of the lung. If the tube is placed in the axillary region, for example in a woman who does not want an exposed scar, the patient should be nursed horizontally, with the affected side uppermost.

A landmark for finding the first intercostal space posteriorly is a point halfway between the vertebra prominens (C7) and the medial edge of the spine of the scapula. The chest wall is 5 to 7.5 cm thick at that point (including the trapezius and rhomboid muscles). From there the approach is slightly inferiorly and laterally. When local anesthetic is injected in the presence of a pneumothorax, air will be aspirated when the needle or tube is deep enough. A Malecot tube is the preferred type, as once it is inserted it can be pulled back until the bulb just catches under the parietal pleura and a long length is not left inside to hold the lung

down and prevent full expansion. A Foley catheter with a 5-ml bag is a good alternative.

Findings

Blood was used to induce pleurodesis in 25 patients with recurrent or persistent spontaneous pneumothorax. The injection of blood was painless and not associated with nausea. The treatment was applied after the lung had expanded and the air leak had stopped, in order to effect better reaction and fibrosis of the pleura.

The follow-up in this series was from 2 to 11 years. There were four recurrences (15%). One developed after 1 week and was managed successfully with a chest-tube injection of nitrogen mustard. One developed after 1 month and was managed by simple chest-tube drainage. The third occurred after 4 years and was treated, after full lung expansion, by instillation of tetracycline.

In the last recurrence, the bleb was excised and chemical pleurodesis induced with tetracycline and iodized talcum powder, which is no longer used, after a report¹⁵ that it caused tumour formation.

There was one pleural infection, managed by thoracenteses (two) and injection of antibiotics.

The following example illustrates the successful use of blood for pleurodesis. A 52-year-old man had a right spontaneous pneumothorax inadequately drained by an axillary basal tube (the leak persisted for 30 days without full lung expansion). This resulted because the tube had been inserted too far, and the end lay at the lung base. The day after apical placement of a Malecot tube in the second intercostal space anteriorly, the lung expanded. Autologous blood was instilled on 2 successive days and the tube was removed 1 day later; the lung remained expanded (Figs. 1 and 2). The chest x-ray film showed a good pleural "cap" of reactive fluid and a small basal effusion. The latter is considered beneficial as an

irritant, as adhesions will form there and at the apex, before and while the fluid is being absorbed.

Discussion

Some chemical agents used for pleurodesis are irritating, cause a good pleural reaction with exudation of pleural fluid but are extremely painful. Silver nitrate injection, for example, may require morphine as an analgesic. It is the favoured agent in the Royal Air Force for pilots who have had a spontaneous pneumothorax. Its efficacy is tested for a nominal period after use, by attempted induction of an artificial pneumothorax. The percentage in whom pneumothorax can be induced is very low, and should one occur another silver nitrate treatment is given.

Chemical agents by themselves are ineffective if the lung is collapsed. The lung must first be expanded. Also, it may be dangerous to generate large amounts of pleural fluid in the presence of an air leak, from even a small bronchus or air sac.

Autologous blood as an agent is not perfect, but it is easy to use, practical and painless. It may be that more than 50 ml should be injected at a time and on several occasions to produce a better reaction with more diffuse adhesions. It is always preferable to inject it at or toward the apex of the thoracic cavity, for most blebs and bullae are in the apical area of the upper lobe, and adhesions here are more likely to seal the leaking site and cause pleurodesis.

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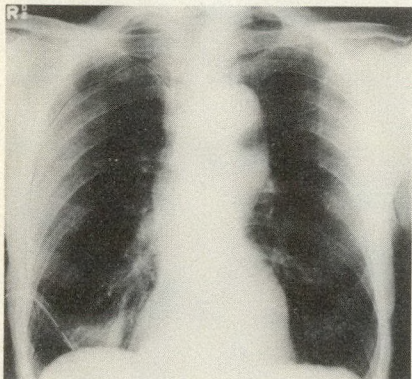


FIG. 1—Posteroanterior view shows that axillary tube has been inserted too far. End of tube lies at lung base and is not coping with apical air.

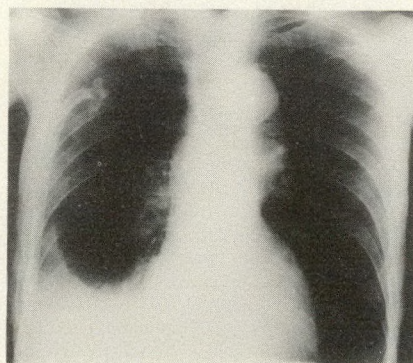


FIG. 2—Posteroanterior view of anterior apical tube with lung expanded shows apical cap of reactive fluid and small basal effusions. Effusion is advantageous, for adhesions will form during its presence and absorption.

Endobronchial Lipoma: Report of Three Cases

Endobronchial lipomas are rare, benign lesions that usually obstruct a major bronchus and cause irreversible pulmonary damage distally. Because of the age, sex and smoking history of the patients in whom they are found, they also simulate malignant tumours. The authors report three cases of endobronchial lipoma. Two of the patients had a long history of cough and respiratory symptoms, the third was asymptomatic. Two patients underwent lung resection and one was managed by local resection through a bronchotomy. The lipoma in all three patients was diagnosed preoperatively and treated successfully.

Les lipômes endobronchiques sont des lésions bénignes et rares qui obstruent généralement une bronche majeure, avec dommage pulmonaire distal permanent. Ils simulent les lésions malignes, affectant comme celles-ci le même groupe d'âge, de sexe et d'exposition au tabac. Ce rapport décrit trois cas cliniques dont deux présentèrent une longue histoire de toux et de problèmes respiratoires, l'autre cas ne manifestant aucun symptôme. Tandis qu'un des cas se prêtait à une résection locale par bronchotomie, les deux autres ont dû subir une résection pulmonaire. On avait établi pour chaque patient un diagnostic préopératoire et les résultats des interventions furent favorables.

Endobronchial lipomas, first described by Rokitansky¹ at autopsy in 1854, are

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composed of mature adult fat cells. They account for 0.1% of all pulmonary tumours.² In the few cases reported in the literature, early diagnosis is stressed to obviate lung damage that may occur distal to the lesion as a result of endobronchial obstruction. The three cases presented represent our experience with this tumour.

Case Reports

Case 1

A 54-year-old man, 177 cm tall and weighing 72 kg, had experienced shortness of breath 3 months earlier, associated with right chest pain and dry cough that did not respond to antibiotic therapy. He had smoked one package of cigarettes a day for 30 years. His vital signs were normal but decreased breath sounds were heard over the right lower thorax. Routine blood and urine laboratory values were normal as was an electrocardiogram. Examination of the sputum for malignant cells and culture for acid-fast bacilli gave negative results. Chest x-ray films showed atelectasis of the right middle lobe and bronchoscopy revealed a yellowish tumour obstructing the right middle-lobe bronchus. A biopsy specimen demonstrated mature adult fat cells consistent with lipoma. Through a right thoracotomy the atelectatic middle lobe was removed. Pathological examination showed a pedunculated submucosal bronchial lipoma measuring 1.3 × 1.0 × 0.7 cm obstructing the right middle-lobe bronchus. The postoperative course was uncomplicated and the patient has remained well.

Case 2

A 49-year-old man was admitted to hospital after two bouts of hemoptysis. There was no history of wheezing, chest pain or weight loss, but he had had a productive cough (60 ml sputum daily) for 3 years. He had stopped smoking 2 years previously. He was well nourished with a blood pressure of 120/80 mm Hg, a respiratory rate of 15/min and heart rate of 80 beats/min. The leukocyte count, hemoglobin value, electrocardiogram and results of urinalysis were all normal. Sputum samples were negative for acid-fast bacilli and malignant cells. The anteroposterior diameter of the chest was normal with some dullness to

percussion and audible rales over the right lower posterior aspect. Chest x-ray films revealed consolidation of the right lower lobe. Bronchoscopy demonstrated a round mass obstructing the right lower lobe bronchus. A biopsy of the mass revealed mature adult fat cells consistent with lipoma. A right lower lobectomy was performed. Gross examination of the resected specimen showed a pedunculated polypoid mass measuring 4 × 1.5 cm situated in the right lower lobe bronchus (Fig. 1). Postoperative recovery was smooth and the patient remains well.

Case 3

A 42-year-old man was referred for investigation of a mass in his right lung seen on a routine chest x-ray film. He was asymptomatic and a nonsmoker. On physical examination no abnormalities were found and routine blood values were within normal limits. The chest x-ray film demonstrated a mass 15 cm in dimension in the right lower lobe. Bronchoscopy revealed a round yellowish tumour which, on biopsy, was diagnosed histologically as a

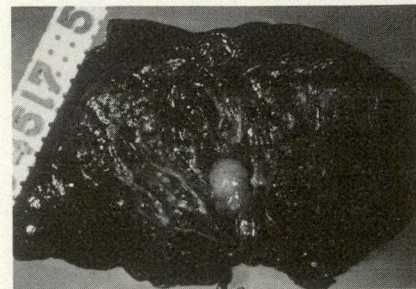


FIG. 1—Case 2. Pedunculated endobronchial lipoma occupying lumen of right lower lobe main bronchus.

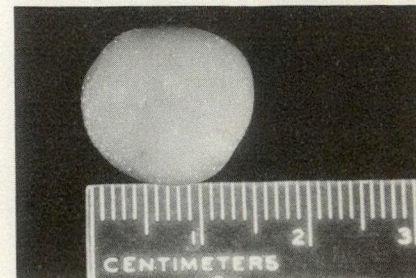


FIG. 2—Case 3. Cross-section of endobronchial lipoma removed at bronchotomy.

lipoma. Through a right posterolateral thoracotomy, a bronchotomy of the lower lobe bronchus was performed to explore the possibility of local resection. This was feasible and a yellowish round pedunculated mass, 1.7 cm in dimension, was removed (Fig. 2). The bronchotomy was closed with interrupted sutures. The patient's recovery was uncomplicated and the radiologic signs resolved.

Discussion

Endobronchial lipomas are rare benign lesions, usually found in middle-aged men.³ These tumours are whitish grey to yellow in colour, measure 1 to 2 cm in dimension and are generally pedunculated, having a narrow stalk. They arise from the submucosal fat and may be covered with normal respiratory mucosa periodically showing squamous metaplasia that is probably the result of chronic inflammation.⁴ Presenting symptoms are due to bronchial obstruction and depend on the size and location of the tumour. They include cough, chest pain, dyspnea, hemoptysis and recurrent pneumonia.^{1,4} Rarely, a patient may be asymptomatic

and the lesion diagnosed incidentally (case 3). Cockcroft and colleagues⁵ reported 1 patient out of 40 who was asymptomatic. At bronchoscopy these tumours are difficult to distinguish from bronchial adenomas unless a biopsy is done. Treatment will depend on whether or not the lung parenchyma distal to the tumour is salvageable at thoracotomy. If permanently damaged, the lung tissue should be resected. Our first two patients were treated this way. If, however, the lung tissue appears salvageable, local resection through a bronchotomy, as in case 3, should be considered.

In the past, because of late diagnosis and mechanical problems, removal of these tumours using a rigid bronchoscope was difficult and infrequent. The advent of the modern flexible bronchoscope has made diagnosis and removal possible at an earlier stage when the lesions are still of manageable size and before irreversible lung damage has occurred. Smirniotopoulos and colleagues⁶ recently reported endoscopic ablation of a bronchial lipoma with a neodymium-YAG

laser. Other modalities for early diagnosis of these lesions are now available and could result in more lesions being removed endoscopically. Nuclear magnetic resonance imaging, because it can differentiate between fatty and non-fatty tissue, may prove to be more useful, as a diagnostic tool, than computed tomography.

We gratefully acknowledge the advice and help of Dr. Marcel Hamonic in the preparation of this report.

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Aortic Surgery and Horseshoe Kidney: a Challenging Surgical Problem

Horseshoe kidney is a rare abnormality that complicates aortic surgery. Three such cases are presented and the literature is reviewed. Although the diagnosis was not made preoperatively in any patient, all were managed safely. Two patients required preservation of abnormal renal arteries and one required division of the renal isthmus for exposure. Special attention is drawn to the need for lateral-angiographic projections of this condition and to the intraoperative injection of indigo carmine dye to delineate the proper line of division of the renal isthmus.

Un rein en fer à cheval est une anomalie rare qui vient compliquer la chirurgie aortique. Trois cas sont décrits et la littérature médicale est passée en revue. Bien

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qu'en aucun cas le diagnostic n'ait été fait en préopératoire, les trois patients ont pu être traités en toute sécurité. Deux patients ont nécessité la sauvegarde d'artères rénales anormales et un a requis une division de l'isthme rénal pour permettre l'exposition. On souligne tout spécialement la nécessité d'effectuer des projections angiographiques latérales de cette affection et de procéder durant l'opération à des injections de carmin d'indigo pour démarquer la ligne de division de l'isthme rénal.

Horseshoe kidney is a rare congenital abnormality that challenges the vascular surgeon when it is encountered during aortic surgery.¹⁻³ It is reported to occur about once in every 500 patients, so no surgeon has much experience with the anomaly and a treatment plan is helpful.^{4,5} A recent survey of the literature revealed only 70 reported cases of horseshoe kidney associated with aortic surgery, including 56 associated with aortic aneurysm and 14 with aortoiliac occlusive disease.⁶

We report our experience of three recent cases seen within 6 months and make some recommendations for management should this condition be encountered during aortic surgery.

Case Reports

Case 1

A 69-year-old man who had undergone a laparotomy earlier in the day at another hospital to resect a 6-cm symptomatic abdominal aortic aneurysm was found to have a horseshoe kidney. There was no evident rupture, the abdomen was closed and he was referred to St. Paul's Hospital for further treatment.

His medical history included symptomatic coronary artery disease and deep venous thrombosis. On examination, he was stable, with a fresh midline laparotomy scar and a palpable tender pulsatile mass. Distal pulses were strong. Laboratory values were normal; the electrocardiogram showed an old inferior myocardial infarction.

Because the aneurysm was symptomatic a repeat laparotomy was immediately performed at which the presence of horseshoe kidney was confirmed. The major right and left renal arter-

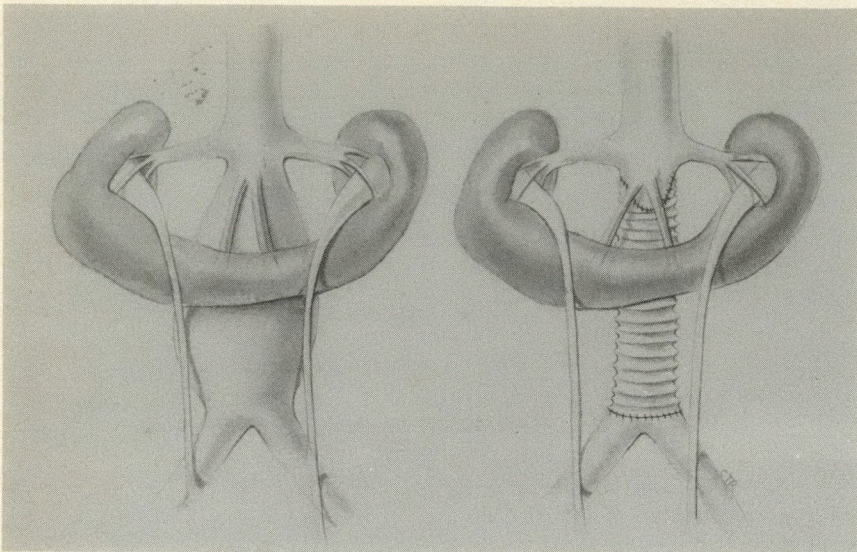


FIG. 1—Case 1. Operative findings and technique.

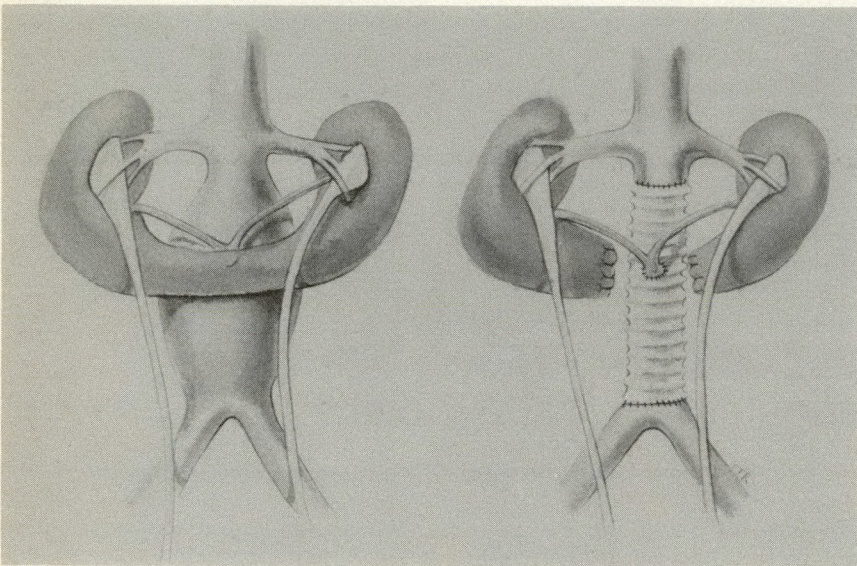


FIG. 2—Case 2. Operative findings and technique.

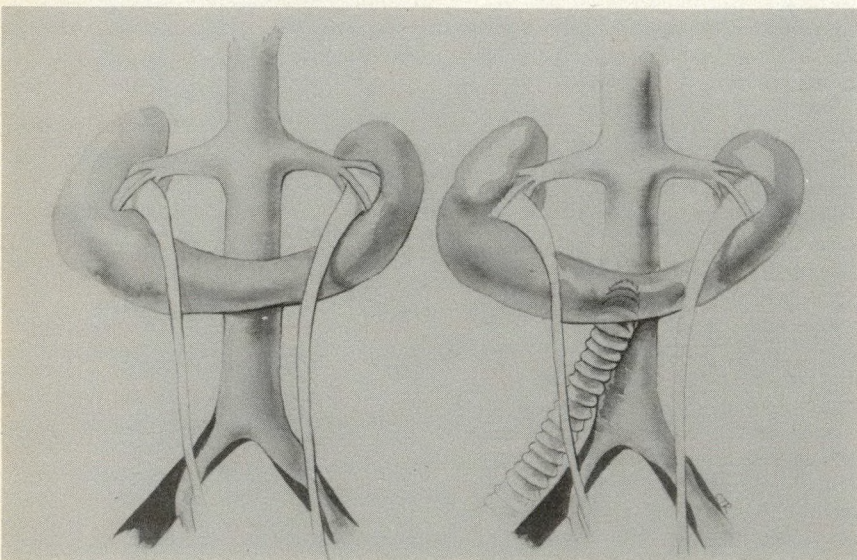


FIG. 3—Case 3. Operative findings and technique.

ies were in their normal position and there were two renal arteries arising from the anterior aspect of the aneurysm, just below its neck. These abnormal vessels were selectively clamped and injected with indigo carmine dye, which clearly delineated the distribution of the blood supply, to determine the proper line of division through the isthmus.

The aneurysm was resected and replaced with a Dacron tube graft. The isthmus of the kidney was not divided but merely elevated to give good exposure. The abnormal renal vessels were preserved on a tongue of the aortic wall anteriorly which was incorporated into the proximal anastomosis (Fig. 1).

The postoperative course was uncomplicated and the patient was discharged 10 days later.

Case 2

A 67-year-old man was admitted for elective resection of an abdominal aortic aneurysm measuring 5.5 cm in diameter, confirmed by ultrasonography. There was no history of heart disease, hypertension or previous surgery. The findings on physical and laboratory examinations were normal except for the presence of a pulsatile nontender abdominal mass.

At laparotomy for aneurysm resection he was found to have a horseshoe kidney with a thick isthmus of renal parenchyma and at least one abnormal renal vessel going to the isthmus. Because the anatomy of the blood supply to the kidney was uncertain, the abdomen was closed. The following day, flush and selective renal angiograms showed normal right and left renal arteries apparently supplying the entire kidney. At reoperation the isthmus of the kidney was divided and oversewn to expose the infrarenal aneurysm. There was a large abnormal renal artery arising from the anterior aspect of the aneurysm, supplying both sides of the isthmus of the kidney, that had not been identified on the angiogram.

The aneurysm was replaced with a Dacron tube graft and the abnormal renal vessel reimplanted onto its anterior aspect with a Carrel patch (Fig. 2). The patient had a smooth recovery.

Case 3

A 78-year-old man had claudication in his right thigh and buttock, occurring after walking a half block. He had no rest pain but some numbness of his right foot at rest. He also had claudication in his left calf.

Medical history included a cerebrovascular accident and left hemiparesis with complete recovery, controlled hypertension and a previous prostatic resection for benign hypertrophy. The findings on physical and laboratory examinations were normal apart from absent pulses in the right lower extremity and in the left below the groin.

An aortogram showed external iliac stenosis, occlusion of the common and superficial femoral arteries on the right side and of the superficial femoral on the left. The renal vessels were not visualized. At operation he had a horseshoe kidney overlying the distal aorta. The isthmus of the kidney was elevated exposing sufficient distal aorta for the aorta-right femoral bypass which was done without difficulty and without division of the isthmus (Fig. 3). The patient had an uncomplicated postoperative course.

Discussion

Horseshoe kidney, a congenital abnormality, occurs when the lower poles of the kidneys fuse at an embryologic age of 4 to 8 weeks.⁴ The isthmus may vary in thickness from a thin fibrous band to thick renal parenchyma and usually lies anterior to the aorta. The ureters generally lie more medially than usual and anterior to the renal isthmus. Most horseshoe kidneys remain asymptomatic but 30% of patients present with urinary infection, renal stone or hydronephrosis.⁷

The blood supply is often complex. Connelly and associates⁶ found abnormal renal arteries in 42 of the 70 patients they reviewed. Most had normal main right and left renal vessels in association with the abnormal ones. In only two cases was the blood supply entirely from multiple, small, abnormal vessels, a condition considered inoperable by most surgeons. This was consistent with our experience — our patients in whom the renal blood supply was demonstrated completely (cases 1 and 2) had normal main right and left renal arteries but had associated abnormal renal arteries arising from the aneurysm. No abnormal major vessels were seen at operation or on the angiogram in the third case.

The diagnosis was made initially in the operating room in all three patients. The first patient had no preoperative investigations because of the urgency of the operation. With the others, ultrasonography in one and angiography in the other failed to disclose the presence of the renal abnormality. Even in retrospect, ultrasonography in case 2 did not show the horseshoe kidney. The aortogram in case 3 did not opacify the kidney but, in retrospect, an abnormal renal outline was visible on the plain film.

In their review of the literature Bietz and Merendino⁸ found that the diagnosis was suspected preoperatively in 60% of cases, usually on the basis of an intravenous pyelogram. This is at variance with our experience, but we are not in the habit of routinely doing intravenous pyelography or angiography on abdominal aortic aneurysms preoperatively. We were disappointed that ultrasonography was not helpful in the one case in which it was used. Although we were not able to make the diagnosis preoperatively, it is difficult to justify routine angiography or even intravenous pyelography to detect a condition that occurs in only 0.25% of patients. Moreover, with intraoperative diagnosis all our patients were managed safely.

We found an anterior aortogram to be inadequate and misleading in that it missed a major renal vessel arising from the anterior aspect of the aneurysm in case 2. Oblique or lateral views must be

included to detect these anteriorly placed vessels.

Preservation of renal blood supply while providing adequate exposure is the key to the proper management of this condition. Two of our three patients underwent either reimplantation or preservation of abnormal renal vessels by standard techniques, one requiring division of the renal isthmus for proper exposure. Selective injection of indigo carmine dye into the abnormal renal vessels was useful in determining the appropriate line of division.⁹ A review of the literature suggests that the renal isthmus requires division for exposure in about 50% of cases while reimplantation or preservation of abnormal vessels is necessary in about one-third.^{6,8,10}

Summary

Horseshoe kidney is an unusual and difficult problem which complicates management in aortic surgery. The diagnosis was not made preoperatively in any of our three patients and ultrasonography was not as useful as might have been expected. The importance of aortography, if the diagnosis is suspected, has been stressed but it must include oblique or lateral views to assess properly the abnormal arterial supply of the kidney. Selective injection of indigo carmine dye into the abnormal renal vessels was a useful adjunct in determining the appropriate line of division of the renal isthmus when necessary. Aortic surgery can be done with safety in the presence of a horseshoe kidney if the renal blood supply is preserved.

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BOOK REVIEWS

continued from page 420

tumours with peritoneal mesotheliomas are emphasized. Noninvasive techniques such as computed tomography and magnetic resonance imaging are well described. Optimal cyto-reduction is fixed to 0.5 cm rather than 2 cm for an improvement of the actuarial survival. Problems of chemotherapy with tissue nonresponse are presented. The histogenetic type of the tumour, its grade, stage and prognosis, in relation to risk, indicates an aggressive primary approach. The chapter on the indications and limitations of radiotherapy in stages II and III disease is interesting. Finally, the last chapter underlines the importance of ovarian markers such as calcium 175 and discusses other future approaches to radiotherapy. This useful book should stimulate the gynecologic and medical oncologist, the radiotherapist and the practising gynecologist.

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MANAGEMENT OF SOFT TISSUE AND BONE SARCOMAS. Monograph Series of the European Organization for Research on Treatment of Cancer. Volume 16. Edited by A.T. van Oosterom and J.A.M. van Unnik. 309 pp. Illust. Raven Press, New York, 1986. \$58.50 (US). ISBN 0-88167-200-9.

This monograph contains 32 often-brief contributions of 95 authors and covers the broad spectrum of musculoskeletal oncology, although with little emphasis on surgical management. Except for six papers from North American centres, the book is of European origin and the editors are from the Netherlands where the symposium was held.

Although the symposium took place in 1984 and the field of sarcoma management is changing rapidly, the material in this volume remains pertinent and as up to date as one can expect in a published work. Some of the articles deal with complex subjects rather superficially and are poorly referenced. The majority, however (notably those on the management of stage 3 disease and metastasectomy, limb-saving surgical procedures and the quality of life and assessment of tumour necrosis), present excellent reviews of current topics and are well referenced. The essays on the use of diagnostic markers, electron microscopy and magnetic resonance imaging are timely.

For the medical or surgical oncologist, this monograph will serve as a record of the 1984 symposium, emphasizing in particular the European view and presenting certain topics often neglected in similar meetings and publications. For surgeons, residents and other med-

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Avulsion of the Pectoralis Major Tendon in a Weight Lifter: Repair Using a Barbed Staple

Avulsion of the pectoralis major tendon is uncommon. The usual mechanism is a sudden muscular contraction with the rupture occurring at any point between the muscle's origins on the clavicle and sternum and its tendinous insertion on the humerus. At least half the reported cases involve athletes. Primary repair is recommended. Surgical correction using a barbed bone staple to reattach the tendinous portion of the pectoralis major to its attachment at the lateral lip of the bicipital groove has not previously been described. The authors obtained an excellent postoperative result in a 20-year-old competitive weight lifter who was able to return to active bodybuilding competition. They advocate prompt surgical correction of this lesion in any active healthy person.

L'avulsion du tendon du grand pectoral est rarement rencontrée. Le mécanisme habituellement en cause résulte d'une contraction musculaire soudaine, la rupture pouvant survenir n'importe où entre les origines du muscle sur la clavicle et le sternum, et ses insertions tendineuses sur l'humérus. Au moins la moitié des cas décrits implique des athlètes. Le traitement de fond recommandé est la réparation chirurgicale. Une technique correctrice faisant appel à des agraffes pour os munies de ardillons, pour rattacher la partie tendineuse du grand pectoral à son insertion sur la lèvre latérale de la gouttière bicipitale, n'avait pas jusqu'ici été décrite. Les auteurs ont obtenu d'excellents résultats postopératoires chez un haltérophile de haut niveau âgé de 20 ans. Celui-ci a pu retourner aux compétitions d'haltérophilie. Chez toute personne active et en santé qui subit une telle

blesure, il y a lieu de procéder promptement à une correction chirurgicale.

Avulsion of the pectoralis major tendon, reputed to be a rare injury,^{1,2} is being reported with increasing frequency in the literature. The current consensus favours primary repair, and most authors have advocated direct suture of the tendon to the humerus. We have recently repaired one such injury with a bone staple and achieved an excellent result. This report describes the anatomy of the muscle, reviews the pertinent literature, documents our method of repair and discusses its potential advantages.

Case Report

A 20-year-old man, a competitive weight lifter, was seen in the emergency department complaining of excruciating pain in the left shoulder. He was performing curls with a 45-kg weight held in the left hand when the injury occurred. He gave no history of musculoskeletal injury and denied using anabolic steroids.

He was a muscular young man in moderate distress, supporting the weight of his internally rotated, adducted left arm. There was a large soft-tissue swelling over the lateral aspect of the upper left side of the chest and deficiency of the anterior axillary fold on the left side as compared with the right (Fig. 1). He was tender over the anterior aspect of the left humerus at the insertion site of the pectoralis major muscle, and there was some ecchymosis under the skin of the left arm laterally. The limb was neurologically intact and there was no evidence of a major vascular injury. Attempts to abduct the arm were extremely painful. A tear of the pectoralis major tendon was diagnosed clinically.

The patient received analgesics and was operated on the following day. Examination under anesthesia revealed that the shoulder joint was intact. We explored the injury through an incision beginning over the site of insertion of the pectoralis major muscle and extending to the left lateral side of the chest. The muscle was identified medially and followed laterally. The tendinous insertion was found lying free, anterior to the humerus in the axillary fold. It had been completely avulsed from the humerus leaving a small area of denuded bone (Fig. 2). With a minimum of dissection it was possible to draw the tendon downward to its point of insertion. Two drill holes were placed in the

humerus and a barbed bone staple was used to attach the tendon.

The arm was maintained in adduction by a Velpo sling for 6 weeks postoperatively and supported with a simple arm sling for a further 6 weeks before active motion was permitted. A full range of movement and muscle strengthening program was then initiated. At 6 months the patient had full range of motion of his shoulder and had resumed weight lifting, using the extremity. At 1 year he had recovered full function and returned to active competition.

Discussion

The pectoralis major muscle comprises two parts. The upper portion extends from the medial end of the clavicle and upper end of the sternum to the lateral lip of the bicipital groove. The inferior half of the muscle arises from the distal end of the sternum, the aponeurosis of



FIG. 1—Preoperative appearance of left shoulder. Note loss of anterior axillary fold and soft-tissue swelling over lateral left side of chest.

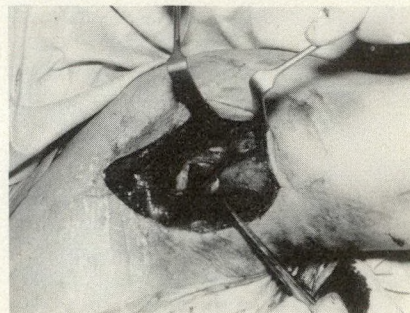


FIG. 2—Site of avulsion of pectoralis major tendon from lateral lip of bicipital groove of humerus.

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the external oblique muscle and the cartilage of the first six ribs. It attaches to the humerus on the superior portion of the lateral lip of the bicipital groove. The tendons of the two parts of the muscle rotate around each other so that the lower portion inserts more proximally on the humerus. The muscle is a powerful adductor, internal rotator and flexor of the shoulder.

Rupture of this muscle was first described by Patissier in 1822. It is considered a rare injury and may be confused with congenital absence of the muscle.¹ A classification of injuries of the pectoralis major muscle, proposed by Tietjen,³ is based on the extent and anatomical location of the tear. Complete rupture can occur at the tendon insertion (as in our patient) within the muscle belly, at the musculotendinous junction or within the tendon itself.

Fifty complete ruptures of the pectoralis major muscle have been reported in the literature to date. We found 24 cases involving athletes; there were 10 weight lifters, 4 football players, 2 hockey players, 1 gymnast, 1 boxer, 1 rodeo rider, 1 rugby player and 1 swimmer.¹⁻¹⁰

The commonest mechanism of injury is sudden muscular contraction. Direct

trauma is the second most common cause. There is general agreement that primary surgical repair is the option of choice for athletes to allow them to regain maximum strength and avoid functional disability.⁶ Controversy exists as to the appropriate management of the injury in nonathletes. Nonoperative expectant therapy provides an acceptable result in most patients when extreme muscular exertion is not required.^{1,2}

Published reports advocating surgical repair recommend suture of the tendon to the humerus.^{1,2,4,5,7-10} When the disruption takes place at this location, we believe the advantages of using a staple are a stronger purchase, reduced dissection and a shorter operating time.

Published reports of surgical repair have noted 80% excellent and 10% good results; nonoperative results are 17% excellent and 58% good.^{1,2} An excellent repair reflects a normal range of movement, no pain or weakness and a good cosmetic result. A good repair denotes a normal range of movement with some pain accompanied by slight weakness or a poor appearance. Our case adds one further excellent result to the literature. In our opinion, surgical exploration and repair is the treatment of choice for this

injury. We do not agree with Delpont and Piper⁷ that surgical repair should be offered only to top athletes.

When the injury involves complete avulsion of the pectoralis major tendon from the humerus and the tendinous portion can be reapproximated to the humerus, we believe a barbed staple provides a simple and secure anchor.

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Free Jejunal Grafts in Pharyngoesophageal Reconstruction

The free jejunal graft with microvascular anastomosis offers the head and neck surgeon a reliable, single-stage method of repair for small cervical defects and also for more extensive pharyngoesophageal defects where one or more loops of jejunum can successfully be used. If microvascular expertise is available, this method of reconstruction offers early alimentary rehabilitation and a physiologic repair.

The free jejunal graft is a reliable method of reconstruction not only after failed gastric pull-up or when that procedure is not feasible, but also, where the facilities exist, as a primary method of pharyngoesophageal reconstruction.

La libre greffe jéjunale avec anastomose microvasculaire offre au chirurgien spécialiste de la tête et du cou, une méthode sûre de la reconstruction directe visant à la fois de petits défauts cervicaux et de plus amples au niveau pharyngoesophagien là où une ou plusieurs boucles du jéjunum peuvent être utilisées avec succès. Ayant accès à l'expertise microvasculaire, cette méthode de reconstruction permet une prompte réadaptation alimentaire ainsi qu'une cicatrisation physiologique.

La libre greffe jéjunale devrait être considérée non seulement comme une solide

méthode de reconstruction qui ne doit pas obligatoirement précéder un échec du réhaussement gastrique, ou encore dans certains cas où le réhaussement n'est pas possible, mais aussi comme une méthode primaire au niveau de la reconstruction pharyngoesophagienne, où il existe des facilités pour effectuer la procédure.

Microvascular anastomosis of free jejunal grafts offers an excellent method of pharyngeal reconstruction. Single-stage reconstruction and the advantage of using tissue with a reliable blood supply makes this method attractive for the head and neck surgeon.

Though first described in 1959 by Seidenberg and Hurwitz,¹ the free jejunal graft has still not come to the forefront of head and neck surgery for various reasons: lack of microvascular expertise, improper patient selection and

occasional poor functional results due to technical problems such as kinking and stricture formation.

Our anatomical study² showed that there is a limit to the extent of the defect that may be bridged by a single loop of jejunum. Appreciation of the geometry of the jejunal anatomy and its vascular supply allows a more exact utilization of free jejunum (Fig. 1).

We review our experience at the Toronto General Hospital between 1984 and 1985, where free jejunal grafts with microvascular reanastomosis were used for pharyngoesophageal reconstruction. A brief comparison of the technique with other modalities follows.

Patients and Method (Table I)

During the study period, eight patients underwent major head and neck resections in which a free jejunal graft was used for reconstruction. The procedures involved the departments of otolaryngology and plastic, general and thoracic surgery. Of the eight patients, six had pharyngeal defects after laryngopharyngectomy, for laryngeal lesions with extension in two and for pharyngeal lesions with extension in four. Three of the four patients with pharyngeal disease had a lesion arising in the piriform fossa with subsequent local extension. The other patient had a recurrent pharyngeal tumour after earlier resection of an oropharyngeal lesion with AO plate and pectoralis major reconstruction. Five of the six patients had received radiotherapy before surgery. One with a primary lesion

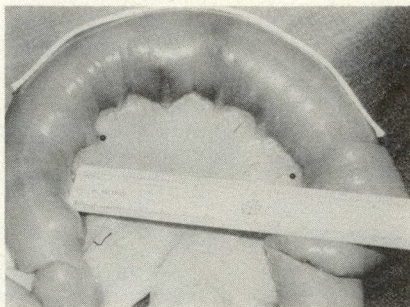


FIG. 1—Single loop of jejunum illustrating difference between specific arc length (antimesenteric border) and equivalent cord length (mesenteric border).

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Table I—Patient Profile

Patient no.	Age, yr	Site of lesion	Previous radiotherapy	No. of segments used	Deglutition
1	49	Pharynx	Yes	1	Yes
2	66	Larynx	Yes	1	No
3	75	Pharynx	Yes	1	Yes
4	62	Pharynx	No	1	Yes
5	66	Pharynx	Yes	1	Yes
6	73	Larynx	Yes	1	Yes
7	27	Esophagus, stomach	No	2	Yes
8	48	Esophagus	No	2	Yes

of the larynx was initially treated by a laryngectomy, but postoperative necrosis and hemorrhage necessitated a single jejunal segment which, when fashioned into a patch graft, successfully closed the anterior pharyngeal defect (Fig. 2).

The other two patients in the series had larger defects (more than 30 cm) that required two segments of jejunum for reconstruction. In the first patient, born with congenital esophageal stricture, carcinoma in situ developed and pharyngoesophagectomy was performed. When both gastric pull-up and colonic interposition failed, free jejunal reconstruction was carried out using two loops of bowel. One was revascularized from vessels in the neck and the other by vessels in the mid-sternal region (internal mammary vessels) (Fig. 3). The second, a young psychiatric patient, suffered extensive corrosive pharyngoesophageal and gastric damage as a result of attempted suicide. Reconstruction required two loops of bowel with two separate vascular pedicles.

Findings

All but one of the patients with cervical defects regained the ability to swallow (Fig. 4). To evaluate each patient's deglutition capacity, a barium swallow x-ray examination was carried out before discharge. The one patient not able to swallow had suffered postoperative necrosis and dehiscence of his irradiated skin flaps with exposure of the (healthy) jejunum. A subsequent pectoralis major flap also failed, exposing the jejunum for a second time. There was vascular thrombosis of the pedicle secondary to infection. Finally, a second pectoralis major flap was successful but he required a permanent feeding jejunostomy.

Minor skin fistulas were the most frequently encountered complication and were treated successfully with conservative management. Serious graft necrosis occurred in only the one patient. The two patients with large defects had good functional results.

Discussion

Numerous methods of reconstruction for pharyngoesophageal defects are available to the head and neck surgeon. The most popular have been regional flap reconstruction, gastric pull-up, colonic interposition and free jejunal grafts. Each method has its advocates, but overall the long-term results in cases of extensive carcinoma of the pharyngoesophagus are poor.³

Regional cervical flaps used by Czerny in the 1870s and Mikulicz in the 1880s were the first method of reconstruction for cervical esophageal defects.³ Cervical cutaneous flaps no longer play a major role in such reconstruction and have been

largely replaced by myocutaneous flaps. The most effective cervical flap was probably the axial deltopectoral skin flap, initially described by Bakamjian in 1965.⁴ The flap could safely be extended laterally past the axillary line if extra length was needed. Its main advantages were the use of nonirradiated tissues and the extra length available. Delay in the latter case increased its reliability. The flap is based inferiorly, thus giving it a dependent, gravity-assisted venous drainage.

Unfortunately, this method of reconstruction requires a two-step approach to close the pharyngostoma. This increases the operative morbidity in patients whose general health is frequently already poor. Once the pharyngostoma is closed, the newly formed tubular lumen is non-peristaltic and therefore nonphysiologic. Moreover, hair-bearing areas may be involved in the tissue transfer. Risk of aspiration after the initial procedure is a problem due to the dependent salivary drainage and its close proximity to the tracheostoma. Finally, overstretching of the flap or placement of the flap over a bony prominence increases the risk of flap necrosis.⁵ Myocutaneous flaps are advantageous because they provide a reliable single-stage procedure, their blood supply is dependable and the flap protects major neck vessels. Unfortunately, the reconstruction is not physiologic and the flap has limited value in extensive reconstruction of pharyngoesophageal defects.

The gastric pull-up continues to be popular after major resection of the pharyngoesophagus.^{6,7} Various modifications of the procedure have been devised to include anastomosis of the gas-

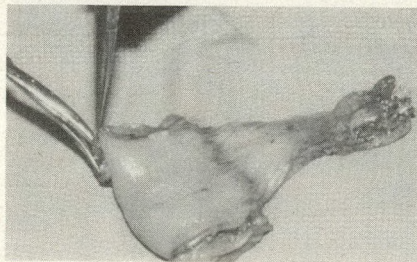


Fig. 2a



Fig. 2b

FIG. 2—Segment of free jejunum to be used as "patch graft". (a) Portion of jejunum opened along antimesenteric border. (b) Segment ready for use as patch graft. Note vascular pedicle on mesenteric border.



Fig. 3a



Fig. 3b

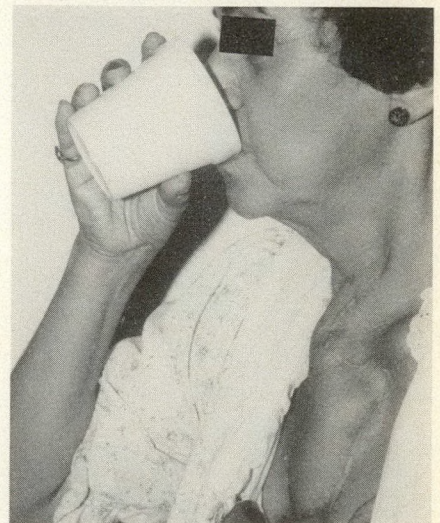


Fig. 3c

FIG. 3—(a) Intraoperative view showing two loops of free jejunum anastomosed in "S" shape for reconstruction following total pharyngoesophagectomy. (b) Patient postoperatively following two-segment reconstruction of pharyngoesophagus. Notice jejunum is placed subcutaneously. (c) Same patient demonstrating deglutition.

tric fundus to the vallecula epiglottica, anastomosis of the greater curvature to the tongue and the reverse gastric tube.⁸ A major advantage of this procedure is the extent of reconstruction possible after extensive pharyngoesophageal resection.

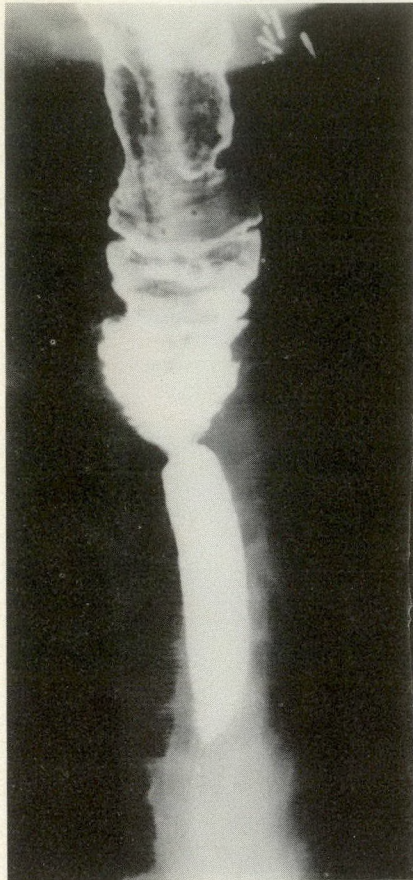


Fig. 4a



Fig. 4b

FIG. 4—Postoperative barium swallow x-ray film. (a) Posteroanterior view. Note peristaltic properties of jejunal segment. (b) Lateral view.

Since the nature of esophageal malignant lesions is frequently multifocal, removal of the complete pharyngoesophagus and periesophageal tissues is frequently required. Gastric pull-up allows a single-stage, single-anastomotic reconstruction of large defects with re-establishment of orogastric continuity. In addition, nonirradiated tissues that are naturally tubular and peristaltic are used. Preservation of the right gastric and gastroepiploic vessels provides a reasonably reliable vascular supply. The gastric pull-up can reach as high as the thyroid if placed in the posterior mediastinum or as high as the cricoid if placed subcutaneously.⁸

The major disadvantage of the procedure is the increased mortality and morbidity associated with laparotomy and entry into the chest cavity, especially in patients whose health is frequently poor to start with. Splenectomy may be necessary when there is difficulty mobilizing the stomach and its vascular supply. Although the vascular supply is well defined, the stomach and its vessels are stretched and the blood supply may become tenuous, resulting in distal tissue necrosis with catastrophic results. Gastrointestinal tract disturbances such as the dumping syndrome and reflux have frequently been reported.^{3,7} The reverse gastric tube, a one-stage procedure like the stomach pull-up, is naturally tubular and has peristaltic properties. The tube can be placed subcutaneously or intrathoracically. Once again, however, a two-team approach is required, and the

increased morbidity and mortality of abdominal, thoracic and cervical surgery remains. Other disadvantages noted in the literature include the disproportion between the pyloric and pharyngeal sites of anastomosis and the risk of necrosis at the reverse tube-fundus junction, secondary to vascular compromise.³

Finally, gastric pull-up and the reverse gastric tube are frequently contraindicated when gastric surgery has been performed previously.

Interposition of a segment of colon either as a left- or right-based pedicle can be used to reconstruct large pharyngoesophageal defects and is not contraindicated by previous gastric surgery. Mesenteric angiography done preoperatively can help identify well-vascularized colon.⁹ The segment of colon and its vascular pedicle can be tunneled either subcutaneously or intrathoracically, although subcutaneous placement of the wide colonic segment often results in a visible, dilated colonic segment and unsightly peristaltic activity postprandially.

As with the gastric pull-up, the colonic tissues are not irradiated and the procedure is done in a single stage. There is, however, a higher rate of failure due to infection and fistula formation at the sites of the three anastomoses. The vascular supply of the colonic segment is also stretched and may become tenuous, with subsequent distal tissue necrosis.

Overall, the literature points to a higher rate of morbidity and mortality when colon interposition is used in pharyngoesophageal reconstruction.^{3,10}

As mentioned earlier, the first free jejunal graft with microvascular reanastomosis was performed in 1959.¹ The operative procedure itself has been well described by various authors^{11,12} and only the essentials will be mentioned here. The basis of the free jejunal graft is the harvesting of a segment of jejunum, preserving its vascular arcade through the mesentery. The donor-segment vein and artery are then anastomosed to the recipient vessels once the tumour and its surrounding tissues have been adequately removed. Usually, the superior thyroid, facial or lingual vessels are used at the recipient site because of vessel size and easy accessibility. In cases in which two segments of jejunum are required in the repair, the transverse cervical or suprascapular arteries may be used for the upper segment. Measurement of tissue oxygen concentration is recommended to allow the surgeon to monitor the tissue transfer. Postoperatively, a temporary gastrostomy is required to ensure satisfactory nutrition.

We have found from our previous work (Fig. 5) that beyond 20 cm of "arc length" (i.e., length of bowel measured antimesenterically between proximal and

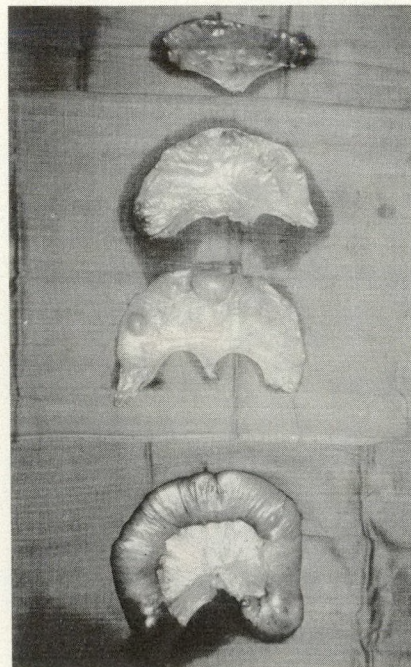


FIG. 5—Four segments of small intestine measuring 10, 20, 30 and 40 cm respectively. Note law of diminishing returns. Increasing arc length produces progressively less increase in cord length.

distal ends of the segment) there is very little increase in usable "cord length" (i.e., absolute length of bowel segment between proximal and distal ends) and we believe that 20 cm is the maximum length of defect that can be bridged with a single loop of jejunum.

The free jejunal graft offers a number of advantages over other methods of reconstruction. It is a single-stage procedure, with two teams working simultaneously, one harvesting the jejunal segment while the other resects the lesion; in our experience, the operative time closely approximates that for gastric pull-up. The operation is extrathoracic, decreasing the risks of complications such as mediastinitis. Graft failure secondary to vessel thrombosis at the site of anastomosis is less of a problem than when other viscera are used since there is plenty of bowel left from which to harvest another segment. The vascular anastomosis provides the graft with a new non-tenuous blood supply, thus reducing the risk of tissue necrosis and contributing to more rapid tissue healing. Since the jejunum is naturally tubular and has peristaltic activity, the reconstruction is physiologic, allowing early alimentary rehabilitation. Gastrointestinal disturbances such as the dumping syndrome and reflux are not a problem postoperatively. The tissues themselves are not irradiated.

Subtotal defects such as those of the anterior pharynx can easily be repaired by fashioning the jejunal segment into a patch graft opened along the antimesenteric border, thus preserving the vascular supply (Fig. 2). Finally, as was mentioned earlier, utilization of two segments of jejunum, each with its own vascular pedicle, anastomosed to each other in an "S" shape can be used successfully to bridge large defects with minimal tissue redundancy. For technical reasons, such a reconstruction is performed subcutaneously.

Unfortunately, not all surgical centres have access to the microvascular expertise required for jejunal free grafts and this limits their use. As in the other procedures discussed, there is still need for laparotomy which is a potential cause for increased morbidity and mortality. Anastomotic leaks and fistula formation intra-abdominally can occur, but it should be noted that small-bowel anastomoses have a much lower complication rate than those involving the large bowel. Perhaps the greatest disadvantage of this technique is the "all or none" aspect of the vascular anastomosis. Thrombosis of the arterial or venous supply will inevitably lead to graft failure and further surgery. Excessive mucous production by the jejunal mucosa has been a problem in some patients but

usually is not severe enough to compromise effective function. Finally, in view of the possibility of multifocal disease, patients who undergo short-segment replacement should be followed up closely by esophagoscopy.

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Remodelling in Slipped Capital Femoral Epiphysis

In-situ pinning of a slipped capital femoral epiphysis is the most common form of treatment for this problem. To find out if remodelling of the upper femur after pinning occurs often enough to justify this form of treatment and whether secondary osteotomies are required for residual deformity, 82 patients with slipped capital femoral epiphyses were reviewed. X-ray films were studied sequentially, noting remodelling changes in the femoral head and neck. Sixty-eight percent of moderate to severe slips that could be properly assessed showed signs of remodelling. The authors recognized two distinct remodelling processes — one, occurring early, affected the neck adjacent to the growth plate, the second appeared later, more distally along the femoral neck. Very few osteotomies were done for residual deformity.

Pinning in situ of a slipped capital femoral epiphysis represents a simple, rapid and effective method of treatment, allowing remodelling even in more severe slips.

Le traitement préféré d'un glissement épiphysaire du fémur proximal demeure toujours l'embrochage in situ. Pour déterminer si le remodelage du fémur proximal après embrochage est suffisant pour justifier cette forme de traitement et si des ostéotomies secondaires sont nécessaires pour déformation résiduelle, 82 patients forment la base de cette étude. Les radiographies ont été révisées notant le remodelage de la tête et le col fémoral. Soixante-huit pourcent des patients avec glissement moyen ou sévère où une évaluation complète était possible démontrait bons signes de remodelage. Deux processus ont été

identifiés — le premier, visible tôt, au niveau du col tout près de la plaque épiphysaire, le deuxième, plus tard, sur le col fémoral plus distal. Des ostéotomies secondaires pour déformation résiduelle étaient rarement nécessaires.

L'embrochage d'un glissement épiphysaire demeure une technique simple, rapide et effective, qui permet le remodelage chez les glissements même sévères.

Remodelling of the upper end of the femur after slipping of the capital epiphysis has been adequately described. Key¹ in 1926 described progressive changes in the proximal femur after slipping. Forrester-Brown² in 1941 wrote of the "interesting and progressive reconstruction of the upper end of the femur" with increased bony apposition in the calcar area and resorption in the non-weight-bearing area. Howorth³ noted rapidly formed callus in the angle between the head and neck inferiorly and posteriorly. Howorth⁴ in 1951 wrote of the residual varus deformity with flattening of the superior contour. In 1977, O'Brien and

Fahey⁵ described the remodelling process in 12 patients with moderate slipping (less than 60°).

Does sufficient remodelling of the upper femur after in-situ pinning of a slipped epiphysis occur often enough to

Table I—Degree of Slipping in 82 Patients

Type of slipping	No. of hips
Pre-slip	16
Mild	56
Moderate	21
Severe	23

Table II—Treatment

Type of treatment	No. of hips
Smith-Petersen nailing	3
Epiphysodesis	5
Femoral osteotomy	4
Hip spica	10
Pinning	
Moore	20
Knowles	7
Steinmann	49
Hagie	17
Unknown	1

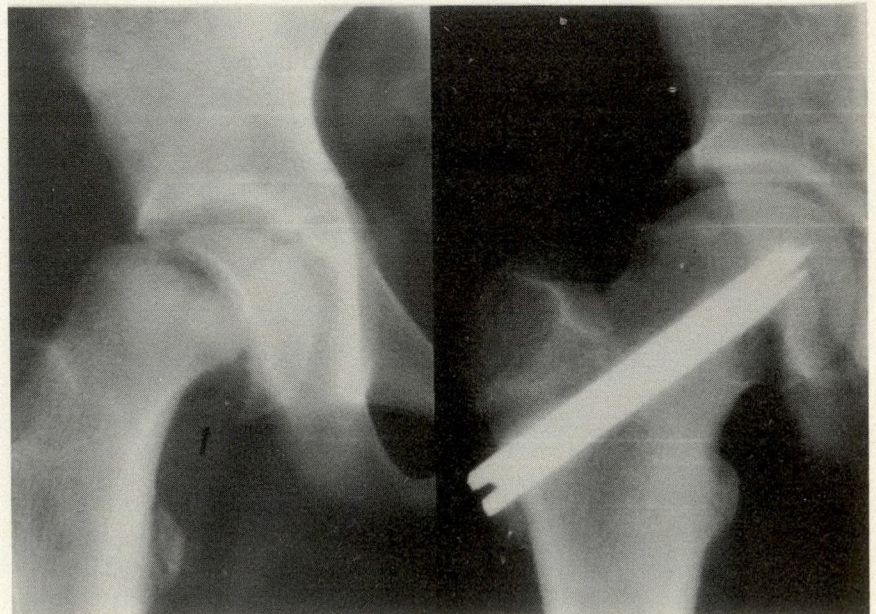


FIG. 1—Changes at head-neck junction.

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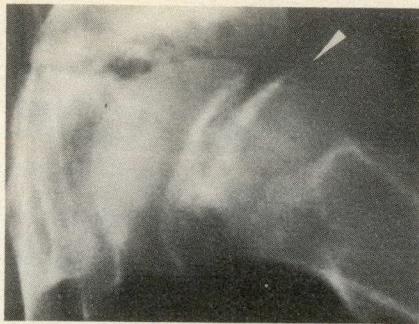


Fig. 2a

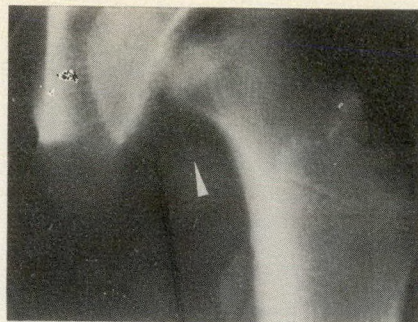


Fig. 3a

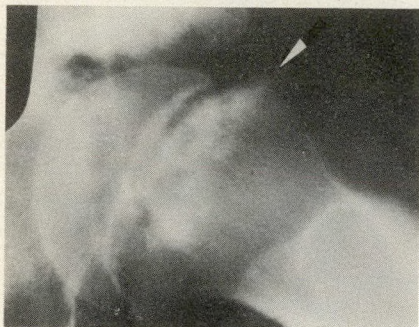


Fig. 2b

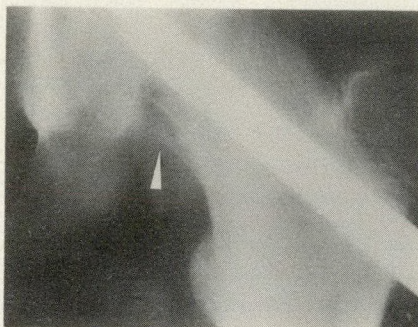


Fig. 3b

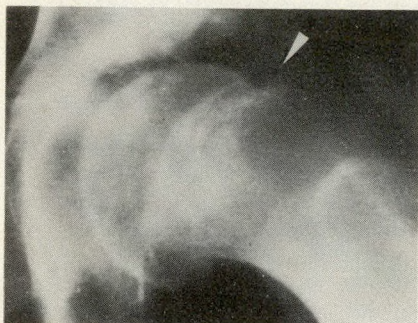


Fig. 2c

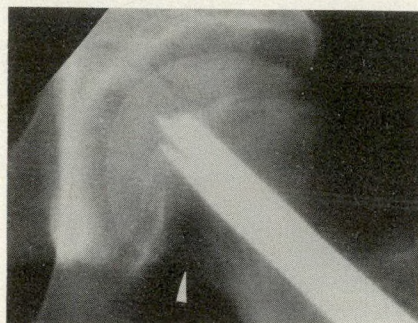


Fig. 3c

FIG. 2—Gradual resorption of superior neck.

FIG. 3—Inferior neck fills with bone.

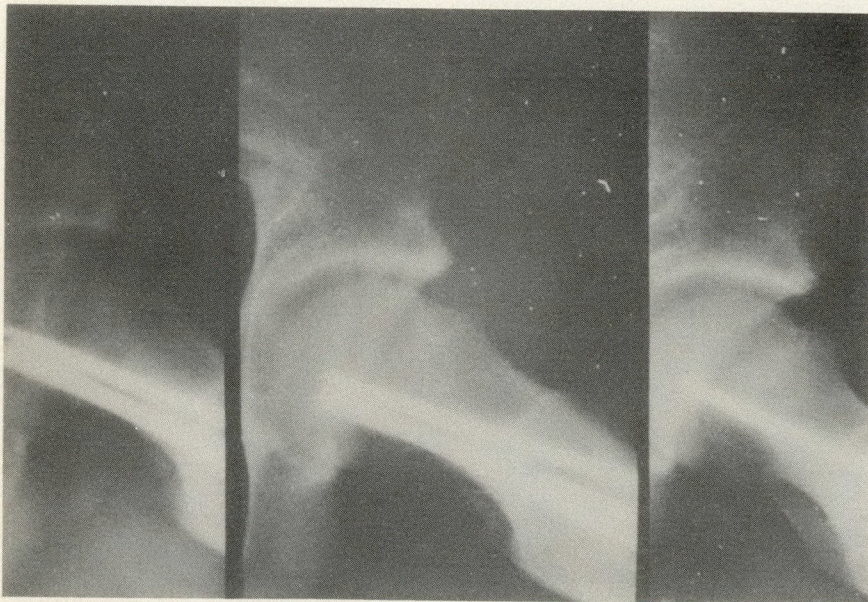


FIG. 4—Erosion of neck and "chronic bump".

justify this form of treatment? Are secondary osteotomies for residual deformity frequently required?

This study was designed to answer these questions.

Patients and Methods

The details of 82 patients (51 males, 31 females) who underwent in-situ pinning of a slipped capital femoral epiphysis, over a 30-year period, were reviewed.

Features of the disease that were noted included: race, body habitus, age, duration of symptoms, preoperative range of motion, history of trauma. X-ray films were graded according to severity and slip angle (O'Brien and Fahey). The types of internal fixation were listed. Postoperative range of movement and residual deformities were analysed.

Findings

Of the 82 patients, 54 were white and 28 black; 57 patients were obese. The average age at presentation was 13 years (range from 9 years 11 months to 18 years 5 months). The average duration of symptoms was 6.6 months (range from 1 day to 3 years). The types of slipping are shown in Table I. The slipped epiphyses were related to trauma in 24 hips. The follow-up ranged from 6 months to 28 years (average 7.8 years). Thirty slips were right-sided, 18 left-sided and 34 were bilateral (116 hips). Table II outlines the types of treatment. Three patients underwent primary osteotomy (four hips).

The remodelling response of the 44 hips with moderate to severe slipping was analysed. The remodelling process could not be studied in 16 because of surgery (6), complications (7) (avascular necrosis, chondrolysis) or poor follow-up (3). Of the remainder, 19 (67.8%) of 28 showed definite signs of remodelling; the others did not.

Discussion

Remodelling of the upper femur after a slipped capital femoral epiphysis is the rule, but the extent of the process is difficult to standardize radiologically.

Changes occur simultaneously at the superior and inferior aspects of the head-neck junction (Fig. 1). Even in the mild slips, the superior and anterior neck become prominent as the head slips posteriorly or inferiorly. What happens to this prominent surface? According to most authors,⁶⁻⁸ the anterosuperior portion of the neck is resorbed, a phenomenon explained by osteoclastic resorption of a surface not exposed to stress — an application of Wolff's law. Note the gradual resorption of the superior neck in Fig. 2. While the superior aspect of the neck is being resorbed, the inferior aspect

fills in with bone, bridging the void created inferiorly (Fig. 3). After the neck prominence has disappeared another change often takes place — a bony process or “chronic bump” appears in a position slightly lateral to the original neck prominence. The area of the head-neck junction, several months after the slip, appears to be eroded by the lateral corner of the acetabulum (Fig. 4). At the outset, a roughening of the superior neck area is evident on the frog-leg view. As time passes, the roughened area is replaced by an indentation of the bone and concurrently, a bony prominence is noted distal to the indentation. This process is noted even in mild slips.

Our study confirms that a high percentage of severe slips remodel extensively, as observed by O'Brien and Fahey.⁵

Ninety-three of the 116 hips were

treated by some form of pinning (Table II). In view of the remodelling potential, this seems to be the most acceptable way of treating a slipped capital femoral epiphysis whether mild or severe. Osteotomy in the intertrochanteric area should likely be reserved for residual deformity. In our study, this was done in only four cases.

Conclusions

Substantial remodelling of the upper end of the femur takes place with a slipped capital femoral epiphysis in moderate to severe cases. The form of treatment proposed should take into consideration the remodelling phenomenon. Simple pinning in situ of a slipped capital femoral epiphysis represents a rapid and effective method of treatment.

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Predicting Failure in Polytetrafluoroethylene Vascular Access Grafts for Hemodialysis: a Pilot Study

In order to determine if serial, noninvasive evaluation of polytetrafluoroethylene (PTFE) vascular access grafts could identify a subgroup of patients at risk for thrombosis, the authors studied flow characteristics, using duplex ultrasonic scanning, in 18 hemodialysis patients with forearm loop grafts. On average, five examinations were performed per patient over the 10-month study period. Seven episodes of thrombosis occurred in six patients. The mean Doppler flow in grafts that subsequently thrombosed was significantly lower than in those that did not (544 ± 218 ml/min versus 843 ± 391 ml/min, $p < 0.001$). The interval from last examination to thrombosis ranged from 13 to 58 days. At a defined cut-off flow of 450 ml/min, this

test yielded a sensitivity of 83% and a specificity of 75% for episodes of thrombosis occurring within 2 to 6 weeks. The authors conclude that episodes of thrombosis in PTFE arm loop grafts are usually preceded by significantly lower Doppler-measured flow than grafts that do not thrombose and that it may be possible, by this means, to identify grafts at risk.

Dans le but de déterminer si des évaluations non sanglantes sériées des greffons vasculaires de polytétrafluoroéthylène (PTFE) permettraient d'identifier un sous-groupe de patients sujets aux thromboses, les auteurs ont étudié par échographie bidimensionnelle les caractéristiques circulatoires de 18 patients d'hémodialyse porteurs d'une telle greffe sur l'avant-bras. Au cours des 10 mois qu'a duré l'étude, cinq examens ont été faits, en moyenne, par patient. Sept épisodes thrombotiques sont survenus chez six patients. Le débit moyen dans les greffons qui se sont par la suite thrombosés était significativement plus faible que dans ceux qui sont demeurés perméables (544 ± 218 ml/min contre 843 ± 391 ml/min, $p < 0.001$). L'intervalle écoulé entre le dernier examen et l'accident thrombotique a varié de 13 à 58 jours. En utilisant un débit limite de 450 ml/min, ce test a donné une sensibilité de 83% et une spécificité de 75% pour les épisodes thrombotiques qui sont survenus dans les 2 à 6 se-

maines suivantes. Les auteurs concluent que les accidents thrombotiques dans les anses de PTFE greffées sur le bras sont généralement précédés d'une baisse significative du débit mesuré à l'appareil Doppler, par rapport aux greffons qui ne thrombosent pas, et qu'il peut être possible d'identifier de la sorte les greffons menacés.

The failure of vascular access through thrombosis is a major limiting factor in the success of long-term hemodialysis and this has been apparent since the introduction of the technique.¹ Despite reported cumulative 3-year patency rates of 60% to 80% for both endogenous arteriovenous fistulas and expanded polytetrafluoroethylene (PTFE) graft prostheses,²⁻¹¹ episodes of thrombosis are frequent. In PTFE grafts, the principal identifiable anatomic defect present in thrombosed grafts is stenosis of the vein proximal to or at the anastomosis,^{10,12,13} secondary to neointimal hyperplasia. Most such conduits can be salvaged by simple Fogarty thrombectomy with or without patch angioplasty or placement of a jump graft.^{6,11}

While impending graft thrombosis may be heralded by rising venous pressure and poor flow characteristics on dialysis, prompting intervention, many such episodes occur without warning. Reconstitution of a patent access must often be performed on a semi-urgent basis and

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temporary vascular access often provided to allow preoperative dialysis.

The ability to predict imminent graft failure more accurately would allow elective as opposed to emergency revision in a greater number of cases. Thus, we undertook a prospective study of flow characteristics in PTFE vascular access grafts by a simple noninvasive method to see if we could identify a group at risk for episodes of thrombosis.

Methods

From July 1984 to May 1985 we studied 18 patients with end-stage renal disease receiving maintenance hemodialysis through PTFE arm loop grafts. The patients were unselected except for their willingness to participate, after informed consent. No consideration was given to the age of the graft, flow or pressure problems on dialysis, or history of previous thrombosis. Eighty-three studies were performed with an average of 4.6 per patient (range from 3 to 8).

Sonographic evaluation was done using commercially available duplex scanning equipment (Model DF400; Diasonics Corp., Milpitas, Calif.) incorporating B-

mode imaging with Doppler flow analysis (Fig. 1). Velocity rates were determined from the spectral analysis of flow at six sites on the graft from the arterial to the venous end. The flow volume was determined by measuring the diameter of the graft at each site and the time-averaged velocity for three cardiac cycles. The flow volume from the six sites was averaged for a single result of each examination. Episodes of graft thrombosis were determined subsequently by review of patient and operative records. Statistical significance was ascertained using Student's *t*-test.

Results

Recorded flow rates ranged from 190 to 1800 ml/min. Six of the 18 patients suffered a total of seven episodes of graft thrombosis over 10 months (incidence 39%). The mean flow rate for 21 studies in the 6 patients who suffered graft thrombosis was 544 ± 218 ml/min whereas the mean of 62 examinations in the 12 patients with no episode of thrombosis was 843 ± 391 ml/min (*p* < 0.001) (Fig. 2). The mean of flow rates in the last examination preceding the episode of

thrombosis in the six patients was 417 ± 144 ml/min (*p* < 0.001) (Fig. 3). The interval from the last examination to the episode of graft thrombosis ranged from 13 to 58 days.

Five (63%) of eight patients who had one or more flow rates less than or equal to 450 ml/min subsequently had a total of six episodes of thrombosis within 13 to 37 days. In contrast, only 1 of 10 patients whose values were always greater than 450 ml/min suffered such an episode, and this was in a patient who was not examined sonographically within 58 days before the thrombosis (Table I).

With a positive study defined as flow less than or equal to 450 ml/min and a negative study as flow greater than 450 ml/min, this test yielded a sensitivity of 83%, a specificity of 75%, a positive predictive value of 63% and a negative predictive value of 90% for episodes of thrombosis occurring within 2 to 6 weeks.

No statistically significant differences were noted in peak systolic velocities or in regression analyses of rates of change of flow over time.

Although anatomic defects were not systematically looked for in this phase of the study, two of the six patients who had thrombosis had potentially correctable

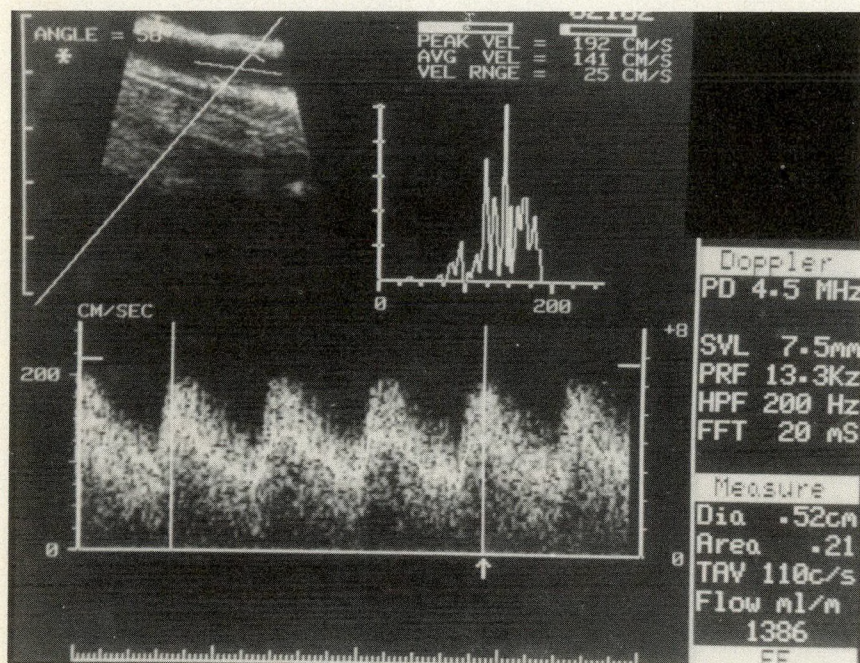


FIG. 1—Typical duplex sonographic display of polytetrafluoroethylene (PTFE) graft showing B-mode image with cursor (upper left), Doppler velocity histogram (upper right), Doppler velocity spectrum (bottom) and derived numerical output (lower right).

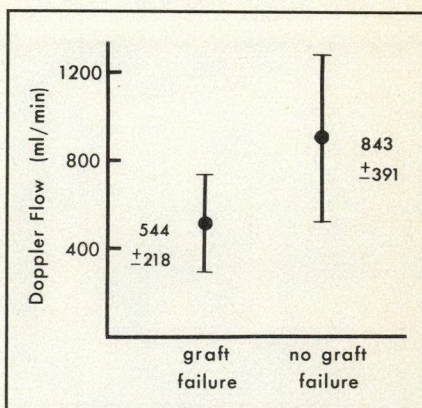


FIG. 2—Mean of all Doppler-measured flows in grafts that thrombosed (left) versus those that did not (right).

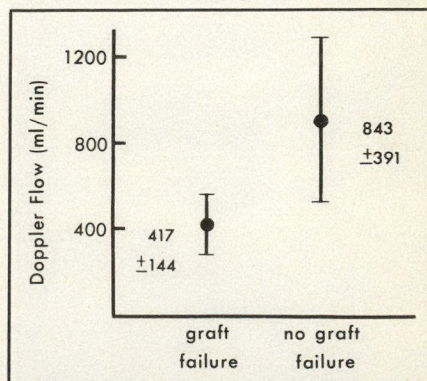


FIG. 3—Mean of Doppler-measured flows from study immediately preceding event in grafts that thrombosed (left) versus mean of all Doppler-measured flows in grafts that did not thrombose (right).

Table I—Relation of Doppler Flow Rates to Thrombosis

	No. of patients	Thrombosis	No thrombosis	Interval from last examination to thrombosis, d
Any Doppler flow rate ≤ 450 ml/min	8	5	3	13 - 42
Doppler flow rates always > 450 ml/min	10	1	9	58

anatomic defects — a pseudoaneurysm in one (Fig. 4) and marked neointimal irregularities in the other (Fig. 5) — noted on the B-mode imaging portion of the scan.

Discussion

The major problem with PTFE grafts for hemodialysis is thrombosis. Decreasing flow and increasing venous pressure on hemodialysis may signal imminent thrombosis, but these findings are not sufficiently predictive. Suspect grafts may be studied by contrast fistulography and electively revised if remedial abnormalities are identified. However, the usual procedure is to await an episode of thrombosis before undertaking revision. When thrombosis does occur, patency can usually be restored but this must be done on a semi-urgent basis and temporary vascular access may have to be established for preoperative dialysis.

In this study, we attempted to analyse the value of routine duplex sonographic evaluation of flow. Despite the small numbers of patients, these preliminary findings suggest that those patients with a Doppler flow rate below 450 ml/min run a high risk of subsequent thrombosis. Conversely, those grafts with a high

flow rate do not appear to be in imminent jeopardy. In this series, the only patient who had thrombosis and a high flow rate did not return for scheduled duplex sonographic examination within 58 days before his episode of thrombosis. It is possible that, in this patient, the flow had decreased markedly in the interval.

Similar results have been reported by Rittgers and colleagues¹⁴ who, using Doppler analysis alone, noted significantly lower flow rates — 307 ml/min versus 849 ml/min — in patients who had thrombosis within 2 weeks as compared with those who did not. In another study, O'Regan and colleagues¹⁵ noted an increased risk of thrombosis in PTFE forearm grafts with flows under 500 ml/min.

In our technique, the addition of the B-mode imaging portion of the duplex scan can detect anatomic defects including stenoses, intimal thickening and pseudoaneurysms. The identification of these abnormalities may preclude the need for angiography in the majority of cases.

If further evaluation on larger numbers of patients confirms the results of our flow analysis, we suggest that routine duplex examination may help detect patients at risk for thrombosis and allow more elective timing of graft revision.

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INDICATIONS AND CLINICAL USES

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- Gynecological infections such as endometritis and pelvic cellulitis
- Septicemia
- Urinary tract infections (including those caused by *Serratia marcescens* and *Serratia* spp.)
- Lower respiratory tract infections
- Bone and joint infections caused by *Staphylococcus aureus*
- Soft tissue infections such as cellulitis, abscesses and wound infections

Appropriate culture and susceptibility studies should be performed to determine the susceptibility of the causative organism(s) to MEFOXIN[®]. Therapy may be started while awaiting the results of these tests, however, modification of the treatment may be required once these results become available.

Organisms particularly appropriate for therapy with MEFOXIN[®] are:

Gram positive

Staphylococci, penicillinase producing and non-producing
Streptococci excluding enterococci

Gram negative (beta-lactamase producing and non-producing strains)

E. coli
Klebsiella species (including *K. pneumoniae*)
Proteus, indole positive and negative
Haemophilus influenzae
Providencia species

Anaerobes

Bacteroides fragilis

MEFOXIN[®] may also be appropriate for the treatment of infections involving susceptible strains of both aerobic and anaerobic bacteria.

Clinical experience has demonstrated that MEFOXIN[®] can be administered to patients who are also receiving carbenicillin, gentamicin, tobramycin, or amikacin (see PRECAUTIONS and ADMINISTRATION).

Intravenous Administration

The intravenous route is preferable for patients with bacteremia, bacterial septicemia, or other severe or life-threatening infections, or for patients who may be poor risks because of lowered resistance resulting from such debilitating conditions as malnutrition, trauma, surgery, diabetes, heart failure, or malignancy, particularly if shock is present or impending.

PROPHYLACTIC USE

MEFOXIN[®] may be administered perioperatively (preoperatively, intraoperatively and postoperatively) to patients undergoing vaginal or abdominal hysterectomy and abdominal surgery when there is a significant risk of postoperative infection or where the occurrence of postoperative infection is considered to be especially serious.

In patients undergoing cesarean section, intraoperative (after clamping the umbilical cord) and postoperative use of MEFOXIN[®] may reduce the incidence of surgery related postoperative infections.

Effective prophylactic use depends on the time of administration. MEFOXIN[®] usually should be given one-half to one hour before

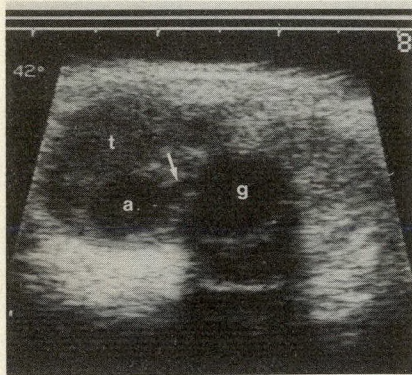


FIG. 4—Transverse B-mode image of PTFE graft (g) demonstrating pseudoaneurysm (a) with circumferential thrombus (t) and communicating channel (arrow).

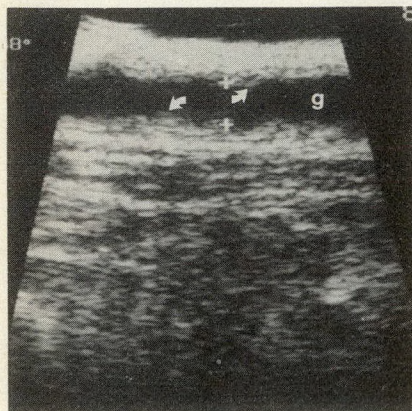


FIG. 5—Longitudinal B-mode image of PTFE graft (g) demonstrating marked neointimal irregularities (arrows).

the operation. Prophylactic administration should usually be stopped within 12 hours. It has been generally reported that continuing administration of any antibiotic beyond 24 hours following surgery increases the possibility of adverse reactions but, in the majority of surgical procedures, does not reduce the incidence of subsequent infection.

If signs of postsurgical infection should appear, specimens for culture should be obtained for identification of the causative organism(s) so that appropriate therapy may be instituted.

CONTRAINDICATIONS

MEFOXIN* is contraindicated in persons who have shown hypersensitivity to cefoxitin or to the cephalosporin group of antibiotics.

WARNINGS

Before therapy with MEFOXIN* is instituted, careful inquiry should be made to determine whether the patient has had previous hypersensitivity reactions to MEFOXIN*, cephalosporins, penicillins or other drugs. MEFOXIN* should be given with caution to penicillin-sensitive patients.

There is some clinical and laboratory evidence of partial cross-allergenicity between cephamycins and the other beta-lactam antibiotics, penicillins and cephalosporins. Severe reactions (including anaphylaxis) have been reported with most beta-lactam antibiotics.

Pseudomembranous colitis has been reported with virtually all antibiotics. This colitis can range from mild to life threatening in severity. Antibiotics should therefore be prescribed with caution in individuals with a history of gastrointestinal disease, particularly colitis. It is important to consider a diagnosis of pseudomembranous colitis in patients who develop diarrhea in association with antibiotic use. While studies indicate that a toxin produced by *Clostridium difficile* is one primary cause of antibiotic-associated colitis, other causes should also be considered.

Any patient who has demonstrated some form of allergy, particularly to drugs, should receive antibiotics including MEFOXIN* with caution.

If an allergic reaction to MEFOXIN* occurs, administration of the drug should be discontinued. Serious hypersensitivity reactions may require treatment with epinephrine and other emergency measures.

PRECAUTIONS

The total daily dosage should be reduced when MEFOXIN* is administered to patients with transient or persistent reduction of urinary output due to renal insufficiency (see DOSAGE AND ADMINISTRATION) because high and prolonged serum antibiotic concentrations can occur from usual doses.

In patients treated with MEFOXIN* a false-positive reaction to glucose in the urine may occur with Benedict's or Fehling's solutions but not with the use of specific glucose oxidase methods.

Using the Jaffe Method, falsely high creatinine values in serum may occur if serum concentrations of cefoxitin exceed 100 µg/mL. Serum samples from patients treated with MEFOXIN* should not be analyzed for creatinine if withdrawn within two hours of drug administration.

Increased nephrotoxicity has been reported following concomitant administration of cephalosporins and aminoglycoside antibiotics.

The safety of MEFOXIN* in the treatment of infections during pregnancy has not been established. If the administration of MEFOXIN* to pregnant patients is considered necessary, its use requires that the anticipated benefits be weighed against possible hazards to the fetus. Reproductive and teratogenic studies have been performed in mice and rats and have revealed no evidence of impaired fertility or harm to the fetus due to MEFOXIN*.

Cefoxitin has been observed in the milk of nursing mothers receiving the drug.

Prolonged use of MEFOXIN* may result in the overgrowth of non-susceptible organisms. Repeated evaluation of the patient's condition is essential and if superinfection occurs during therapy, appropriate measures should be taken. Should an organism become resistant during antibiotic therapy, another antibiotic should be substituted.

In children 3 months of age or older, higher doses of MEFOXIN* (100 mg/kg/day and above) have been associated with an increased incidence of eosinophilia and elevated SGOT.

ADVERSE REACTIONS

MEFOXIN* is generally well tolerated. Adverse reactions rarely required cessation of treatment and usually have been mild and transient.

Local Reactions

Thrombophlebitis has occurred with intravenous administration. Some degree of pain and tenderness is usually experienced after intramuscular injections using water. Induration has occasionally been reported.

Allergic

Maculopapular rash, urticaria, pruritus, eosinophilia, fever and other allergic reactions have been noted.

Gastrointestinal

Symptoms of pseudomembranous colitis can appear during or after antibiotic treatment. Nausea and vomiting have been reported rarely.

Blood

Transient eosinophilia, leukopenia, neutropenia, hemolytic anemia, and thrombocytopenia have been reported. Some individuals, particularly those with azotemia, may develop positive direct Coombs tests during therapy with MEFOXIN*.

Liver Function

Transient elevations in SGOT, SGPT, serum LDH, and serum alkaline phosphatase have been reported.

Kidney

Elevations in serum creatinine and/or blood urea nitrogen levels have been observed. As with the cephalosporins, acute renal failure has been reported rarely. The role of MEFOXIN* in changes in renal function tests is difficult to assess, since factors predisposing to pre-renal azotemia or to impaired renal function have often been present.

TREATMENT OF OVERDOSE

Other than general supportive treatment, no specific antidote is known. MEFOXIN* can be eliminated by dialysis in patients with renal insufficiency.

DOSAGE AND ADMINISTRATION

MEFOXIN* may be administered intravenously or intramuscularly when required. (See complete monograph on ADMINISTRATION and RECONSTITUTION.)

TREATMENT DOSAGE

Adults

The usual adult dosage is 1 g or 2 g of MEFOXIN* every 6 to 8 hours. Dosage and route of administration should be determined by severity of infection, susceptibility of the causative organisms, and condition of the patient. The usual adult dosages are shown in the Table below.

Usual Adult Dosage

Type of infection	Daily Dosage	Frequency and Route
Uncomplicated forms* of infections such as pneumonia, urinary tract infection, soft tissue infection	3-4 g	1 g every 6-8 h I.V. or I.M.
Moderately severe or severe infections	6-8 g	1 g every 4 h or 2 g every 6-8 h I.V.
Infections commonly needing anti-biotics in higher dosage (e.g. gas gangrene)	12 g	2 g every 4 h or 3 g every 6 h I.V.

*Including patients in whom bacteremia is absent or unlikely

Therapy may be started while awaiting the results of susceptibility testing.

Antibiotic therapy for group A beta-hemolytic streptococcal infections should be maintained for at least 10 days to guard against the risk of rheumatic fever or glomerulonephritis. In staphylococcal and other infections involving a collection of pus, surgical drainage should be carried out where indicated.

Adults with Impaired Renal Function

MEFOXIN* may be used in patients with reduced renal function but a reduced dosage should be employed and it is advisable to monitor serum levels in patients with severe impairment.

In adults with renal insufficiency, an initial loading dose of 1 g to 2 g should be given. After a loading dose, the following recommendations for maintenance dosage may be used as a guide:

RENAL FUNCTION	CREATININE CLEARANCE mL/min	DOSE	FREQUENCY
Mild impairment	50-30	1-2 g	every 8-12 h
Moderate impairment	29-10	1-2 g	every 12-24 h
Severe impairment	9-5	0.5-1 g	every 12-24 h
Essentially no function	<5	0.5-1 g	every 24-48 h

In the patient undergoing hemodialysis, the loading dose of 1-2 g should be given after each hemodialysis, and the maintenance dose should be given as indicated in the Table above.

Neonates (Including Premature Infants), Infants and Children (See WARNINGS for Neonates under ADMINISTRATION in the complete monograph.)

Premature Infants with Body Weights Above 1500 g	20-40 mg/kg every 12 h I.V.
Neonates	
0-1 week of age	20-40 mg/kg every 12 h I.V.
1-4 weeks of age	20-40 mg/kg every 8 h I.V.
Infants	
1 month to 2 years of age	20-40 mg/kg every 6 h or every 8 h I.M. or I.V.
Children	20-40 mg/kg every 6 h or every 8 h I.M. or I.V.

In severe infections, the total daily dosage in infants and children may be increased to 200 mg/kg, but not to exceed 12 g per day.

MEFOXIN* is not recommended for the therapy of meningitis. If meningitis is suspected, an appropriate antibiotic should be used.

At present there is insufficient data to recommend a specific dosage for children with impaired renal function. However, if the administration of MEFOXIN* is deemed to be essential the dosage should be modified consistent with the recommendations for adults (see Table above).

PROPHYLACTIC USE

For prophylactic use, a three-dose regimen of MEFOXIN* is recommended as follows:

Vaginal or abdominal hysterectomy and abdominal surgery

2 g administered intramuscularly or intravenously just prior to surgery (approximately one-half to one hour before initial incision).

The second and third 2 g doses should be administered at 2-6 hour intervals after the initial dose.

Cesarean Section

The first dose of 2 g should be administered intravenously as soon as the umbilical cord has been clamped. The second and third 2 g doses should be given intravenously or intramuscularly four hours and eight hours after the first dose.

AVAILABILITY

MEFOXIN* is supplied as sterile powder in boxes of 10 vials:

3356 Ca - 1 g cefoxitin as sodium salt
3357 Ca - 2 g cefoxitin as sodium salt

Storage

MEFOXIN* in the dry state should be stored below 30°C.

PRODUCT MONOGRAPH AVAILABLE ON REQUEST

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(425-a,6,87)



A Single Treadmill Exercise Test Does Not Accurately Quantitate Claudication

The diagnosis of vascular occlusive disease is confirmed by documenting a fall in the ankle-brachial pressure index following a treadmill exercise test. The authors hypothesize that this test does not provide a reproducible quantitative assessment of the patient's disability due to the disease. In 25 patients a series of five treadmill exercise tests were performed on the same day. There was a significant ($p < 0.05$) increase in the time to the occurrence of claudication when tests 3, 4 and 5 were compared with test 1. There was also a significant ($p < 0.05$) rise in the maximum time walked comparing test 3 with test 1. There was no difference in the fall in ankle-brachial pressure index with each test. The majority of patients had achieved their maximum walking distance by test no. 3.

It is concluded that a single treadmill exercise test will not accurately assess disability due to intermittent claudication and it is recommended that three tests be performed for a reproducible evaluation.

On confirme le diagnostic de maladie vasculaire occlusive en vérifiant la chute de l'index tensionnel cheville-bras après un test d'effort. Les auteurs émettent l'hypothèse que ce test ne permet pas d'obtenir une évaluation quantitative reproductible de l'incapacité du malade causée par la maladie. On a fait subir à

25 patients une série de cinq épreuves d'effort effectuées la même journée. On a observé un allongement significatif ($p < 0.05$) du temps nécessaire à l'apparition d'une claudication lors des tests 3, 4 et 5 par rapport au premier test. On a aussi constaté entre le test 3 et le test 1 une augmentation significative ($p < 0.05$) du temps maximum de marche. Aucune différence de la baisse de l'index tensionnel cheville-bras n'a été notée entre les épreuves. La majorité des patients avait atteint sa distance de marche maximum à la troisième épreuve.

On en conclut qu'un seul test d'effort ne permet pas d'évaluer avec précision l'incapacité due à la claudication intermittente et on recommande de faire effectuer trois épreuves pour obtenir une évaluation reproductible.

The treadmill exercise test has become a standard investigation for cardiovascular and peripheral vascular occlusive disease. In patients suspected of having vascular occlusive disease, the diagnosis is confirmed by documenting a substantial fall in the ankle-brachial pressure index (ankle systolic pressure divided by brachial systolic pressure) associated with the onset of typical pain in the legs.¹ This occurs even in patients with minimal disease and a normal ankle-brachial pressure index at rest. The sensitivity of this test is 97%.² Although well established in diagnosis of vascular occlusive disease, it is not accepted that this test, in its present state, accurately quantifies the disability.³ Because interest in the natural history of intermittent claudication is increasing and the tendency is toward conservative or drug therapy, it is necessary to reproducibly estimate the patient's walking distance.

It is our hypothesis that a single treadmill exercise test does not reproducibly quantify disability due to vascular occlusive disease, but that a series of tests may provide an accurate assessment.

Patients and Methods

Included in this study were 25 patients

with stable symptoms of intermittent claudication and no physical condition limiting their ability to walk on a treadmill. Each patient was allowed 30 minutes' rest before the first test and between subsequent tests. After the baseline brachial artery pressure and bilateral ankle pressures were measured, the ankle-brachial index was calculated. A Bach-Simpson BFD18 probe (Bach-Simpson Ltd., London, Ont.) was used to measure pressures and to record the highest brachial pressure and the highest ankle pressure in the most symptomatic leg. The treadmill (Quinton Inc., Seattle, Wash.) was set at 12° incline and a speed of 2.4 km/h for all patients for all tests. Patients were asked to report the onset of typical claudication pain (claudication time — CLT) and continue to walk until they could go no further (maximum walking time — MWT). The ankle and brachial artery systolic pressures were then measured every minute for 20 minutes. After a 30-minute rest the procedure was repeated until five tests were done. The results were analysed by comparing consecutive tests and by comparing all tests to test no. 1. Results were analysed by the paired *t*-test. Other parameters of vascular occlusive disease were compared by linear regression analysis.

Results

There was considerable variability in the individual performance between tests (Figs. 1 and 2). There was a significant ($p < 0.05$) increase in the time taken to reach claudication when walks 3, 4 and 5 were compared with walk no. 1. There was also a significant ($p < 0.05$) increase in the time taken to reach maximum performance (MWT) in tests 2 and 3 compared with test 1 (Table I). In addition, there was a significant ($p < 0.05$) increase in the MWT between tests 2 and 3. The reduction in MWT between tests 4 and 5 can be attributed to fatigue (Table I). The pre-test and immediate post-test ankle-brachial pressure indices were the same in all tests, indicating that a similar degree of ischemia was achieved in each test.

Of the 25 patients, 19 achieved their

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individual greatest distance (maximum performance) on test 3. There was no significant increase in the walking time to either claudication or maximum distance after test 3 (Fig. 3). In this study no correlation was found between ankle-brachial pressure index and the time walked in either test 1 or 3.

Discussion

By demonstrating significant differ-

ences in the times walked in a series of treadmill exercise tests performed on 1 day, our study confirms the great variability of the test when used to quantitate the severity of intermittent claudication. The previously discovered accuracy of this test in diagnosing vascular occlusive disease is unquestioned, but no attempt should be made on the basis of a single treadmill exercise test to quantify the disability caused by the disease.

There are many possible explanations

for the variability in times. Fear of a new test, the machinery and personnel may diminish the distance walked in the early tests. A similar problem has been described in obtaining accurate blood-pressure measurements.⁴ Initially, blood-pressure measurements were variable, but after the third reading the variance was minor, leading the investigators to suggest that the second⁵ or third reading⁴ was the appropriate one.

We have not identified any physical changes that might account for the increased walking distance in test no. 3. A previous study of a small series of patients attributed the increased walking distance to increased blood flow to the lower limb.⁶ The degree of ischemia as assessed by the fall in ankle-brachial index was the same at the end of each test in our study. No assessment can be made from our results of actual muscle blood flow at the end of the test. There was no difference in the physical appearance of the foot after each test and every attempt was made to ensure the patients did not change their gait pattern or lean more heavily on the supports of the treadmill.

The documented improvement in intermittent claudication distance over time with exercise therapy has been attributed to increased myocyte myoglobin content,⁷ altered muscle-to-capillary ratio⁸ or increased levels of mitochondrial oxidative enzymes,⁹ but it does not seem reasonable that over the short period of one morning these factors could play a role in this improvement.

There was a significant increase in both the MWT and the CLT on test 3 compared with test 1. Over 75% of patients had walked their greatest distance by test 3 and had no further significant increases in times. It was our impression that fatigue contributed to the decreased maximal walking time between tests 4 and 5.

This study confirms that resting blood-pressure measurements do not correlate with walking performance. It is essential to have a valid assessment of the disability caused by vascular occlusive disease if drug therapies are to be assessed objec-

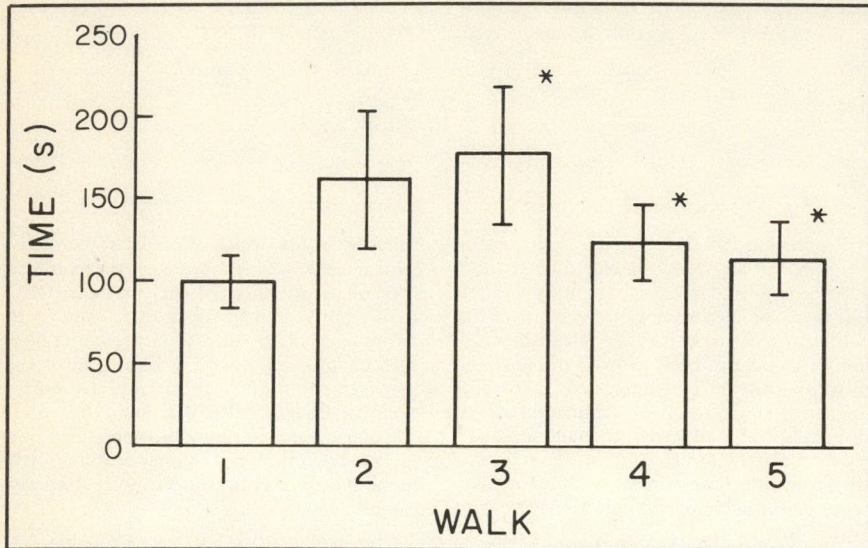


FIG. 1—Time to claudication. Bars represent \pm standard error of mean. * = $p < 0.05$ compared with walk no. 1.

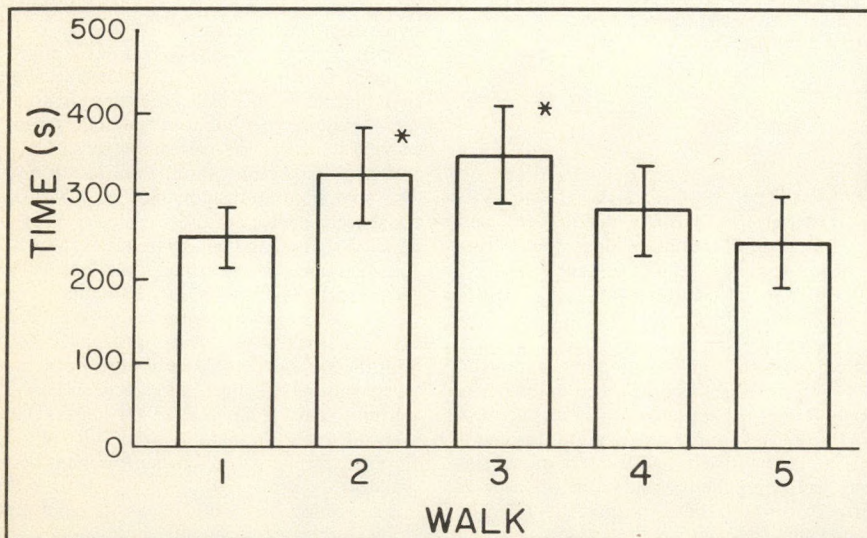


FIG. 2—Maximum time walked. Bars represent \pm SEM. * = $p < 0.05$ compared with walk no. 1.

Table 1—Walking Times on Five Treadmill Exercise Tests

Test no.	Time to claudication, s \pm SEM	Time to maximum distance, s \pm SEM
1	100.2 \pm 12.4	252.4 \pm 29.4
2	163.4 \pm 36.8	325.2 \pm 49.0*
3	178.8 \pm 38.3*	348.8 \pm 51.4*
4	122.9 \pm 20.4*	283.4 \pm 46.8
5	113.5 \pm 20.5*	245.0 \pm 48.1

*Significant ($p < 0.05$) difference from test 1.

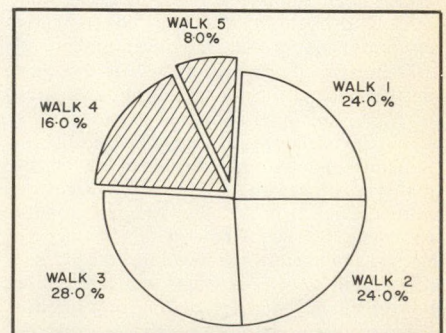


FIG. 3—Walk during which patients achieved greatest individual distance. At completion of walk no. 3, 75% of patients had attained their greatest distance.

tively. Further elucidation of the natural history of the disease and validation of exercise programs depend upon a reproducible test. The great variability demonstrated in the CLT and MWT in our study suggests that a single exercise test is not sufficient, but our results do suggest that the third test may be a reproducible quantitative assessment of disability in the patient with intermittent claudication. We are currently assessing the reproducibility of this measurement over several days.

Conclusions and Recommendations

A single treadmill exercise test does not reproducibly quantitate the patient's disability caused by peripheral vascular

occlusive disease. The significant increase in both the time to claudication and the maximum walking time after the first test suggests that patients do not perform to their maximum capacity initially. It is recommended that a series of three treadmill exercise tests be carried out to obtain an accurate assessment of the walking distance. Consideration may be given to the longest distance walked.

The technical assistance of Dr. J.H. Duff and J. Harris, RN and the secretarial assistance of N. Capstick are gratefully acknowledged.

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BOOK REVIEWS

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ical practitioners less committed to oncology, it will provide a current and concise overview of the management of soft tissue and bone sarcomas.

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NORMAL AND ABNORMAL BONE GROWTH. BASIC AND CLINICAL RESEARCH. Proceedings of the Second International Conference held at the University of California Center for the Health Sciences, Los Angeles, California, January 3-5, 1985. Edited by Andrew D. Dixon and Bernard G. Sarnat. 524 pp. Illust. Alan R. Liss, Inc., New York, 1985. \$76. (US). ISBN 0-8451-5037-5.

This volume, as the proceedings of the first conference on factors and mechanisms influencing bone growth held in 1982, was published in the monograph series, *Progress in Clinical and Biological Research*. These conferences were sponsored by the UCLA Dental Research Institute, which explains the emphasis on craniofacial growth and development.

The intent of the organizers was to bring together basic scientists and clinical researchers to create an interdisciplinary milieu and encourage exchanges of ideas. The results of this endeavour are not immediately obvious in published proceedings. Usually, a global or synthetic view is provided by the participants who come to the conference with a broad perspective and interest. In this volume the presentations will be of particular value to those indirectly involved in a given topic or a specific technique used to study a restricted problem. Similarly, some attempts at the synthesis of a session as well as the reports of the workshops will be of particular interest to an "undifferentiated" reader.

Proceedings of the second conference on bone growth and development will constitute a logical and valuable companion to the first. But these volumes are not for beginners. They will be of great value to basic scientists working in the field of bone growth and development and to clinicians interested in developing medical or surgical treatments of the disorders related to it (i.e., to orthopedic surgeons, pediatricians, orthodontists and plastic surgeons, those whose practical activity relies on the advances in basic sciences in this field).

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OPERATIVE TECHNIQUES IN ARTERIAL SURGERY. A.S. Ward and J.M. Cormier. 412 pp. Illust. MTP Press Ltd., Lancaster, Mass.; Precept Press Inc., Chicago, 1986. \$89.00 (US). ISBN 0-931028-72-8.

This book is the result of a long collaboration between the English and French authors. As such, it might be expected to give an overview of European vascular practice, but instead it is a comprehensive review of international stature, reflecting the present status of vascular surgery on both sides of the Atlantic. The stated aim of the book is to provide a clear and comprehensive guide to the selection and performance of appropriate vascular procedures, as well as dealing with technical difficulties that may arise. This subject is dealt with by 15 chapters devoted to all aspects of vascular surgery, including the common ones of abdominal aortic aneurysms, aortoiliac occlusive disease, femoropopliteal occlusive disease and extracranial vascular disease. Other chapters are devoted to less-common aspects, such as vascular injuries, arteriovenous fistulas and the management of the femoral bifurcation.

The book begins with a chapter on basic techniques of vascular surgery, discussing exposure, vascular suture, anastomosis and

endarterectomy, which will interest the vascular trainee as well as the general surgeon who may, on occasion, have to perform an arterial repair. Although the book deals primarily with the technical aspects of vascular reconstruction, each chapter starts with a discussion of the management of the problems and the indications for the surgical repair. Similarly, intra- and postoperative complications are well reviewed and there is a chapter devoted solely to the management of complications of arterial surgery.

In a work of this nature it is obvious that personal preferences will enter into the choice of procedures, but in some cases, such as the preference for end-to-end over end-to-side anastomosis of the aorta during aortobifemoral bypass grafting, the reasons for the author's specific preference are discussed but not well defined. Similarly, the use of endarterectomy in conjunction with prosthetic aortic or femoral repair is deprecated without the understanding that sometimes a repair cannot be satisfactorily accomplished without endarterectomy. The somewhat unfashionable operation of endarterectomy for aortoiliac occlusive disease is well discussed and will be of much value to those surgeons whose training has not given them much exposure to this technique.

The section on surgery of the deep femoral artery is excellent and deals particularly well with the exposure of the mid-portion of the artery without needing to dissect the proximal portion. This technique is very useful in difficult repeat situations when dissection through vascular scar tissue in the groin is best avoided.

The section on in-situ bypass is carefully detailed, although, again, not all will agree with the methods of valve destruction, and the treatment of venous tributaries may seem cavalier to some.

All sections are organized in a similar fashion. The type is easy to read. Descriptions are clear and easy to follow. The many line drawings are beautifully done and add significantly to the text, even if they are sometimes oversimplified. Each chapter is well referenced.

The book is timely, up to date, and will be of most value to residents and trainees. However, even experienced surgeons operat-

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HISTORY OF SURGERY

MARTIN ENTIN, MD, FRCSC, FACS*

The Dynasties of Research at the Royal Victoria Hospital, Montreal

Progress in medicine comes from new knowledge. Organized research at the Royal Victoria Hospital began with establishment of the McGill University clinic headed by Dr. Jonathan C. Meakins. Two generations of doctors probed the field of respiratory physiology and its alteration in disease. Drs. J.S.L. Browne and E. Venning focused on adrenal glands. Their successors extended their work to thyroid and pituitary glands. The pioneering work of Dr. Arthur Vineberg and his medical colleagues in coronary artery diseases opened up the field of surgical treatment with the saving of many lives. Most recently, Dr. Lloyd MacLean has assembled a group of researchers interested in shock and the relation of host defences to trauma and disease.

Along with staff in the many other departments of the Royal Victoria Hospital, these pioneers have made discoveries that have been applied to the treatment of patients and enhanced the reputation of the institution.

Les nouvelles connaissances sont à la source des progrès de la médecine. À l'Hôpital Royal Victoria, la recherche organisée a démarré avec la mise sur pied de la clinique de l'Université McGill ayant à sa tête le docteur Jonathan C. Meakins. Deux générations de médecins ont investigué le domaine de la physiolo-

The Royal Victoria Hospital will be celebrating its centennial in 1994. The author is chairman of the subcommittee that is charged with producing a commemorative volume on the history of the hospital. Any items of interest from former staff doctors, residents and nurses would be welcome.

gie respiratoire et de ses dérèglements. Les docteurs J.S.L. Browne et E. Venning se penchèrent sur le champ de la surrénale. Leurs successeurs prolongèrent leurs travaux en y ajoutant la thyroïde et la pituitaire. Les travaux de défrichage du docteur Arthur Vineberg et de ses collègues dans le domaine des coronaropathies ont ouvert le champ du traitement chirurgical, ce qui permit de sauver de nombreuses vies. Plus récemment, le docteur Lloyd MacLean a réuni un groupe de chercheurs intéressés au choc et au rapport entre les défenses immunitaires et les traumatismes et maladies.

Avec le personnel de plusieurs autres services de l'Hôpital Royal Victoria, ces pionniers ont été à l'origine de découvertes qui ont été appliquées au traitement des malades et qui ont grandi la réputation de cet établissement.

Progress in medicine comes only from the quest for new knowledge in the medical sciences and related disciplines. Although not every discovery has clinical application, without new knowledge medicine stagnates. Research is the life-blood of medicine and surgery.

The Royal Victoria Hospital (RVH) opened its doors for the clinical care of patients almost 100 years ago and has a proud record in treating an ever-increasing number. But clinical care alone is not sufficient to stimulate improvements in the practice of medicine. Patient care, teaching and research form the triumvirate of activities in a university hospital, but it is research that provides the impetus to advance medical treatment.

Organized Research at RVH

Research activities were in progress at the RVH before World War I. Dr. E. Archibald, who introduced scientific methods to Canadian surgery, carried out experiments on pancreatitis and evaluated the surgical treatment of tuberculosis before and after World War I.

Organized research did not begin at the RVH until the early 1920s. Following Sir William Osler's suggestion regarding full-time appointments and a research department, Dean Charles F. Martin was instrumental in getting financial support from the Rockefeller Foundation to establish the McGill University clinic at the Royal Victoria Hospital. He persuaded Dr. Jonathan C. Meakins (Fig. 1), Christianson professor of therapeutics in Edinburgh, who was pursuing cardiorespiratory research, to become the director of the university clinic, physician-in-chief of the Royal Victoria Hospital and chairman of the Department of Medicine at McGill University. Meakins established an encouraging environment for research at the university clinic and attracted bright young people to work



FIG. 1—Jonathan C. Meakins who established first dynasty of research into respiratory physiology.

From the Department of Surgery, Royal Victoria Hospital, Montreal, PQ

Presented to the members of the Royal Victoria Hospital Quarter Century Club, Montreal, PQ, June 9, 1986

**Associate professor of surgery, McGill University, Montreal*

Accepted for publication Mar. 4, 1987

Reprint requests to: Dr. M.A. Entin, Department of Surgery, Royal Victoria Hospital, 687 Pine Ave. W, Montreal, PQ H3A 1A1

there. The friendly competition that developed among the young investigators generated new ideas that helped advance and broaden the scope of their research.

When the results of the investigative work became known, other young researchers came to the clinic, creating a continuity of research projects from year to year. Thus, an extended family of researchers was developed, first at the clinic and later in other departments and medical disciplines.

Over the years, the RVH has acquired an international reputation based on the research done in many departments. Limitation of space permits me to focus on only four areas of this exciting story.

The first dynasty was established by Dr. Jonathan C. Meakins and perpetuated by a sequence of doctors interested in respiratory physiology and its alteration in disease.

Meakins was followed in the 1950s by Ronald Christie who brought with him from England David Bates as director of the respiratory physiology laboratory. Dr. Peter Pare, a chest physician, joined the group and these three contributed much to the understanding of pulmonary function in health and disease. In the last two decades Peter Macklem carried on at the Meakins-Christie Respiratory Laboratory, investigating the role of the diaphragm and intercostal muscles in normal and diseased lungs.

Another family of research activities was established in the field of endocrinology in 1933 under J.S.L. Browne, one of Dr. Meakins' protégés. Dr. Browne was a brilliant young scientist, the first to crystallize pregnandiol, and with E. Venning he pioneered research into female hormones and their role in reproduction. They demonstrated the cyclic nature of ovarian function, carried out fertility studies and later focused their research on the hormones of the adrenal gland.

Other young workers soon joined the department. Dr. Bram Rose investigated the relationship of the adrenal gland to histamine and later pioneered a new division of the clinic into research in allergic disease. Chauncey Pattee studied the physiology of the thyroid gland in normal and in diseased states.

Dr. Max McKenzie measured the thyroid stimulating hormones and related compounds in the serum. These studies helped in the understanding of toxic goitre (Graves' disease). Eleanor McGarry and John Beck opened up a new field by studying pituitary growth hormones; Henry Friesen in 1971 isolated human prolactin which became an important tool in diagnosing pituitary dysfunction and amenorrhea. (Current research on pituitary and other hormones is being continued at RVH by Drs. Posner, Goldsmith, Patel, Solomon and Bennett.)

Arthur Vineberg pioneered research

into coronary artery disease in the 1940s. He produced an experimental model in laboratory animals that enabled him to test various methods of treatment. Vineberg used internal mammary artery implanted into the heart muscle to improve coronary circulation. He also used the omental transplant for the same purpose.

These procedures opened the field of coronary artery disease to surgical treatment and the saving of lives.

The medical aspects of the disease were researched by Dr. Arnold Johnson, whose work led to establishment of cardiopulmonary resuscitation (CPR). Maurice MacGregor continued the study of the physiology of coronary circulation in patients with normal and diseased hearts in the 1970s, and Allan Sniderman extended his research of the role of lipoproteins in coronary artery disease which led to new methods of management in susceptible individuals.

Initiated by Dr. Lloyd MacLean as chief of the Department of Surgery, research has extended our understanding of the causes of surgical shock, shock due to infection, the role of host defences and disease in response to trauma and to surgical intervention.

Like Dr. J.C. Meakins, 40 years before, Dr. MacLean assembled a group of young surgeons interested in research — Drs. Harry Shizgal, Peter McLean, Nicolas Christou and Jonathan L. Meakins. With the help of Julius Gordon and H. Rode from experimental surgery, they pursued investigation on the role of

host defence, developed methods of its assessment and measured the probability of survival of specific patients to the stress of proposed surgical procedures.

Benefits of Research

While space permits focusing only on four dynasties of research, it helps us appreciate the tremendous resulting benefits.

The most obvious, of course, is the practical application of these findings to the treatment of patients seen at the Royal Victoria Hospital. I have alluded to the area of cardiac surgery for coronary artery disease and to the assessment and correction of depleted host defences.

Another example is application of the pituitary hormone studies, allowing diagnosis of pituitary tumours before devastating manifestations of such tumours develop and early, more definitive, neurosurgical treatment. Three hundred patients with pituitary tumours have been treated surgically in the past 10 years by a team of doctors from the RVH and Montreal Neurosurgical Institute.

Presentation of the Findings and Publication

Publication of work done at RVH creates an international reputation for the hospital. Of the 1000 most-quoted contemporary scientists in the world literature, 3 are from the RVH: B.E.T. Murphy, P. Macklem and J. Milic-Emili.¹

Our Colleagues Are in Demand

Doctors on the staff of RVH are sought after by other universities in Canada. Several chiefs of medicine, surgery, physiology and immunology have been appointed to various university positions in the last 15 to 20 years (Table I).

The reputation of the RVH as an institution where the quest for new knowledge is an established tradition is enhanced. Seeking to decode nature's secrets adds romance and adventure to medical research and attracts promising young researchers. They join the extended family of researchers and participate in a process generated by what Alan Gregg of the Rockefeller Foundation so aptly called, "the contagious companionship of excellence".

I am indebted to Drs. Eleanor McGarry and Allan Sniderman for their help in delineating the contribution of the individual investigators.

Reference

1. GARFIELD E: The 1000 contemporary scientists most-cited 1965-1978. *Current Contents* 1981; 41: 5-14

Table I—Royal Victoria Hospital Staff Appointed to Head Departments at Other Canadian Universities

Surgery	
Queen's University	Dr. J.R. McCorriston
	Dr. John R. Gutelius
	Dr. E.J.P. Charrette (cardiovascular)
University of Western Ontario	Dr. John H. Duff
University of Saskatchewan	Dr. Fred Inglis
	Dr. Charles Wright
Dalhousie University	Dr. Bernard Perey
Medicine	
University of British Columbia	Dr. John Dirks
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ing in unfamiliar territory will welcome the opportunity that this book provides to refresh their memories or to provide insight into modern techniques. It is, therefore, a valuable addition to any vascular surgeon's library.

The purist may feel that the book is too "light", but for quick and easy reference to a technical problem it will be hard to beat.

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PERIOPERATIVE ASSESSMENT IN VASCULAR SURGERY. Science and Practice of Surgery, Volume 9. Edited by D. Preston Flanigan. 384 pp. Illust. Marcel Dekker, Inc., New York, 1987. \$89.95 (US). ISBN 0-8247-7632-1.

The defined purpose of this book is to assist the vascular surgeon in the perioperative period in making the correct diagnosis, selecting the correct procedure, assuring a technically excellent operation and recognizing impending or actual graft failure. The editor states that it is not a book about the treatment of patients but an attempt to discuss, in detail, current methods of assessment with the aim of substantially improving overall patient management.

The book is divided into three major sections dealing with preoperative, intraoperative, and early and late postoperative assessment. Preoperative methods include noninvasive arterial and venous assessment, tests for selection of patients for suprainguinal versus infrainguinal bypass, evaluation of vasculogenic impotence, selection of patients for renal revascularization and the use of ultrasonography and computed tomography in the diagnosis of vascular disease. Intraoperative methods include prebypass and postbypass arteriography, carotid monitoring, hemodynamic assessment of the adequacy of extremity and portal vascular reconstructions, the intraoperative role of ultrasonography and spectral analysis, assessment of in-situ bypass grafts, vascular endoscopy and methods to assess bowel viability. The postoperative section describes early and late monitoring of extremity graft function and carotid endarterectomy.

This book is not intended to be an inclusive work on vascular diagnosis and thus has no sections on history and physical examination, routine angiography, routine noninvasive testing or other traditional modalities. Twenty-seven contributors have combined to write the 21 chapters, creating some unevenness in presentation. However, most of the chapters have extensive current references and present fairly complete and unbiased reports. The chapter on preoperative selection of amputation level is an excellent summary of assessment methods and the current goals of management of this difficult group of patients. The chapter on ancillary techniques in diagnostic angiography

examines the various techniques used to improve its value and also discusses the recently defined limitations of digital subtraction angiography.

This book is well written and will be of greatest value to the practising vascular surgeon who wishes to have a comprehensive review of current methods of patient management. It should also be read by senior vascular residents to improve their standards of patient care and to prepare them for certification examinations.

T. KEITH SCOBIE, MD, FRCSC

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Division of Vascular Surgery,
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1053 Carling Ave.,
Ottawa, Ont.
K1Y 4E9

THE SAGA OF DOCTOR THOR. T.A.J. Cunnings. 635 pp. Illust. University of Manitoba Press, Winnipeg, Man., 1986. \$29.95. ISBN 0-919932-25-8.

The subject of this biography, Dr. Paul Hendrik Thorbjorn Thorlakson, requires no introduction in Manitoba, which has been his home for nearly a century, nor in medical circles throughout Canada, where he has gained a national reputation for his services to the profession. Half Icelandic, on his father's side, and half Norwegian, he spent his boyhood years in Selkirk, Manitoba, not far from Winnipeg, with whose future medical and social life his career would be closely interwoven.

At 18 he began the study of medicine that was to prepare him for a spectacular career. The relationship established in his student days with the Medical School at the University of Manitoba and with the Winnipeg General Hospital was to last a lifetime.

After a brief stint overseas he returned to Winnipeg to complete medical school and his surgical internship, and took a year of internship at the Children's Hospital of Winnipeg. He became Doctor of Medicine and Master of Surgery in May 1919.

That was the beginning. What followed in quick succession was a brief interval as a general practitioner in Shoal Lake, his marriage to Gladys Maree Henry in 1920, a union that was to endure until her death in 1987, and 3 more years (1920 to 1923) of postgraduate medical study in England. At its conclusion, he was given membership in the Royal College of Surgeons and became a licentiate of the Royal College of Physicians in London. On his return to Winnipeg, a partnership with Neil MacLean gave him the early experience in group practice that led inevitably to establishing the surgical partnership known as the Maclean-Thorlakson Clinic. This in turn evolved into the better known Winnipeg Clinic, a pioneer in private group medical practice in Canada. This was in 1938, the year in which Dr. Thorlakson, for the sum of \$14 000, purchased the property at the corner of St. Mary Avenue and Vaughan Street where the city's first multispecialty private group practice clinic would soon stand.

To physicians and surgeons in Canada and elsewhere, the evolution of medical group practice, as told in these pages by the late T.A.J. Cunnings, will undoubtedly constitute the most interesting segment in this monumental bio-

graphy. If only because the genesis of medical group practice has remained so obscure, the story as it unfolds in these pages makes a valuable contribution to Canadian medical history. The older and larger Mayo Clinic, in Rochester, Minn. is better known to Canadians and North Americans. Thorlakson and his two sons were to do for Manitoba medicine what the Mayos had succeeded in doing in the United States (i.e., establish a group practice clinic that would serve as a centre for high-quality diagnosis and treatment).

The movement quickly caught on in other parts of the country, in spite of sharp divisions in medical opinion about these integrated groups of doctors. The initial professional concerns generally regarded the potential for excessive referrals within the group, the inherent tendency to confine consultations to members of the group and the pooling of fees, which some felt violated the ban on "fee-splitting". Counterbalancing these objections was the potential group practice had for the enhancement of the quality of patient care.

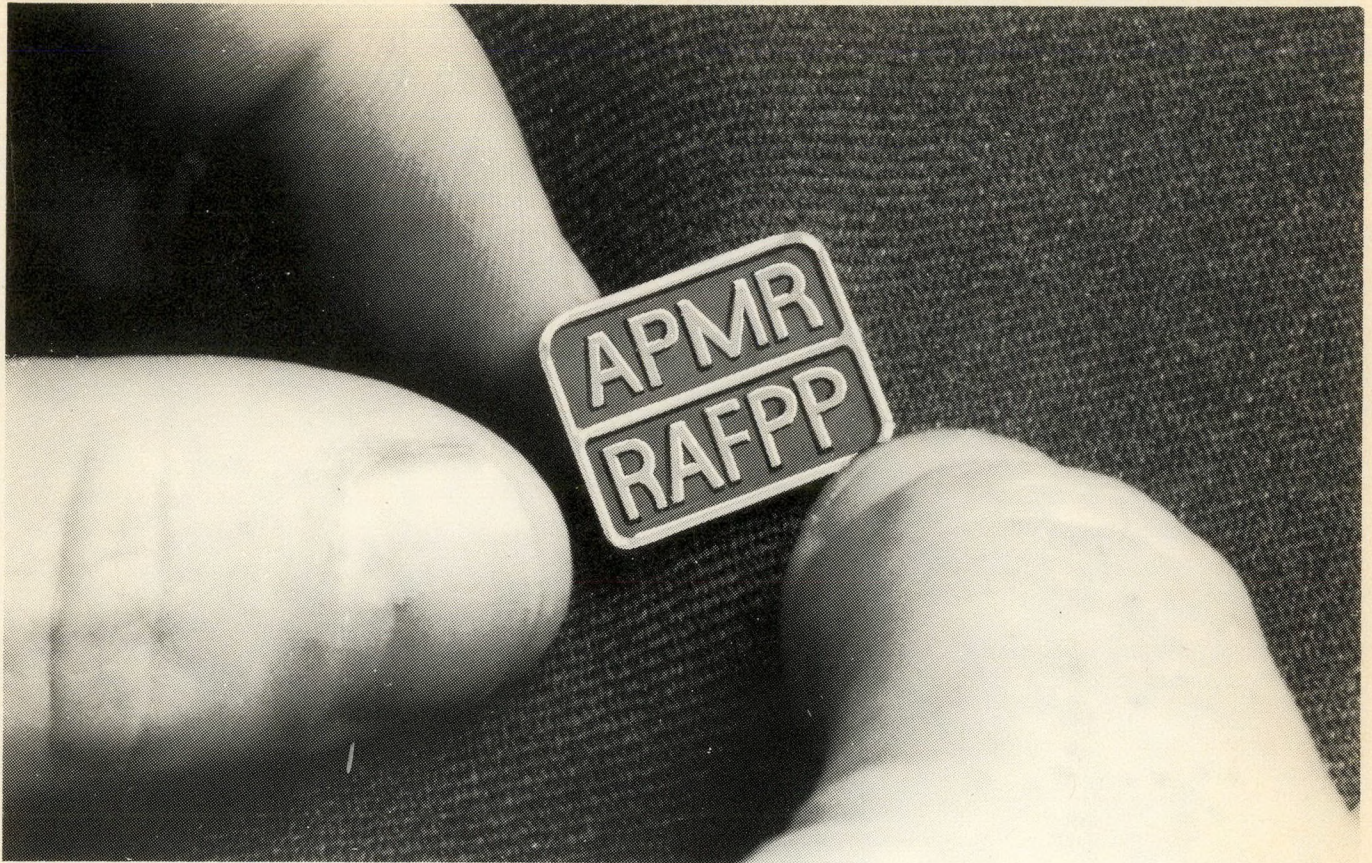
If this alone represented his greatest achievement, Thorlakson's position in Canadian medical history would be secure. But again, it was only another beginning. There followed, over the years, expanding, consolidating and directing the Clinic; securing the principle of federal funding for medical research, a task in which Dr. Thorlakson worked closely with Sir Frederick Banting, after a comprehensive survey of medical research resources in Western Canada; the establishment of the Manitoba Institute for the Advancement of Medical Education and Research; the organizing and incorporation of Winnipeg's complex known as the Medical Centre, an idea conceived by Dr. Thorlakson and executed only after 3 years of persistent organizational effort on his part, and eventually, its evolution into the Health Sciences Centre.

Anyone familiar with medical history would be aghast to learn that all these innovative achievements were brought to fruition through the fund-raising ability and broad vision of one man. Many more civic contributions and the honours that accompanied them could be chronicled here, if space permitted. Not least of them was the term of 9 years "Dr. Thor" served as Chancellor of the University of Winnipeg. As its president once said, in introducing him, "Your Chancellor works hard, has worked hard all his life". Few are given the talents and the nine decades he has been granted to use them for the benefit of society; fewer still have contributed so much to the common good.

This is a well-written, comprehensive, and, not surprisingly, uncritical biography since it is probably authorized, but that fact does not detract from its authenticity or its usefulness. The wealth of documentary material on which it is based has been expertly used by the author, who has managed to produce a book that is well organized internally and readable. Everyone, especially those in medicine or in health-care delivery of any kind, will find this a fascinating and instructive life story.

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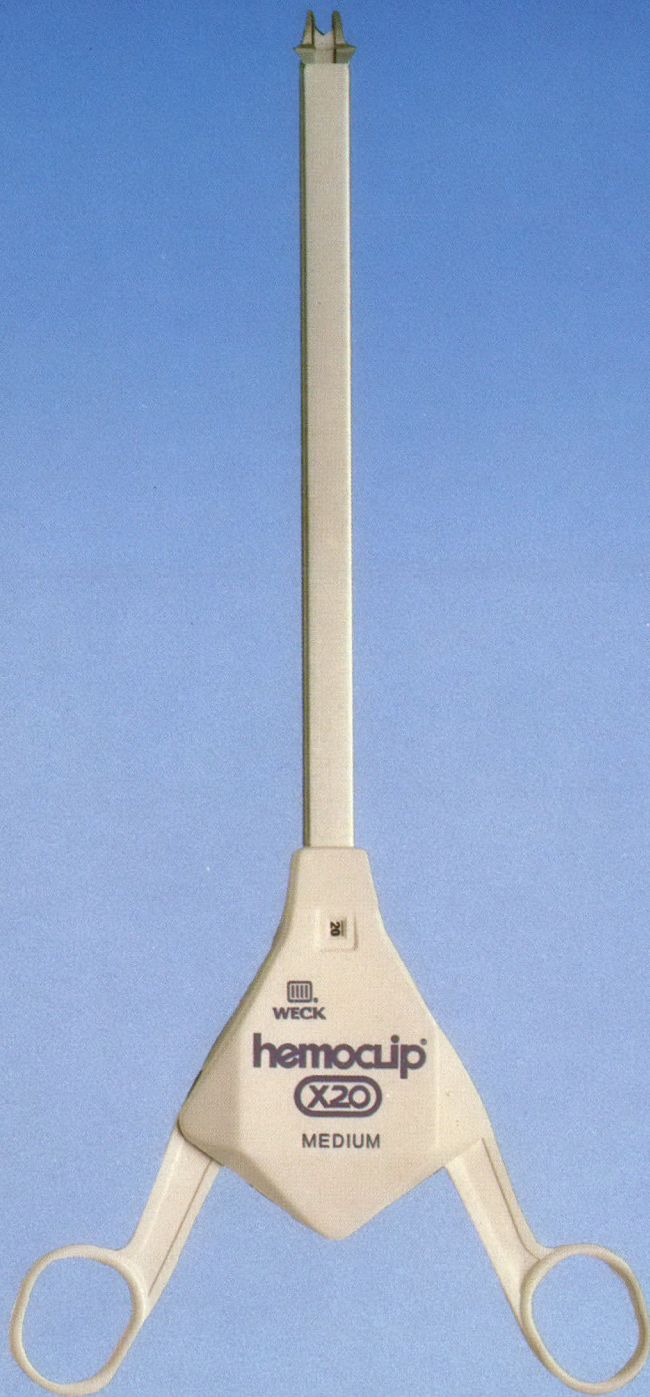
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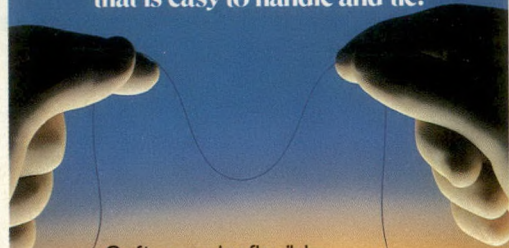
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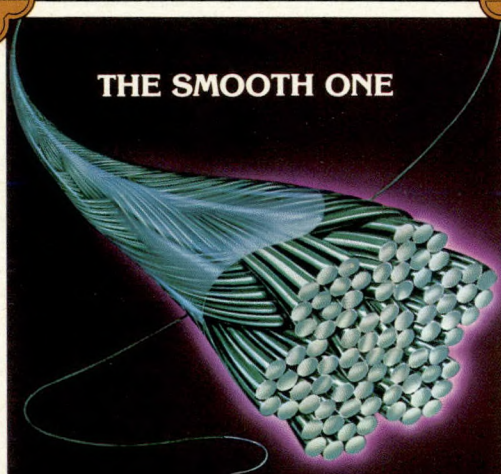
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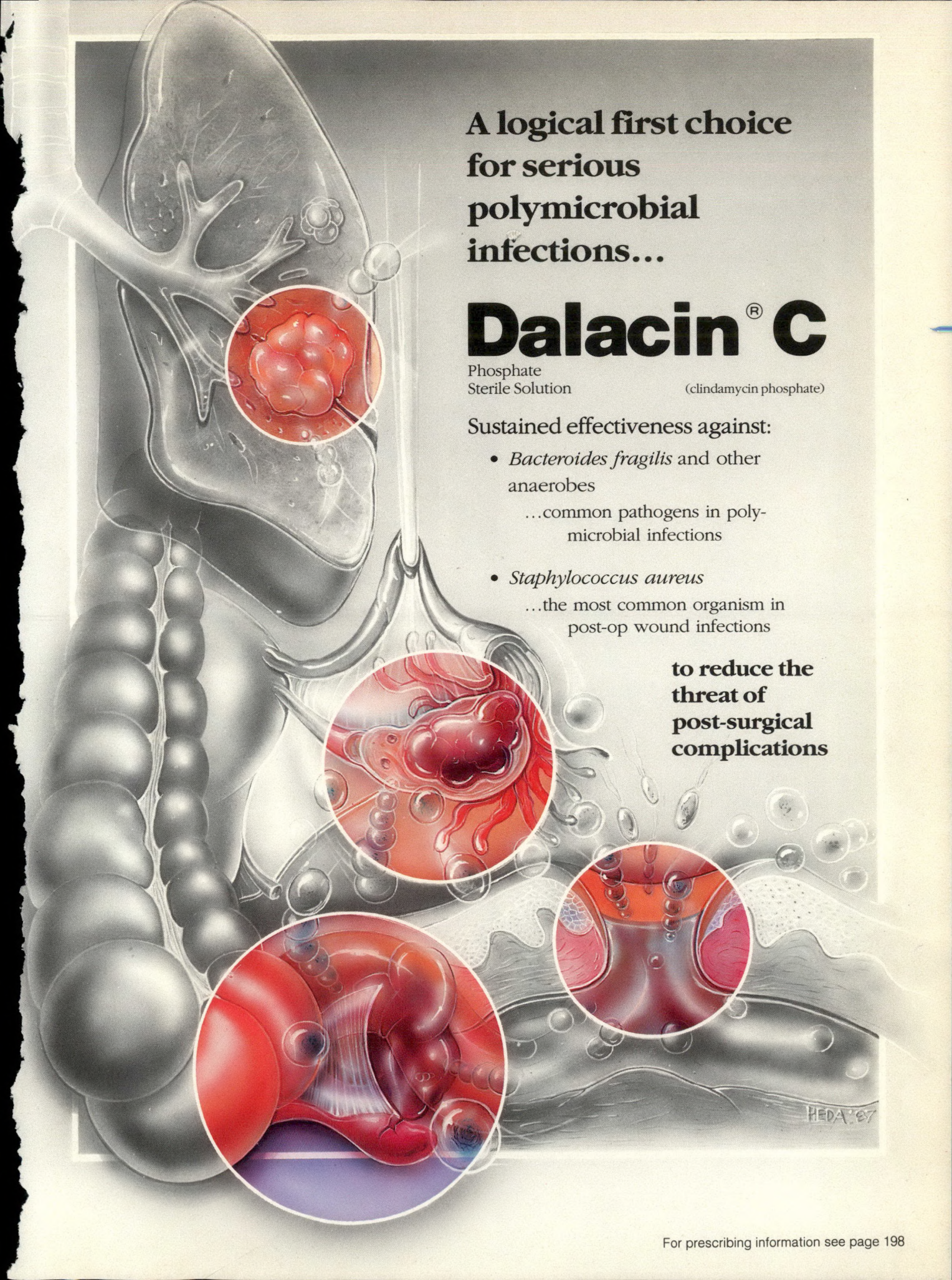
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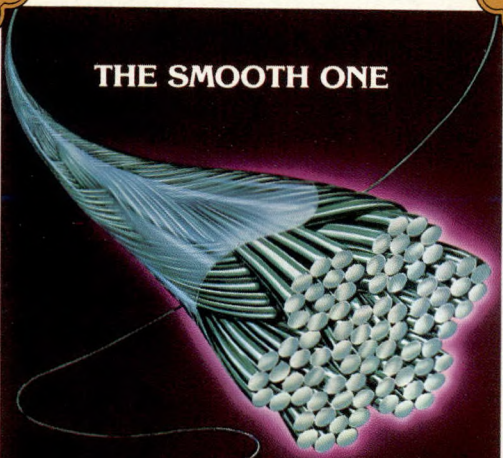


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