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Volume 30, No. 2, March 1987

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The Canadian Journal of Surgery

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

The Cost of Arthroscopy

To the editors.—The letters of Profitt and Giachino and of Sullivan in the September 1986 issue of the Journal (page 301) both deserve comment.

Simple arithmetic indicates that Profitt and Giachino are doing about 10 arthroscopic examinations per week — a considerable number. Have they given any thought to "containing" the cost of investigating knee symptoms by reducing the number of arthroscopies?

I agree with Dr. Sullivan about the existence of enthesopathy — more commonly known as "tendon–bone junction syndrome" — but it can be diagnosed without arthroscopy. Indeed, the bone–tendon interface at the lower pole of the patella cannot be seen from inside the joint as it is covered with synovium and the retropatellar fat pad.

I think far too many arthroscopic examinations are being done and that this leads to unwarranted surgical procedures, particularly now that instruments for arthroscopic surgery are widely available.

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M5G 2C4

The Need to Use the Huber-point Needle in the Port-A-Cath Implantable Device

To the editors.—The Port-A-Cath (Pharmacia [Canada] Inc., Dorval, PQ) is a totally implantable drug delivery system, with a stainless steel port connected to a silicone catheter, which is implanted into a vein. The reservoir is entered through a self-sealing silicone rubber septum which, according to the manufacturer's manual, will accept 2000 punctures, using an atraumatic 22-gauge Huber-point needle, without leakage. The manufacturer's recommendation is not to use regular needles, such as a 22-gauge Yale hypodermic needle, for fear of damaging the septum.

Since March 1984 we have implanted over 75 Port-A-Cath devices at the Royal Victoria Hospital in Montreal, using mainly the Huber-point needle to gain access to the venous system. Occasionally, we ran short of Huber-point needles, making access through the Port-A-Cath impossible.

In view of the lack of information in the medical literature on the use of disposable Yale hypodermic needles through the Port-A-Cath septum, we decided to test and compare leakage from the septum using both types of needle.

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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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A Report on Clinical Trials of NU GAUZE* Sponges including in vitro and in vivo comparisons with conventional cotton gauze sponges

In this study by Dr. Dale C. Birdsell, Chief of Plastic Surgery at Calgary's Foothills Hospital, and his associate Dr. John S.D. Davidson, also of Foothills Hospital, conventional cotton gauze sponges were compared with NU GAUZE* rayon sponges.

In the field of medicine, the most newsworthy items are usually new surgical procedures or medications. Little attention is given to advances made in the everyday 'tools of the trade', so to speak, such as instruments, sutures, dressings and sponges. As Dr. Birdsell says in his study, "One could take the view that the cotton gauze sponges presently used (in use for more than 50 years) are perfectly adequate and no changes are required. This would be wrong. Firstly, they may be adequate, but they are not perfect." Dr. Birdsell then gives a very appropriate comparison of our attitudes towards our 'tools of the trade', "If surgeons 20 years ago had not taken a progressive attitude concerning new suture materials, we would probably still be using silk and cotton sutures. Is it possible that the presently used cotton gauze sponge will someday be considered in the same category with silk and cotton sutures?"

Considering the work that the sponge is called upon to do, everything from prepping to dressing wounds, it should do these tasks with maximum efficiency and minimal possible deleterious side effects. A lot has been written about effects of lint in wounds and about maceration under wet dressings. Dr. Birdsell investigated linting and absorption, both in vitro and in clinical trials, comparing NU GAUZE* sponges and cotton gauze sponges.

The results of these clinical investigations showed that NU GAUZE* sponges fared considerably better than cotton gauze sponges.

ABSORPTION CAPACITY (in mL of citrated blood) OF NU GAUZE* SPONGES COMPARED TO 8 AND 12 PLY COTTON GAUZE SPONGES

Trial #	NU GAUZE*	Cotton gauze	Difference	Cotton gauze	Difference
		8 ply		12 ply	
1	17	11	6	14	3
2	16	11	5	14	2
3	17.5	11	6.5	14	3.5
4	18	11	7	13	5
5	17	11	6.5	13.5	4
Average	17.2	11	6.2 (56.4%)	13.7	3.5 (25.5%)

"The total absorption capacity of the NU GAUZE* sponge exceeded that of the 8 ply and 12 ply cotton gauze sponges by approximately 56% and 26% respectively. Furthermore, subsaturation amounts of blood were always more completely absorbed by the NU GAUZE* sponges in both the laboratory and clinical settings. In the latter case, donor sites were left drier and hence more amenable to easy and efficient dressing of the wound. As well, removal of the NU GAUZE* sponge from the wound was consistently associated with less disruption of the exposed and friable dermal capillary bed. Less disruption and thus less bleeding contributed to the efficiency of dealing with the donor site wound.

In vitro studies show quite conclusively that NU GAUZE* sponges contain less free lint than conventional cotton gauze sponges. Free lint in surgical wounds poses a real threat from the standpoint of inciting foreign reactions. Such reactions could enhance scar formation that may jeopardize the final outcome in plastic surgical procedures ranging in scope from cosmetic surgery to tendon and peripheral nerve surgery. Further, any retention of lint (a foreign body) could increase the likelihood of bacterial contamination progressing to infection."

Concerning the handling properties of NU GAUZE* sponges, both investigators found the enhanced resiliency of the NU GAUZE* sponges to be a positive feature when packing closed spaces or applying dry pressure dressings.

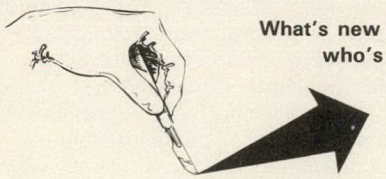
As Drs. Birdsell and Davidson summarized, "From these investigations, the NU GAUZE* sponges display features that make them comparable to, and in many aspects superior to conventional cotton gauze sponges. We found NU GAUZE* to have better absorption, while being less linting, less wound disruptive and more resilient than ordinary cotton gauze sponges. This makes NU GAUZE* a more rational choice for an all-purpose, absorbent sponge for dressing and wound care."

NU GAUZE* Sponges are available from Johnson & Johnson Inc.

For a copy of the complete clinical report, contact the Patient Care Division, Johnson & Johnson Inc., Montreal, Quebec H1V 2E4.

*Trademark of JOHNSON & JOHNSON

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.

Determining and Rationalizing the Supply of Physicians

The Royal College of Physicians and Surgeons of Canada and the Canadian Medical Association are working together to determine how many specialists are needed now and in the future. Their first step is to find out how many physicians are currently practising in the 39 specialties, relying mainly on data collected by CMA's "physician manpower questionnaire" sent out in 1982, and they are validating the information.

Coordinating the operation is James A. Low, FRCSC, who chairs the manpower committee of the Royal College; he is supported by staff in the CMA Department of Economics who expect the job to be complete about December 1987. Also, each medical and surgical specialty has a working group to share the task of contacting hospitals across the country. Once the information has been updated, the groups will be drafting statements about the current numbers in the specialty and the "ideal" number as a proportion of the population.

For example, the Canadian Association of General Surgeons' manpower and economics committee undertook the task for general surgery. The committee, chaired by Frank Turner, FACS, FRCSC, in Kelowna, BC, had completed the legwork at the end of January.

Said Turner, "We split the task up by province; in Prince Edward Island, the job was not so bad — of the 11 surgeons on the list, 6 were in practice. In Ontario where we found 560 surgeons, the task was done in two ways because Ontario already had a list. We compared the names on the two lists and then called colleagues to verify information not appearing on both lists.

"The figures indicate that of 2683 surgeons listed on CMA's data bank as full-time general surgeons only 1517 (56.5%) are in fact practising general surgery full time. Quite a number have retired, several have died, and others have moved into other branches of medicine or into administration. This figure seems to apply right across the country, which means that government forecasts have been based on incorrect data, and it explains why we as an association have always been hearing about 2000 general surgeons but could only get about 1200 members.

"In some parts of the country, physicians, although not certificated, are practising general surgery, but most are senior doctors in remote communities who have done it for years and are quite competent.

"To get a handle on the needs for the future, we have been approaching communities and finding out whether they have enough or too many general surgeons", but the group is still wrestling with the problem of determining an appropriate ratio for general surgeons to population.

Turner commented: "We may find that in a large community one general surgeon can serve 17 000 people whereas a community of 10 000 also needs at least one surgeon."

Said N. Tait McPhedran, FACS, FRCSC, of Calgary, who has been working with Turner, "We've known for at least 10 years that general surgeons are one of the groups getting older. It was one of the first specialties to fill after the War, and general surgeons are retiring as predicted very quickly. We are going to see a major shortage within the next 5 to 10 years.

"Training takes a minimum 4 years so there's no turn on, turn off mechanism. We have attempted to interest university people and government in providing more slots for training, but so far our requests have fallen on deaf ears."

The federal/provincial advisory committee on health manpower forecast a shortage of 994 in the surgical specialties and 389 in laboratory specialties by the year 2000. The same report, founded mainly on information from Southam Medical Data Base and released early in 1985, asserted that a surplus of general practitioners and medical specialists existed in 1980 and that it would grow to 4870 and 2495, respectively, by the year 2000. However, CMA and the Royal College believe that the forecast was inaccurate for several reasons, not the least of which was an underestimate of death and retirement of physicians in the next four decades. Also the government committee, which did not include any physicians, projected a decline in emigration rates.

Figures about the ages of physicians suggest that annually 600 physicians will retire or die during the years 1986 to 1990 and the numbers will rise to 1550 each year during the period 2010 to 2020. According to the Royal College and CMA, this finding and the current emigration rates indicate an overall shortfall of 1754 physicians in the year 2000 even if the government's physician-to-population ratios are correct.

Two specialty groups — laboratory medicine and neurology — undertook validation as a pilot project last summer. Both called for growth not cutbacks in residencies. For example, the committee for laboratory medicine recommended increases such that the ratio, which is currently one specialist to 19 764 people, would be one to between 15 659 and 17 307. The committee based its recommendation on numbers of vacant positions currently funded in hospitals across the country and estimates by laboratory directors about positions needed to provide standard services.

Both McPhedran and Turner agreed that few specialty groups are likely to ask for a cut in residency positions, but, said McPhedran, "There are some that are obviously overfilled — if you look at it objectively — pediatrics, family practice and medical specialties."

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.

The groundwork for validation of data about medical specialists and family physicians has been laid. Emergency physicians have already completed the task. Said Jan Ahuja, FRCPC, "We were fortunate in that we as a group (the Canadian Association of Emergency Physicians) had undertaken in the summertime a study on our own. We used the same five people in the geographic areas and they had subcommittees phoning every hospital in Canada.

"For the Ottawa area, I participated in the original survey and I spent about 10 hours on the phone; I'm quite sure that literally hundreds of man hours went into this. We contacted department heads and sent them a questionnaire."

Like general surgeons, the emergency physicians found the data were not reliable: "We found many people who were listed as emergency physicians but did not have certification from the Royal College or from the College of Family Physicians of Canada." The implication is that more such specialists are needed so the focus is to find out not only who has formal qualifications to practise a specialty but who is actually practising, that is, spending about 70% of his or her time working in the specialty.

In the next issue of the Journal the question of mandatory retirement will be discussed.

Work Under Way on New Heart Facilities for VGH

A project estimated at $2.7 million will give the Vancouver General Hospital six new operating rooms and 62 new beds — 18 for cardiac intensive care and 44 for patients who have had heart operations.

Costs of the project will be shared on a 60 to 40 basis by the provincial government and the Greater Vancouver Regional Hospital District. Completion is expected in autumn 1987.

Defence Association Wants More Surgeons Ready for Service

The Canadian Forces Medical Services need more surgeons who are familiar with the military and who can respond in an emergency, said representatives at the annual conference of defence associations, held in Ottawa in January.

A.V. Grasset, MCFP, president of the Defence Medical Association, outlined concerns to CJS: "We discussed the lack of medical specialists, specifically trauma surgeons, orthopedic specialists and anesthetists, for the armed forces to respond in case of a crisis.

"There are barely enough in the Canadian forces for peacetime conditions. If there were an overseas crisis or one in Canada, such as a 747 going down in the Arctic, the Canadian forces with its potential transport, mobility and expertise could be called upon to help and should be able to supply sufficient medical care. If there were sudden hostilities in Europe, the NATO forces would require 24 surgical teams immediately. About seven could be provided by allies on the spot but the Canadian Forces Medical Services would have to provide 17 teams of surgeons, anesthetists and surgical assistants.

"At the moment, the total number of trained surgical specialists on strength is 13; the total number of anesthetists on strength is 6. One possibility is to invite names on a list to supplement the reserves; the group could be given some basic training at times convenient to them. In other words we could ask for volunteers to be ready for emergencies; they would be given some incentive and orientation and would be available in emergencies. We are asking the government for such a program, which would be in addition to the medical reserves. The reserves provide regular part-time experience in the military and also badly need health professionals of all sorts."

AMY CHOUINARD

REVIEW ARTICLE

A. MINIACI, MD; C.H. RORABECK, MD, FRCSC, FACS*

Tibialis Anterior Muscle Hernia: a Rationale for Treatment

Tibialis anterior muscle hernia is an orthopedic problem that should be dealt with carefully since the potential complications of treatment are serious. The literature is reviewed to provide a better understanding of the natural history, incidence, classification and treatment of muscle hernias.

Guidelines are proposed for a rational treatment plan for tibialis anterior muscle hernias. Asymptomatic hernias need no treatment. Longitudinal fasciotomies are recommended as the treatment of choice in symptomatic tibialis anterior muscle hernias that are refractory to conservative treatment.

La hernie du muscle jambier antérieur est un problème orthopédique qui doit être abordé avec précaution car les complications du traitement peuvent être sérieuses. On a fait l'étude des publications sur le sujet afin d'en ressortir une meilleure connaissance de l'histoire naturelle de la hernie musculaire, de son incidence, sa classification et son traitement.

On suggère une marche à suivre visant à offrir un plan de traitement logique des hernies du muscle jambier antérieur. Les hernies asymptomatiques ne nécessitent aucun traitement. Une fasciotomie longitudinale est recommandée comme traitement de premier choix dans les cas de hernies musculaires qui résistent à un traitement conservateur.

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Accepted for publication Nov. 6, 1986

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Herniation of the tibialis anterior muscle is generally asymptomatic and a relatively minor orthopedic problem, but if not treated with the utmost care it can have serious consequences. There is a group of patients who will seek medical attention because they experience symptoms or are concerned with the cosmetic appearance of the leg. Therefore, a thorough understanding of the natural history of muscle hernia and an appreciation of potential complications arising from proposed treatment are necessary for a rational approach to management.

History

Muscle hernias are not rare but have received little attention in the medical literature, even though the earliest published report was by Richet in 1855.[1,2] A number of other reports followed[3] and in 1929 Ihde[1] published the first comprehensive review of the literature. In addition he provided a system of classification for muscle hernia and reported 12 cases in the leg and 1 in the thigh, all occurring in military personnel. Through to the late 1940s most of the reports were provided by military physicians, describing their personal experiences with diagnosis and management of muscle hernias in military recruits.[4–9] Since then there has been a relative paucity of published information on the subject. Authors have outlined modes of treatment that vary from simple closure of fascial defects[5,7,10] to patch repair with fascial grafts,[5,11,12] most reporting good functional and cosmetic results. Recently, serious complications have been reported after treatment of muscle hernias.[13,14] Wolfort and colleagues[14] described two cases of anterior tibial compartment syndrome (Fig. 1) after hernia repair.

The purpose of this paper is to propose guidelines for the management of muscle hernias, that, if followed, should reduce the risk of this complication.

Incidence

Opinions vary as to the true incidence of muscle hernia. Ihde[1] reported the condition as rare, because there were few reports of muscle hernia at that time.

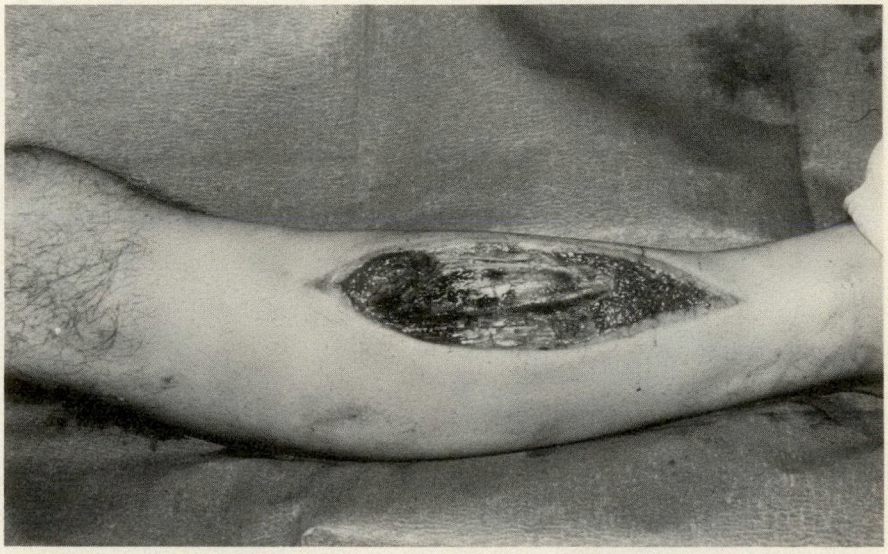

FIG. 1—Compartment syndrome, serious complication of repair of tibialis anterior muscle hernia.

Other authors have now concluded that the condition is more common.[7,15] McMaster in 1943[7] reviewed 1800 hospital admissions to an orthopedic hospital for marines and found 21 men with 38 muscle hernias. Only two reports in the literature of muscle hernia occurred in women, but since most of these reports are of military personnel this may not reflect the true incidence of muscle hernias in the general population. Obermaier and Wilson[15] reported their experience with muscle hernia and postulated that its incidence in the general population is underestimated since most cases are asymptomatic and the patients do not seek medical attention. They also noted that in a large number of patients the initial diagnosis was incorrect and patients were not considered for surgery. There does not seem to be any specific tendency towards race or geographic location. Most patients are young men between 18 and 40 years of age.

Etiology and Classification

The preponderance of healthy, active, young men with this disorder suggests that heavy muscular activity may predispose to muscle hernia. The tibialis anterior muscle is the one most often affected, but hernias have been reported in other muscles in both upper and lower extremities.[14] The simplest and most useful classification was proposed by Ihde,[1] who divided muscle hernias into two groups: constitutional and traumatic. Constitutional hernias result from a congenital defect in the muscle fascia that enlarges, permitting a muscle hernia. This theory has been supported by various authors.[7,15] Although Ihde only noted single hernial defects, later reports[6] suggested that constitutional hernias could be either single or multiple and were often bilateral. Obermayer and Wilson[15] noted that most hernias occurred approximately 15 cm above the lateral malleolus, the area in which the small saphenous vein connects with the deep venous system. McMaster[7] postulated that herniation occurred at the site where the superficial peroneal nerve exits the anterior compartment fascia. Herniation at this site could lead to nerve entrapment and be a cause of symptoms. Traumatic defects (Fig. 2) can be either direct or indirect. Direct hernias result from injury to the muscle fascia, as with a sharp penetrating wound. Indirect hernias are the result of a blow to the contracted muscle causing rupture of the fascia and subsequent muscle herniation.[7]

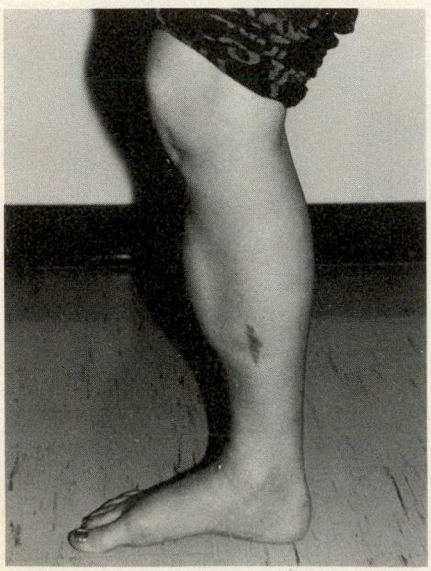

FIG. 2—Post-traumatic tibialis anterior muscle hernia in young woman.

Clinical Presentation

Most patients present with a well-circumscribed mass at the junction of the middle and distal thirds of the tibia that may be asymptomatic but causes the patient concern because of the cosmetic deformity or the possibility of a tumour. Symptoms include aching after prolonged exertion that subsides with rest. On physical examination the fascial margins are easily palpable.[1,7,9,15] The hernias are usually soft and easily reducible and can be accentuated by various maneuvers including the "fencer's lunge" position (the patient weight bearing and the hip, knee and ankle all flexed) described by Pichon.[3] The differential diagnosis should include thrombophlebitis,[16] varicosities,[1,7] hematoma,[1] lipoma,[7,13,15] fibroma, angioma[13,15] and soft-tissue sarcoma.

Treatment

Conservative therapy such as the use of support hose[1,10,13] may be beneficial if symptoms are mild. Various surgical procedures have been advocated, ranging from simple fascial suturing[5,6,17] to repair of the fascial defects with fascia lata grafts.[9,11,12] More recently, Boriani[13] advocated a periosteal patch graft for fascial defects that are adjacent to the anterior tibial border and LeRiche proposed a longitudinal fasciotomy for symptomatic hernias.[13]

Discussion and Conclusions

Closure of a fascial defect in the anterior muscle compartment of the leg by simple suturing or patch grafting will inevitably lead to elevated pressures within that compartment by converting an open system to a closed system with a fixed volume capacity. Postoperative edema and hematoma formation will accentuate this increase in pressure and may lead to a compartment syndrome.

Simple repair of a fascial defect by direct apposition of fascial edges is especially dangerous because not only does it close the compartment but it also reduces the volume of that osteofascial compartment. There are reports in the literature[9,18] of compartment syndrome following simple muscle hernia repair. We consider it an unacceptable complication.

Other procedures that have met with some success include fascia lata grafts[9,11,12] and periosteal patch grafts from the tibia.[13] We have no experience with these techniques and, theoretically, the risk of compartment syndrome is higher. We propose the following guidelines for the management of tibialis anterior muscle hernia.

- Asymptomatic muscle hernias need no treatment. Cosmesis is usually not an indication for surgery as operative complications are serious.
- For mild cases with symptoms, use of support hose may be of benefit.
- Surgery may be considered for patients with moderate to severe symptoms and unsuccessful conservative management. Simple fascial repair should never be attempted.

If fascial patch grafting is the procedure chosen, great care should be taken not to close the compartment tightly, and careful postoperative monitoring is necessary. We suggest longitudinal fasciotomy to decompress the entire anterior compartment and avoid the potential complication of compartment syndrome.

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P.F. MCGOEY, MD, FRCSC; J.P. WADDELL, MD, FRCSC

Long-Term Review of the McGoey–Evans High-Friction Uncemented Total Hip Arthroplasty

To assess the long-term clinical results of uncemented total hip arthroplasty with the McGoey–Evans bipolar high-friction hip prosthesis, the authors reviewed the findings in 86 such hip replacements. The minimum patient follow-up was 5½ years (mean 9 years). Overall, satisfactory results were obtained in 46.5% of cases. There were no deep infections. In contrast to the experience with the cemented hip replacements, the authors found that the results were better in men than women and that most of the revisions were done within 5 years of the original operation. Tissue hypersensitivity resulted in implant loosening in only two cases and no harmful systemic effects arose from the use of this uncemented cobalt-chromium prosthesis.

Although this particular hip prosthesis is not recommended because of its inferior design, the findings of the study could be useful in the current practice of uncemented hip arthroplasty.

Dans le but d'évaluer les résultats à long terme de l'arthroplastie complète de la hanche n'utilisant aucun ciment et faisant appel à la prothèse bipolaire à friction élevée McGoey–Evans, les auteurs ont passé en revue les observations de 86 arthroplasties de ce type. Les patients ont fait l'objet d'examens de surveillance pendant un minimum de 5½ ans (moyenne de 9 années). Dans l'ensemble, des résultats satisfaisants ont été obtenus dans 46.5% des cas. On n'a constaté aucune infection profonde. Contrairement à ce que l'on sait des prothèses cimentées de la hanche, les auteurs ont observé que les résultats ont été meilleurs chez les hommes que chez les femmes et que les révisions ont été effectuées dans les 5 années qui suivirent la première opération. L'hypersensibilité tissulaire fut la cause d'un relâchement de la prothèse dans deux cas seulement. Aucune réaction systémique adverse n'a été reliée à l'utilisation de la prothèse au cobalt-chrome.

Bien que cette prothèse particulière de la hanche ne puisse être recommandée du fait de sa moins bonne conception, les observations recueillies dans cette étude peuvent servir dans la pratique actuelle des arthroplasties de la hanche sans ciment.

From the Department of Surgery, St. Michael's Hospital, Toronto and the Department of Surgery, Scarborough Centenary Hospital, Scarborough, Ont.

Presented in part at the 7th annual meeting of the Canadian Association of General Surgeons, held in conjunction with the 53rd annual meeting of the Royal College of Physicians and Surgeons of Canada, Montreal, PQ, Sept. 12, 1984

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A significant early contribution to hip arthroplasty was that of Smith-Petersen who, in 1923, introduced the cup arthroplasty to cover the reshaped femoral head.[1] Subsequently Moore[2] and Thomson[3] described proximal femoral hemiarthroplasty. A few years later, Urist[4] and McBride[5] introduced the acetabular cup replacement arthroplasty. The combination of an acetabular cup with a proximal femoral replacement started the modern era of total hip arthroplasty. The early prostheses, with all-metal components, were implanted into bone either with or without the use of acrylic cement. In 1964 McGoey and Evans in Toronto started using a cementless all-metal total hip replacement prosthesis. Based on the concept of low friction, hip arthroplasties[6,7] sharply improved results and with time rendered early total hip systems obsolete. However, long-term studies have shown a number of late complications related to these prostheses, the most common of which is component loosening, a particularly worrisome complication in younger active patients.[8–12] These long-term problems have led to the promotion, especially in Europe, of newer types of uncemented hip arthroplasties.[13–16] Long-term follow-up results of these new uncemented arthroplasties with respect to durability and biocompatibility are not yet available.[17]

The renewed interest in the uncemented total hip replacement prompted us to review the long-term results obtained with the McGoey–Evans high-friction uncemented hip prosthesis, in the hope that some of the lessons learned from its use would apply to the current practice of cementless hip replacement surgery.

Patients and Methods

To make the results of this study meaningful we included only cases in which the patient was followed-up for at least 5½ years; that is, patients who had undergone a McGoey–Evans uncemented total hip replacement arthroplasty between 1964 and 1976. In 121 patients (48 men, 73 women), 135 prostheses were implanted (14 bilateral replacements). The mean age of patients at the time of surgery was 60 years (range from 17 to 84 years). Indications for operation were osteoarthritis (81 hips), congenital hip dislocation (17), post-traumatic hip arthrosis (13), rheumatoid arthritis (10), osteonecrosis (7), hip degeneration related to slipped femoral capital epiphysis (4), ankylosing spondylitis (1), hip arthrosis secondary to Morquio's syndrome (1) and pathologic fracture of the femoral neck due to a bone cyst (1 hip). In 20 of the hips other reconstructive procedures had been performed previously; they included Moore's hemiarthroplasty (2 hips), acetabuloplasty with a McBride's cup (1), resectional hip arthroplasty (1) and hip fusion (1). The surgeons who developed

the hip replacement under review performed all the operations.

The Prosthesis

The prosthesis was a combination of McBride's acetabular cup and Moore's femoral endoprosthesis (Fig. 1). Both components were constructed from vitallium (a cobalt-chromium alloy). The components were correctly paired to allow total contact during weight-bearing (Fig. 1).

Operative Technique

The hip joint was approached through a long lateral skin incision followed by an inverted Y trochanteric osteotomy (Olympic approach to the hip joint) (Fig. 2). Initially, stabilization of the acetabular cup was obtained by pressing the three dorsal fins of the cup into the decorticated acetabulum. Later the early stability of the socket was enhanced by cancellous screws inserted through pierced projections placed superolaterally in the rim of the cup. On the femoral side, the Moore's prosthesis was inserted in the regular fashion. Care was taken to insert the prosthesis with the widest proximal stem for optimal bone–implant contact. The two trochanteric fragments were then reapproximated and held together by either a single wire loop (in most cases) or two long screws.

All operations were carried out in a standard operating room without clean air or laminar flow system.

Perioperative Care

None of the patients received anticoagulants or antibiotics prophylactically. They were kept in bed for an average of 30 days then gradually mobilized using crutches and canes.

Complications of the Operation (Table I)

Systemic problems intraoperatively or immediately after occurred in nine patients. One patient died of myocardial infarction. Four patients sustained pulmonary embolism and another five suffered deep venous thrombosis.

Table I—Local Complications

Complication	No.
Intraoperative	
Fractured acetabulum	1
Split fracture of proximal femur	1
Postoperative	
Superficial infection	6
Hematoma (sterile)	1
Wound dehiscence	1
Dislocated prosthesis	1
Subluxation of prosthesis	2
Dislodgement of femoral component secondary to femoral split fracture	1

Results

We were able to locate 68 of the original 121 patients. Sixteen others had died and the remaining 37 were lost to follow-up. In 57 of the 68 patients, the McGoey–Evans hip prostheses were still in place (7 patients had bilateral replace-

FIG. 1—McGoey–Evans uncemented total hip prosthesis. Original McBride cup has been modified by adding two pierced superolateral projections for screw fixation.

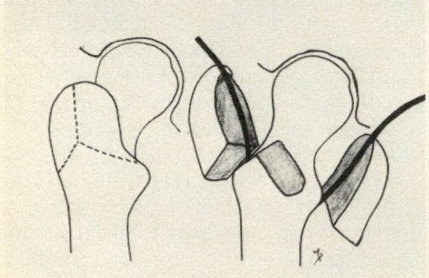

FIG. 2—Olympic approach to hip joint. Greater trochanter is divided (left) with one vertical and two oblique cuts at 120° to each other. Two fragments are retracted (right) laterally and superiorly to facilitate exposure.

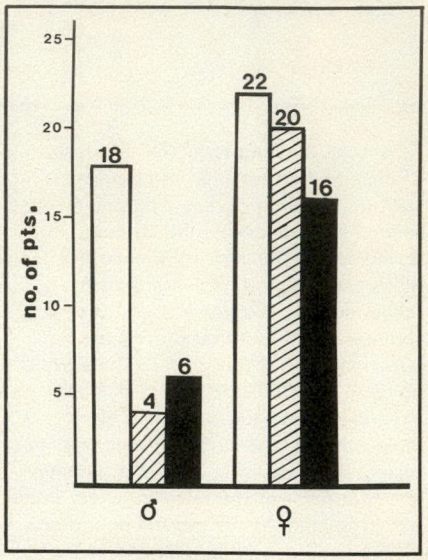

FIG. 3—Results of McGoey–Evans total hip arthroplasty in men and women. White bars = satisfactory, hatched bars = unsatisfactory, black bars = revisions.

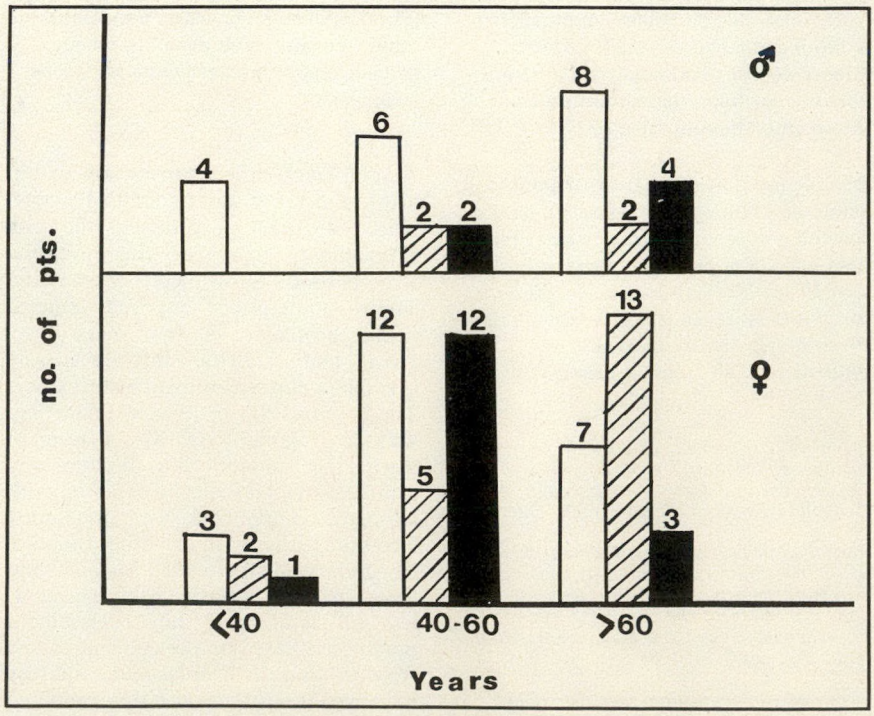

FIG. 4—Results of McGoey–Evans total hip arthroplasty in three age groups. It is evident that men (top) obtained better results overall than women (bottom). White bars = satisfactory, hatched bars = unsatisfactory, black bars = revisions.

ment); the remaining 11 had undergone revision. (In the charts of patients who died or who did not return for follow-up we found that 11 had undergone revisions of this prosthesis. Thus, the total documented revised cases were 22.)

The long-term results are based on 79 (62%) patients with 86 prostheses. Included are all the recalled patients and all those with documented revisions. The average follow-up was 9 years (range from 5½ to 16 years). The results were assessed objectively, subjectively and, whenever possible, radiologically. For the objective assessment, the Harris hip evaluation system was used.[18] The results were classified as satisfactory if the hip score was 80 to 100 points and unsatisfactory if less than 80 points; revisions were considered failures. The patient's own satisfaction with the performance of the artificial joint was used for the subjective evaluation. Assessed radiologically were the formation of heterotopic bone, loosening of the component, subsidence of the femoral prosthesis and union of the greater trochanter. The method of Jowsey and colleagues[19] was used to classify heterotopic bone formation. A component was considered loose whenever 2 mm or more of radiologic lucency was seen between it and the adjacent sclerotic bone. Subsidence was considered a change in distance between the inferior margin of the neck of the femoral component and the proximal part of the lesser trochanter.

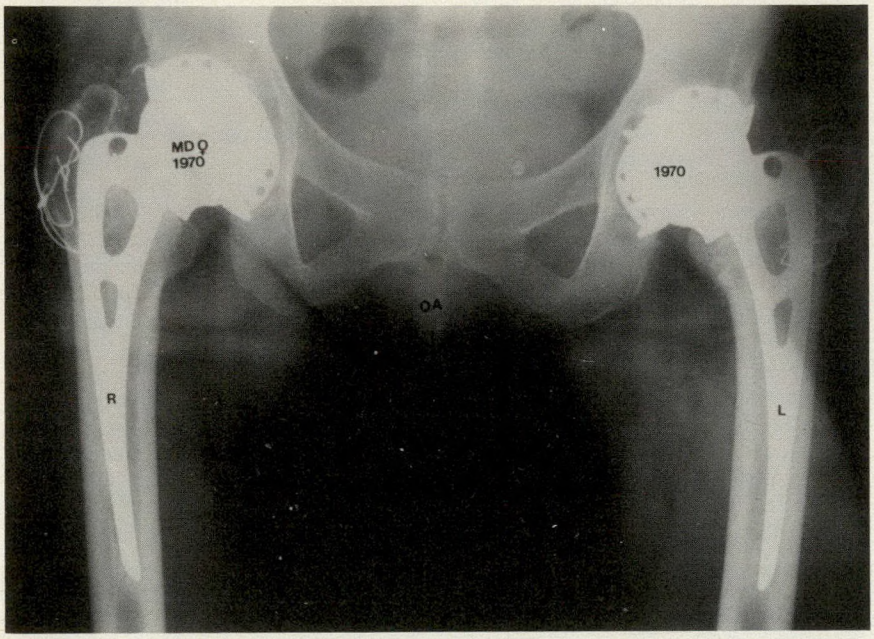

FIG. 5—Bilateral McGoey–Evans total hip arthroplasty for osteoarthritis. In this case procedure on left side was performed 6 months after that on right. Follow-up at 10½ and 11 years respectively showed that both prostheses were performing satisfactorily (hip score 94 bilaterally).

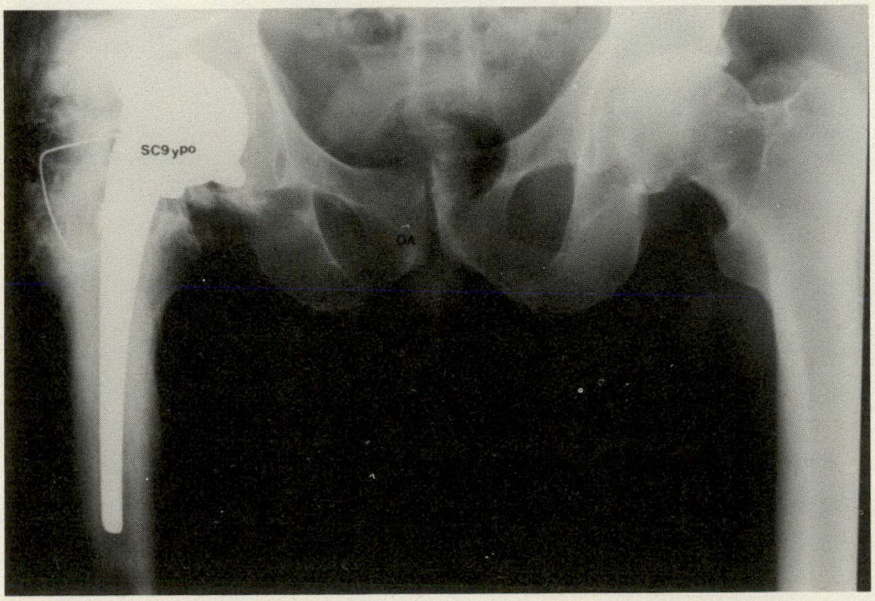

FIG. 6—This McGoey–Evans prosthesis had been inserted 9 years previously. At follow-up, results were rated as poor (hip score 54). There are signs of loosening of femoral component and marked heterotopic ossification.

Objective Results

Overall, a satisfactory result with this prosthesis was obtained in 46.5% of cases. Further analysis of the results showed substantially different success rates between the two sexes. In men, the rate was 64.3% (18 of 28) compared with 38% (22 of 58) in women (Fig. 3). The favourable results in men were apparent in every age group (Fig. 4). Furthermore, although there were five women over the age of 60 years with very low hip scores (less than 40), no man of any age had a hip score of less than 50. In six of seven patients with bilateral hip replacement, both hips had similar scores. No deep infections were recorded in this group of patients.

Subjective Results

Most patients stated that it took 1 to 2 years before they regained maximum strength at the operated site. Many complained of persistent stiffness, but 85% of the 57 patients questioned expressed satisfaction with the overall performance of the artificial hip.

Radiologic Results

The x-ray films of 44 hips were available for review.

Heterotopic bone formation.—This was seen predominantly in men with osteoarthritis and considered extensive in 11 hips (Fig. 5). In all but one of these cases, it was associated with a radiologically loose implant.

Radiologic loosening.—Components of 11 hip arthroplasties were considered loose radiologically (Fig. 6); 3 involved the acetabular cup, 3 the femoral component and 5 both of these. A poor functional result correlated with radiologic loosening in only five cases; two involved both components, two the acetabular cup and one the femoral stem only.

Subsidence.—Consecutive x-ray films of 23 hips were available. In seven, some settling of the femoral component was measured (in most cases between 1 and 2 cm). No clinical correlation between this subsidence and the clinical outcome was found.

Trochanteric union.—All but one osteotomized greater trochanters reunited. Clinically, the patient with nonunion exhibited a notable pelvic lurch during walking and had an overall unsatisfactory objective result.

Revisions

The revision rate for the McGoey–Evans total hip arthroplasty in this study was 26% (22 of 86). Closer analysis showed that the incidence of revision in men was less than that of women (21% versus 27.5%), middle-aged women had the highest revision rate (Fig. 4) and most revisions (17 of the 22) were performed within 5 years of the original replacement. Seventeen patients who underwent revision surgery stated that they were never relieved of their symptoms after the original hip replacement. The remaining five (two men, three women) enjoyed a pain-free period ranging from 3 to 9 years before symptoms began. None of the revisions were done as a result of acute injury.

In 18 revisions, the reasons were recorded clearly — a loose acetabular cup (8), a loose femoral component (5) and loosening of both components (5). Infection was never recorded as a cause of revision. Severe metal reaction was seen in the tissues of two patients with revision. In both cases (revision performed after 3½ years and 7 years) the surgeon attributed prosthetic loosening to this local tissue reaction.

Discussion

The McGoey–Evans uncemented total hip arthroplasty is outdated and does not have a place in the current practice of hip surgery. However, retrospective review of the results obtained with this prosthesis (the first long-term follow-up of an uncemented hip arthroplasty in North America) has yielded certain interesting findings that may be useful in prosthetic hip replacement of the cementless variety today.

The fact that we found no deep infections in the patients reviewed is of particular importance when one considers that antibiotics were not given prophylactically and no ultra-clean operating rooms were used. We believe that the absence of bone cement may have been a major factor, and experimental evidence supports this. As shown in the laboratory, the methylmethacrylate bone cement interferes with the ability of the local tissues to destroy bacteria by depressing the chemotactic factors of the complement sequence[20] and by reducing the ability of the leukocytes to phagocytose.[21] Also, it has been noted that cemented arthroplasties in experimental animals tend to fail from sepsis much more frequently than uncemented ones.[22]

That younger patients and male sex benefitted the most from this prosthesis is contrary to the experience with the cemented hip prostheses[8,11,12,17] but is in accord with the results obtained so far with the newer generation of uncemented hip replacements.[13,23,24] We believe this finding suggests that the strength of the biologic fixation is closely related to the quality of the host bone. The difference in the good results between men and women noted in our study has not previously been reported. The increased tendency for osteoporosis in women might have been the underlying cause.[25]

The revision pattern of this prosthesis differs from that of the cemented ones. Here the majority of the patients who required revision never became symptom-free, but most patients with cemented prostheses usually enjoy a few years of painless hip motion.[10,17,26] The explanation for this should be sought in the difference in implant fixation. With the cemented hip replacement maximal fixation is obtained at the time of surgery,[17] whereas in the noncemented one the biologic fixation, by fibrous membrane or, in the newer uncemented prosthesis, by bone ingrowth, takes place gradually.[23,27] This is the reason why the symptoms after a noncemented hip arthroplasty disappear gradually. The persisting symptoms that often lead to revision surgery should be attributed to

the failure, for whatever reason, of this natural bond to mature.

The loosening in 2 of the 22 revised arthroplasties was attributed to local tissue hypersensitivity. A similar low incidence of loosening related to local tissue reaction has been reported before.[27,28] Local tissue hypersensitivity to the metallic implant, therefore, appears to be a minor factor in prosthetic loosening. Finally, despite the prolonged presence of these implants in living tissues no evidence of systemic toxic side effects to cobalt or chromium or development of a malignant lesion near the implant was noted.

Conclusions

Although the advances in the total joint replacement technology have made the McGoey–Evans prosthesis obsolete, long-term review of the results of its use showed that an uncemented prosthesis carries a low risk of infection, patients with good quality bone (younger, male) get better results, revision of the arthroplasty is more frequent early and less frequent later after the initial replacement and local metal hypersensitivity is an uncommon cause of prosthetic loosening.

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Is Preoperative Colonoscopy in Carcinoma a Realistic and Valuable Proposition?

Colonoscopy was performed preoperatively in 100 consecutive patients as a prospective study to establish the feasibility of the procedure and its value, which was considered "adequate" when the colon remaining after surgical resection had also been examined preoperatively. Colonoscopy was adequate in 35 of 46 patients (76%) with malignant tumour located in the cecum and ascending and transverse colon, but in only 15 of 54 patients (28%) who had a tumour in the left colon or rectum. Synchronous malignant tumours were present in 2 patients, and 54 additional adenomas were discovered in 29 patients. These adenomas could be removed endoscopically in 13 patients and were included in the standard resection in 12. Extension of the planned operation was necessary in only four patients with synchronous adenomas. Routine preoperative colonoscopy to assess the presence of synchronous colonic tumours is more likely to be adequate in proximal or right-sided large-bowel tumours than in left-sided tumours because of the annular configuration of the latter. Because of the high rate (46%) of synchronous adenomas in adequate examinations, inadequate preoperative colonoscopy should be complemented by a repeat examination 3 to 6 months postoperatively in every patient with a malignant tumour of the large bowel.

Afin d'établir les possibilités et la valeur réelle d'une coloscopie préopératoire dans le cancer du gros intestin, les auteurs ont fait une étude prospective chez 100 patients consécutifs porteurs d'un cancer du côlon et du rectum où une coloscopie préopératoire a été tentée. Ils avaient considéré que cette coloscopie était adéquate si la portion non réséquée du côlon à la suite de leur opération avait été examinée endoscopiquement. Ainsi la coloscopie a été jugée comme étant adéquate chez 35 des 46 malades (76%) où la tumeur maligne était localisée dans la partie proximale du côlon (caecum, côlon ascendant et transverse). Par ailleurs, elle ne fut adéquate que chez 15 des 54 patients (28%) où la lésion maligne était située dans le côlon gauche et le rectum. La présence de deux lésions malignes synchrones additionnelles fut établie et 54 adénomes synchrones ont également été démontrés chez 29 patients. Ces adénomes étaient enlevables endoscopiquement chez 13, furent inclus dans le spécimen standard de résection chez 12 et nécessitèrent une extension de cette résection standard chez seulement 4 patients avec des adénomes additionnels. Les auteurs estiment que la coloscopie préopératoire de routine pour le cancer du côlon afin de déterminer la présence de tumeurs synchrones a plus de chance de réussir et d'être adéquate pour les cancers du côlon proximal à cause de la nature sténosante des tumeurs situées dans le côlon gauche. Aussi à cause du haut taux (46%) d'adénomes synchrones lorsque l'examen du côlon fut adéquat les auteurs recommandent qu'une coloscopie postopératoire dans un délai de 3 à 6 mois soit faite pour tous les cas de cancers opérés chez qui une coloscopie préopératoire n'a pu être tentée ou réussie.

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Resection of a segment of large bowel remains the most appropriate treatment for colorectal carcinoma.[1] Standard patterns of resection, depending on the site of the tumour, are well established.[2] Total colectomy and even proctocolectomy have been advocated for multiple malignant lesions and for concomitant benign and malignant neoplasms in separate segments of the colon.[3] Although these extensive resections may be indicated for synchronous carcinomas, they are now rarely performed for synchronous benign adenomas, since total colonoscopy allows both excision of the adenomas and follow-up of the patient.[4–6] The surgeon performing a colonic resection for carcinoma is anxious to ensure that all tumour has been removed. The reliability of barium examinations to reveal additional lesions in the colon is often discussed.[7,8] Careful palpation of the colon at laparotomy may reveal gross tumour,[9] but the soft or small, benign, villous adenomas are likely to be missed. For these reasons, several authors[10–14] have recently proposed total colonoscopy to achieve proper screening of the bowel for synchronous tumours. These reports generally mention a 5% prevalence of synchronous carcinomas and 25% to 50% of benign adenomas. Unfortunately, the majority of these studies do not report consecutive cases,[10–12,14] some include postoperative examinations[11,13] and others exclude incomplete colonoscopy.[11–14] Because a realistic picture of the expectations of routine preoperative colonoscopy is not adequately presented, we carried out a prospective study to assess the value and feasibility of this procedure.

Beginning in January 1984 colonoscopy was attempted preoperatively in 100 consecutive patients with colorectal carcinoma.

Patients

There were 56 men and 44 women ranging in age from 35 to 90 years (mean 64 years). The proportion of index tumours according to nonmodified Dukes' staging was class A — 17, B — 45 and C — 21; 17 had distant metastases. Barium enema established the presence of carcinoma in 75 patients. In seven,

colonoscopy was performed to assess a questionable finding of barium enema. In 11, the barium enema findings were normal and colonoscopy was performed in an effort to elucidate symptoms; finally, in 7, barium enema was not done, as colonoscopy was the primary procedure that led to the diagnosis of carcinoma. Ninety-five patients underwent some type of curative or palliative resection. One woman had a transanal excision of a small rectal lesion and four tumours were judged unresectable; we did an internal bypass of the tumour in three and the other had laparotomy only.

For analysis, patients were divided into two groups according to the site of the carcinoma: group 1, 46 patients in whom the primary tumour was located in the right colon (cecum and ascending and transverse colon) and group 2, 54 patients who had primary tumour in the left colon (from the splenic flexure to the rectum). One patient had two primaries, one on each side of the colon, and was placed in group 1.

Preoperative colonoscopy was considered "adequate" if the unresected portion of the colon had been examined (i.e., in group 1 to the level of the ileocolonic anastomosis and in group 2 to the cecum).

Results

Preoperative colonoscopy was adequate in 50 patients (35 [76%] group 1 patients and 15 [28%] group 2). Reasons for inadequate examinations in both groups are listed in Table I. The technical failures were due either to fixation of the sigmoid colon by previous pelvic surgery or to excessive redundancy. In three instances, preoperative colonoscopy was inadequate because the resection was palliative, leaving intact a portion of bowel proximal to the lesion that had not been visualized by endoscopy; all tumours were transverse colon primaries. In two patients with low rectal lesions, the pain was severe, and physical and endoscopic examinations had to be done under anesthesia, which limited the extent of the endoscopy. In 30 group 2 patients the tumour narrowed the lumen to the extent that the endoscope could not be passed. No complications occurred from the procedure.

Synchronous carcinomas were present in two patients, but since both were seen on barium enemas their finding cannot be credited to the colonoscopic inspection. Fifty-four benign adenomas were discovered at colonoscopy in 29 patients: in 23 of the 50 who had adequate colonoscopy and in 6 of the 50 who had inadequate colonoscopy. Thirty-two (59%) of these adenomas were less than 1 cm in dimension and of the other 22, 4 were greater than 2 cm. Their distribution throughout the colon is shown in Table II; the majority (80%) were located in the left colon.

Extension of the standard resection for one primary carcinoma was performed in the two patients with two primaries but cannot be credited to preoperative colonoscopy for the reason already mentioned. The adenomas were included in the standard resection for the malignant tumour in 12 patients. In 17, they were beyond the limits of the standard resection but were removed or judged to be removable at a later time by endoscopy in 13 patients. Therefore extension of the standard cancer resection was indicated in only four patients to include the benign adenoma(s), because of their size or sessile configuration in three patients, and because of their number (seven) in the fourth.

Discussion

The concept of preoperative colonoscopy in colorectal carcinoma has evolved from the studies of synchronous[3,9,15] and metachronous[16,17] tumours in the bowel. Several authors[3,6] have stated that a metachronous lesion discovered within 1 or 2 years of surgery is really a missed synchronous tumour. On the basis of 4884 cancer operations performed between 1928 and 1970, investigators at St. Mark's Hospital have established the incidence of synchronous carcinoma at 3%.[18] This rate was further analysed by Heald and Bussey,[9] who noted that in only 16% was the diagnosis of two cancers known to the surgeon preoperatively. Moreover, in 54%, the second cancer was found only in the resected specimen. Colonoscopy has since re-established the incidence of synchronous carcinoma at 5%.[13] The frequency of benign adenomas in patients suffering from colorectal carcinoma has been determined by pathological studies of operative specimens to be 28%.[19] Colonoscopy theoretically allows inspection of the entire large bowel and it is not surprising that the number of synchronous adenomas should be greater,[12,14] especially if we accept Cohen and Waye's estimate[20] that 10% of polyps are likely to be missed at the initial colonoscopic examination. The purpose of our study was not to establish a similar or distinct rate for synchronous tumours but to put into a proper perspective both the limitations and benefits of systematic preoperative colonoscopy.

We thought it preferable to analyse a consecutive series of cases and, although limited to 100 patients, our study did not exclude a single case of colorectal cancer and in this way, differs from those previously published.

Reilly and associates,[10] in a study of 157 cases, 65 of which were examined postoperatively, reported a 7.6% incidence of synchronous carcinoma. Their polyp yield (62%) seems elevated but was based on a 5-year follow-up. Maxfield,[11] who studied 114 cases but excluded incomplete examinations, reporting on 90, gave an incidence of 4.4% and 40% for synchronous carcinomas and adenomas respectively. The extension of resection is mentioned only for the patients with carcinoma. Pagana and colleagues[12] studied 185 patients and reported on 157 after excluding the incomplete examinations. Their rates were 7.2% and 28.7% for synchronous carcinomas and adenomas. They also mentioned extension of the resection in 11% of patients overall and in 26.3% of those with synchronous polyps, both figures being substantially higher than in our own experience. Langevin and Nivatvongs[13] reported a 4.8% incidence of multiple carcinoma and 27.7% of synchronous adenomas in 166 consecutive patients, a study that also excluded the incomplete examinations and was based on pre- and postoperative colonoscopic examinations. They also stated that 67% of the adenomas were found in anatomical segments of the colon distinct from

Table I—Reasons for Inadequate Colonoscopy

Reason	Group 1 (n = 46)	Group 2 (n = 54)
Technical difficulty	6	5
Diverticular disease	2	–
Palliative resection	3	–
Stricture	–	1
Poor preparation	–	1
Pain (anorectal)	–	2*
Lumen narrowed by tumour	–	30
Totals	11	39

*Endoscopy under anesthesia.

Table II—Distribution of 54 Adenomas in the Colon

Location	No.
Cecum	5
Ascending	3
Transverse	3
Descending	18
Sigmoid	22
Rectum	3

the carcinoma, but they made no mention of the impact of these findings on the extent of resection. The most recent study by Thorson and colleagues[14] with 176 non-consecutive preoperative examinations (excluding incomplete studies) reported rates for synchronous carcinoma and adenomas of 3.4% and 55.1%.

In our study we did not exclude any of 100 patients and we also report on the so-called incomplete colonoscopy specifically to assess the feasibility of routine endoscopic examination of every patient with colorectal carcinoma.

Our definition of adequate rather than complete colonoscopy seems more appropriate for the purpose of preoperative colonoscopy, since adequate colonoscopy asserts that no substantial benign or malignant tumour is left behind at operation. The word "clearance" of the colon has been used by some[6,21] to define this aim which can be divided in three components: (a) to determine the presence of more than one malignant lesion, (b) to discover benign adenomas that must be removed by extending the standard planned procedure and (c) to remove all endoscopically excisable adenomas.

In that respect, we found a 29% incidence of associated adenomas. This figure is in accordance with some of the previously mentioned figures, but rises to 46% if we include only the adequate examinations. In 12 patients, the adenomas were to be part of planned surgical resection, but in only 4 of the remaining 17, was extension of the resection judged necessary.

Extension of a standard resection for a single malignant tumour as a subtotal or total abdominal colectomy has long been advocated for multiple carcinomas and for a single carcinoma associated with adenomas in a different segment.[3,15] This recommendation still holds for multiple carcinomas especially when they are in separate segments[9] but is debatable for synchronous adenomas.[22] Colonoscopy allows removal of the majority of those adenomas and provides appropriate follow-up to remove newly formed ones. Extension of any standard resection to include adenomas in other segments should be reserved for those that would not be excisable endoscopically because of their size, configuration, possible malignancy or the risk of complications from the polypectomy.

The percentage of inadequate examinations in our study seems elevated. Others[11,12] have mentioned a high failure rate due to the obstructive nature of left-sided colonic tumours. Most reports do not dwell extensively on incomplete colonoscopic examinations: they either exclude them[13,14] or simply mention them when they are done postoperatively.

Conclusions

Physicians attempting routine preopertive colonoscopy in patients with colorectal carcinoma should expect an overall adequacy rate of 50%: 76% in tumours of the proximal half of the bowel and 20% in tumours of the distal half.

Synchronous adenomas will be present in up to 46% of patients in which the colonoscopy is adequate.

Extension of the standard cancer operation to include adenomas will be needed in 4%, which represents 14% of the patients with additional adenomas.

Because of the high rate of adenomas found when preoperative colonoscopy was adequate, we recommend interval postoperative colonoscopy in patients in whom preoperative colonoscopy could not adequately be performed.

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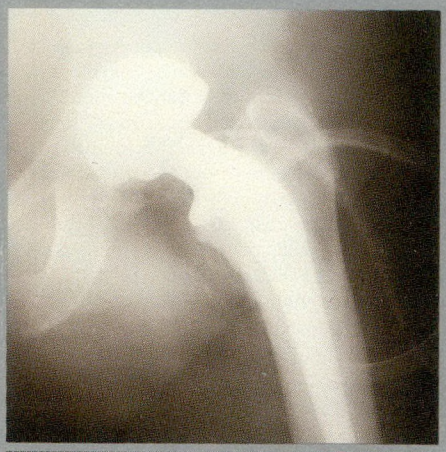
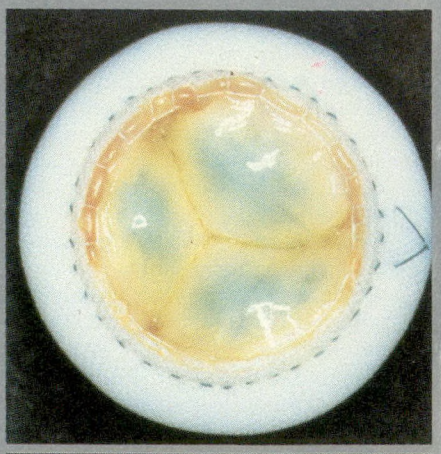
MORE CONFIDENCE IN ANTITHROMBOTIC THERAPY

New Guidelines for Antithrombotic Therapy In Surgical Cases



The American College of Chest Physicians and the National Heart, Lung and Blood Institute recently issued new guidelines for antithrombotic therapy.[1] There were four Grade A recommendations for the use of warfarin (Coumadin®) in surgical cases. In each of these four (and other Grade A and B recommendations for Coumadin®) a PT ratio of 1.2-1.5 (rabbit brain) was emphasized for clinical efficacy and reduced side-effects risk.



INDICATIONS: **Elective hip surgery / surgery for fractured hips.**

". . . patients undergoing elective hip surgery should be pretreated prophylactically with adjusted-dose heparin or moderate-dose warfarin sodium . . ."

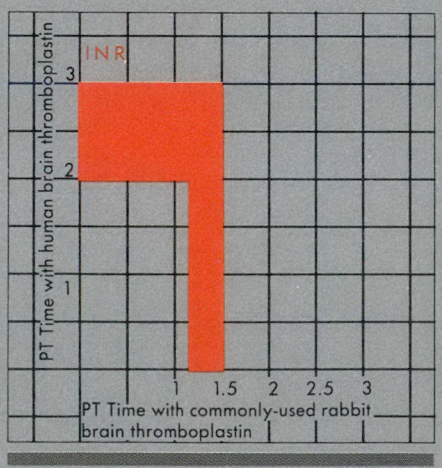
". . . patients undergoing surgery for fractured hips should be treated prophylactically with moderate-dose warfarin.

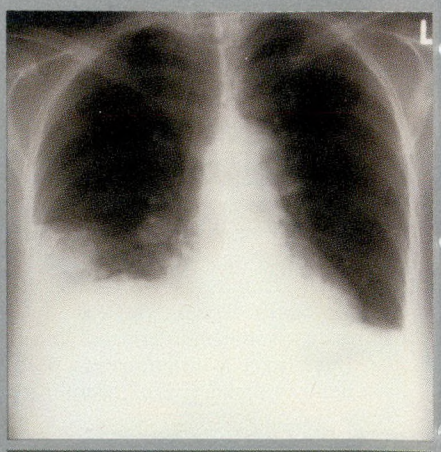
CONDITION: **Bioprosthetic heart valves.**

". . . all patients with bioprosthetic heart valves in the mitral position be treated for the first three months after valve insertion with less intense warfarin . . ."

INDICATION: **Prophylaxis of venous thromboembolism.**

"It is strongly recommended that the therapeutic range for prophylaxis . . . in high-risk medical or surgical patients should be equivalent to an INR of 2.0-3.0 (corresponding rabbit brain thromboplastin ratio 1.2-1.5)."





CONDITION: **Prophylaxis of venous thromboembolism.**

"It is recommended that anticoagulant therapy should be continued for three months using oral anticoagulants to prolong prothrombin time . . ."

"We believe these recommendations will be of value to practicing physicians."

James E. Dalen, M.D., F.C.C.P., Jack Hirsh, M.D., F.R.C.P.C., Co-Chairmen: ACCP-NHLBI Conference on Antithrombotic Therapy

1. **Chest** 1986;89(2);1S-106S

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Portal Vein Injury

With the increasing number of traumatic injuries being seen in emergency departments, physicians must be aware of the less common and less obvious types of serious injury. Portal vein injury is serious (death rate 50%) and may be diagnosed only at laparotomy. Fortunately this injury is rare. Its management can be difficult, but an awareness of the possible methods of treatment could be life-saving. The authors report their experience with this injury and survey the literature on the subject.

Comme les salles d'urgence voient de plus en plus de blessures individuelles, il est important de pouvoir reconnaître certaines lesions moins fréquentes. Une atteinte à la veine porte est heureusement assez rare. Elle peut n'être reconnue qu'à la laparotomie. Son exploration et sa reconstruction peuvent être difficiles, et une bonne connaissance des résultats possibles du traitement peut être vitale, cette lésion entraînant une mortalité de 50%. Les auteurs font part de leur expérience personnelle et présentent une revue des autres travaux déjà publiés.

From the Department of Surgery, University of Saskatchewan, Saskatoon, Sask.

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Published reports of portal vein injury are uncommon, possibly because of the rarity of the injury or because such patients often die of exsanguination before surgical exploration can be carried out. We report three cases, review the literature and discuss the possible methods of managing this injury.

Case Reports

Case 1

A 36-year-old man was admitted to the emergency department with a knife wound to the right upper abdomen. On examination he was unresponsive and there was no blood pressure. There was little response to attempted resuscitation so he underwent immediate laparotomy. The knife wound was seen to penetrate the liver and there was a large hematoma around the free edge of the gastrohepatic omentum. This area was rapidly cleared and a severed posterior superior pancreaticoduodenal artery ligated. Continued bleeding, on further exploration, was found to be coming from the portal vein. Finger compression was applied to the area while adequate dissection of the vein was carried out to control the bleeding. Anterior and posterior lacerations of the portal vein, behind the head of the pancreas, were repaired by lateral venorrhaphies. Further exploration of the area, including the right renal vessels, revealed no abnormalities. The abdomen was closed and the patient made an uncomplicated recovery. A total of 8.6 L of fluid was given intravenously; this included 2 L of saline given immediately on admission and 3 L of blood.

Case 2

Twenty-four hours after the patient in case 1 was admitted, a 13-year-old boy was transferred from a hospital 250 km away with a knife wound in the right upper abdomen. He had already received 2 L of crystalloid solution intravenously. On arrival, his blood pressure was 70/50 mm Hg and his pulse rate 150 beats/min. Laparotomy again revealed a large hematoma in the area of the porta hepatis, and exploration uncovered the following injuries: a through-and-through stab wound to the left branch of the portal vein at the porta hepatis, a tear in the anterior wall of the inferior vena cava and a completely severed left hepatic duct. The Pringle maneuver was used to control bleeding from the portal vein to permit lateral venorrhaphy of the inferior vena cava and exposure of the proximal portal vein. Fogarty balloon catheters were only moderately successful in controlling back bleeding in the right and left portal veins. Intermittent finger pressure was therefore necessary until the left branch of the vein was repaired, again by lateral venorrhaphies. The left hepatic duct was repaired over a stent and the abdomen was closed. Blood loss was estimated to be 5 L. The patient was given 7 L of crystalloid fluid and eight units of blood as replacement. He had a smooth recovery. A T-tube cholangiogram before discharge showed that the duct repair was satisfactory and when seen at 6-month follow-up he was well.

Case 3

During the course of a subtotal pancreatectomy for intractable pain in a 61-year-old man with chronic pancreatitis, the portal vein was inadvertently injured at its origin. Both ends were immediately controlled by vascular clamps and the subtotal pancreatectomy was completed. An attempt at end-to-end anastomosis was not successful as the gap between the superior mesenteric vein and the portal vein itself was too great. The segment of splenic vein, removed with the specimen, was dissected off the tail of the pancreas and used as an interposition graft. Flow through the graft was satisfactory. A superior mesenteric angiogram 3 months later showed, in the venous phase, that the interposition vein graft was patent and of normal calibre. Blood loss during this procedure was 2 L.

Discussion

The portal vein averages 2 cm in diameter, has a blood pressure of 10 mm Hg and a flow rate of approximately 1 L/min. Injury to this vein therefore will almost certainly result in hypovolemic shock. Review of the literature and our own experience confirms that this is the usual clinical picture. Fifty percent of these patients will have a temporary

← For prescribing information see page 132

initial response to resuscitation with intravenous fluids, while the remainder will fail to respond before laparotomy and control of the bleeding.

Again, review of the literature and our two trauma cases, show that at least one other organ will be injured (Table I), and 70% of these organs will be other major vascular structures, giving an overall death rate of 46% in the reported cases. Because of the seriousness of this injury there are very few preoperative diagnostic measures on record; the diagnosis is usually made only at the time of laparotomy, where rapid control of bleeding is the obvious but often difficult solution. It may be necessary to cross-clamp the aorta below the diaphragm to achieve local control and permit the patient's condition to be stabilized. Exploration of the portal vein itself requires adequate mobilization of the duodenum enhanced by division of the cystic duct with eventual cholecystectomy, thus allowing more mobilization of the structures in the porta hepatis. If the injury lies behind the neck of the pancreas, division of that organ will be required.

There are various methods of dealing with portal vein injury (Table II). Lateral venorrhaphy, if possible, gives an excellent result. The portal vein will frequently have a through-and-through injury making lateral venorrhaphy more difficult, but narrowing of the vein is acceptable under these circumstances.

When lateral venorrhaphy is not feasible, Stone,[1] in his latest series, considers ligation to be the method of choice. In his last 10 cases, treated by ligation, the death rate was lowered to 20%.

End-to-end anastomosis is rarely possible but obviously would restore continuity.

Free interposition grafting, using either a vein or a synthetic graft, would appear to be ideal, where appropriate, but to our knowledge this procedure has only been carried out on three occasions. In the series of Petersen and colleagues,[2] and in our third case, the splenic vein was used. Other veins available for grafting in the abdomen are the inferior mesenteric or the left renal vein, while the internal jugular or the long saphenous vein are available from the periphery. On the one occasion when a synthetic graft was used it thrombosed necessitating exploration the following day, but the patient died.[3]

Control of bleeding is certainly the most difficult problem and although cross-clamping of the aorta will slow the flow of blood, retrograde bleeding will continue to be a problem. Use of Fogarty balloon catheters may help locally in the portal vein, but the Pringle maneuver likely will be the most useful method of local control until dissection and vascular clamps or catheters can be used at a distance. It may be necessary to defer management of the injury to the portal vein while other major vascular structures (the inferior vena cava, the aorta, or the renal vessels) are being repaired. Although Stone's results with ligation were excellent, there is no long-term follow-up of the effects of portal vein ligation, his follow-up of 3 years without problems being the longest reported. When the portal vein is ligated, overtransfusion is necessary because of the pooling of blood in the portal system leading to systemic hypovolemia. Johnstone[4] recorded a 50% reduction in the circulating blood volume of experimental animals after ligation of the portal vein. Starzl and colleagues[5,6] indicated possible endocrine deprivation of the liver and showed that insulin is required for the total integrity of the liver cells. Neidner and Mattes (quoted by Hubbard[7]) and Patton and Johnson[8] reported the development of portal hypertension with its consequences in patients who had previously undergone ligation of the portal vein due to injury. Chisholm and Lenio[3] reported thrombosis of the portal venous system after ligation and suggested a second-look procedure, after 24 hours, to exclude this and to assess the bowel for areas of vein thrombosis and infarction.

If the patient's condition permits, an interposition graft should be considered when safe closure of a portal vein injury is impractical. Busuttil and associates[9] and Petersen and colleagues[2] used this method with apparently excellent results.

Synthetic grafts are unsatisfactory in this situation.

Table I—Other Organs and Arteries Injured in Conjunction With Portal Venous Injuries (in Descending Order of Frequency)

Stomach
Liver
Inferior vena cava
Duodenum
Pancreas
Small bowel
Colon
Aorta
Spleen
Bile ducts
Kidney
Hepatic artery
Superior mesenteric artery

Table II—Methods of Possible Management of Portal Vein Injury: Cases Reported in the Literature

Method	No.	Survived
Lateral repair	66	44
Ligation	30	14
End-to-end anastomosis	7	5
Portacaval shunt	2	1
Free interposition graft	2	2
None	16	0
Totals	123	66

Conclusions

The preoperative, perioperative and intraoperative management of portal vein injury is a formidable undertaking, carrying a death rate of 50%. For the surgeon who is not well versed in vascular surgery, ligation appears to be the method of choice, but lateral venorrhaphy, when possible, will give a much more satisfactory result. If Starzl and colleagues[5,6] are correct in suggesting that there is a factor that is necessary for the integrity of liver cells, and since the long-term effects of ligation are unknown, vascular reconstruction using a vein graft should be considered whenever possible.

As reported in the literature, portacaval shunting under these circumstances carries an extremely high incidence of encephalopathy and should not be considered as an immediate method of management. Patient survival is paramount, secondary problems such as portal hypertension can be dealt with later.

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Direct Effects of Autotransfused Blood on Myocardial Muscle Mechanics in Man

Homologous blood transfusions carry risks — febrile reactions, isoimmunization incompatibility reactions and transmission of infectious diseases such as AIDS and hepatitis. Although autotransfusion techniques will reduce the need for banked homologous blood, autologous shed blood does contain various cellular fragments that may act directly as myocardial depressants. Accordingly, the myocardial muscle mechanical properties of isolated human right atrial trabeculae contracting in vitro were measured in a bath containing either blood collected in the Sorensen ATS Autotransfusion Receptal unit or arterial autologous blood. Muscles were tested randomly in each solution by measuring their isometric resting and developed forces and the mean rate of developed force at different stimulation rates (force–frequency relation). In addition, biochemical, hematologic and immunologic assays were performed on each blood specimen. Significant increases ($p < 0.05$) in potassium and plasma-free hemoglobin indicated that cell disruption had occurred in blood collected in the autotransfusion apparatus; however, there was no statistically significant difference in mechanical performance between muscles contracting in either solution. From these results, the authors conclude that autotransfused blood does not directly affect human heart-muscle mechanics.

La transfusion de sang homologue entraîne certains risques — réactions fébriles, iso-immunisation, réactions d'incompatibilité et transmission de maladies infectieuses telles que le SIDA et l'hépatite. Même si les techniques d'autotransfusion peuvent réduire les besoins en réserves de sang homologue, le sang autologue renferme divers fragments cellulaires susceptibles d'agir directement comme dépresseurs du myocarde. En conséquence, on a étudié les propriétés mécaniques du myocarde en mesurant in vitro les contractions des colonnes charnues de coeur humain isolées dans un bain renfermant soit du sang recueilli à l'aide d'un récipient d'autotransfusion Sorensen ATS, soit du sang artériel autologue. Les muscles ont été testés au hasard dans chacune des solutions par la mesure des forces isométriques de repos et d'effort, et le taux moyen de la force développée à divers fréquences de stimulation (rapport force–fréquence). De plus, des épreuves biochimiques, hématologiques et immunologiques ont été effectuées sur chaque échantillon de sang. Des augmentations significatives ($p < 0.05$) du potassium et de l'hémoglobine libre de plasma indiquaient qu'il y avait eu bris cellulaire dans l'équipement d'autotransfusion. Néanmoins, on n'a enregistré aucune différence significative de fonctionnement mécanique entre les muscles qui se contractaient dans l'une ou l'autre des solutions. A partir de ces résultats, les auteurs concluent que le sang autotransfusé n'affecte pas directement la mécanique du muscle cardiaque humain.

From the University of Ottawa Heart Institute, Ottawa Civic Hospital, Ottawa, Ont.

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In our institution, up to one-third of all banked blood is used for cardiovascular, thoracic and trauma surgery. There is increasing concern over the risks of using banked blood and the rising costs of processing. To reduce the amount of blood used, autotransfusion has become popular, especially in cardiac surgery where notable conservation has been achieved.[1] However, autotransfusion carries potential risks.[2] Autotransfused blood contains products of cellular autolysis that may affect hemodynamics, either directly or indirectly. The administration of autotransfused blood is sometimes accompanied by a marked decrease in blood pressure. This may result from the release of vasoactive products acting alone, peripherally, or combined with electrolyte changes, or acting directly as myocardial depressants. The direct effect of autotransfused blood has not been assessed. The purpose of this study was to evaluate the direct myocardial inotropic responses to autotransfused blood using one of the clinically available units.

Material and Methods

The atrial muscles and blood used for this study were taken from eight patients (five men, three women) who underwent coronary artery bypass grafting. Patients ranged in age from 44 to 70 years (mean ± SEM, 51.3 ± 3.3 years).

The Sorensen Mediastinal ATS Receptal System (Sorensen Research Corp., Salt Lake City, Utah) was evaluated at the University of Ottawa Heart Institute on patients who underwent open-heart surgery. Right atrial appendages were taken from consenting patients at the time of cardiopulmonary bypass. As cannulation was proceeding, the Receptal unit was connected to the cardiotomy suction apparatus by way of plastic tubing (the system was used in accordance with the manufacturer's specifications). Patients were heparinized (300 mg/kg) before cardiopulmonary bypass was instituted and blood was suctioned from the pericardial cavity and mediastinum directly into the Receptal unit. This arrangement was designed to assess the effects of the Receptal unit on blood, independent of the damaging effects of the cardiopulmonary bypass circuit. The appendage and two blood samples (100 ml of suctioned blood and 50 ml of the patient's heparinized arterial blood) were

sent to the laboratory. The blood samples were analysed for their electrolyte composition (Technicon SMAC; Technicon Instruments Corp., Tarrytown, NY), hemoglobin content (Coulter counter, Model S-Plus IV; Coulter Electronics Inc., Hialeah, Fla.) and serum complement levels — C3 and C4 with the Beckman ICS Analyze II (Beckman Instruments Inc., Toronto, Ont.) and CH50 by hemolytic assay.

Myocardial performance was assessed using individual trabeculae isolated from the patient's right atrial appendage. The muscles were placed between two stainless-steel clips of a muscle stand. The upper clip was attached to a force transducer (Statham–Gould UC-2; Statham Instruments, Oxnard, Calif.) whose output was amplified and recorded on a writer-recorder (Grass, model 7 polygraph; Grass Instruments, Quincy, Mass.). Muscles were immersed in a muscle bath containing a buffered Tyrode's solution aerated with 95% oxygen and 5% carbon dioxide and maintained at 34°C by a water-jacketed thermoregulating system. Field stimulation (Grass stimulator, model S88) was used to induce isometric contractions using square-wave pulses 5 to 10 milliseconds in duration at voltages 20% greater than that required to elicit a maximal response. Muscles were first lightly preloaded and stimulated at 0.1 Hz for 30 minutes then at 1 Hz for 15 minutes. Muscles were stretched until maximum force developed (L_{max}, peak of Frank–Starling relation) and then maintained at this length for the duration of the experiment. Conditions and procedures have already been reported.[3]

Muscle mechanical performance was measured from isometric contractions in terms of isometric resting force (RF) and developed force (DF) and mean rate of developed force (MRDF). Once muscles had equilibrated for 10 minutes, the bath was drained and replaced with either the arterial blood or the Receptal blood in random fashion. After a 10-minute equilibration period, a frequency–force relation was determined by stimulating the muscle at different frequencies randomly: 0.5, 1.0, 1.5, 2.0 and 2.5 Hz. The muscle was allowed to contract for 2 minutes before measurement of RF, DF and MRDF at each frequency. When the frequency–force measurements were completed, the bath was again drained and replaced with the remaining blood solution (either arterial or Receptal unit).

Statistical analysis of the muscle mechanical and blood test results was performed using a paired *t*-test. Probability values less than 0.05 were considered significant. At the time of cannulation, some saline was introduced into the pericardial cavity. Results of the complement test were corrected for dilution by multiplying the Receptal unit results by a correction factor (arterial hemoglobin/Receptal hemoglobin).

Results

The eight trabeculae used in this study had an average muscle length of 6.44 ± 1.05 mm at L_{max}, a weight of 6.54 ± 1.01 mg, and a calculated cross-sectional area of 0.93 ± 0.09 mm^2. Control muscle mechanical measurements in Tyrode's solution at a stimulation rate of 1.0 Hz were 0.19 ± 0.05 g RF, 1.30 ± 0.08 g DF and 13.05 ± 0.71 g/s MRDF.

A comparison of the RF, DF and MRDF between Receptal and arterial blood at each frequency revealed no statistically significant differences (Fig. 1).

There were significant differences in concentrations of electrolytes between samples from the Receptal unit and arterial blood. The most striking difference was seen in potassium concentration (5.3 versus 3.9 mmol/L [mean values] in Receptal and arterial blood, respectively) (Fig. 2).

The total hemoglobin level was significantly lower in the Receptal blood than arterial blood (92 g/L versus 110 g/L). Plasma free hemoglobin concentration was higher in the Receptal blood (3.2 g/L versus 0.12 g/L) ($p < 0.05$). C3, C4 and CH50 were corrected for dilution. The differences between Receptal and arterial blood were not statistically significant (Fig. 3).

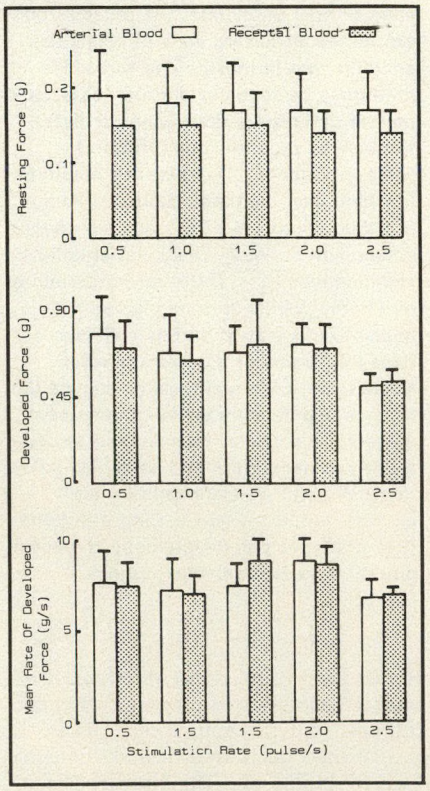

FIG. 1—Myocardial mechanical results (mean ± SEM) of human atrial trabeculae contracting on arterial (white bars) blood and to blood collected by Receptal unit (dotted bars).

Discussion

Autotransfusion reduces homologous blood transfusion requirements[1,2,4] and was popularized in the 1960s in Vietnam.[5] With respect to cardiac surgery, 41.7% of the patients in our institution bled more than 500 ml in the first 4 hours after surgery (unpublished data), a large percentage who may require blood transfusions. Schaff and colleagues[1] demonstrated a 50% reduction in the use of banked blood when patients who bled more than 400 ml in the first 4 hours postoperatively were autotransfused (52.3% of patients). Cosgrove and coworkers[6] at the Cleveland Clinic reported that more than 60% of patients who underwent cardiac surgery did not require banked blood transfusions as a result of autotransfusion. These results are impressive.

The risks of homologous blood transfusion are well known. They include febrile reactions, isoimmunization, incompatibility reactions and transmission of infectious diseases such as hepa-

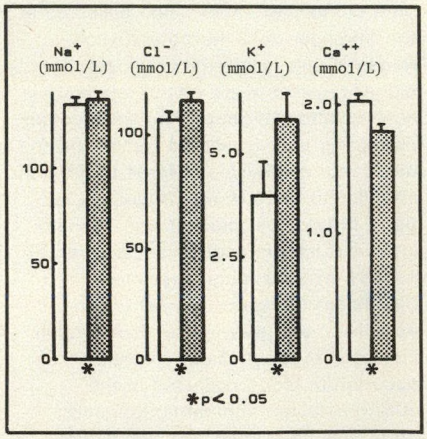

FIG. 2—Electrolyte data (mean ± SEM) for serum sodium, chloride, potassium and calcium. White bars = arterial blood, dotted bars = Receptal blood.

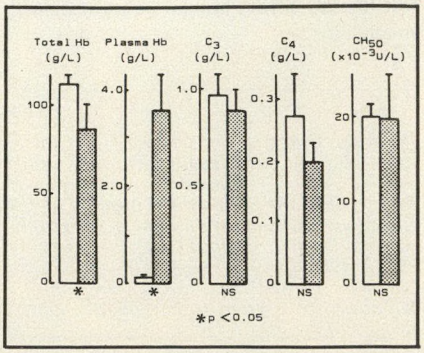

FIG. 3—Hemoglobin and complement levels (mean ± SEM) from arterial (white bars) and Receptal (dotted bars) blood. (Note: Receptal complement values have been corrected for dilution.)

titis and AIDS. There may also be problems with coagulation disorders and citrate toxicity. Autotransfusion has its own risks. They include sepsis, microembolism, hemolysis, thrombocytopenia, coagulopathies and renal failure.[5]

Although it is now clear that there are increasing risks and costs associated with banked blood transfusions, there are numerous questions to be resolved concerning the considered alternative. Autotransfused blood has increased plasma-free hemoglobin levels[1,7] as a result of hemolysis. With cellular disruption there is a release of intracellular constituents including electrolytes, enzymes and hemoglobin. Electrolyte changes affect myocardial performance[8] and there is the possibility that other released factors may have myocardial depressant actions. This study tried to assess the possible direct effects that autotransfused blood might have on myocardial performance.

The Receptal unit was used in such a way that its effect on blood could be assessed directly without the derangements created by passing blood through the cardiopulmonary bypass system. The protocol for this study used samples of fresh arterial blood and the right atrial appendage from the same patient. To test the effects of mediastinal shed blood collected postoperatively, the patient's own appendage would not be of use since information (unpublished data) indicates that the mechanical performance of this unique preparation would deteriorate with time and thus limit its capacity to evaluate the inotropic properties. We recognize that blood collected from the mediastinum postoperatively contains more cellular debris than the blood tested in the present study, but our primary concern was to evaluate the Receptal unit itself. Although the results indicate that the unit will not produce or induce a negative inotropic response, further experiments with a different protocol may be warranted to evaluate the combined effects of the Receptal unit and mediastinal shed blood. At the time of cannulation, saline introduced into the pericardial cavity diluted the blood collected in the Receptal unit, leading to a small but important rise in sodium and chloride and a decrease in calcium. Also there was a marked increase in potassium, which was underestimated because of the dilutional effect of the saline and presumably was a result of hemolysis. While the total hemoglobin value was reduced in the Receptal blood (due to dilution), plasma free hemoglobin was markedly increased. Changes in complement levels did not reach statistical significance which is surprising since contact with foreign surfaces is supposed to be a major activating factor as seen with cardiopulmonary bypass.[9,10] This finding might suggest that the physical trauma of cardiopulmonary bypass (bubble oxygenation and roller pumping) is the culprit in complement activation.

A useful way to study the impact of the above changes in blood composition on cardiac function is using isolated myocardial muscle contracting in vitro. It has been demonstrated that the relation between frequency of activation of human atrial muscle and the force of contraction describes a fundamental property of this tissue[11,12] and has been termed the Bodwitch phenomenon. Using this technique, we could find no difference in the contractile performance of human atrial trabeculae either in Receptal or arterial blood, despite differences in their composition. This leads us to suggest that any changes in hemodynamics due to autotransfusion are more likely to be indirectly or peripherally mediated. It should be noted that these trabeculae were adequately oxygenated so that the results from these studies may only be valid for normoxic hearts in the postoperative situation.

We thank Mrs. Diane Ayres for her technical assistance in performing these studies and Miss Maura Watson for her assistance with the graphs in this manuscript.

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SESAP V Question

3. An 11-year-old boy arrives in the emergency department after traumatic amputation of the right middle fingertip. An open wound through the pulp measures 1 cm in diameter. No bone is exposed. Appropriate treatment for this injury is

(A) split-thickness skin graft to the wound

(B) removal of the distal third of the distal phalanx with primary closure

(C) full-thickness skin graft from the postauricular area

(D) occlusive dressings

(E) cross-finger flap from the dorsal skin of the ring finger

For the incomplete statement above, select the one completion that is best of the five given.

For the critique of Item 3 see page 131.

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Surgical Treatment of Bronchogenic Carcinoma: the Importance of Staging in Evaluating Late Survival

From 1971 to 1980, 1292 patients with lung cancer were admitted to the Hôpital du Sacré-Coeur de Montréal. This diagnosis represented 0.5% of admissions in 1971 and 1.7% in 1980 (240% increase). Only 4% of patients were nonsmokers. Patients ranged in age from 30 to 93 years with a male to female ratio of 5.5 to 1.

Of 414 cervical mediastinoscopies carried out for right and left pulmonary tumours, 120 (29%) showed mediastinal lymph-node metastasis (positive biopsy). For 35 left-sided lesions, both cervical and left parasternal mediastinoscopies produced 13 (37%) positive biopsies. For 45 left upper lobe and left hilum tumours, left parasternal mediastinoscopy alone yielded 18 (40%) positive biopsies. Only 297 (23%) of the 1292 patients were considered to have operable lesions and they underwent thoracotomy — 164 (55%) lobectomies, 104 (35%) pneumonectomies, 2 (1%) segmentectomies and 27 (9%) exploratory thoracotomies.

The most common postoperative complication was respiratory failure — in 27 cases (9%); there were 12 (4%) bronchopleural fistulas. The operative death rate was 5% — 1.8% for lobectomy, 7.4% for exploratory thoracotomy and 9.6% for pneumonectomy. Causes of death were respiratory failure (60% of the deaths), hemorrhage (13%), cardiac events (13%) and bronchopleural fistula (13%). The overall 5-year survival was 9.2%. For the 297 patients operated on, the survival at 5 and 10 years was 55% and 36% for stage I disease, 30% and 20% for stage II disease and 10% and 8% for stage III disease, respectively. The mean postoperative follow-up was 41.5 months (range from 3.5 to 14 years). The incidence of cancer of the lung is still increasing. Pre-treatment staging according to the TNM system is essential. Long-term survival is related to the stage of the disease at the time of surgical treatment. Pneumonectomy is associated with a relatively high death rate.

De 1971 à 1980, 1292 patients avec cancers du poumon furent admis à l'Hôpital du Sacré-Coeur de Montréal. Cette pathologie représentait 0.5% des admissions en 1971 et 1.7% en 1980, pour une augmentation de 240%. La moyenne d'âge des patients était de 61 ans, variant de 30 à 93 ans et seulement 4% des patients étaient non fumeurs. Le rapport homme–femme était 5.5:1. Dans l'évaluation préopératoire, des 414 médiastinoscopies cervicales pratiquées pour des tumeurs pulmonaires droite et gauche, 120 (29%) ont démontré des métastases ganglionnaires médiastinales (biopsies positives). Pour 35 tumeurs du poumon gauche, des médiastinoscopies cervicales et parasternales ont résulté en 13 (37%) biopsies positives, tandis que pour 45 lésions du lobe supérieur gauche et du hile gauche, seule une médiastinoscopie parasternale gauche fut pratiquée, donnant lieu à 18 (40%) biopsies positives. De tous les patients, seulement 297 (23%) furent considérés comme opérables: 164 (55%) ont subi une lobectomie, 104 (35%) une pneumonectomie, 2 (1%) une segmentectomie et 27 (9%) une thoracotomie exploratrice.

La complication postopératoire la plus fréquente fut l'insuffisance respiratoire dans 27 cas (9%); 12 (4%) fistules broncho-pleurales furent relevées. La mortalité postopératoire fut de 5%: 1.8% pour les lobectomies, 7.4% pour les thoracotomies exploratrices et 9.6% pour les pneumonectomies. Les causes de décès furent l'insufficance respiratoire (60%), l'hémorragie (13%), une fistule broncho-pleurale (13%) et d'origine cardiaque (13%). La survie globale à 5 ans, des 1292 patients, fut de 9.2%. Pour les 297 cas chirurgicaux, la survie à 5 ans et à 10 ans fut de 55% et 36% pour les stades I, de 30% et 20% pour les stades II et de 10% et 8% pour les stades III, respectivement. La relance moyenne fut de 41.5 mois allant de 3.5 à 14 ans. L'incidence de cancer du poumon continue d'augmenter dans notre centre hospitalier. Nous concluons que la stadification selon la méthode TNM est essentielle, que la survie à long terme est reliée au stade de la maladie au moment du traitement et que la pneumonectomie est associée a un taux relativement élevé de mortalité.

The occurrence of lung cancer is still increasing annually at an incredible rate, especially for women. It is a worldwide problem, particularly in industrial countries. For annual death rate, Canada ranks 17th in the world for men and 11th for women.[1]

The published results of treatment have varied greatly over the years, but with more uniform staging of the disease, it is becoming easier to evaluate and to compare results.

The purpose of this study was to evaluate our results of surgery for lung carcinoma, using the staging method of the American Joint Committee for Cancer Staging and End Results Reporting.[2]

Method

We reviewed the medical records of 1292 patients with bronchial carcinoma admitted to the Hôpital du Sacré-Coeur de Montréal, from Jan. 1, 1971 to Dec. 31, 1980. Our study was limited to patients with histologically or cytologically confirmed carcinoma of the lung according to the World Health Organisation classification.[3,4] Data on the sex of patients, age at time of diagnosis and history of cigarette smoking were tabulated.

Patients were staged according to the methods of the American Joint Commit-

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tee for Cancer Staging and End Results Reporting.[2] Patients who were possible candidates for surgery underwent further staging procedures. Early in the series, concurrent scalene-node biopsy and cervical mediastinoscopy were done routinely, but the former procedure was discontinued[5] because of the low yield of positive biopsies. Beginning late in 1974, left parasternal mediastinoscopy was added as a staging procedure for left-sided tumours. Later, left parasternal mediastinoscopy alone was carried out for left upper lobe tumours as pre-treatment staging of mediastinal lymph nodes. Some results and the surgical technique of this procedure were reported previously.[6]

Mediastinal node metastasis (positive biopsy) at mediastinoscopy and a preoperative diagnosis of small-cell tumour were considered contraindications to surgery. All patients who underwent thoracotomy had routine intraoperative staging with sampling of nodes from the bronchopulmonary area, hilum and mediastinum. Positive mediastinal node biopsy at the time of thoracotomy was not necessarily a contraindication to resection. All postoperative hospital deaths were included in the surgical death rate.

Data were entered on a CYBER-70 (Control Data, Arden Hills, Minn.) for validation and statistical analysis. The SPSS (Statistical Software for Social Sciences) was used to perform actuarial analysis which was based on the method described by Berkson and Gage.[7] The differences between the actuarial distributions were compared by the χ^2 test, using Lee and Desu's algorithm.[8]

The accuracy of mediastinal node staging by cervical mediastinoscopy, left parasternal mediastinoscopy and by both techniques, was evaluated using the method of Galen:[9] sensitivity = TP/(TP + FN); specificity = TN/(TN + FP); efficiency = (TP + TN)/(TP + TN + FP + FN); predictive value of a positive test = TP/(TP + FP); predictive value of a negative test = TN/(TN + FN), where TP is true positive, FN is false negative, TN is true negative and FP is false positive.

Findings

Patient Data

Of the 1292 patients, 199 were women, giving a male to female ratio of 5.5:1. Of 19 415 patients admitted to our hospital in 1971, 87 (0.5%) bore this diagnosis, compared with 280 (1.7%) of 16 098 in 1980, for an increased incidence of 240%. In 1971, 7% (4 of 59) of newly diagnosed cases of lung cancer were in women compared with 20% (33 of 168) in 1980. The average age of the group was 61 years (ranging from 30 to 93 years). Data on smoking habits were available for 1122 (87%) patients. Only 4% (45) had never smoked and 76% had smoked 20 or more cigarettes a day.

Pathological Features

The histologic diagnoses for 1175 patients were as follows: 510 (43%) squamous-cell carcinomas, 241 (21%) small-cell carcinomas, 214 (18%) adenocarcinomas, 127 (11%) large-cell carcinomas, 18 (1.5%) adenosquamous carcinomas and 65 (5.5%) miscellaneous undifferentiated cell type. For 117 (9.1%) of the 1292 patients, the diagnosis was made on positive cytologic findings alone without definition of the exact cell type.

Staging

Of the study group, surgery was contraindicated in 995 (77%) patients, because of extension of the disease, inadequate pulmonary, cardiac or renal function, or because they refused surgical treatment. Cervical mediastinoscopy was done for right- and left-sided tumours in 414 patients. For 35 with left-sided tumour, both cervical and left parasternal mediastinoscopy were carried out. Forty-five patients underwent left parasternal mediastinoscopy alone, for left upper lobe and left hilar lesions. Mediastinal lymph-node metastasis was identified through these staging procedures in 151 patients. Results of pre-treatment staging are shown in Tables I and II. Table II includes the number of patients found to have unexpected mediastinal node metastasis at operation (false-negative staging procedure) and the

Table I—Staging Procedures, Tumour Location and Results of Nodal Biopsy

	Tumour site							
Procedure/positive biopsy	Right upper lobe	Middle lobe	Right lower lobe	Right hilum	Left upper lobe	Left lower lobe	Left hilum	Not localized
Cervical mediastinoscopy, no.	153	18	85	4	70	64	12	8
Positive biopsy, no. (%)	54 (35)	6 (33)	20 (24)	2 (50)	14 (20)	18 (28)	3 (25)	3 (38)
Cervical and left parasternal mediastinoscopy, no.	–	–	–	–	23	11	1	–
Positive biopsy, no. (%)	–	–	–	–	11 (48)	2 (18)	0	–
Left parasternal mediastinoscopy, no.	–	–	–	–	42	–	3	–
Positive biopsy, no. (%)	–	–	–	–	16 (38)	–	2 (66)	–

Table II—Overall Results and Value of Pre-treatment Staging

	Staging procedure		
Results	Cervical mediastinoscopy (n = 414)	Cervical and parasternal mediastinoscopy (n = 35)	Parasternal mediastinoscopy (n = 45)
Positive biopsy, no. %	120 (29)	13 (37)	18 (40)
Thoracotomy, no.	225	19	27
Mediastinal metastasis at thoracotomy, no. (%)	45 (20)	2 (11)	3 (11)
Sensitivity, %	73	87	86
Specificity, %	100	100	100
Predictive value of a positive test, %	100	100	100
Predictive value of a negative test, %	80	89	89
Efficiency, %	87	94	93

accuracy of these procedures as determined by statistical analysis.

Results of Surgery

Of the 1292 patients, only 297 (23%) were found suitable for surgical treatment. Further staging was performed at the time of thoracotomy. There were 184 (62%) squamous-cell carcinomas, 60 (20%) adenocarcinomas, 30 (10%) large-cell carcinomas, 12 (4%) small-cell carcinomas, 9 (3%) adenosquamous carcinomas and 2 (0.7%) undifferentiated carcinomas.

The type of operation performed and the hospital death rate are set out in Table III. The cause of death was secondary to respiratory failure in 9 (60%) instances, to cardiac events in 2 (13.3%), to bronchopulmonary fistula in 2 (13.3%) and to hemorrhage in 2 (13.3%).

Complications related to operations were not uncommon. Respiratory failure (prolonged intubation or reintubation) was encountered in 27 (9.1%) cases, atelectasis in 25 (8.4%) and pneumonia in 8 (2.7%). There were 12 bronchopleural fistulas (4%). Morbidity from cardiac causes was related to arrhythmia in 16 (5.4%) instances and to cardiac failure in 15 (5.1%). Hemorrhage, necessitating multiple transfusions postoperatively or repeat thoracotomy, occurred in five (1.7%) and of the four repeat thoracotomies for hemorrhage, three followed a pneumonectomy. There was one postoperative cerebrovascular accident and one upper gastrointestinal hemorrhage. Miscellaneous complications such as superficial wound infection, urinary tract infection and gastric dilatation occurred in 21 (7%) patients.

Survival

Overall survival for the 1292 patients was 9.2% ± 0.5% (± standard error) at 5 years and 5.8% ± 0.8% at 10 years. For the 995 patients who had no surgical treatment, 91% ± 0.5% died in the 12 months after diagnosis. At 3 years, only 2% ± 0.5% were alive and at 5 years, 1% ± 0.5%. Overall survival for the 297 patients who were operated on was 36% ± 3% at 5 years and 24% ± 3% at 10 years. Mean follow-up was 41.5 months (ranging from 3.5 to 14 years). Overall survival after operation was significantly ($p < 0.0001$) greater for patients with stage I disease than for those with stages II and III disease (Fig. 1). Figure 2 indicates that overall survival after operation for patients with no lymph-node involvement (N0) or minimal involvement (N1) is significantly ($p < 0.0001$) greater than that for patients with mediastinal node involvement (N2).

Five- and 10-year survival after surgery, according ro cell type, was 39% ± 3.8% and 25% ± 3.9% for 184 squamous-cell carcinomas, 35% ± 6.5% and 22% ± 6.8% for 60 adenocarcinomas, 28% ± 8% and 17% ± 8% for 30 undifferentiated large-cell and 18% ± 12% and 0% for 12 undifferentiated small-cell carcinomas. Comparison of the probability of survival by cell type was not statistically significant. Best results were obtained in patients having T1N0 disease: 5- and 10-year survival for 33 squamous-cell carcinomas was 73% ± 8% and 50% ± 10% and for 15 adenocarcinomas 59% ± 13% and 50% ± 14% respectively.

Discussion

The trend in our hospital to increasing incidence of lung cancer, particularly in women, is consistent with Canadian and North American tendencies.[1,10–12] All physicians involved agree on the importance of an accurate assessment of patients with lung cancer in order to select the proper treatment. Consideration must be given to cardiopulmonary status, histologic findings and stage of the disease according to the TNM system.[2] Particular attention must be given to the nodal status which is directly related to long-term results (Fig. 2).

We believe that preoperative mediastinal node evaluation by mediastinoscopy is necessary for all bronchial tumours, the only exceptions being peripheral lesions smaller than 2 cm.[5] Cervical mediastinoscopy in this series yielded 29% positive node biopsies which is comparable to the results of others.[13,14] Many thoracic surgeons believe that left upper lobe tumours cannot be adequately staged by cervical mediastinoscopy alone.[5,14–17] Lymphatic vessels of the superior regions of the left upper lobe drain into the ligament node of Botallo and then to the periaortic nodes. The ligament node may also communicate with the left paratracheal area. The lower area of the left upper lobe has lymphatic connections with the ligament node and the tracheobronchial nodes.[18,19]

Table II indicates the accuracy of the staging procedures. We believe that no attempt should be made to compare the accuracy of cervical mediastinoscopy and left parasternal mediastinoscopy, as these procedures are complementary, each assessing different nodal areas. In our series, the accuracy of cervical mediastinoscopy for right and left lung tumours was not as high as that demonstrated by others,[13,20] but all mediastinal node metastases found at thoracotomy were listed as false negative, and no attempt was made to exclude node metastases that might be judged inaccessible by mediastinoscopy. On the other hand, our results indicate that left parasternal mediastinoscopy alone is quite accurate to assess left upper lobe and left hilar tumours (sensitivity = 86%). It does not appear that both procedures, cervical and left parasternal mediastinoscopy, add substantially to the accuracy of preoperative assessment of mediastinal lymph nodes for left upper lobe tumours. More recently, the trend toward extensive lymph-node mapping[21] has led us to perform more routinely both cervical and parasternal mediastinoscopy for left-sided lesions.

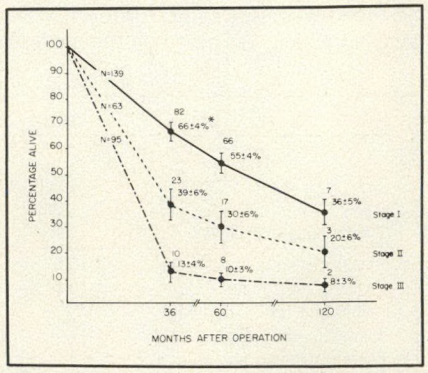

FIG. 1—Actuarial survival curves of 297 surgical patients according to stage of disease. Percentages are cumulative probabilities ± standard error.

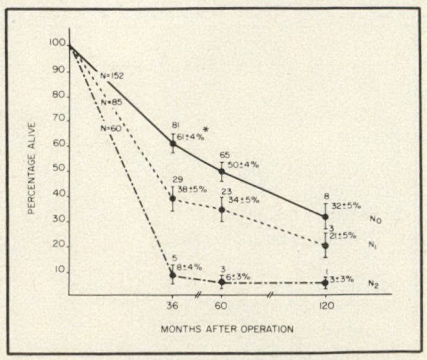

FIG. 2—Relationship of nodal status to survival in 297 surgical patients with bronchogenic carcinoma.

Table III—Surgical Procedure and Death Rate

Operation	Number of cases (% of total)	Hospital deaths, no. (%)
Lobectomy	164 (55)	3 (1.8)
Pneumonectomy	104 (35)	10 (9.6)
Segmentectomy	2 (1)	0
Exploratory thoracotomy	27 (9)	2 (7.4)
Totals	297 (100)	15 (5.1)

For some authors mediastinal node metastasis is not a contraindication to surgery, especially if curative resection can be accomplished.[21-23] These surgeons usually do not carry out mediastinoscopy preoperatively. On the other hand, when mediastinal node involvement is demonstrated at mediastinoscopy, others have shown that the results of surgical resection are very poor, particularly if the procedure is palliative.[24,25] For these reasons, we like to avoid surgery and recommend palliative treatment if mediastinal node metastasis is demonstrated at mediastinoscopy. Figure 2 illustrates the poor surgical results we have obtained with patients having N2 disease.

Among patients who underwent thoracotomy, a resectability rate of 91%, a hospital death rate of 5% and a 4.4% incidence of bronchopleural fistula are all good results, comparable to data found in the literature.[26-31]

The death rate following pneumonectomy remains high but comparable to that of other reports and is directly related in most instances to resected functional pulmonary parenchyma leading to respiratory failure. Of the 10 deaths after pneumonectomy, 8 were secondary to respiratory failure either as the main cause of death or as an important contributing factor.

The overall 5-year survival of 9.2% for patients with bronchial carcinoma has not changed much in the past decades. Results after resection have improved because of better patient selection for surgery. If surgical resection is performed early, better survival is to be expected. Overall survival of 36% and 24% at 5 and 10 years for the 292 patients who underwent surgery is comparable to the rates in many series.[26-31] Figures 1 and 2 clearly show that if the tumour itself is invasive or there is nodal involvement, survival decreases rapidly. We had poor results in patients with stage III disease, especially when mediastinal nodes were involved. Our longest survival rates were, of course, obtained in early-stage squamous-cell carcinoma: a small tumour (3 cm or less in dimension) without node involvement (T1N0).

Conclusions

The incidence of bronchogenic carcinoma is still increasing in Canada and is reflected in our hospital admissions. The increase is even more striking in women. The use of the TNM staging system as recommended by the American Joint Committee for Cancer Staging and End Results Reporting is most important, not only for evaluation but also to compare results.

Mediastinoscopy as pre-treatment staging is an excellent means of assessing superior mediastinal nodes. Left parasternal mediastinoscopy with or without cervical mediastinoscopy is essential for adequate evaluation of left upper lobe tumours.

The final solution to lung cancer is prevention, but results of treatment are excellent if the cancer is detected and surgical treatment instituted early. At an earlier stage of the disease, a lobectomy can usually be carried out, but in more advanced disease, a pneumonectomy with its associated higher morbidity and mortality is often necessary.

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CORRESPONDENCE

continued from page 75

Two new Port-A-Cath devices were used. One was tested with repeated punctures at 90° through the septum using a 22-gauge Yale hypodermic needle and the other using a 22-gauge Huber-point needle. After each 10 punctures with the same type of needle, the seal was checked by injecting air from a 10-ml syringe through the catheter, with the reservoir placed under water. After 100 punctures the seal was checked again by injecting air through the needle in the septum, with the reservoir under water and the catheter clamped.

An air leak was found at 1150 punctures with the regular 22-gauge Yale hypodermic needle and at 1165 punctures with the Huber-point needle. The centre of the septum in both devices was macerated.

We, therefore, could make the following conclusions.

- The self-sealing septum showed signs of leakage at 850 punctures less than that stated by the manufacturer, regardless of the type of needle used.
- The 22-gauge Yale hypodermic needle seems to be as safe as the Huber-point needle.
- A safe number of punctures would be 1000 regardless of the needle used.
- Because the Huber-point needle costs $1.74 versus $0.26 for the Yale hypodermic needle (a difference of $1.48), the latter is more cost effective.

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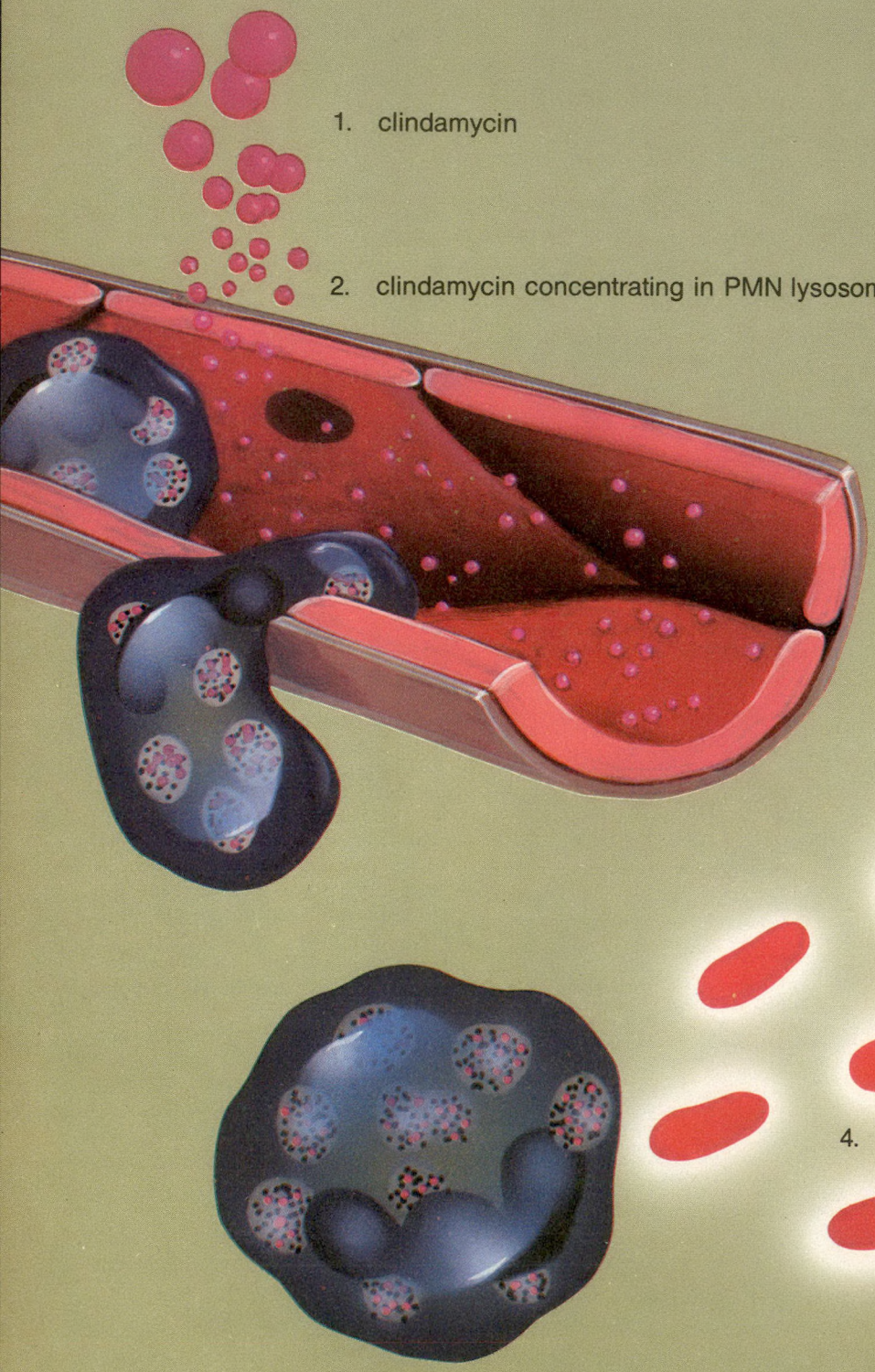

1. clindamycin

2. clindamycin concentrating in PMN lysosomes

3. clindamycin-laden PMN moving toward the site of infection

4. the invading bacteria

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Recent *in-vitro* research has shown that clindamycin concentrates within the PMN in amounts greater than are found outside of the PMN.[1] The rates of chemotaxis, phagocytosis and killing of bacteria by PMNs are also enhanced by the presence of this antibiotic.[2,3] These characteristics may help explain clindamycin's outstanding record of clinical efficacy in both anaerobic and gram-positive aerobic infections.

Since host defense factors may be crucial in determining the outcome of an infection, selection of antibiotics based on host defense parameters may become a trend in infectious disease therapy.

1) Klempner MS, et al (Nov 1981) J Infect Dis *144*(5)
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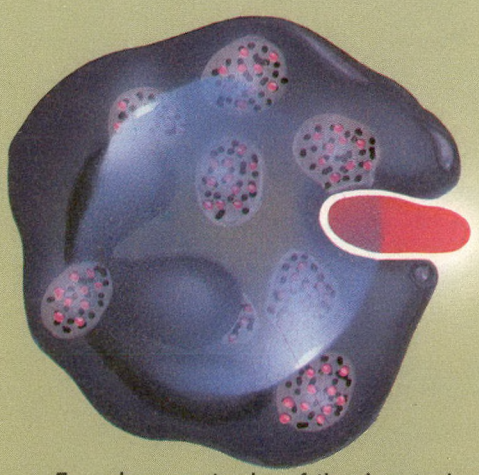
3) Gemmell C, et al (1980) Current Chemotherapy and Infectious Disease (eds. J Nelson, C Grassi) Am Soc Microbiol Vol 2



5. phagocytosis of the bacterium by antibiotic-enhanced PMN

6. degranulation and killing of engulfed bacterium

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LILLY J. MIEDZINSKI, MD; GERSHON KEREN, MD

Serious Infectious Complications of Open-Heart Surgery

Serious infectious complications of open-heart surgery in 521 adults who underwent 534 open-heart procedures are reviewed. Bacteremia complicated seven (1.3%) of the procedures, carditis six (1.1%) and deep sternal wound infections nine (1.7%). The overall rate of these infections was 4.1% with an associated death rate of 11.7% (2 of 17). With respect to the risk of this complication, no differences were noted in the age of the patients, duration of surgery or perioperative prophylaxis with cephalothin or cloxacillin. The chance of carditis developing was significantly related ($p < 0.001$) to a valve replacement procedure and the risk of a deep sternal wound infection ($p < 0.01$) to a procedure classed as "other". Staphylococci remained the most commonly isolated pathogens with an almost equal frequency of *Staphylococcus epidermidis* and *Staphylococcus aureus*. Gram-negative aerobes and *Streptococcus faecalis* were found to be other important pathogens in this clinical setting.

On a étudié les complications infectieuses sérieuses qui sont apparues chez 521 adultes ayant subi 534 opérations à coeur ouvert. Une bactériémie est venue compliquer sept (1.3%) de ces interventions, une cardite six (1.1%), et une infection de plaie sternale profonde, neuf (1.7%). Pour l'ensemble, le taux d'infection a été de 4.1%, avec une mortalité associée de 11.7% (2 cas sur 17). En ce qui a trait au risque de complication infectieuse, aucune différence n'a été observée pour l'âge des malades, la durée de la chirurgie ou l'usage prophylactique peropératoire de céphalothine ou de cloxacilline. Le risque de voir se développer une cardite a été significativement relié à une valvoplastie ($p < 0.001$), et le risque d'infection de plaie sternale profonde, à une opération classifiée comme "autre" ($p < 0.01$). Les staphylocoques demeurent les pathogènes les plus fréquemment isolés, *Staphylococcus epidermidis* et *Staphylococcus aureus* étant à peu près retrouvés avec une égale fréquence. Dans cet environnement clinique, les aérobies gram-négatifs et *Streptococcus faecalis* ont été les autres pathogènes importants.

Serious infectious complications of open-heart surgery include bacteremia, endocarditis, purulent pericarditis and deep sternal wound infections. The frequency of endocarditis has ranged from 1% to 10%,[1-5] with associated death rates as high as 86%.[2,3,6-8] The rate of sternal wound infections and mediastinitis is reported to range from 0.6% to 8.1%,[9-15] with associated death rates of 2.3% to 71%.[11,13,14] Factors associated with an increased incidence of sternal wound infections and mediastinitis include the type of closure,[10,11] tracheostomy,[9-11] prolonged mechanical ventilation,[10,11] reoperation for bleeding,[9-12] closed-heart massage,[9,10] low cardiac output postoperatively,[9,12] prolonged perfusion time,[12] surgery lasting longer than 6 hours[16] and age over 65 years.[16] Despite the lack of adequate placebo-controlled trials,[17] antibiotic prophylaxis is recommended for patients who undergo cardiac valve replacement.[17,18] A few studies[19,20] have shown the value of antibiotic prophylaxis in decreasing the incidence of sternal wound infections after cardiac surgery, and at present it is recommended for all open-heart surgical procedures.[18]

Staphylococcus sp. are the most common pathogens in postoperative endocarditis[6,7] and sternal wound infections[9,12,14,21] with *Staphylococcus epidermidis* being recognized most frequently in these clinical settings.[1,9,12,22] Changing antibiotic sensitivity of the staphylococci, including resistance to conventional agents, have been reported.[22-27] Gram-negative aerobes are also important pathogens.[6,9,10,21,28] These issues have raised questions regarding the adequacy and appropriateness of the present regimens used for antibiotic prophylaxis.

The purpose of this retrospective review was to determine the frequency of serious infectious complications of open-heart surgery, death rates associated with these complications and factors that may relate to the development of such complications. The organisms involved in these infections and their antibiotic sensitivity patterns were also examined.

Patients and Methods

We reviewed the medical records of 521 adults (mean age 56 years, range from 23 to 78 years) who underwent 534 open-heart surgical procedures at the University of Alberta Hospital between Jan. 1, 1981 and Nov. 30, 1982. The procedures were considered in four groups — coronary artery bypass, valve replacement, combined coronary bypass and valve replacement, and "other". The last category included pericardiotomies, ventricular aneurysm repairs, removal of atrial myxomas and repair of congenital cardiac defects. Data relating to infectious complications of these procedures were

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noted. An infection was defined as serious if it involved bacteremia, carditis or deep sternal wound infection. The term carditis was used to include both endocarditis and purulent pericarditis. Endocarditis was diagnosed if positive blood cultures were accompanied by clinical features compatible with endocarditis or if bacterial cultures of valvular material obtained at surgery were positive. Clinical criteria supporting a diagnosis of endocarditis included a new or changing murmur, fever, clubbing, splenomegaly, conjunctival petechiae, Osler's nodes, Janeway lesions and embolic phenomena. Purulent pericarditis was confirmed by positive bacterial cultures of pericardial fluid. Deep sternal wound infections included sternal osteomyelitis, mediastinitis and sternal dehiscence associated with positive bacterial cultures of bone, mediastinal fluid, surgical tissue or sternal wound drainage. Sternal wound cellulitis that responded favourably to a short course of parenterally administered antibiotics was not considered a serious infectious complication.

Death rates within 2 months of surgery were examined and correlated with the presence or absence of infectious complication as defined above.

Factors examined that may have been related to these serious infections included age of the patient, type of surgical procedure, duration of surgery and the prophylactic agent used. During the early part of 1981, we used cloxacillin routinely for prophylaxis in patients who underwent open-heart surgery. It was administered intravenously in 1-g doses 1 hour preoperatively and every 6 hours for 72 hours postoperatively. Cephalothin subsequently replaced cloxacillin in the same dosage.

The organisms involved in the serious infectious complications were examined, with sensitivity reports based on agar diffusion studies.

As this was a retrospective study, the data may be incomplete. Patients who may subsequently have been admitted to

Table I—Clinical Data in Seven Cases of Bacteremia After Open-Heart Surgery

Patient no.	Sex	Age, yr	Procedure	Duration of operation, h	Surgeon	Organism isolated	Resistant to	Prophylaxis	Outcome
1	F	71	CAB X 2 + MVR	5	B	*Staphylococcus aureus*	Penicillin	Cephalothin	Cerebral infarct, discharged
2	M	65	CAB X 1 + AVR	12	A	*Streptococcus mitis*	Erythromycin	Cephalothin	Discharged
3	M	66	CAB X 4 + MVR	8	B	*Serratia marcescens*	Cephalothin, ampicillin, tetracycline, chloramphenicol	Cephalothin	Deep sternal wound infection, discharged
4	M	67	CAB X 2	4.5	C	*Staphylococcus aureus*	Penicillin	Cephalothin	Deep sternal wound infection, discharged
5	M	60	CAB X 2	5	C	*Propionobacter*	+	Cephalothin	Deep sternal wound infection, disharged
6	F	67	CAB X 2	5.5	D	*Staphylococcus epidermidis* (2 strains)	1 — penicillin, erythromycin 2 — +	Cloxacillin	Superficial sternal wound infection, discharged
7	M	50	MVR	5	A	*Staphylococcus aureus*	+	Cloxacillin	Purulent pericarditis, discharged

CAB = coronary artery bypass, MVR = mitral valve replacement, AVR = aortic valve replacement, + = sensitive to all antibiotics tested.

Table II—Clinical Data in Six Cases of Carditis After Open-Heart Surgery

Patient no.	Sex	Age, yr	Procedure	Duration of operation, h	Surgeon	Organism isolated	Culture site	Resistant to	Prophylaxis	Outcome
7	M	50	MVR	5	A	*Staphylococcus aureus* (1 mo postop)	Blood, pericardial fluid	Penicillin	Cloxacillin	Alive
8	M	37	AVR	4	C	*Staphylococcus epidermidis* (7 wk postop)	Blood	Penicillin, erythromycin	Cephalothin	Alive
9	M	61	MVR	5	A	*Staphylococcus epidermidis* (3 strains) (3 wk postop)	Blood	1 — penicillin 2 — penicillin, gentamicin, erythromycin 3 — clindamycin, clotrimazole	Cephalothin	Died after valve replacement
						Streptococcus faecalis (2.5 mo postop)	Valve	Gentamicin, penicillin, erythromycin		
10	M	34	AVR	6	B	*Streptococcus faecalis* (3 wk postop)	Blood	Cephalothin, gentamicin, penicillin, erythromycin	Cephalothin	Marfan's syndrome, died after dissection
11	M	54	AVR	4	C	Diphtheroids (4 mo postop)	Blood	Penicillin, cloxacillin	Cloxacillin	Alive
12	M	63	AVR	3.5	B	*Staphylococcus epidermidis* (2 mo postop)	Blood, valve ring	Not available	Cloxacillin	Alive

other institutions with complications would not have been included. The χ^2 test and paired Student's *t*-test were used for statistical analysis.

Findings

Four-hundred and one cardiac procedures were performed on men and 133 on women. The majority of the procedures (435 [81%]) were elective and all were performed by one of four cardiovascular surgeons.

Of the 534 procedures performed, 383 (72%) were coronary artery bypasses, 97 (18%) were cardiac valve replacements and 37 (7%) were classed as "other".

Overall, the mean duration of surgery was 4.6 hours. When examined by procedure, it was 4.5 hours for coronary revascularization, 4.7 hours for valve replacements alone, 6.3 hours for combined coronary revascularization and valve replacement and 4.5 hours for the procedures classified as "other".

Cloxacillin was administered in 168 (31.5%) of the 534 procedures and cephalothin in 348 (65.2%). In 18 (3.4%) of the procedures, there was either no prophylaxis or some other agent was used.

Tables I to III outline the clinical details of the serious infectious complications documented in this review. Excluding cases of endocarditis, 7 (1.3%) of the 534 procedures performed were complicated by bacteremia (Table I) occurring within 4 weeks of surgery. Carditis (Table II) was a complication of six (1.1%) procedures (five cases of endocarditis and one of purulent pericarditis). Four of the five cases of endocarditis occurred within 2 months of surgery. Nine (1.7%) open-heart procedures were complicated by deep sternal wound infections (Table III). Five patients had more than one serious complication. Three patients with deep sternal wound infections and the sole patient with purulent pericarditis also had bacteremia. In the fifth patient prosthetic valve endocarditis developed after valve insertion and, 1 year later, a deep sternal wound infection developed after surgery to repair his paravalvular leak. In total,

Table III—Clinical Data in Nine Cases of Deep Sternal Wound Infection After Open-Heart Surgery

Patient no.	Sex	Age, yr	Procedure	Duration of operation, h	Surgeon	Organism isolated	Resistant to	Prophylaxis	Outcome
3	M	66	CAB X 4 + MVR	8	B	*Serratia marcescens*	Cephalothin, tetracycline, ampicillin, chloramphenicol	Cephalothin	Débridement rectus flap, alive
						Staphylococcus aureus (2 strains)	1 — penicillin 2 — +		
4	M	67	CAB X 2	4.5	C	*Staphylococcus aureus*	Penicillin	Cephalothin	Débridement rectus flap, alive
5	M	60	CAB X 2	5	C	Diphtheroids	Penicillin, cloxacillin, gentamicin	Cephalothin	Débridement X 3
						Staphylococcus epidermidis	Penicillin		
						Serratia marcescens	Cephalothin, tetracycline, ampicillin, chloramphenicol		
12	M	63	Suturing paravalvular leak	3.5	B	*Staphylococcus epidermidis*	Penicillin, cloxacillin, erythromycin	Cloxacillin	Débridement, alive
13	M	61	CAB X 2	4.5	A	*Streptococcus viridans*	+	Cephalothin	Débridement rectus flap, alive
14	M	56	Removal left atrial myxoma	3	C	*Klebsiella pneumoniae*	Ampicillin, kanamycin, penicillin, erythromycin	Cloxacillin	Débridement X 2, alive
						Staphylococcus aureus	+		
						Staphylococcus epidermidis (2 strains)	1 — penicillin, erythromycin, gentamicin 2 — penicillin, erythromycin, gentamicin, cloxacillin, cephalothin, kanamycin		
15	M	35	Tetralogy of Fallot repair	8	D	*Staphylococcus aureus*	Penicillin	Cephalothin	Drainage, débridement, alive
						Staphylococcus epidermidis	Penicillin		
16	M	64	CAB X 4	4.5	D	*Proteus mirabilis*	Tetracycline, colistin	Cephalothin	Débridement X 2, muscle flap, alive
						Streptococcus faecalis	Cephalothin, gentamicin, penicillin		
17	M	65	CAB X 3	3.5	D	*Staphylococcus epidermidis*	+	Cephalothin	Débridement, alive

22 serious infectious complications were documented following 534 open-heart surgical procedures, a rate of 4.1%. These complications occurred in 17 (3.3%) of the 521 patients and were evenly distributed among patients operated on by the four cardiovascular surgeons.

The mean age of patients with serious infections was 57.8 years compared with 55.9 years for those who did not experience such complications. This difference was not statistically significant, nor was the mean duration of surgery in patients with (5.4 hours) and without (4.6 hours) serious infectious complications.

In 15 (4%) of the 348 procedures that were performed with cephalothin prophylaxis there were infectious complications compared with 7 (4%) in the 168 procedures performed with cloxacillin prophylaxis. There was no significant difference between cephalothin and cloxacillin prophylaxis and the risk of serious postoperative infection as determined by χ^2 analysis. This held true for all complications combined ($p > 0.6$) and when each complication was examined separately (bacteremia $p > 0.8$, carditis $p > 0.35$ and sternal wound infection $p > 0.5$).

In examining the relationship of procedure and risk of serious infection, we noted that all six patients with carditis had undergone valve replacements alone. This complication was significantly ($p < 0.001$, χ^2 test) related to procedure. There was also a significant ($p < 0.01$, χ^2 test) relation between the development of sternal wound infection and the patient having undergone a procedure classified as "other". There was no statistically significant relation between bacteremia and any of the procedures performed. Table IV presents the numbers and types of infectious complications as a function of each group of procedures. Although bacteremia was not statistically related to procedure as determined by χ^2 analysis, three of seven episodes occurred in patients who had undergone combined coronary artery bypass and valve replacement, of which 23% were complicated by a serious infectious complication.

Thirty-two of 521 patients died within 2 months of surgery — an early death rate of 6.1%. Of these 32, only 2 (6%) patients had a documented serious postoperative infection. The death rate of those with serious infectious complications, however, was 11.8% (2 of 17), almost double the overall death rate.

The organisms most frequently isolated from patients with serious infectious complications were staphylococci, isolated in 14 of the 22 complications. There was an almost equal frequency of isolation of *Staphylococcus aureus* (8 of 22 complications) and *S. epidermidis* (9 of 22 complications). Two of the 13 strains of *S. epidermidis* involved in these infections were reported resistant to cloxacillin. The sensitivity of another 1 of the 13 strains was unavailable. None of the *S. aureus* isolates were cloxacillin resistant. Gram-negative aerobic bacteria were isolated in 5 of the 22 complications. Of interest is that *Streptococccus faecalis* was isolated from two cases of early prosthetic valve endocarditis and, in association with another organism, from one case of sternal wound infection.

Figure 1 outlines the distribution of serious infectious complications with respect to the time of operation and specifically to the 18 surgical procedures that were associated with a serious infectious complication. These infections occurred randomly with no evidence of clustering. It should be noted that in those months when more than two infections occurred, the surgeon and infecting organisms differed for each infection.

Discussion

Our study demonstrates that despite antibiotic prophylaxis, serious bacterial infections can occur following open-heart surgery. The reported rate of bacteremia in this review was 1.3%, carditis 1.1% and deep sternal wound infections 1.7%, with a combined frequency of 4.1%. Although these figures are relatively low, and in keeping with the less than 5% rate expected for clean surgical procedures,[17] the associated mortality and morbidity were substantial. Two of the seventeen patients (11.7%) with such complications died. Of the five patients with endocarditis, four underwent repeat surgery for replacement of their infected valve. Five of the nine patients with deep sternal wound infections required myocutaneous flaps in addition to débridement. Despite the rather low rate of serious infectious complications following open-heart surgery and the controversy regarding the need for antibiotic prophylaxis in clean surgery,[17] the mortality and morbidity associated with these complications supports the practice of antibiotic prophylaxis for patients who undergo open-heart surgery.[17,18,29]

A change in the antibiotic used in our centre occurred during the study and allowed us to compare the efficacy of cloxacillin and cephalothin in preventing endocarditis and sternal wound infection. The study showed no significant difference in rates of serious infectious complications in patients receiving either of these agents prophylactically. This was in keeping with the findings of Myerowitz and colleagues[30] and Fong and associates[19] who used methicillin or cephalothin with no significant difference. It is interesting to note that in a number of cases, the isolated pathogen was sensitive to the prophylactic agent used. During the study period, 1-g doses of cloxacillin and cephalothin were used and one might speculate that this dose was too low to produce adequate blood levels in patients placed on the bypass pump.

The cephalosporins have become the preferred prophylactic agents for open-heart surgery even though comparative trials have failed to support their superiority.[19,30] Theoretical advantages such as their broadened gram-negative activity and in-vitro sensitivity of methicillin and oxacillin-resistant staphylococci may have been considerations accounting for this

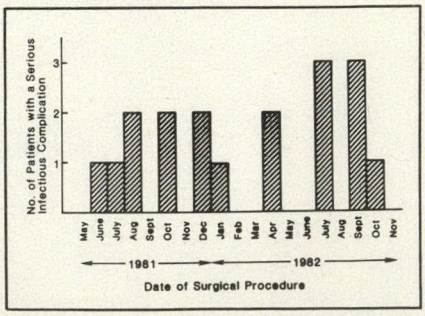

FIG. 1—Distribution of serious infectious complications with respect to time of operation.

Table IV—Serious Infectious Complications and Procedures

	Procedure				
	CAB	Valve replacement	CAB + valve replacement	Other	Totals
No. of patients (% of total)	383 (72)	97 (18)	17 (3)	37 (7)	534
No. of infectious complications* (%)	8 (2)	7 (7)	4 (23)	3 (8)	22
Bacteremia	3	1	3	0	
Carditis	0	6	0	0	
Sternal wound infection	5	0	1	3	

*These 22 complications occurred in 17 patients, whose clinical features are detailed in Tables I, II and III.

practice. However, increasing reports of methicillin-resistant staphylococci,[24-26,31] and reports of cross-resistance to the cephalosporins[22,24] leave open to question the widely accepted use of the cephalosporins as prophylactic agents for open-heart surgery. Although our figures did not suggest methicillin resistance was a major problem at our centre, oxacillin and methacillin resistance was documented in 2 of the 13 strains of *S. epidermidis* involved in the serious infectious complications reviewed. Data from other centres[22,24,25,31] should alert us to potential future problems with methicillin-resistant staphylococci.

Although staphylococci were the most frequently documented pathogens, our study confirmed the importance of gram-negative aerobes as pathogens in this setting. Interestingly, three of the five gram-negative pathogens isolated were resistant to cephalothin, the agent administered prophylactically during the procedure.

The isolation of *S. faecalis* in 3 of 22 patients with infectious complications suggests this organism may also be important in open-heart surgery. This would be of particular relevance since enterococci are generally resistant to the cephalosporins.

In examining factors that may have been associated with the development of a serious infectious complication, we found a significant relation between certain procedures performed and specific infectious complications that developed. All cases of carditis occurred in patients who had undergone valve replacements. There was also a statistically significant relation ($p < 0.01$) between the risk of suffering a sternal wound infection and having undergone a procedure defined as "other". Although one might expect such procedures to be more complicated than bypass procedures or valve replacement, this is not reflected in an increased duration of surgery, and other factors need to be considered. Of interest is that all patients who had sternal wound infections were men, raising the question of the importance of preoperative shaving of the chest and its relation to wound infection. Cruse and Foord[32] in their extensive review, found that shaving the operative site increased the infection rate of clean wounds. It is important to indicate that at the time of this review, preoperative shaving of the chest was standard procedure at this institution. No statistically significant correlation was demonstrated between age of the patient or duration of surgery and the risk of a serious postoperative infection.

One of the priorities in cardiovascular surgery is to define factors predisposing to serious infections and minimize them. The relation between operative procedure and specific complications needs to be more closely examined since other factors such as shaving may be important. Staphylococci and gram-negative aerobes were the most frequently isolated pathogens and the prophylactic agent or agents used should provide coverage for most of these organisms. By using broad-spectrum antibiotics we may encourage the development of multiresistant organisms and possibly superinfections due to enterococci or fungi. Narrower spectrum drugs, on the other hand, directed at staphylococci alone might promote gram-negative infections. Although this study showed no significant differences between cephalothin and cloxacillin, it would appear that better controlled trials of prophylactic agents for open-heart surgery are appropriate.

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D.B. VAIR, MD, FRCSC;* S.F. BOUDREAU, MD, FRCPC;† E.L. REID, MD, FRCPC‡

Pancreatic Islet-Cell Neoplasia, With Secretion of a Parathormone-like Substance and Hypercalcemia

In a 47-year-old woman with a pancreatic mass associated with hypercalcemia and mental confusion, medical measures failed to restore her serum calcium level to normal. To do so, radical resection of a locally invasive vascular neoplasm arising from the body and tail of the pancreas was necessary. The neoplasm was a pancreatic islet-cell tumour. Serum parathormone assays demonstrated abnormally high secretion of a parathormone-like substance. Ectopic secretion of such substances from islet-cell tumours should be considered in association with refractory metabolic disturbances. In view of the often indolent clinical course of islet-cell tumours and the potential for life-threatening hormonal effects, biopsy confirmation of adenocarcinoma should be obtained before resorting to palliative surgical management of pancreatic neoplasms.

Les mesures médicales habituelles ont échoué à rétablir une calcémie normale chez une femme de 47 ans présentant une masse pancréatique associée à une hypercalcémie et à de la confusion mentale. Pour y parvenir, il fallut pratiquer une résection radicale d'une néoplasie vasculaire localement envahissante, affectant le corps et la queue du pancréas. Il s'agissait d'une tumeur pancréatique des cellules des îlots de Langerhans. Les dosages de la parathormone sérique ont révélé une sécrétion anormalement élevée d'une substance semblable à la parathormone. Une sécrétion ectopique de telles substances à partir d'une tumeur des cellules insulaires doit être envisagée en présence de troubles métaboliques réfractaires. Devant l'évolution souvent indolente des tumeurs des cellules insulaires et le risque d'effets hormonaux pouvant entraîner la mort, une confirmation par biopsie d'adénocarcinome doit être obtenue avant d'en venir au traitement chirurgical palliatif des néoplasies pancréatiques.

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The majority of pancreatic tumours are adenocarcinomas, neoplasms with a poor prognosis and a low rate of resectability.[1] Physicians are understandably pessimistic when faced with pancreatic neoplasms and have adopted a conservative approach to their surgical management. Occasionally, neoplasms arise from the endocrine pancreas; they are easily misdiagnosed as inoperable carcinoma, but have a much slower rate of growth and warrant a more aggressive attitude in regard to resection.[2] Moreover, these tumours can secrete a variety of hormones,[3–6] any of which may produce bizarre systemic syndromes and have been associated with elevation of the serum calcium level not related to bone metastases or hyperparathyroidism.[7–11]

Case Report

A 47-year-old woman was admitted to the Halifax Infirmary with a 1-month history of left upper quadrant abdominal pain associated with fatigue and a weight loss of 14 kg. Apart from hypertension, treated with diuretics, she had been well. The liver edge was palpable just below the costal margin and there was an ill-defined mass in the left subcostal area. Physical examination was otherwise unremarkable.

Complete blood count and urinalysis gave normal results. The erythrocyte sedimentation rate was 22 mm/h. The following were also within normal limits: serum phosphate, bilirubin, transaminase, creatinine, blood urea nitrogen, albumin and globulin levels and protein electrophoresis. Serum electrolyte levels were normal apart from mild hypokalemia. Urinary cyclic adenosine monophosphate levels were not determined. The serum calcium level was elevated to 4.14 mmol/L (normal 2.13 to 2.63 mmol/L). The serum uric acid level was elevated to 530 μmol/L and alkaline phosphatase to 161 U/L.

A chest x-ray film and electrocardiogram obtained on admission appeared normal. A technetium liver-spleen scan disclosed no abnormalities. Abdominal ultrasonography demonstrated an irregular mass, 9 cm in diameter, in the left upper quadrant of the abdomen, possibly arising from the left lobe of the liver or tail of the pancreas.

Computerized tomography of the abdomen confirmed a large retrogastic, soft-tissue mass involving the body and tail of the pancreas, possibly obstructing the splenic vein (Fig. 1).

Shortly after admission, the patient became confused and lethargic with loss of orientation. Neurologic examination revealed no focal abnormalities; an electroencephalogram suggested a diffuse metabolic disorder. Her elevated serum calcium level, repeatedly confirmed, was aggressively treated with saline diuresis and furosemide and gradually brought under control, with return of normal mental status.

In the absence of clinical and radiologic evidence of skeletal disease, the cause of the patient's hypercalcemia was unclear. The possibility of primary hyperparathyroidism was considered as was the potential for secretion of a hypercalcemic stimulant by her abdominal tumour. Serum parathormone assay was carried out and reported as 291.0 pg/ml from the C-terminal mid-region (normal, less than 500 pg/ml) which, in association with a total calcium concentration of 4.1 mmol/L was thought to be compatible with ectopic secretion of a parathormone-like substance.

Laparotomy, after her serum calcium level had stabilized, disclosed a highly vascular mass arising from the body of the pancreas, infiltrating the greater curvature of the stomach and the splenic hilum (Fig. 2). The mass appeared fixed retroperitoneally but was not associated with hepatic or lymph-node metastases. An incisional biopsy of the lesion was attempted but abandoned because of profuse bleeding. In view of the apparent invasion of adjacent

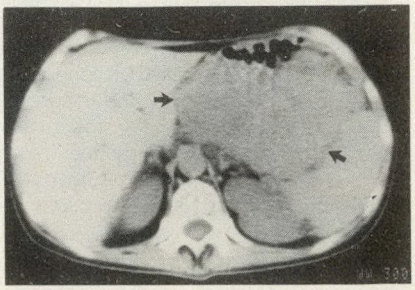

FIG. 1—Abdominal computerized tomogram demonstrates mass arising from pancreas (arrows) infiltrating splenic hilum with anterior displacement of stomach.

organs, resection was judged to be unfeasible and the abdomen was closed.

Postoperatively, despite continued saline infusion with diuretics, high-dose prednisone and treatment with calcitonin and mithramycin, her serum calcium level remained elevated although her mental status was normal. Before resorting to chemotherapy, we decided to repeat the laparotomy in an attempt at radical resection of the tumour. Preoperative mesenteric angiography confirmed a highly vascular irregular mass in the region of the lesser sac and splenic hilum, encasing the splenic vessels and suggesting an islet-cell tumour of the pancreas or retroperitoneal sarcoma (Fig. 3).

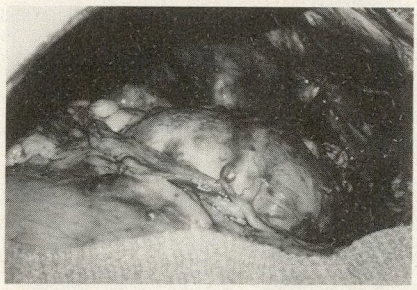

FIG. 2—Tumour in body of pancreas with extensive neovasculature.

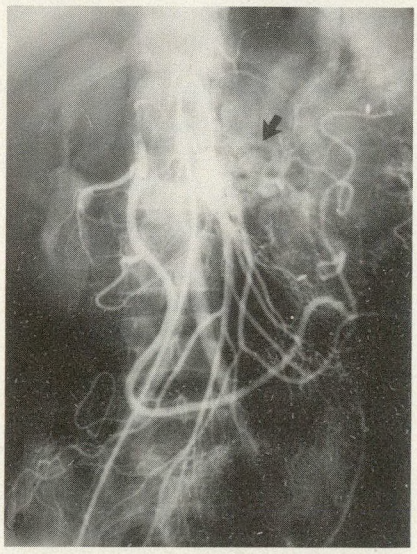

FIG. 3—Mesenteric angiography demonstrates vascular neoplasm (arrow) within body of pancreas.

FIG. 4—Histologic section of tumour with well-defined cells and minimal evidence of cytologic atypia or pleomorphism (hematoxylin and eosin, original magnification × 63).

In an attempt to reduce tumour vascularity before operation, the patient received a 3300 R course of external cobalt radiation. Because of continued nausea and inability to maintain adequate caloric intake, total parenteral nutrition was begun. Two episodes of subclavian catheter-induced sepsis occurred, necessitating its removal and replacement. A cellulitis surrounding the catheter insertion site responded to cloxacillin.

At the second operation a thoracoabdominal approach was used to mobilize the pancreas and spleen from surrounding retroperitoneal structures. It was apparent that despite local invasion of the fundus of the stomach and spleen, the tumour was resectable. There was no evidence of invasion of the left kidney or of intra-abdominal metastases. An en bloc resection of the body of the pancreas, spleen and greater curvature of the stomach was carried out and a feeding jejunostomy tube placed so that total parenteral nutrition could be withdrawn.

Histopathologically, the pancreatic tumour was composed of small regular uniform cells displaying little or no mitotic activity (Fig. 4). These cells occurred in small ribbons and nests diagnostic of an islet-cell tumour of the pancreas. The margins of excision were free of tumour and regional lymph nodes were uninvolved. Immunoperoxidase staining for parathormone was not carried out.

Postoperatively, there was a prompt and permanent fall in her serum calcium level, and during the early postoperative period she required intravenous calcium supplementation to maintain normocalcemia.

Her postoperative course was uncomplicated until day 4 when there was evidence of systemic sepsis. After appropriate culture specimens were taken, she was started on broad-spectrum antibiotics intravenously. Despite thorough clinical and radiologic investigations no focus of sepsis could be determined.

One week later, despite a normal serum calcium level, she became confused and dysarthric, as she was preoperatively. Blood and urine cultures now became consistently positive for *Staphylococcus aureus*. The investigations for phlebitis were negative and despite intravenous administration of cloxacillin, her neurologic symptoms failed to improve. A pansystolic murmur developed and echocardiography confirmed subacute bacterial endocarditis with mitral regurgitation. Despite high-dose cloxacillin and fusidic acid therapy, her cardiac status deteriorated and placement of a porcine mitral valve was necessary. Postoperatively, her sepsis was controlled and her neurologic status improved with a return of orientation and speech. Two years postoperatively her neurologic status and serum calcium and serum parathormone levels were normal, with no clinical evidence of tumour recurrence.

Discussion

The association of hypercalcemia with malignant disease is not uncommon and usually suggests metastatic disease involving bone or unrecognized hyperparathyroidism. Recent reports have drawn attention to the ability of various tumours to produce an elevated serum calcium level independent of bone metastases or parathyroid dysfunction, compatible with "ectopic hyperparathyroidism".[7–11]

Considerable controversy exists as to whether the hypercalcemia is indeed linked to ectopic production of parathormone or to tumour synthesis of nonhormonal substances capable of inducing hypercalcemia by separate mechanisms. These include osteoclast-activating factor and prostaglandins of tumour origin with effects on bone mimicking the action of parathormone. Recent work[12] has suggested that certain tumours induce hypercalcemia by stimulating adenylate cyclase in bone through secretion of substances immunologically distinct from parathormone. As suggested by Skrabanek and colleagues[13] criteria that suggest ectopic parathormone secretion include: hypercalcemia with normal parathyroid glands, the absence of bone metastases, correction of hypercalcemia following removal of the tumour and elevation of parathormone in the tumour and the blood. A thorough analysis of the literature failed to reveal any case reports that unequivocally met these criteria and it was suggested that hypercalcemia in association with neoplasia may have a variety of etiologies independent of parathormone.

A number of recent case reports[7–11] have described the association of hypercalcemia with islet-cell neoplasia of the pancreas. As in our case, the rigid criteria for ectopic hyperparathyroidism are difficult to fulfil with certainty, and these cases possibly represent secretion by the tumour of a stimulus of hypercalcemia distinct from parathormone.

The ability of pancreatic endocrine cells to secrete a variety of hormonally active peptides, including parathormone, may be linked to the APUD concept, the islet cell being one of a number with a common neural crest origin.[14,15] This immature stem cell likely becomes undifferentiated with the neoplastic process and acquires the ability to secrete peptides with varying endocrine effects.[16]

Although hypercalcemia in association with a pancreatic mass is easily attributed to skeletal metastases, isolated spread to bone is uncommon in pancreatic adenocarcinoma[17] and should suggest other causes. The diagnosis of hyperparathyroidism is suggested by a series of associated biochemical abnormalities including decreased serum phosphate and elevated serum chloride levels, both of which are also compatible with pseudohyperparathyroidism. The differentiation of these two disorders may be made by the detection of an elevated serum parathormone level in primary hyper-

parathyroidism. However, the value of parathormone radioimmunoassay remains controversial because of difficulties in interpreting values as a result of immunologic heterogeneity and interlaboratory variation.[18] The finding of a normal serum parathormone level in our patient suggests the presence of other factors related to the neoplasm that may have induced hypercalcemia.

Although thiazide diuretics may induce hypercalcemia, it persisted in our patient for several weeks after they were discontinued. The multiple endocrine adenomatosis, type 1, syndrome is always a diagnostic consideration in association with endocrine tumours of the pancreas. It could reasonably be excluded in our patient by the presence of a normal skull x-ray film and computerized tomogram indicating the absence of pituitary neoplasia.

The symptoms of hypercalcemia are often nonspecific, with involvement of multiple organ systems that may easily be attributed to the neoplasm itself rather than the underlying metabolic disturbance. Prompt recognition of hypercalcemia associated with neoplasm is important because of its often fulminant course and failure to respond to conservative medical measures. Our case illustrates this point with permanent control of the serum calcium level being achieved only after the tumour had been surgically resected.

Unlike adenocarcinoma, islet-cell tumours of the pancreas are often indolent, slow-growing neoplasms with the potential for long-term patient survival after recognition and appropriate management. For this reason it is imperative that any mass arising from the pancreas be confirmed as adenocarcinoma before abandoning an aggressive surgical approach. As in our case, this lesion may be highly vascular with a risk of profuse bleeding at attempted biopsy.

Because of the poor prognosis of pancreatic adenocarcinoma, with invasion into contiguous organs, radical surgery is contraindicated. In contrast, the less-aggressive nature of islet-cell neoplasms warrants an en bloc resection of all involved tumour if technically feasible.[2,9,19] Indeed, in view of the possibility of life-threatening associated hormonal effects, resection of isolated hepatic metastases has been advocated, as this may provide effective palliation for the slow-growing tumour. Unresectable or metastatic tumours have been reported to respond favourably to streptozotocin chemotherapy with prompt regression of associated systemic effects.[7,8]

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Snowblower Injuries to the Hand

A single heavy snowstorm in Saskatoon in late 1984 resulted in nine patients sustaining snowblower injuries to 19 digits. Factors leading to injury included rapid onset of colder temperatures, sudden reuse of snowblowers after storage for the summer, a heavy mid-week storm that created a sense of urgency to clear snow in dusky light conditions after a day at work, frustration as exit chutes became repeatedly clogged with heavy wet snow and limited operator education. The injuries themselves resembled low-velocity "missile" injuries. A practical preventive measure would be to encourage manufacturers to equip machines with remotely located spring-opening clutches.

Au cours d'une seule tempête de neige forte survenue à Saskatoon à la fin de 1984, neuf patients ont subi des blessures causée par des souffleuses à neige, impliquant 19 doigts. Plusieurs facteurs ont contribué aux blessures dont une chute rapide de la température, la réutilisation soudaine de la souffleuse à neige après remisage pour l'été, une forte tempête en milieu de semaine qui a créé un besoin urgent de nettoyer la neige dans la semi-obscurité après une journée de travail, la frustration découlant du blocage répété de la cheminée d'évacuation par une neige lourde et mouillée et le peu d'expérience des utilisateurs. Les blessures en soi ressemblaient à des lésions par des "projectiles" à faible vélocité. Une mesure préventive pratique consisterait à inciter les fabriquants à équiper leurs machines d'embrayages à ressort placés à distance.

On Oct. 16, 1984, an unusually early snowstorm hit Saskatoon. Forty centimetres of wet heavy snow fell on the city — an unusual occurrence in an area that usually receives a light fluffy powder. Driving was nearly impossible and a sense of urgency forced people to clear away the rapid accumulations of snow. The wet snow did not flow smoothly through snowblowers and accidents happened. Within 48 hours we saw and treated nine patients with injuries to 19 digits caused by snowblowers.

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Mechanism of Injury

Snowblower design varies, but the typical homeowner's model is a two-stage gasoline-powered machine (Figs. 1 and 2). The first stage is a slowly rotating auger mounted at the front. This passes snow back to the second stage which is an impeller blade that rotates rapidly to throw snow out of an exit chute. Both auger and impeller are driven from the gasoline-powered engine. A system of belts and pulleys reduces the high engine revolutions to the correct rate for the turning blades. A clutch allows for disengagement of the auger and impeller from the engine.

Most hand injuries occur when the patient's fingers are struck by the impeller blade whilst clearing snow out of a clogged exit chute. The impeller blades are close to the exit chute opening which is frequently not guarded.

Patients and Method

The inpatient and outpatient charts of the nine patients (eight men, one woman) were analysed with respect to age, sex, hand dominance, location of accident, injuries sustained, management and outcome. Nine months after treatment, all patients were called back for follow-up examination and more-detailed questioning about the circumstances of their injury.

Findings

Nine patients sustained 21 injuries to 19 digits (Fig. 3). Six had multiple finger involvement with segmental injuries to two digits. The patients ranged in age from 25 to 68 years. All patients were right handed and in only one was the non-dominant hand involved. Only one accident occurred in the work place, the remainder happened at the patient's home.

Two patients sustained their hand injuries unclogging jammed first-stage augers. The other seven patients were injured by second-stage impeller blades, six of them attempting to clear clogged exit chutes and one when using the exit chute as a handle to lift the machine out of a snow drift. None of the machines were fitted with proper safety clutches. Asked how their injuries had occurred, seven of the nine said they put their hands into the moving blades hastily without thinking or because they thought there was more distance between the exit-chute opening and the rotating impeller blade or because they thought that the first-stage auger was the only blade on the machine. Two patients, however, had turned their snowblower off but reached

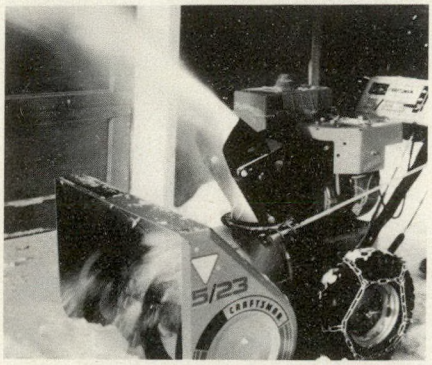

FIG. 1—Typical homeowners' two-stage gasoline-powered snowblower.

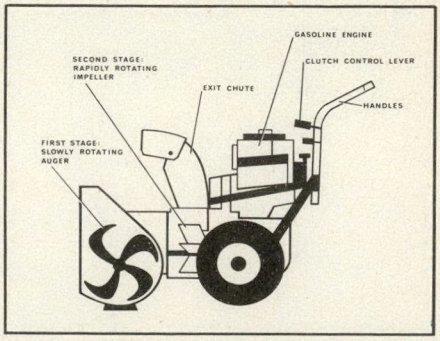

FIG. 2—Diagrammatic representation of working parts of two-stage gasoline-powered snowblower.

inside before the blades had stopped spinning.

All injuries were distal to the metacarpophalangeal joints and in each case the blade hit the dorsum of the digit. Apart from the complete amputations, there were no flexor tendon injuries and only one digital nerve laceration. This was on the radial side of a ring finger and, because it was only partial and very distal, repair was not carried out. Injuries ranged from skin lacerations through open fractures to complete amputations. All patients were treated with antibiotics, tetanus prophylaxis when necessary, wound excision, primary repair and closure of tissues. Efforts were made to conserve as much of the patients' fingers as possible.

Ten amputations occurred, 7 through distal phalanges and 3 through middle phalanges. Replantation was not possible for any of the amputations, either because injuries occurred distal to the digital artery trifurcation or because of distal segment damage. Three amputations were distal with no exposed bone. These were covered with a split-thickness skin graft. The seven others were closed with phalangeal shortening and using local skin flaps.

There were eight open fractures, two in middle phalanges and six in distal phalanges. In each case, the fracture was explored and its wound excised and copiously irrigated. After reduction, Kirschner wires were used for internal fixation, avoiding transfixion of the distal interphalangeal joint whenever possible. Apart from carefully repairing the specialized nailbed tissue, all other lacerated skin was only very loosely approximated.

There was one open dislocation of a distal interphalangeal joint. This was cleaned like an open fracture and then primarily fused with a single transarticular Kirschner wire. The remaining two injuries were skin lacerations, which were excised, irrigated and sutured.

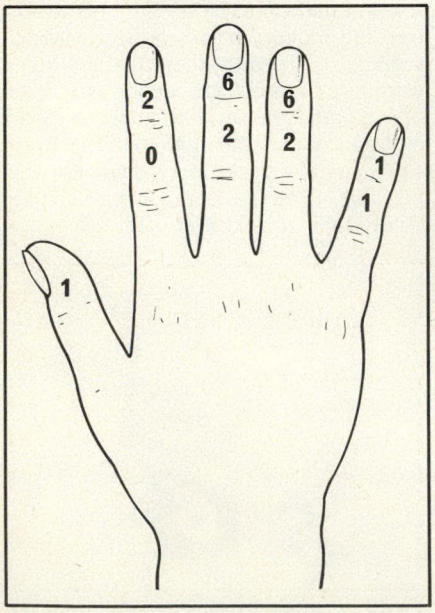

FIG. 3—Distribution of injuries sustained by nine patients.

All patients had sutures removed within 7 to 10 days and were followed up for 9 months.

There were no postoperative infections or ischemic flaps or fingertips. No amputations required revision and, in particular, there were no problems with digital nerve neuromas, paresthetic flaps or tight or unsightly amputation stumps. None of the patients who had undergone amputation experienced quadriga or "lumbrical-plus" syndrome. In patients with proximal digital injuries, tendon adhesion was not a problem and thus tenolysis was never necessary. Intolerance to cold was experienced by six patients but was always mild. Other forms of cutaneous hypersensitivity were not seen. The patient with the digital nerve injury achieved 8-mm two-point discrimination by the end of follow-up and this produced no functional disability.

Rehabilitation was started immediately postoperatively as none of the injuries needed cast immobilization. Patients were seen weekly until rehabilitation was complete and the clinic therapist strongly encouraged active motion. Only two joints did not achieve a full active range of motion within 6 weeks. One was the fused distal interphalangeal joint, in which there was complete bony union and good function by 3 months. The other was in a patient with an open fracture of the distal phalanx who received 1 week of formal hand therapy during the second month and eventually achieved 0° to 40° of active motion. All patients had returned to work by 6 weeks.

Discussion

Few publications have reported on snowblower injuries to the hand. There have been three epidemiologic studies,[1-3] which demonstrated that most injuries occurred when patients used their hands to clear blocked exit chutes. Accidents were most likely in heavy wet snow conditions and at a time when people were relatively unprepared, not having used the machines over the summer months. Other etiologic factors were operator inexperience and inadequately functioning machines. In our study, factors leading to injury were similar: rapid onset of colder temperatures, sudden need for snowblowers after storage for the summer, a mid-week storm with an urgency to clear snow in poor light after a day at work, frustration as exit chutes became repeatedly clogged with heavy wet snow and limited operator education.

Only one previous paper[4] has been concerned with the injuries themselves. In a biomechanical study, Barry and Linton compared the speed of the blade tips and kinetic energy between rotary lawnmowers and snowblowers. Results showed that lawnmower injuries were comparable to those from high-velocity missiles whereas snowblower injuries were more like those from low-velocity missiles. For this reason, patients in this series were treated with thorough but minimal wound excision and wounds were closed primarily. The cosmetic and functional results were good, patients returned to work early, and the troublesome complications that frequently occur after trauma to the fingers were not seen. These results were typical of those associated with low-velocity missiles.

With respect to the exact mechanism of injury, snowblower injuries, unlike many other forms of accident are frequently related to the machines themselves. Most of the people stated that they were surprised how close the impeller was to the exit chute opening and some did not even know that there was a second-stage impeller. Improved operator education would theoretically be the ideal way to prevent these injuries from occurring. Unfortunately, because of the sporadic use of snowblowers by the casual operator, simple safety rules have either never been learned or been long forgotten. Most patients also admitted that, at the time of injury, they were hurrying to keep up with an overwhelming quantity of snow, were frustrated because of the repeatedly clogged exit chutes and acted hastily without really thinking about what they were doing.

Several newer snowblower models have spring-loaded safety clutch bars mounted on the handles and require two hands to be gripping the handle bar in order to have power engaged on the rotating blades. With machines constructed in this way, it should not be possible to reach both clutch bars and rotating blades at the same time. Theoretically, therefore, if all machines were built in this manner, the number of accidents could be considerably reduced, particularly if impeller blades were made to stop turning abruptly when the clutch bar was released.

It would seem that the most practical preventable measure would be to improve the safety of snowblowers, and manufacturers should be encouraged to fit all snowblowers with similar remotely located spring-opening clutches.

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BILL C-22
Rx FOR QUALITY HEALTH CARE

CANADA'S NEW DRUG PATENT BILL C-22 –WHAT DOES IT MEAN FOR YOU AND YOUR PATIENTS?

The new drug patent bill has sparked political debates, advocacy campaigns, and a degree of public concern. PMAC wishes all practising health professionals to understand how these changes will affect the quality of health care and the cost of drugs for Canadians. Here are the facts from which you can judge the benefits of Bill C-22 for yourself and your patients.

KEY FEATURES OF BILL C-22

Recognizes intellectual property of health scientists

Bill C-22 restores partial recognition of the intellectual property of the inventors of new and improved drug products by preventing a generic company from copying the product for seven or ten years depending on whether or not the generic company makes the fine chemical in Canada. These fixed periods of protection are shorter than those provided by all of our western industrialized trading partners. Nevertheless, Bill C-22 does establish a fixed period of protection where none exists today.

Creates a Favorable Investment Climate

Fourteen individual PMAC members have already publicly announced that they will spend more than $500 million over the next five years on new research and development. In total, PMAC has made a commitment to the government to double the rate of research and development spending over the next ten years. Total funding will be $3.0 billion, of which $1.4 billion is due to changes in Bill C-22 and the favorable investment climate it creates. This funding will directly create 3,000 high-tech jobs. The Bill also establishes a full government review of the industry's commitments after four and ten years. Failure to honor these commitments will result in a loss of protection.

Improves Quality of Health Care

Quality biomedical research is at the heart of the best health care systems. The more we have of biomedical research of the highest calibre, the more our society gains from earlier access to new medicines and medical procedures with an overall improvement in quality of life. The $3.0 billion that the industry will spend on Canadian research over the next ten years is more than just money and high-tech jobs for our university graduates. It is an investment in new, high quality treatment for AIDS, cancer, Alzeheimer's and other diseases. It is an investment in the health care of the 21st century.

Protects Patients from High Prices

Bill C-22 creates a Drug Price Review Board which will limit the amount manufacturers can charge for a new product and the amount of yearly price increases. The Board will determine if the prices of new products are excessive by comparing them against the prices of existing products in the same therapeutic class. The Board will limit the rate of annual price increases for all protected products to no more than that of the Consumer Price Index. Manufacturers that fail to abide by a directive of the Price Board will immediately lose protection for their products.

Maintains Availability of Generic Products

Under Bill C-22, all generic products on the market will remain on the market. Forty (40) more high volume generic products will reach the market over the next five years as protection periods expire. This is three times the number of generic products that reached the market in the past five years.

BILL C-22 A QUALITY Rx FOR CANADA

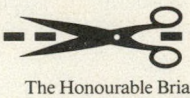
Bill C-22 is a positive reward to the inventor who has investigated 10,000 chemicals, spent ten years time, and invested $100 million to develop his one new product for better health. Bill C-22 stimulates biomedical research in Canada to develop cures for the 21st century. Bill C-22 protects patients by creating a new powerful Board to regulate prices. Bill C-22 is a fair balance to all.

You be the judge. If you think the benefits of Bill C-22 are good for Canada, please write to the Prime Minister, or sign and send him this prescription for Canadian health care.

PMAC thanks you for your support.

PMAC ACIM

PHARMACEUTICAL MANUFACTURERS ASSOCIATION OF CANADA
Innovation and Social Responsibility



For: The Honourable Brian Mulroney, Prime Minister of Canada
Address: Langevin Building, Wellington Street
Ottawa, Ontario K1A 0A2

Date: _____

Rx BILL C-22

mitte: A sound policy for consumer protection, expanded biomedical research, and quality health care for all Canadians.

sig: As a Canadian professional health practitioner, I support this policy.

_____ M.D.

_____

LE PROJET DE LOI C-22
Rx: SOINS DE QUALITÉ

LE NOUVEAU PROJET DE LOI CANADIENNE SUR LES BREVETS (C-22) : RÉPERCUSSIONS POUR VOUS ET VOS PATIENTS

Le nouveau projet de loi sur les brevets pharmaceutiques a déclenché un débat politique, des campagnes d'opinion et une certaine controverse publique. L'ACIM souhaite que tous les praticiens du secteur de la santé soient au courant de la façon dont les réformes proposées influeront sur la qualité des soins et sur le coût des médicaments. Voici donc des faits qui vous permettront de juger des avantages que présente le projet de loi C-22 pour vous-même et pour vos patients.

LES GRANDES LIGNES DE LA RÉFORME

Reconnaissance de la propriété intellectuelle des scientifiques

Le projet de loi C-22 rétablit en partie les droits de propriété intellectuelle de ceux qui découvrent de nouveaux médicaments ou qui perfectionnent des produits pharmaceutiques existants. Pour ce faire, la nouvelle loi interdira aux fabricants de médicaments génériques de copier les produits brevetés pendant une période de sept ou dix ans selon qu'ils se livrent ou non à la production de chimie fine au Canada. La durée de cette protection est certes plus courte que celle que garantissent tous nos partenaires industrialisés occidentaux, mais l'adoption d'une période fixe est déjà un grand progrès pour le Canada.

Instauration d'un climat favorable aux investissements

Quatorze laboratoires pharmaceutiques membres de l'ACIM ont déjà annoncé qu'ils alloueront plus de 500 millions de dollars leurs budgets de recherche-développement au cours des cinq prochaines années. Au total, l'ACIM s'est engagée envers le gouvernement à doubler le niveau des dépenses de recherche-développement dans un délai de dix ans. Le budget total de la recherche s'élèvera à 3 milliards de dollars, dont 1,4 milliard provenant directement des réformes introduites par le projet de loi C-22 et du climat favorable qu'il contribuera à créer en matière d'investissement. Ce niveau de financement permettra de créer directement 3 000 emplois dans un secteur de pointe. La nouvelle loi prévoit également que les pouvoirs publics passeront intégralement en revue le niveau de réalisation des engagements pris par l'industrie quatre ans et dix ans après l'adoption de la réforme. Les entreprises qui ne tiendront pas promesse seront privées de leur exclusivité.

Amélioration de la qualité des soins

La qualité de la recherche biomédicale est garante de la qualité des soins. Plus le niveau de la recherche biomédicale canadienne s'élève, plus notre pays profite de la disponibilité immédiate de médicaments et traitements nouveaux, et plus notre qualité de vie s'améliore. Les 3 milliards de dollars que l'industrie consacrera en dix ans à la recherche canadienne ne serviront pas seulement à améliorer les revenus de nos chercheurs et à créer des emplois pour nos diplômés. C'est un investissement dans la qualité future des soins qui permettront de lutter contre le SIDA, le cancer, la maladie d'Alzheimer et les autres maladies encore invaincues ou imparfaitement maîtrisées. C'est un investissement dans la santé des Canadiens au XXI[e] siècle.

Une garantie contre la cherté des médicaments

Le projet de loi C-22 prévoit la création d'un Conseil d'examin des prix des médicaments qui limitera le prix de lancement des médicaments nouveaux et le montant des hausses périodiques. Pour les nouveaux médicaments, le Conseil procédera par comparaison avec les prix des produits existants dans chaque catégorie thérapeutique. Le prix d'aucun produit exclusif ne pourra augmenter plus vite que la progression annuelle de l'indice des prix à la consommation. Tout laboratoire qui ne respecte pas les directives du Conseil d'examin sera immédiatement privé de son exclusivité pour ses produits.

Maintien des produits génériques sur le marché

Aux termes de la nouvelle loi, tous les produits génériques actuels pourront rester sur le marché. Une quarantaine de nouveaux produits génériques à grand débit seront mis sur le marché d'ici cinq ans à mesure qu'expireront les brevets qui les protègent encore. Ce chiffre est cinq fois plus élevé que le nombre de produits génériques lancés depuis cinq ans.

LE PROJET DE LOI C-22 : Rx QUALITÉ POUR LE CANADA

Le projet de loi C-22 récompense de façon tangible l'inventeur qui, en dix années de travail, a étudié 10 000 molécules et investi 100 millions de dollars pour mettre au point un médicament nouveau afin de protéger la santé. Le projet de loi C-22 stimule la recherche biomédicale au Canada pour conquérir les maladies du XXI[e] siècle. Le projet de loi C-22 protège les patients en créant une puissant Conseil d'examin des prix. Le projet de loi C-22 rend justice à tous.

Jugez-en vous-même. Si vous pensez que le projet de loi C-22 est bon pour notre pays, écrivez au Premier ministre du Canada, ou signez cette ordonnance dûment remplie pour assurer la santé future des Canadiens.

L'ACIM vous remercie de votre appui.

PMAC
ACIM

ASSOCIATION CANADIENNE DE L'INDUSTRIE DU MÉDICAMENT
Innovation et responsabilité sociale

Pour :	L'honorable Brian Mulroney, Premier ministre du Canada
Adresse :	Édifice Langevin, rue Wellington Ottawa (Ontario) K1A 0A2
Date :	_____
Rx	Projet de loi C-22
mitte :	Une saine politique de protection du consommateur, d'expansion de la recherche biomédicale et de soins de qualité pour tous les Canadiens.
sig :	En qualité de praticien du secteur canadien de la santé, j'appuie cette politique.

M.D.

ROSS K. LEIGHTON, MD, FRCSC;* DAVID PETRIE, MD, FRCSC†

Arthrodesis of the Wrist

In a retrospective study, the wrists of 18 patients who underwent arthrodesis by the AO technique were assessed clinically, for hand strength and function. Follow-up averaged 4 years (range from 1 to 7 years). Although wrist arthrodesis improved grip strength, it was still only 50% to 60% of normal. Hand function improved to within normal limits in 78% of patients and bony union occurred in 94.4%. Thirteen patients were back at work within 18 months. The AO technique of wrist arthrodesis allows correction of deformity, relief of pain, increased grip strength and improved hand function.

Ce fut une étude rétrospective de 18 patients ayant reçu une arthrodèse du poignet utilisant la techique AO. La moyenne de post-observation fut de 4 ans avec une portée de 1 à 7 ans. Tous les patients furent cliniquement évalués ainsi que d'éprouver des assais formaux pour l'intensité et fonction de la main. Les résultats ont démontré que le taux d'union fut 94.4%. Malgrés que l'arthrodèse du poignet améliore la force de serrage; ce n'est que 50% à 60% dans les limites de la normal chez 78% des patients. Treize patients retournèrent au travail en dedans de 18 mois. Alors la technique AO d'arthrodèse du poignet alloue une bonne amélioration de déformité, soulage la douleur, augmente l'intensité de serrage et améliore la fonction de la main.

From the Department of Orthopedics, Dalhousie University, Halifax, NS

**Orthopaedic Department, The Moncton Hospital, Moncton, NB*

†Associate professor, Dalhousie University, Victoria General Hospital, Halifax, NS

Accepted for publication Dec. 2, 1986

Reprint requests to: Dr. Ross K. Leighton, Ste. 407, 100 Arden St., Moncton, NB E1C 4B7

Arthrodesis is an excellent procedure for improving function in a disabled wrist. Although the literature shows that surgeons agree on the desirability for a position of slight dorsiflexion, the technique used to achieve fusion varies.[1-6] In this study the method of compression arthrodesis of the wrist was in accordance with the principles for stable internal osteosynthesis described by Muller and colleagues.[7]

The current indications for wrist fusion include irreversible destruction secondary to rheumatoid arthritis or osteoarthritis, causing prolonged pain and deformity, and flaccid or spastic paresis causing difficulty in using the hand.

Materials and Methods

The charts of 30 patients who underwent wrist arthrodesis at the Victoria General Hospital in Halifax in the 7 years between 1974 and 1981 were reviewed. Of these, 18 patients were assessed clinically and form the basis of this study. In 15 cases the fusion was required for traumatic osteoarthritis, in 2 it was secondary to inflammatory disease and in 1 to a spastic monoplegia secondary to trauma. The follow-up averaged 4 years (range from 1 to 7 years).

Operative Method

Under general anesthesia, a tourniquet is applied high on the upper arm and inflated to 250 mm Hg. The wrist area is prepared and draped. The joint is exposed with a standard dorsal approach. Articular cartilage is removed with hand-held curettes, rongeurs and a Hall drill. A trough is then created from the radius to the second and third metacarpals and a bone graft from the iliac crest is fashioned as a slab to fit the trough. Small cancellous bone grafts should be packed into the intercarpal and radiocarpal joints. The dynamic compression plate (six- to seven-holes narrow 4.5 mm) is then contoured to 10° to 20° of dorsiflexion while its position on the second metacarpal should allow 5° of ulnar deviation. The plate is anchored over the bone graft by at least two screws in the second metacarpal, one in the carpus and at least three in the radius. Care should be taken to prevent the extensor pollicis longus from crossing a screw head, as there have been reports of rupture secondary to attrition. The tourniquet is released, hemostasis obtained and the wound irrigated and closed over a Hemovac drain. Operating time is approximately 60 minutes.

Postoperative Care

All patients wore a protective gauntlet for 2 to 4 weeks. Physiotherapy was begun within 7 days. The hardware was left in for an average of 2 years.

Results

The patients in this study were tested for hand strength by the method outlined by the Sister Kenny Institute,[8] and for hand function according to the method of Jebsen and colleagues.[9] These investigators administered tests to more than 300 people with normal hands and drew up tables, adjusting the results for age, sex and dominant versus non-dominant hand.

In order to assess hand strenght, the 18 patients were first given four tests: grip strength, palmar pinch, three-point pinch and lateral pinch. The results were compared with those for normal hands (Table I). The wrist that required arthrodesis for painful tenosynovitis, was in the 90% to 100% group. The two wrists in the 10% to 25% group were fused in 5% to 10% ulnar deviation. One of the three in the under 10% group had associated median and ulnar nerve pal-

Table I—Hand Strength

Percent of normal	Wrist arthrodesis
90 – 100	1
75 – 90	0
50 – 75	10
25 – 50	2
10 – 25	2
< 10	3

sies, one had a pseudarthrosis and the third was the only patient in the study with spastic monoplegia.

Hand function was then assessed by giving each patient the following tests and relating them to time: (a) writing, (b) ability to pick up a small common object, (c) simulated feeding using a spoon, (d) ability to stack checkers, (e) ability to handle large light objects and (f) ability to handle large heavy objects.

The results of these timed trials were then related to the normal, as drawn up by Jebson and colleagues[9] (Table II). The patient with pseudarthrosis was within 1 standard deviation of normal but three others scored greater than two standard deviations. One had median and ulnar nerve palsies, one had spastic paraplegia and the third had chronic ulnar osteomyelitis. Therefore, after fusion, 78% had acceptable hand function.

Patients were also asked to evaluate their wrists subjectively with respect to function and pain. The results were as follows: excellent – no pain and unlimited activity, good – no pain but some limited activity, fair – minimal discomfort and limited activity, poor – increased pain with activity (Table III). Two patients in the good group were unhappy with the wrist position, complaining of too much flexion. One in the fair group and one in the poor group complained of pain over the plate. All but one patient in the poor group, who had the pseudarthrosis, felt that the discomfort was much reduced and functional level improved over the preoperative state.

Complications

Only one pseudarthrosis developed, giving a union rate of 94.4%. This nonunion was the direct result of a split fracture of the second metacarpal which, despite external immobilization, progressed to pseudarthrosis.

There were two infections. One was superficial and cleared with antibiotic treatment and wound care within 2 weeks. The other was treated with antibiotics for 1 year and at follow-up after 5 years showed good union, with the plate still firmly in position.

Table II—Hand Function

Range	Wrist arthrodesis
Normal	14
1 std deviation	1
> 2 std deviations	3

Table III—Subjective Evaluation of Function

Evaluation	Wrist arthrodesis
Excellent	12
Good	3
Fair	1
Poor	2

Discussion

Previous techniques, using external fixation to immobilize the wrists, were complicated by pseudarthroses. With bone grafts the frequency of this complication is reported to range between 2% and 12%. However, cast fixation for as long as 4 to 6 months, with further protection in a splint, may be required to obtain adequate union. With the AO technique, union was obtained in our study in all wrists but one, and in that case nonunion was secondary to a split fracture of the second metacarpal. If a split fracture does occur it should be repaired operatively to achieve rigid internal fixation.

Arthrodesis of the wrist should result in an increase in the power of grip but, as this study shows, not much more than 50% to 60% of normal can be expected. By using internal fixation the patient has an early start in the use of the hand, thereby minimizing the risk of adhesions between the skin and the gliding extensor mechanism.

The plate should be placed on the second metacarpal bone, radial to the tendons of the extensor digitorum communis muscle. It does not seem to impair function of the extensor pollicis longus although rupture of that tendon has been reported,[7] probably caused by the tendon crossing over one of the screw heads.

The use of a dynamic compression plate is recommended, as opposed to the narrow plate and compression instrument described by Muller and colleagues.[7] The dynamic compression plate gives adequate compression and does not require the extra exposure demanded by the compression instrument.

The plate should probably be removed between 6 and 12 months postoperatively. This is supported by Uhthoff and Dubuc[10] who noted that periosteal resorption occurred after 6 months of application of a plate. However, it is very difficult to tell if the fusion is solid and this accounted for our delay. Bone remodelling and regression of the osteopenia occur after the plate is removed.[10,11]

Hand function was improved to within acceptable limits in 78% of the wrists operated on. The poor results were due to pseudarthrosis, nerve palsy, spastic monoplegia and chronic osteomyelitis. Seventy-two percent of our patients were back at work within 18 months of operation.

Arthrodesis of the wrist using the AO technique offers a stable internal fixation that gives optimum conditions for rapid bony union. It allows correction of deformity, relief of pain, and better hand grip and function. The most important contribution of this technique is the high rate of fusion despite major deformity preoperatively.

We acknowledge the work of Cathy McAuley and Jill Tasker from the Dalhousie University Physiotherapy Department.

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NOTICES

First International Shock Congress

The First International Shock Congress and the Tenth Annual Conference on Shock will be held in Montreal, June 7–11, 1987. The scientific program will consist of workshops, symposia, submitted papers and poster presentations. As well, the four finalists of the Young Investigator Awards Competition will present their work. For information contact Dr. Sherwood M. Reichard, Medical College of Georgia, Augusta, GA 30912.

Continuing Education — Gastroenterology

The University of Rochester School of Medicine is sponsoring a course entitled "Rochester Review in Gastroenterology" in Toronto, Oct. 8–10, 1987. Dr. Jagdish C. Mangla is the course director and Dr. Sheila Sherlock from The Royal Free Hospital in London the guest speaker. Information can be obtained from: Office of Continuing Professional Education, UR Medical Center, 601 Elmwood Ave., Box 677, Rochester, NY 14642 (telephone: [716] 275-4392).

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N.K. DOWN, MD, FRCSC;* L. MAKOWKA, MD, PH D;* B. LANGER, MD, FRCSC;*
R. COLAPINTO, MD, FRCPC;† R.H. WENSEL, MD, FRCPC‡

Successful Treatment of a Traumatic Hepatic Artery–Portal Vein Arteriovenous Fistula by Interpositional Mesocaval Shunting

Hepatic artery–portal vein fistula is an occasional sequel to invasive procedures on the liver, such as biopsy and transhepatic cholangiography. When the fistula is large it may result in portal hypertension, gastrointestinal bleeding and histologic and functional changes in the liver. Treatment is usually directed at the fistula, either embolizing, dividing or resecting it. Portal decompression has been discouraged in the past. The authors describe a case in which recurrent gastrointestinal bleeding, uncontrolled by attempts at embolization, was subsequently managed successfully by portosystemic shunting. They suggest that when the primary symptom related to the fistula is variceal bleeding, portal decompression is a reasonable therapeutic option.

Une fistule entre l'artère hépatique et la veine porte apparaît en de rares occasions comme séquelle d'une intervention avec pénétration hépatique telle qu'une biopsie ou une cholangiographie transhépatique. Dans les cas de fistules importantes il peut s'ensuivre une hypertension porte, des saignements gastro-intestinaux ainsi que des modifications histologiques et fonctionnelles du foie. On s'applique habituellement à corriger la fistule, soit par embolisation, séparation ou résection. Dans le passé, la décompression du système porte a été déconseillée. Les auteurs décrivent un cas où des saignements gastro-intestinaux récidivants, non corrigés par une tentative d'embolisation, ont pu être réprimés par la suite par une dérivation du système porte. Ils suggèrent que quand le symptôme primaire de la fistule est l'hémorragie variqueuse, la décompression du système porte est une option thérapeutique acceptable.

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Hepatic artery–portal vein arteriovenous fistulas are very rare but potentially fatal. A small number are congenital but most are a result of penetrating trauma,[1] including surgical manipulation or invasive diagnostic procedures such as needle biopsy or percutaneous transhepatic cholangiography.[1] In fact, with the increased use of diagnostic angiography, asymptomatic arteriovenous fistulas secondary to percutaneous needle puncture are often identified.[2]

Symptoms are proportional to the size of the fistula, with large fistulas leading to portal hypertension and its complications. After angiographic confirmation of the diagnosis, treatment is usually surgical and directed at the fistula. Concern that treating the portal hypertension with a portosystemic shunt will precipitate cardiac failure appears to be more theoretical than real. This paper reports a patient with hepatic artery–portal vein fistula whose serious portal hypertension was treated successfully by mesocaval shunting.

Case Report

A 67-year-old woman, who had no history of alcoholism, was referred to the Toronto General Hospital in July 1984 for treatment of upper gastrointestinal bleeding. Her medical history included long-standing peptic ulcer disease, treated with cimetidine, and a gastric fundoplication performed in 1977 at which time splenectomy was necessary due to intraoperative injury. In 1978 a percutaneous needle biopsy of the right lobe of the liver was performed during investigation of jaundice and demonstrated steatosis histologically. Endoscopy carried out for an upper gastrointestinal hemorrhage in January 1982 revealed esophagitis and gastritis. A second percutaneous biopsy of the right lobe of the liver, done in 1982, showed nonalcoholic steatonecrosis and fibrosis. In May 1982, a second, major upper gastrointestinal hemorrhage occurred. Bleeding esophageal varices were seen on endoscopy; these were managed conservatively. Angiography demonstrated a large fistula between a branch of the right hepatic artery and the portal vein (Fig. 1). Gelfoam embolization of the right hepatic artery was performed with successful closure of the fistula (Fig. 2). Hematemesis recurred in October 1983, and endoscopy demonstrated a chronic duodenal ulcer and esophageal varices which were thought to be the source of the bleeding. A superior mesenteric arteriogram revealed that the hepatic arteriovenous fistula was patent, so embolization was repeated using wire coils (Fig. 3). At follow-up endoscopy 1 week later, the varices were flat with no evident bleeding.

A left nephrectomy was performed in November 1983 for removal of a suspicious left renal mass, which was found to be a benign nephroma. The patient remained well for 8 months when she had massive hematemesis, preceded by a 2-week history of melena, nausea and malaise. No ulcer was present but

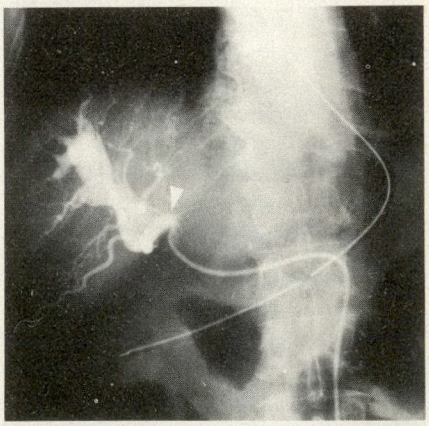

FIG. 1—Initial angiogram demonstrating fistula (arrow) between branch of right hepatic artery and portal vein.

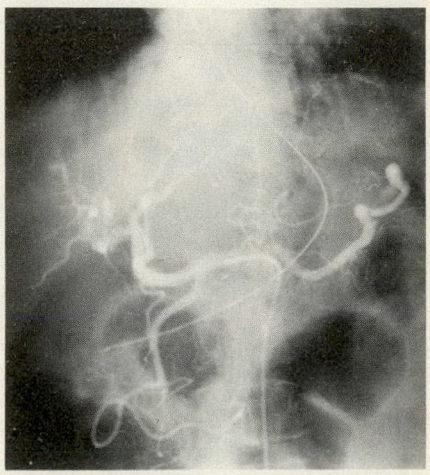

FIG. 2—Angiogram after Gelfoam embolization of hepatic artery–portal vein fistula.

esophageal varices were again seen. These were sclerosed with 3% sodium tetradecyl sulfate (Thrombovar) and an intravenous infusion of Pitressin was started. Angiography demonstrated that the hepatic artery–portal vein fistula in the right lobe of the liver was again patent. She was transferred to the Toronto General Hospital for further management.

On admission she was hemodynamically stable, not icteric and had no peripheral stigmas of chronic liver disease. Her liver was mildly enlarged and nontender with no audible bruit in the epigastrium or right upper quadrant. Results of laboratory investigations, including liver function tests, were all within normal limits. Endoscopy revealed esophageal varices which were sclerosed with 10 ml of ethanoleum oleate.

In July 1984, after another variceal hemorrhage, a portal systemic mesocaval shunt was performed without difficulty using an interpositional Weavenit graft (Meadox Medical Inc., Oakland, NJ). The liver appeared cirrhotic. A wedge biopsy from the right hepatic lobe demonstrated advanced macronodular cirrhosis, compatible with a previous viral infection. She made a smooth recovery and was discharged 9 days later. An angiogram obtained before discharge revealed a patent mesocaval shunt and filling of the arteriovenous fistula through arterial collaterals with retrograde flow in the portal vein.

Follow-up endoscopy 3 months later showed flat esophageal varices, and 30 months postoperatively she remained well, with no recurrence of bleeding.

Discussion

Due to the close proximity of the biliary, arterial and venous conduits in the portal tract, there is a substantial risk of injury to adjacent structures in trauma and during invasive procedures aimed at deliberate transhepatic cannulation of the bile ducts. Okuda and colleagues[2] demonstrated that the risk of arteriovenous fistula rises with increasing needle calibre and length of penetration of the instrument. None of the patients they studied experienced appreciable symptoms and several who had follow-up arteriograms at 15 months and 5 years after percutaneous transhepatic procedures failed to demonstrate a fistula. The authors suggested that small intrahepatic fistulas may be occluded by regenerating hepatocytes and fibrosis.[2] Nevertheless, occasionally a hepatic artery–portal vein communication may persist, secondary to necrosis of sequestered hepatic parenchyma, breakdown of a necrotic vessel-wall hematoma or pseudoaneurysm formation. Fistulas occurring after major liver trauma rarely close because of their large size and the greater destruction of surrounding hepatic parenchyma.[3]

Symptoms and signs vary, depending on the size of the fistula and the timing of presentation. When a hepatic artery–portal vein fistula occurs directly after abdominal trauma, acute portal congestion and hyperemia of the intestinal mucosa may present an enteritis-like picture,[4] with diarrhea, abdominal pain and, occasionally, gastrointestinal bleeding.

Careful clinical examination may reveal a machinery type loud bruit over the liver or epigastrium. Such patients may deteriorate rapidly because of acute gastrointestinal or intrahepatic bleeding.[5] If the fistula is small, collateral circulation may provide adequate compensation for the change in liver blood flow so that the patient remains asymptomatic. Eventually, usually after 4 or 5 years,[3] the patient may present with the sequelae of portal hypertension — variceal bleeding and, less commonly, ascites. The hemodynamic alterations resulting from a portal systemic fistula are such that the blood flow into the liver exceeds the capacity of the outflow tract, and portal hypertension ensues.[6] However, unlike large systemic arteriovenous malformations, where tachycardia, elevated cardiac output, cardiomegaly, widened pulse pressure and heart failure are seen, cardiac effects are unusual with hepatic arterioportal fistulas.[7] It appears that the high venous flow rate is dampened by the resistance of the hepatic sinusoids, thereby sparing the heart.[8]

The definitive diagnosis is made by angiography, although the history of trauma or an invasive procedure, followed by symptoms of portal hypertension and an epigastric bruit detected on physical examination, are highly suggestive. The typical angiographic picture, as seen in our patient, is one of early visualization of the portal vein on aortic or celiac artery injection, or filling of the portal vein on a selective hepatic arteriogram.[4] Distal to the fistula arterial calibre is diminished and the portal vein may be tortuous and dilated.

Typically, liver function is normal, consistent with the normal histologic appearance of the liver parenchyma. Thickening of the muscularis of the portal vein with dilatation of the liver sinusoids histologically is frequently described and has been termed hepatoportal sclerosis.[6]

Hepatic artery–portal vein fistulas, particularly those located in the periphery, are often small, have few collaterals and usually close spontaneously. In contrast, centrally located fistulas are often large and more hemodynamically important. Their large size and the collateral blood flow makes treatment difficult. The dual hepatic blood supply makes angiographic embolization an attractive treatment option,[9–11] but fistula size and the large number of collaterals may reduce the likelihood or duration of success. Surgical obliteration is generally regarded as the treatment of choice.[1,2,4,5,7] Proximal ligation of the hepatic artery frequently fails because there is a compensatory increase in the collateral flow, and the fistula persists. Division of the arterial venous channel is desirable but often technically impossible in deep-seated fistulas. In this situation hepatic lobe resection has been suggested.[12] Attempts at reducing the portal hypertension by means of a portosystemic shunt have been condemned by several authors,[1,4] who argue that this merely diverts the flow back to the systemic circulation, thereby risking the subsequent development of such hemodynamic side effects of a systemic fistula as cardiac failure.

In spite of this theoretical consideration, we did not find any reports of systemic complications resulting from a

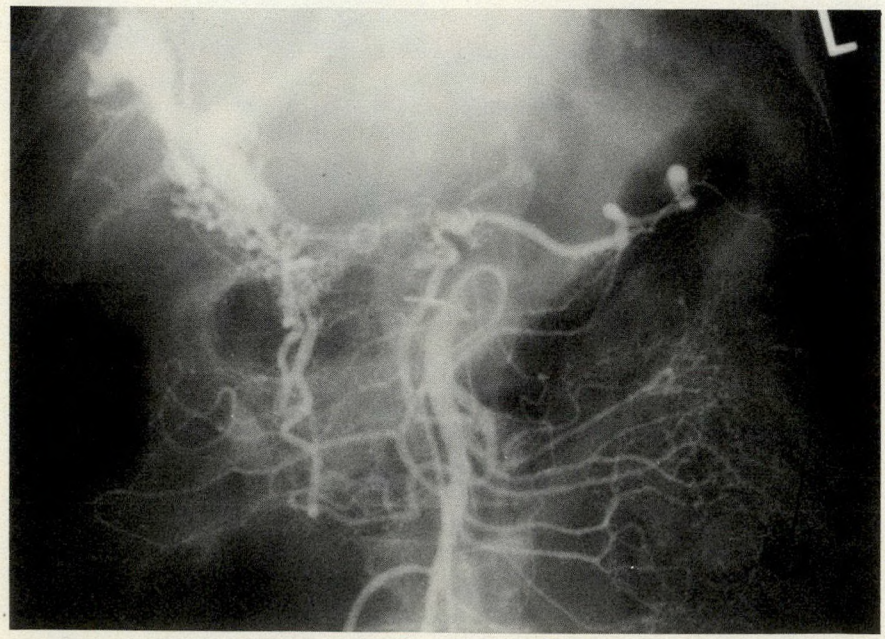

FIG. 3—Angiogram demonstrating re-embolization of recurrent hepatic artery–portal vein fistula.

functioning portosystemic shunt for hepatic artery–portal vein communication. Ryan and Lorber[13] reported the case of a 61-year-old man with a traumatic fistula treated successfully with a portacaval shunt. Ascites developed when the shunt thrombosed, but the condition was easily controlled medically. A woman with a traumatic fistula was treated by Donovan and colleagues[6] with an end-to-side portacaval shunt. The portal hypertension was relieved and she did not suffer any deleterious cardiac effects.

Surgical treatment of our patient was directed at relief of the portal hypertension that led to life-threatening variceal bleeding. A mesocaval shunt, functionally a side-to-side portosystemic shunt, was well tolerated and did not precipitate high output cardiac failure or other sequelae as has been suggested.[1,4,14,15] Thirty months after the shunt procedure, she remains symptom-free. We suggest, contrary to long-standing beliefs, that portosystemic shunting is a safe, well-tolerated means of treating portal hypertension associated with large hepatic artery–portal vein fistula, and it should be considered a therapeutic alternative if more conservative methods of controlling the fistula fail.

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Ticarcillin/Clavulanic Acid (Timentin) Compared to Metronidazole/Netilmicin in Preventing Postoperative Infection After Elective Colorectal Surgery

A randomized controlled trial was performed to compare the effectiveness of ticarcillin/clavulanic acid to metronidazole/netilmicin in preventing postoperative infections after elective colorectal surgery. Ninety-two patients were randomly allocated to receive three doses of ticarcillin, 3 g, with clavulanic acid, 100 mg every 8 hours, or three doses of metronidazole, 500 mg, and netilmicin, 80 mg intravenously every 8 hours. All patients received a mechanical bowel preparation with 3 L of Go-lytely solution.

There were no operative deaths. Eight patients had wound infections — three in the ticarcillin/clavulanic acid group and five in the metronidazole/netilmicin group. One patient in the ticarcillin/clavulanic acid group had an intra-abdominal abscess. There were two anastomotic leaks, one in each group.

Ticarcillin/clavulanic acid and metronidazole/netilmicin appear to be equally effective in preventing postoperative infections after elective colorectal surgery.

Il s'agit d'un essai randomisé et contrôlé où l'on a comparé l'efficacité d'un traitement ticarcilline/acide clavulanique et celle d'une association métronidazole/nétilmicine dans la prévention des infections postopératoires consécutives à la chirurgie colorectale non urgente. Quatre-vingt-douze patients ont été affectés au hasard à l'un de deux groupes destinés à reçevoir trois doses de 3 g de ticarcilline et 100 mg d'acide clavulanique aux 8 heures, ou trois doses de 500 mg de métronidazole et 80 mg de nétilmicine par voie intraveineuse aux 8 heures. Tous ont reçu une préparation intestinale à l'aide de 3 L d'une solution de Go-lytely.

Il n'y a eu aucun décès opératoire. Huit patients ont eu des infections de plaies, trois dans le groupe ticarcilline/acide clavulanique et cinq dans le groupe métronidazole/nétilmicine. Un patient du groupe ticarcilline/acide clavulanique a souffert d'un abcès intra-abdominal. On a enregistré deux bris d'anastomoses, un dans chaque groupe.

Les associations ticarcilline/acide clavulanique et métronidazole/nétilmicine semblent être d'égale efficacité dans la prophylaxie des infections postopératoires secondaires à la chirurgie colorectale non urgente.

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It has long been recognized that surgical transection of the colon or rectum is associated with a relatively high rate (30% to 77%[1-3]) of postoperative wound infection in patients who undergo elective colorectal surgery without antibiotic prophylaxis. Although mechanical bowel preparation may reduce the volume of stool and thus, the volume of bacteria, it is now accepted that the short-term administration of antibiotics is necessary perioperatively in order to reduce the risk of postoperative wound infections.[4] Studies[5] have indicated that anaerobes and gram-negative organisms are the most important causative organisms in this setting; therefore agents that are effective against these organisms should be used prophylactically. Timentin (Beecham Laboratories, Inc., Pointe Claire, PQ), a combination of a semisynthetic penicillin (ticarcillin) and clavulanic acid, has been shown to be such an agent. The object of this study was to compare Timentin to a combination of metronidazole and netilmicin with respect to their effectiveness in preventing postoperative infections in patients who undergo elective colorectal surgery.

Patients and Method

All patients scheduled to undergo surgery of the small bowel, colon or rectum at the Toronto General Hospital between Apr. 1, 1984 and Mar. 31, 1985 were eligible for entry into the study provided that they had not been on antibiotics within 7 days of operation. Excluded were patients with liver or renal disease, a bleeding disorder, a history of sensitivity to any of the study medications, and pregnant women. Informed consent was obtained from all patients. The study was approved by the Research Ethics Committee of the Toronto General Hospital.

Ninety-nine patients were randomly grouped in blocks of 10. This was done by the pharmacy department at the hospital, according to a predetermined scheme. The clinicians and investigators were unaware of the treatment given to individual patients.

All patients received metoclopramide, 10 mg intramuscularly, followed by mechanical bowel preparation consisting of clear liquids and 3 L of Go-lytely given over 3 hours.

Fifty patients were randomized to the ticarcillin/clavulanic acid group (group 1); they received ticarcillin disodium equivalent to ticarcillin 3 g and potassium clavulanate equivalent to clavulanic acid 100 mg in 100 ml of 0.9% sodium chloride solution infused over 15 minutes. In addition, 100 ml of normal saline was given as a placebo and infused over 15 minutes. Forty-nine patients randomized to the metronidazole/netilmicin group (group 2) received metronidazole, 500 mg in 100 ml of sterile water, buffered with sodium phosphate, citric acid and sodium chloride, and netilmicin, 80 mg in 100 ml of 0.9% solution of sodium chloride, each infused over 15 minutes. All patients received three doses of the respective medications. The first dose was infused within 15 minutes of induction of anesthesia, and the second and third doses were given 8 hours and 16 hours later.

At surgery, the bowel preparation, the presence of sepsis or contamination, the amount of blood lost and the length of the operation were assessed and recorded. Postoperatively, wounds were examined and body temperatures recorded daily for 1 week. Patients discharged from hospital within 1 week of operation were reassessed at the clinic 2 weeks after the procedure. A wound infection was recorded

when the surgical wound or peritoneal cavity produced purulent discharge. Clinically infected wounds were cultured both aerobically and anaerobically using standard procedures.[6,7] Urine, blood, sputum and wound tissue were cultured when patients had body temperatures of greater than 38.3°C on two occasions 4 hours apart (excluding the first 24 hours after surgery). Susceptibility of aerobes to netilmicin was tested at 4 and 8 mg/L by agar dilution according to standards of the National Committee for Clinical Laboratory Standards.[8] Susceptibility of aerobes to Timentin was performed using the disk diffusion method.[9] Susceptibility of anaerobes was performed using the disk elution method of Wilkins and Thiel.[10] Five (5 μg) discs of metronidazole were added to 5 ml of anaerobic brain heart infusion broth to give a final concentration of 5 mg/L. Five Timentin discs were placed in anaerobic broth for final concentrations of 75 mg/L of ticarcillin and 10 mg/L of clavulanic acid.

Findings

Of the 99 patients, 7 (4 in group 1 and 3 in group 2) were excluded from the analysis because they failed to meet the protocol criteria. In three, the bowel was not opened at surgery, two received other antibiotics postoperatively and the wound was left open in one patient. The last patient was excluded because of excessive intraoperative bleeding which the surgeons believed may have been related to the administration of ticarcillin/clavulanic acid. Later, it was recognized that the patient had had an elevated partial thromboplastin time preoperatively.

The remaining 92 patients (49 men, 43 women) had a mean age of 43 years (range from 15 to 86 years). The groups were well matched according to patient characteristics, diagnosis and procedure (Table I).

The mechanical bowel preparation was modified in 45 patients — 21 in group 1 and 24 in group 2. The antibiotic prophylaxis was modified in four patients. Two patients in group 1 received an average of 17 extra doses of metronidazole and netilmicin. In addition, one of these received 18 doses of cefazolin, 1 g intravenously, while the other received 23 doses of ampicillin, 500 mg intravenously. Two patients in group 2 received an average of 16 extra doses of the study medications. One of these also received 32 doses of cefazolin, 1 g intravenously, and the other 11 doses of ampicillin, 500 mg intravenously.

Bowel preparation, assessed in 89 patients, was considered excellent in 62 (69.7%), fair in 18 (20.2%) and poor in 9 (10.1%). Fecal contamination occurred in three patients but none had septic complications as a result.

The mean blood loss was 440 ml in group 1 and 490 ml in group 2. The mean operative times in the two groups were 2.9 hours and 2.8 hours respectively.

There were no operative deaths. Complications are listed in Table II. There were no significant differences in the number of postoperative infections between the two groups. *Escherichia coli* was isolated from the wounds of two patients in group 1 and group D *Streptococcus* from one of them. *Escherichia coli* was cultured from the peritoneal cavity of a third patient, and coagulase-negative staphylococci and *Corynebacterium* sp. (most likely resident skin flora) from the wound. In group 2, a mixed growth of gram-negative organisms was identified. *Escherichia coli* was isolated from all patients and in addition, *Proteus vulgaris* (one patient), *Proteus mirabilis* (one), enterococci (one), group B *Streptococcus* (two), *Enterobacter cloacae* (one) and *Corynebacterium* sp. (one) were also cultured.

One patient in each group with urinary tract infection had temperature spikes, but no source was identified nor was there microbiologic confirmation of sepsis. Both patients were treated with antibiotics. There were no complications attributable to the antibiotics. In particular, no bleeding complications or significant changes in the partial thromboplastin time were detected in group 1 patients.

Table I—Patient Characteristics

Characteristic	Group 1 (n = 46)	Group 2 (n = 46)
Age, yr		
Mean	43	44
Range	16–75	15–86
Male:female	25:21	24:22
Diagnosis		
Ulcerative colitis	16	18
Crohn's disease	7	10
Cancer	17	14
Other	6	4
Surgical procedure		
Colectomy	16	19
Proctocolectomy	0	1
Restorative proctocolectomy	7	3
Anterior resection	2	3
Abdominoperineal resection	1	2
Small-bowel resection	4	2
Ostomy closure	12	16
Other	4	0

Table II—Complications

Complication	Group 1, no. (%)	Group 2, no. (%)
Wound infection	3 (6.5)	5 (10.9)
Intra-abdominal abscess	1 (2.2)	0 (0)
Urinary tract infection	1 (2.2)	5 (10.9)
Fever – unknown etiology	1 (2.2)	1 (2.2)
Anastomotic dehiscence	1 (2.2)	1 (2.2)
Small-bowel obstruction	1 (2.2)	2 (4.3)

Discussion

The prophylactic use of broad-spectrum antibiotics is indicated for patients who undergo surgical resection of the colon or rectum. Ticarcillin is a parenteral semisynthetic penicillin effective against a wide range of bacterial infections including those caused by *Pseudomonas aeruginosa*. It is not, however, effective against certain bacteria that produce the β-lactamase enzyme. In order to protect it from the destructive effect of these bacteria, ticarcillin has been combined with potassium clavulanate which is a noncompetitive inhibitor of β-lactamase. Ticarcillin/clavulanic acid has proven to be effective against *Staphylococcus aureus, Haemophilus influenzae, Neisseria gonorrhoeae, E. coli, Klebsiella* sp., *Enterobacter aerogenes, Providencia, Proteus mirabilis, P. vulgaris* and *Bacteroides fragilis*. Group D streptococci are moderately resistant to this combination.[11]

In this study, wound infection rates were low: 6.5% in group 1 and 10.9% in group 2. Previous trials[2,12–17] have documented the effectiveness of metronidazole as a prophylactic agent in colorectal surgery, although the wound infection rates have varied from 0% to 25%. Jagelman and colleagues[14] reported no wound or intra-abdominal infections in 31 patients who received metronidazole intravenously and neomycin orally. In a series of 27 patients who received only metronidazole for prophylaxis,[16] no anaerobic infections were reported but there were four infec-

tions due to aerobic organisms. A wound infection rate of 25% was observed in a trial conducted by Cunliffe and colleagues,[12] in which patients received metronidazole alone. Thus, it would appear that an agent which is effective against gram-negative aerobic organisms should be given in combination with the metronidazole. Our standard regimen has been metronidazole and an aminoglycoside, netilmicin.

Ticarcillin/clavulanic acid appears to be equally effective in preventing septic complications after elective colorectal surgery. It has two potential benefits over the metronidazole and netilmicin combination. First, although the risk of nephrotoxicity associated with short-term use of an aminoglycoside is low, this risk is avoided by using ticarcillin/clavulanic acid. Also, because of Timentin's broad spectrum, only one drug is administered, thus reducing the time spent by nursing and pharmacy staff and decreasing the potential risk of drug error. This drug was well tolerated by patients in our study. No drug-related complications were detected.

The Birmingham group[18] has advocated a 5-day perioperative course of antibiotics for patients with inflammatory bowel disease who undergo elective colorectal surgery. In a randomized controlled trial (57 patients) comparing three doses of metronidazole and gentamicin to placebo, they reported abdominal wound infection rates of 37% in the control group and 23% in the treatment group, not a significant difference. In a later study, 30 patients were given metronidazole and gentamicin for 5 days and results were compared with those obtained in the randomized controlled trial. The abdominal wound infection rate in the patients treated with the 5-day course was 13%, significantly ($p < 0.05$) lower than that of the placebo group but not significantly different from that of the group treated with only three doses of antibiotics. Similar results were found when the total infection rates (i.e., abdominal, perineal and intra-abdominal abscess and septicemia) were compared. In this study, patients with inflammatory bowel disease had more septic complications (eight in 51 patients with inflammatory bowel disease versus one in 41 patients with other indications for surgery [$p < 0.05$]). We attribute this increased infection rate to those patients with ulcerative colitis who had a restorative proctocolectomy (ileal reservoir and ileoanal anastomosis). Five of 11 patients (2 of 7 in group 1 and 3 of 4 in group 2) who had this procedure subsequently had septic complications. At our institution, the average time for these operations is 6 hours, which may account for the increase in wound infection rate. If these 11 patients are excluded from the study, then the overall septic complication rate was 7.5% in patients with inflammatory bowel disease and 2.4% in patients with other conditions necessitating colorectal surgery ($p > 0.05$). Furthermore, the wound infection rate in patients with Crohn's disease was only 5.9%. Thus, we do not routinely use prolonged perioperative antibiotic coverage for patients with inflammatory bowel disease except those who undergo reconstructive procedures (i.e., continent ileostomy or restorative proctocolectomy).

Conclusion

This study demonstrates that ticarcillin/clavulanic acid (Timentin) and metronidazole/netilmicin are equally effective in preventing septic complications after elective colorectal surgery.

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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 super-infection 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 prerenal 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 for full details 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 antibiotics 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* (sterile cefoxitin sodium, Frosst Std.) is supplied as sterile powder in boxes of 10 vials:

No. 3356 1 g cefoxitin as sodium salt
No. 3357 2 g cefoxitin as sodium salt

Storage
MEFOXIN* in the dry state should be stored below 30° C.

PRODUCT MONOGRAPH AVAILABLE ON REQUEST

421-a,11,84

Frosst
P.O. BOX 1005, POINTE-CLAIRE
DORVAL, QUEBEC H9R 4P8

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Hazards of Epidural Anesthesia in Patients With Previous Vascular Grafts

Two cases are described in which thrombosis of both limbs of an aortobifemoral bypass occurred after epidural anesthesia for a nonvascular operation. This has not previously been reported, and possible reasons for its occurrence are discussed. It seems likely that the hypotension associated with epidural anesthesia, particularly in patients already hypotensive or volume depleted, may precipitate this phenomenon. In addition, the sensory loss produced by the anesthetic may mask the signs and symptoms of acute vascular occlusion. Epidural anesthesia is not recommended in heparinized patients because of the risk of an epidural hematoma.

On fait ici la description de deux cas où une thrombose des deux branches d'un pontage aortobifémoral est apparue consécutivement à une anesthésie épidurale lors d'une chirurgie non vasculaire. Ceci n'a pas été signalé jusqu'à maintenant. On en commente les raisons possibles. Il apparaît vraisemblable que l'hypotension qui accompagne l'anesthésie épidurale puisse précipiter ce phénomène, particulièrement chez des patients déjà hypotendus ou hypovolémiques. De plus, la perte sensorielle produite par l'anesthésique peut masquer les signes et symptômes d'une occlusion vasculaire aiguë. L'anesthésie épidurale n'est pas recommandée chez les patients traités à l'héparine à cause du risque d'hématome épidural.

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Epidural anesthesia provides an effective method of pain control. In addition to its use in obstetrics it may benefit patients with chronic obstructive pulmonary disease or other problems that make general anesthesia inadvisable because of postoperative respiratory depression. Instead of traditional narcotics it may be used for postoperative pain control to facilitate chest physiotherapy and ambulation.[1] It is not recommended for patients who require high abdominal incisions, and some[2] believe it is contraindicated when heparin has been given prophylactically before operation or in patients who will be completely heparinized intraoperatively, because there is a risk of producing an epidural hematoma.

Despite occasional local neurologic complications due to injection and insertion of the catheter, this form of anesthesia is generally considered safe if the appropriate indications and contraindications are observed.[3] The purpose of this report is to describe two patients who received epidural anesthesia intra- and postoperatively and in whom thrombosis of both limbs of a previously placed aortobifemoral graft subsequently developed. The usual signs were masked by the epidural anesthesia, leading to a marked delay in diagnosis in each case.

Case Reports

Case 1

In 1973, this 60-year-old man underwent aortobifemoral bypass grafting. Subsequently he was well until January 1984 when he required resection of the sigmoid colon for carcinoma. Postoperatively, an epidural catheter was inserted to control pain. During that night his lower limbs became cool and mottled and he complained of pain, which subsided with further injections through the epidural catheter. The following morning he had severe ischemia of both feet and loss of pulsation in the bypass graft. Bilateral thrombectomies and right fasciotomy were attempted, but adequate flow was established only to the left leg. A subsequent digital subtraction angiogram revealed total occlusion of the right limb of his graft and a stenosis of the aorta proximal to the takeoff of the graft. Renal failure developed with myoglobinuria. He was transferred to The Wellesley Hospital for treatment.

Upon arrival he was dyspneic and diaphoretic, with a pulse rate of 120 beats/min and a blood pressure of 130/80 mm Hg. Findings on examination of his respiratory and cardiac systems were otherwise within normal limits. He had fresh scars on his abdomen and both groins. No pulsation could be felt in the right limb of the aortic graft, but it was adequate in the left limb. On the right lower limb there was mottling of the skin with no sensation or movement distal to the buttock. There was diminished sensation in the toes on the left with some limitation of movement. The muscles visible at the fasciotomy site were doubtfully viable although the fat bled well. After hemodialysis he was taken to the operating room where a Fogarty catheter could be passed from the right common femoral artery to the foot with the return of a small amount of liquefied thrombus. A right axillofemoral graft was constructed. With re-establishment of blood flow there was considerable swelling of the leg requiring a full four-compartment fasciotomy of the lower leg. Postoperatively, although the graft remained patent, the lower limb was not revascularized and demarcated at the level of the middle thigh. A high above-knee amputation was subsequently carried out and many of the major muscle groups at this level were found to be necrotic. Following operation he did poorly. He had no return of renal function and remained confused until his death 3 weeks later.

Comment.—The actual cause of graft occlusion in this patient is debatable. Although there was no major blood loss during the operation, it is possible that hypotension associated with the postoperative epidural block may have led to thrombosis, particularly in the presence of the aortic stenosis above the graft. With the epidural anesthesia for pain control, the diagnosis of acute lower limb ischemia was delayed so the ischemic muscle was not revascularized. If the graft occlusion had been diagnosed earlier, corrective surgery might have preserved the viability of the limbs and subsequently the patient's life.

Case 2

A 62-year-old woman was transferred from another hospital for treatment of bowel

obstruction. In 1978 she had undergone aortobifemoral bypass grafting for claudication. The graft had since functioned well. In 1981, a left modified radical mastectomy was performed for carcinoma of the breast. One of three nodes in the specimen contained tumour. Three years later she had bowel obstruction that failed to improve with conservative treatment.

On examination at The Wellesley Hospital, the pulse rate was 80 beats/min and regular and the blood pressure was 120/80 mm Hg. The abdomen was grossly distended with ascites, and a mobile central abdominal mass could be felt. All peripheral pulses were present.

At operation for relief of her small-bowel obstruction, multiple metastases were found in the liver, spleen, omentum and ovary. Approximately 5 L of ascitic fluid were present in the abdominal cavity. The anesthetic for the laparotomy consisted of high epidural anesthesia with a general anesthetic. One additional injection was given into the epidural catheter in the recovery room. Throughout the operation and in the recovery room she was hypotensive with a systolic pressure of 60 mm Hg, probably due to a combination of hypovolemia and the loss of vasomotor control secondary to the epidural block.

The next day she had profound weakness in her lower limbs, which progressed over the next 24 hours, with decreased tone in the hips, knees and ankles, worse on the left than the right. She had a lax anal sphincter. The neurologic defect was thought to be compatible with a lesion at the level of L1–2. An emergency myelogram appeared normal but computerized tomography revealed a spinal cord infarct. It was not until 48 hours later that the previously felt femoral pulses were noted to be absent. On examination of the lower limbs at this time there was some movement in the right but not the left foot. Her position sense was maintained in both feet but the limbs were areflexic. Capillary refill was sluggish and no femoral or distal pulses were palpable. After occlusion of the aortobifemoral bypass graft and thrombosis of the anterior spinal artery were diagnosed, we attempted to restore blood flow to her lower limbs. Multiple thrombectomies were required on both sides due to repeated clotting of the grafts. Over the next week both limbs of the graft remained patent but there was no neurologic improvement. Subsequently she suffered from an acute psychosis for which no cause could be found. During this episode she became hypotensive and her right foot again became cold and mottled. As she was now a formidable operative risk no attempt was made to revascularize the leg. A high above-knee amputation was carried out. Postoperatively the stump healed, her confusion cleared and she was discharged home. There was little neurologic recovery of the left leg.

Comment.—The only apparent etiologic factor for the graft thrombosis was the hypotension that was noted both intra- and postoperatively. Although this could have been secondary to fluid shifts associated with drainage of the ascites it might have been made worse by the loss of vasomotor control secondary to the epidural block. Although thrombectomy of her graft would probably not have altered the outcome neurologically, the diagnosis of graft occlusion was delayed because of the effects of the epidural anesthesia. Had the diagnosis of graft occlusion been made in the recovery room, an earlier thrombectomy could have been carried out.

Discussion

Thrombosis of a previously placed aortobifemoral graft in conjunction with epidural anesthesia has not been reported previously. In both our patients the diagnosis of graft occlusion was delayed due to masking of the signs and symptoms of ischemia by this particular form of anesthesia. The unlikely event of thrombosis of *both* limbs of both aortic grafts, which was noted only once in 40 acute occlusions of 364 aortic grafts surveyed by Ameli and associates,[4] suggests that hypotension may have played a part, as was noted in case 2. Since hypotension is sometimes seen with epidural anesthesia associated with high block or hypovolemia, or both, there is a possible connection between the use of epidural anesthesia and the graft thrombosis in both of our patients. The cardiovascular effects of extradural anesthesia have been reviewed by Stanton-Hicks.[5] He noted that there was a linear relationship to the height of the block and the degree of hypotension but also commented that a normovolemic man could compensate for vasodilatation due to segmental blockade of the sympathetic outflow up to the T5 level, by vasoconstriction in the upper part of the body. Presumably, when the patient is hypovolemic this compensatory mechanism is impaired. Neurologic deficits associated with epidural or spinal anesthesia were reviewed by Kane[3] in 1981, but of the 36 patients with severe neurologic deficit after epidural block, only 4 were noted to have hypotension as a causative factor. In three cases an epidural hematoma was blamed.

Late occlusion of vascular grafts is usually due to neointimal hyperplasia or progression of atherosclerotic arterial disease. However, patients requiring an operation for other reasons may be predisposed to occlusion of these grafts because of altered coagulation secondary to hypercoagulability caused by cancer, dehydration or by hypotension and low flow states. The cardinal signs and symptoms of graft occlusion are the disappearance of a pulse in the graft and a cool, painful, pale limb that becomes paralysed and anesthetic as the limb becomes nonviable. Since epidural anesthesia alters pain sensation and because paralysis will be difficult to assess, vascular occlusion and a nonviable extremity may not be diagnosed. It is of paramount importance that the diagnosis of vascular occlusion be made early so that treatment can be instituted. The tolerance of resting skeletal muscle to ischemia has been reported[6] to be as little as 6 to 8 hours depending upon the degree and acuteness of the episode.

When the warning signs of early graft occlusion may be masked by epidural anesthesia, it is essential to evaluate the pulses in the limb frequently. This may give early evidence of acute limb ischemia and thus permit urgent revascularization. Epidural anesthesia may not be the technique of choice in patients with previous vascular grafts as these grafts are particularly vulnerable to thrombosis during the periods of hypotension that may be associated with this form of analgesia and anesthesia, and neither medical nor nursing staff are likely to be attuned to the possibility of acute graft occlusion under the circumstances. Fuchs and colleagues[7] have recommended continuous epidural anesthesia for patients with vascular disease, both for arteriography and for aortobifemoral or femoral–distal bypass grafting. They noted profound pain relief with minimal depression of pulmonary and myocardial performance and no epidural complications in 193 patients. However, they suggested that epidural anesthesia should not be used if blood is obtained when the needle is introduced into the epidural space, because of the risk of epidural hematoma in patients who require anticoagulation during their operative procedure. They also mentioned that hypotension can occur with the use of this anesthetic. In their series, hypotension usually responded to fluid administration but in some cases vasopressors were required.

The two cases we describe indicate that epidural anesthesia may be hazardous when used for intraoperative anesthesia or postoperative analgesia in patients who have had a previously placed vascular bypass graft, unless the risks of associated hypotension are recognized by the anesthetists. The nursing staff and medical attendants should also be aware of the increased risks of thrombosis of the grafts under these circumstances.

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Dalacin® C Phosphate S.S.
(clindamycin phosphate)

Recommended Applications

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 microaerophilic 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.

Is 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 indicated 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 anuretic 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 and 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 (6 mg/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. In 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.

When necessary the pH is adjusted with sodium hydroxide and/or hydrochloric acid to maintain a pH range of 5.5 to 7.0.

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YVES E. LECLERC, MD; ANTOINE LOUTFI, MD

Implantable Device for Venous Access

This paper reports the experience at the Royal Victoria Hospital in Montreal with the first 50 Port-A-Cath devices implanted for venous access in patients requiring long-term chemotherapy. There were 25 women and 22 men, ranging in age from 18 to 85 years. Twenty-two devices were implanted for hematologic malignant disease, 26 for solid tumours and 2 for benign disease. The mean operative time was 46.3 minutes, using a percutaneous subclavian stick technique in 94% of insertions. Blood sampling and infusions were easy in 88% and 92% respectively. Seventy-eight percent of the patients accepted the device well. Nine devices were removed, four at the end of therapy (median functioning time of 208.5 days) and five because of sepsis (median time 18 days). The median time of the still-functioning devices in live patients is 141.5 days. Septic complications were seen in 12%, blockage in 6% and skin necrosis in 2%. One death occurred from sepsis in a poor-performance patient with stage IV breast cancer and hypercalcemia. We believe that the Port-A-Cath is efficient, safe and easily accessible for patients on long-term chemotherapy.

Cet article fait le bilan des 50 premières implantations d'instruments Port-A-Cath à être pratiquées à l'hôpital Royal Victoria de Montréal pour établir un accès veineux chez des patients ayant besoin d'une chimiothérapie à long terme. On comptait 25 femmes et 22 hommes dont l'âge variait de 18 à 85 ans. Vingt-deux instruments ont été implantés pour des affections hématologiques malignes, 26 pour des tumeurs solides et 2 pour des maladies non cancéreuses. Le temps opératoire moyen a été de 46.3 minutes; une technique d'insertion sous-clavière a été utilisée dans 94% des cas. Les prélèvements sanguins et les perfusions ont été facilités dans respectivement 88% et 92% des cas. Soixante-dix-huit pourcent des patients ont bien accepté l'instrument. Neuf appareils ont été retirés, quatre à la fin du traitement (après un temps médian de fonctionnement de 208.5 jours) et cinq pour cause d'infection (temps médian de 18 jours). Chez les patients qui survivent, la médiane du temps de fonctionnement est de 141.5 jours. Des complications infectieuses ont été observées dans 12% des cas, un blocage dans 6%, et une nécrose cutanée dans 2%. Un décès est attribuable à l'infection; il s'agit d'une patiente souffrant d'un cancer du sein au stade IV et d'hypercalcémie, et qui a mal évolué. Selon les auteurs, le Port-A-Cath est efficace, sûr et à la portée des patients devant recevoir une chimiothérapie au long cours.

Suitable venous access in cancer patients receiving chemotherapy is often a major problem. Peripheral veins may be inadequate from the outset or progressively occlude. The frequently used central venous catheters require a certain amount of care from the patient. Recently, a completely implantable device has been introduced, and we report on the first 50 cases of implantation of these devices for venous access.

Patients and Methods

From March 1984 to January 1986, 47 patients had 50 insertions of implantable devices for venous access (3 patients had a second device inserted after removal of the first). There were 22 men and 25 women; the median age was 48.5 years (range from 18 to 85 years) (Fig. 1). The types of tumours encountered are shown in Table I. Two patients with benign disease had the device inserted because of poor venous access and the necessity for frequent blood transfusion.

The drug delivery system used was the totally implantable Port-A-Cath (Pharmacia [Canada] Inc., Dorval, PQ). It consists of a stainless steel portal with a silicone catheter that self-seals by means of a stainless steel lock. The reservoir is entered through a self-sealing silicone rubber septum that will accept without leakage at least 1000 punctures with an atraumatic 22-gauge Huber-point needle or a 22-gauge Yale hypodermic needle (see this issue page 75). The external diameter of the catheter is 2.79 mm, the internal diameter 1.02 mm and the internal volume of the reservoir 0.4 ml.

Surgical Procedure

Under sterile conditions in the operating room and with local anesthesia in most cases, the catheter is introduced by puncturing the subclavian vein percutaneously, using a modified Seldinger technique and a special peel-away introducer used for pacemaker introductions. With the patient in the Trendelenburg position the subclavian vein is entered with a

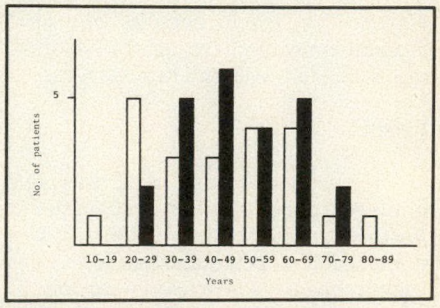

FIG. 1—Age and sex distribution. White bars = men, black bars = women.

Table I—Types of Tumour

Type	No.
Hematologic	22
Lymphoma	16
Leukemia	6
Solid tumours	26
Gastrointestinal	2
Breast	9
Lung	5
Gynecologic	5
Genitourinary	4
Mediastinal paraganglioma	1
Benign	2

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16-gauge needle. A steel J guide wire is introduced and its position checked by fluoroscopy with the C arm. An oblique incision 5 cm long is made parallel to the deltopectoral groove, incorporating the puncture site at its upper end. A pocket is fashioned medially over the pectoralis major fascia. In obese patients, the subcutaneous fat is thinned to a thickness of 5 to 7 mm. The vessel dilator and sheath introducer are positioned using the guide wire. The dilator is removed and the catheter slipped into the peel-away sheath which in turn is removed leaving only the catheter in place. The catheter position is checked by fluoroscopy; its length is adjusted and it is connected to the reservoir. The reservoir is then sutured to the fascia and the incision closed. The system is flushed with 5 ml of heparinized saline at a concentration of 100 units/ml. We do not tunnel a catheter.

Method of Use

After the skin has been disinfected with iodine solution and alcohol, the septum is punctured percutaneously with an L-shaped 90° bent Huber-point needle connected to an extension tube that has been flushed with saline. If blood return is good the system is connected to an intravenous solution and the infusion is carried out. Blood sampling follows the same procedure, after initial flushing of the reservoir. First, 10 ml of blood is aspirated, discarded and the sample is then taken. After infusion or blood sampling, the system is flushed with 5 ml of heparin-saline solution containing 100 units/ml of heparin. Heparinization is initially carried out in the operating room, and then every 4 weeks, or less in patients who have chemotherapy more frequently. No dressing is applied over the injection site.

Results

The mean operating time was 46.3 minutes (range from 15 to 180 minutes). Forty-seven (94%) implantations were done using a percutaneous subclavian stick technique. Three (6%) were done by cephalic cut-down, one after failure of the percutaneous technique. Thirty-eight (76%) were placed in the left side; 12 (24%) in the right side.

Of the 50 implanted devices only 9 were removed — 4 at the end of therapy and 5 because of sepsis. Fourteen patients died with the device in place. The median time of function was 67.5 days (range from 17 to 353 days). The respective median times of the functioning devices were 115.5 days (range from 12 to 400 days) for the 41 left implanted, 208.5 days (range from 89 to 553 days) for the ones removed at the end of therapy and 18 days (range from 14 to 63 days) for the ones removed because of sepsis.

Infusion was easy in 46 cases and difficult, requiring a change in the patient's position, in 4. Blood sampling was easy in 44, difficult in 3 and impossible in another 3 cases. Of 42 patients assessed, tolerance and acceptance of the device were good to excellent in 33 (79%) and acceptable in 9.

Table II—Complications

Complication	No.	%
Sepsis	6	12
Blockage	3	6
Skin necrosis	1	2
Pneumothorax	0	–
Hematoma	0	–

Complications

Sepsis occurred in six (12%) cases, blockage in three (6%) and skin necrosis one (2%). Pneumothorax or hematuria were not encountered (Table II). There was one death, thought to be caused by sepsis in a poor-performance patient with breast cancer who had widespread metastases, hypercalcemia, and in whom the insertion was done under general anesthesia.

Five of the six patients had their catheters removed. Blood cultures from the Port-A-Cath were positive for *Staphylococcus aureus* in two, *Staphylococcus epidermidis* in three and *Escherichia coli* in one (Table III). After intensive chemotherapy, 50% of the patients were neutropenic at the time of sepsis, which developed twice in one patient, and the device had to be removed each time. In the other three, the leukocyte count ranged from 3.0×10^9/L to 12.1×10^9/L. Three catheters blocked, two at 21 and 31 days respectively after implantation. Patency was restored in these two by streptokinase infusion but the third had to be repositioned.

Discussion

The Port-A-Cath venous access system was well accepted by 78% of the patients; blood sampling was easy in 88% and infusion in 92% of the cases, thus reducing patient anxiety and improving their general well-being. The failure of blood sampling in three patients is difficult to explain especially since infusion was adequate. We placed the catheters laterally in order to avoid compression between the clavicle and first rib, as described by Aitken and Minton.[1]

Catheter-related sepsis has been a major problem in other angioaccess methods. Sepsis with the Hickman catheter is reported to be from 3% to 13%.[2–4] Slater and colleagues[5] reported a 13% sepsis rate in 140 patients receiving chemotherapy, using a silicone elastomer catheter placed percutaneously without tunnelling. We encountered sepsis in 12% of our cases. We did not routinely use prophylactic antibiotics perioperatively. In only three instances was the leukocyte count lower than 1.0×10^9/L when sepsis developed and two of these occurred in the same patient with acute leukemia. In five of the six septic patients, the catheter was removed after persistent fever, with positive blood cultures and adequate administration of broad-spectrum antibiotics. The median time at removal was 18 days. Early sepsis might suggest that contamination occurred in the peri-implantation period rather than after prolonged use so perioperative administration of antibiotics might be helpful in decreasing the incidence of infection. Our results are not in keeping with those reported by Brincker and Saeter,[6] who reported no cases of septicemia in 78 implantations.

The duration of function compares favourably with that of the Hickman catheter, where the median duration of function was 91 days,[7] compared to 115.5 days overall when the device was in place and functioning.

Conclusions

The implantable Port-A-Cath system

Table III—Septic Complications

Event	Day postop	Leukocyte count, X 10^9/L	Cancer type	Infecting organism	Outcome
1*	2	6.0	Breast, stage IV	*Staphylococcus aureus*	Died
2	63	3.0	Breast, stage IV	*Staphylococcus epidermidis*	Device removed
3	45	12.1	Lymphoma	*S. aureus*	Device removed
4†	18	0.4	Leukemia	*S. epidermidis*	Device removed
5†	18	0.7	Leukemia	*Escherichia coli*	Device removed
6	14	0.2	Lymphoma	*S. epidermidis*	Device removed

*General anesthesia.
†Same patient.

offers important advantages over previous methods of venous access: operating time is relatively short, the implantation technique is easy and patient acceptance has been good. It provides easy and reliable venous access and the complication rate is low. We believe that the Port-A-Cath is a good implantable device for patients on chemotherapy with poor venous access.

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Innovative Palliative Surgical Procedure for Hypoplastic Left-Heart Syndrome

A novel surgical procedure was performed on a 2-day-old infant with hypoplastic left-heart syndrome. It consisted of partitioning the pulmonary trunk thereby creating two channels, one leading to the pulmonary arterial system and the other to the aorta, and atrial septectomy to relieve left atrial pressure and facilitate mixing of blood. The technique avoids the use of conduits.

Une nouvelle opération chirurgicale fut tentée chez un nourisson de 2 jours de vie qui présentait un hypoplasie du coeur gauche. Cette intervention comprend: a) la diviser de l'artère pulmonaire, créant deux canals, l'un vers le système artériel pulmonaire et l'autre vers l'aorte et b) une septectomie auriculaire visant à diminuer la pression dans l'oreillette gauche et faciliter la mélange du sang. Cette technique n'utilise pas les conduits artificielles.

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The generic term hypoplastic left-heart syndrome[1] or, as earlier described, hypoplasia of aortic tract complex[2,3] includes aortic atresia or severe aortic stenosis with mitral stenosis and coexistent aortic and mitral atresia.[4] Neonates with hypoplastic left-heart syndrome usually die during the first week of life. The problem is especially important because most of these infants are born at term and are otherwise normal.

So far the methods of treatment have been futile, highly controversial or promising but risky. We describe and illustrate a first-stage palliative surgical procedure that was performed with satisfactory early results in one case.

Case Report

A male infant weighed 2.8 kg when born at term. Cyanosis, tachypnea and metabolic acidosis were noted soon after birth. Two dimensional echocardiography demonstrated the features of hypoplastic left-heart syndrome. Preoperative management included continuous infusion of prostaglandin E_1 and administration of sodium bicarbonate as required. Two days after birth, the following procedure was performed.

The anterior mediastinum was exposed through a median sternotomy. The thymus was partially excised and the innominate vein ligated and divided. The major branches of the aorta and the right and left pulmonary arteries were encircled with silk ligatures. Deep hypothermic (13°C) extracorporeal circulation was instituted after cannulating the pulmonary trunk with a no. 10 cannula for arterial inflow and the right atrium with a no. 18 cannula for venous return. The right and left pulmonary arteries were occluded. Subsequently, the atrial septum was excised through a right atriotomy, taking care to avoid damage to conductive tissue. Total circulatory arrest was initiated with occlusion of major branches of the aorta. Additional cephalic surface cooling was provided by ice bags. The coronary circulation was perfused intermittently with slightly cooled blood (34°C) injected through a no. 8 French catheter inserted in the proximal aortic arch. The ductus arteriosus was excised. The orifice created in the aorta was enlarged in the form of a tear drop with the tapered end pointing toward the descending aorta. The pulmonary trunk was opened longitudinally by parallel incisions along its lateral borders. The roof of the pulmonary trunk was tipped forward to expose the floor of the artery and orifices of the two main branches. A calibrated Hegar dilator (4 mm) was used as a guide to construct a narrowed pulmonary trunk from this posterior portion of artery. A 3 × 1-cm lanceolated patch, fashioned from autologous pericardium, formed the floor of the anterior portion of the artery, thus creating a second augmented channel originating at the bifurcated pulmonary trunk. The distal end of the augmented tube was connected to the descending aorta at the site of the transected ductus arteriosus. The right atriotomy was closed. Coronary artery perfusion was discontinued. Cardiopulmonary bypass was resumed with gradual rewarming and when it was discon-

tinued there was good contraction and ejection with normal sinus rhythm and a systolic pressure of 80 mm Hg. Bypass time was 3 hours, systemic circulatory arrest was 80 minutes and intermittent coronary perfusion was maintained for 50 of the 80 minutes of total arrest.

Postoperatively, the infant spent 6 days in the pediatric intensive care unit. His condition was monitored with a radial artery line, central venous pressure catheter, cerebral function monitor and a pulse oximeter. He was mechanically ventilated using a Servo 900C ventilator (Siemens Corp., Iselin, NJ) and paralysed with pancuronium bromide. Cardiogenic shock required dopamine, dobutamine and dextrose-calcium-insulin infusions. A 20-second episode of asystole following suctioning occurred on postoperative day 2. This responded to a 1-ml bolus of epinephrine and 5 ml sodium bicarbonate and was attributed to a vagal or hypoxic response to suctioning. Periods of ectopic atrial tachycardia not requiring therapy were noted. Hemodynamic and ventilator support were withdrawn 5 days after operation. Oral feeding and digitalis were begun on day 6, and the infant was transferred to the neonatal unit. Cardiopulmonary function was excellent — an oxygen saturation of 85% to 90% on 30% oxygen by face mask, normal serum creatinine level, no neurologic deficit and a normal elec-

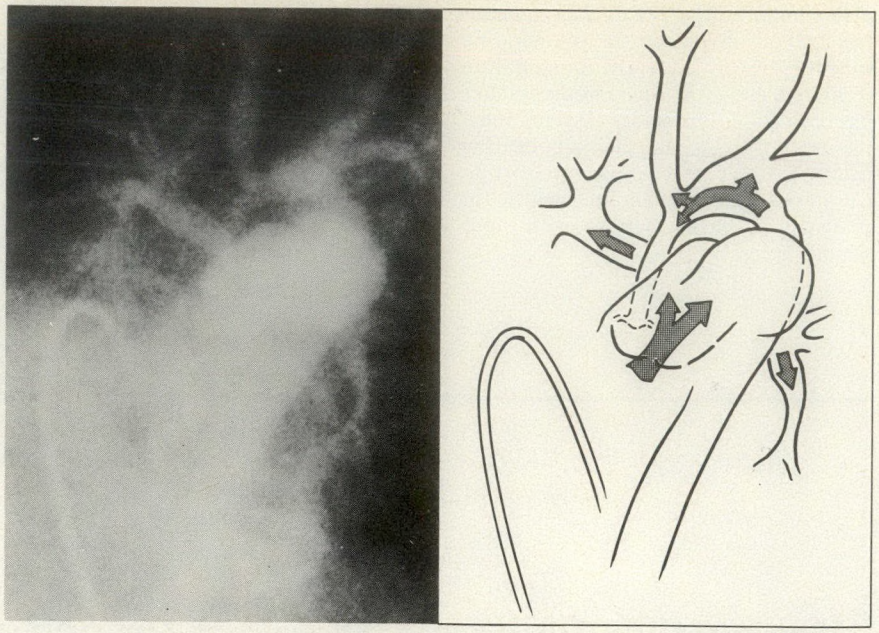

FIG. 2—Postoperative angiogram. Oblique view after injection of contrast in right ventricle showing retrograde flow into ascending aorta (common coronary), adequate passage into thoracic aorta and branches, and symmetric filling of pulmonary arteries.

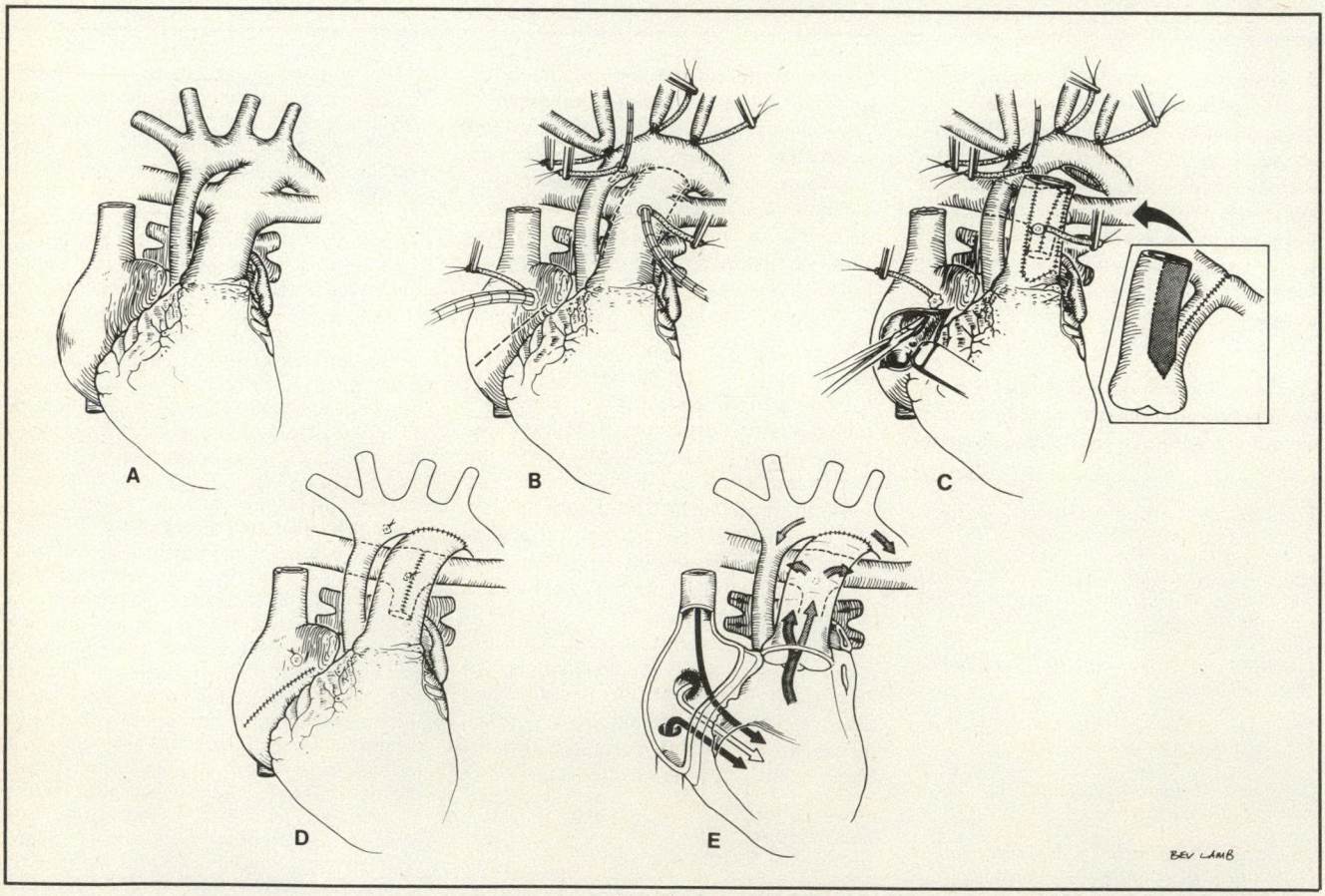

FIG. 1—Surgical approach to hypoplastic left-heart syndrome. (A) Operative findings. Huge pulmonary trunk (12 mm diameter) and markedly narrowed ascending aorta (4 mm diameter); diameter of left main pulmonary artery was 5 mm and that of right main pulmonary artery 6 mm. Left atrium was small and tense. (B) Cardiopulmonary bypass was conducted at deep hypothermia (13°C). Ice bags were used for surface cooling of head. Dashed lines indicate sites of incisions. (C) Atrial septum was cut away with scissors. Ductus arteriosus was dissected and transected at its aortic and pulmonary ends. Pulmonary trunk was divided longitudinally along lateral borders. Parallel incisions were extended proximal to orifices of two main branches. Direct closure of posterior portion of artery created narrowed (4 mm diameter) pulmonary trunk. Pericardial patch was inserted to form floor of anterior channel, with special caution to increase calibre at its origin from pulmonary artery. (D) Anterior channel was connected to descending aorta. (E) After surgery, mixed blood was ejected through only ventricular outlet into short common artery where it must detour preferentially towards aorta through channel of almost same calibre as descending aorta and to main pulmonary arteries through calibrated trunk.

troencephalogram. Premature atrial beats and episodes of moderately rapid supraventricular tachycardia were controlled with digoxin and Inderal. Cardiac catheterization was carried out 1 month postoperatively. The mean pressure in each atrium was 3 mm Hg. The right ventricular pressure was 104 mm Hg systolic with an end-diastolic pressure of 4 mm Hg. Left atrial saturation was 91%. Right ventricular saturation was 73%. It was not possible to guide a catheter into the reconstructed main pulmonary artery. Contrast medium injected into the right ventricle demonstrated unobstructed, balanced flow through both systems. A pulmonary perfusion study done 1 month after surgery gave normal results. Seven weeks after the operation the baby weighed 3.7 kg. Blood pressure was 78/45 mm Hg. At 53 days of age the infant was discharged and treatment with digoxin and Inderal was continued. At 3 months of age his weight was 4.6 kg.

Discussion

Although relatively infrequent among congenital heart defects, hypoplastic left-heart syndrome accounts for almost one in four cardiac deaths occurring in infants during the first week of life.[5]

Because of the generally good condition of these infants at birth and their rapid deterioration once the ductus arteriosus starts to close, surgeons have become interested in finding an operative procedure that offers some hope for long-term survival.[6–12] Prompt clinical recognition, echocardiographic confirmation and adjunctive pharmacologic intervention to arrest the closure of the ductus[13] and to maintain acid-base balance are crucial in preparation for surgery.

The initial stage in the surgical palliation described here (Fig. 1) establishes unobstructed pulmonary venous return and assures mixing of blood. A morphologic right ventricle supports both the pulmonary and the systemic circulations. The former is restricted by partitioning the pulmonary trunk and the latter is restored by anastomosing a diverted segment of the pulmonary trunk to the descending aorta (Fig. 2). The procedure bridges the frequently encountered obstruction of coarctation of the aorta.[14–16] Eventually, one anticipates that separation of the two circulations can be accomplished by applying the Fontan concept.[17]

The procedure described here was conceived about 2 years ago. We tried it on cadavers and attempted it clinically once, unsuccessfully. The result of the operation in our second case led us to present this preliminary report with the confidence that it can be done successfully by others.

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SESAP V Critique

ITEM 3

For small pulp defects without exposed bone, simple occlusive dressings minimize the loss of time from work, preserve length, avoid immobilization of the digit, and provide both satisfactory appearance and good two-point discrimination. Skin grafting is not necessary for such defects. While useful for more severe defects, cross-finger flap procedures require immobilization, and may result in ankylosis of the donor finger and excessive scarring or diminished sensation in the recipient digit. Removal of the distal portion of the distal phalanx shortens the finger and is not necessary for this type of injury.

D

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Pregnancy: COUMADIN® is contraindicated in pregnancy because the drug passes through the placental barrier and may cause fatal hemorrhage to the fetus *in utero*. Furthermore, there have been reports of birth malformations in children born to mothers who have been treated with warfarin during pregnancy. Women of childbearing potential who are candidates for anticoagulant therapy should be carefully evaluated and the indications critically reviewed with the patient. If the patient becomes pregnant while taking this drug, she should be apprised of the potential risks to the fetus, and the possibility of termination of the pregnancy should be discussed in light of those risks. *Hemorrhagic tendencies or blood dyscrasias. Recent or contemplated surgery of:* 1. central nervous system 2. eye 3. traumatic surgery resulting in large open surfaces. *Bleeding tendencies associated with active ulceration or overt bleeding of:* 1. gastrointestinal, genitourinary or respiratory tracts 2. cerebrovascular hemorrhage 3. aneurysms – cerebral, dissecting aorta 4. pericarditis and pericardial effusions 5. subacute bacterial endocarditis. *Threatened abortion*, eclampsia and preeclampsia. *Inadequate laboratory facilities* or unsupervised senility, alcoholism, psychosis, or lack of patient cooperation. *Spinal puncture* and other diagnostic or therapeutic procedures with potential for uncontrollable bleeding. *Miscellaneous:* major regional, lumbar block anesthesia and malignant hypertension.

WARNINGS The most serious risks are hemorrhage in any tissue or organ and, less frequently, necrosis and/or gangrene of skin and other tissues. The risk of hemorrhage is related to the level of intensity and the duration of anticoagulant therapy. Hemorrhage and necrosis have in some cases been reported to result in death or permanent disability. Necrosis appears to be associated with local thrombosis and usually appears within a few days of the start of anticoagulant therapy. In severe cases of necrosis, treatment through debridement or amputation of the affected tissue, limb, breast or penis has been reported. Careful diagnosis is required to determine whether necrosis is caused by an underlying disease. Warfarin therapy should be discontinued when warfarin is suspected to be the cause of developing necrosis and heparin therapy may be considered for anticoagulation. Although various treatments have been attempted, no treatment for necrosis has been considered uniformly effective. See below for information on predisposing conditions. These and other risks associated with anticoagulant therapy must be weighed against the risk of thrombosis or embolization in untreated cases.

Warfarin sodium is a potent drug with a half-life of 2.5 days; therefore, its effects may become more pronounced as daily maintenance doses overlap. It cannot be emphasized too strongly that treatment of each patient is a highly individualized matter. Dosage should be controlled by periodic determinations of prothrombin time or other suitable coagulation tests. Determinations of whole blood clotting and bleeding times are not effective measures for control of therapy. Heparin prolongs the one-stage prothrombin time. Therefore, to obtain a valid prothrombin time when heparin and COUMADIN® are given together, a period of at least 5 hours should elapse after the last intravenous dose and 24 hours after the last subcutaneous dose of heparin, before blood is drawn. Caution should be observed when administered in any situation or in the presence of any predisposing condition where added risk of hemorrhage or necrosis is present. Administration of anticoagulants in the following conditions will be based upon clinical judgement in which the risks of anticoagulant therapy are weighed against the risk of thrombosis or embolization in untreated cases. The following may be associated with these increased risks: • *Lactation* – Coumarins may pass into the milk of mothers and cause a prothrombinopenic state in the nursing infant. • *Severe to moderate hepatic or renal insufficiency.* • *Infectious diseases or disturbances of intestinal flora* – sprue, antibiotic therapy. • *Trauma* which may result in internal bleeding. • *Surgery or trauma* resulting in large exposed raw surfaces. • *Indwelling catheters.* • *Severe to moderate hypertension.*

Known or suspected heredity, familial or clinical deficiency in protein C: This condition, which should be suspected if there is a history of recurrent episodes of thromboembolic disorders in the patient or in the family, has been associated with an increased risk of developing necrosis following warfarin administration. Skin necrosis may occur in the absence of protein C deficiency. It has been reported that initiation of anticoagulation therapy with heparin for 4 to 5 days before initiation of therapy with COUMADIN® may minimize the incidence of this reaction. Warfarin therapy should be discontinued when warfarin is suspected to be cause of developing necrosis and heparin therapy may be considered for anticoagulation.

Miscellaneous: polycythemia vera, vasculitis, severe diabetes, severe allergic and anaphylactic disorders. Patients with congestive heart failure may become more sensitive to COUMADIN,® thereby requiring more frequent laboratory monitoring, and reduced doses of COUMADIN.® Concurrent use of anticoagulants with streptokinase or urokinase is not recommended and may be hazardous. (Please note recommendations accompanying these preparations.) Abrupt cessation of anticoagulant therapy is not generally recommended; taper dose gradually over three to four weeks.

PRECAUTIONS *Periodic determination of prothrombin time or other suitable coagulation test is essential.*

Numerous factors, alone or in combination, including travel, changes in diet, environment, physical state and medication may influence response of the patient to anticoagulants. It is generally good practice to monitor the patient's response with additional prothrombin time determinations in the period immediately after discharge from the hospital, and whenever other medications are initiated, discontinued or taken haphazardly. The following factors are listed for your reference; however, other factors may also affect the prothrombin response.

The following factors, alone in or combination, may be responsible for increased prothrombin time response: ENDOGENOUS FACTORS: Carcinoma; collagen disease; congestive heart failure; diarrhea; elevated temperature; hepatic disorders – infectious hepatitis; hypothyroidism; jaundice; poor nutritional state; vitamin K deficiency – steatorrhea. EXOGENOUS FACTORS: Alcohol†; allopurinol; aminosalicylic acid; amiodarone; anabolic steroids; antibiotics; bromelains; chloral hydrate†; chlorpropamide; chymotrypsin; cimetidine; cinchophen; clofibrate; COUMADIN® overdosage; dextran; dextrothyroxine; diazoxide; dietary deficiencies; diflunisal; diuretics†; disulfiram; drugs affecting blood elements; ethacrynic acid; fenoprofen; glucagon; hepatotoxic drugs; ibuprofen; indomethacin; influenza virus vaccine; inhalation anesthetics; mefenamic acid; methyldopa; methylphenidate; metronidazole; miconazole; monoamine oxidase inhibitors; nalidixic acid; naproxen; oxolinic acid; oxyphenbutazone; pentoxifylline; phenylbutazone; phenyramidol; phenytoin; prolonged hot weather; prolonged narcotics; pyrazolones; quinidine; quinine; ranitidine†; salicylates; sulfinpyrazone; long-acting sulfonamides; sulindac; thyroid drugs; tolbutamide; triclofos sodium; trimethoprim/sulfamethoxazole; unreliable prothrombin time determinations.

The following factors, alone or in combination, may be responsible for decreased prothrombin time response: ENDOGENOUS FACTORS: Edema, hereditary resistance to coumarin therapy, hyperlipemia, hypothyroidism. EXOGENOUS FACTORS: Adrenocortical steroids; alcohol†; antacids; antihistamines; barbiturates; carbamazepine; chloral hydrate†; chlordiazepoxide; cholestyramine; COUMADIN® underdosage; diet high in vitamin K; diuretics†; ethchlorvynol; glutethimide; griseofulvin; haloperidol; meprobamate; oral contraceptives; paraldehyde; primidone; ranitidine†; rifampin; unreliable prothrombin time determinations; vitamin C. A patient may be exposed to a combination of the above factors, some of which may increase and some decrease the patient's sensitivity to COUMADIN.® Because the net effect on prothrombin time response may be unpredictable under these circumstances, more frequent laboratory monitoring is advisable. Drugs not yet shown to interact or not to interact with coumarins are best regarded with suspicion, and when their administration is started or stopped, the prothrombin time should be determined more often than usual. Coumarins also affect the action of other drugs. Hypoglycemic agents (chlorpropamide, tolbutamide and glyburide) and anticonvulsants (phenytoin and phenobarbital) may accumulate as a result of interference with their metabolism or excretion.

ADVERSE REACTIONS Potential side effects may include: • Hemorrhage from any tissue or organ. This is a consequence of the anticoagulant effect. Signs and symptoms will vary according to location and degree or extent of bleeding. Therefore, the possibility of hemorrhage should be considered in evaluating the condition of any anticoagulated patient with complaints which do not indicate an obvious diagnosis. Bleeding during anticoagulant therapy does not always correlate with prothrombin activity. (See TREATMENT FOR OVERDOSAGE.) Bleeding which occurs when the prothrombin time is within the therapeutic range warrants diagnostic investigation, since it may unmask a previously unsuspected lesion, e.g. tumor, ulcer, etc. • Necrosis of skin and other tissues. (SEE WARNINGS). • Other adverse reactions are infrequent and consist of alopecia, urticaria, dermatitis, fever, nausea, diarrhea, abdominal cramping, a syndrome called "purple toes," and hypersensitivity reactions. • Priapism has been associated with anticoagulant administration, however, a causal relationship has not been established.

DOSAGE: Should be gauged according to prothrombin time determinations by a suitable method. Blood prothrombin time should be determined daily after the administration of the initial dose until prothrombin time results stabilize in the therapeutic range. Intervals between subsequent prothrombin time determinations should be based upon judgement of the patient's reliability and response to warfarin in order to maintain the individual within the therapeutic range. Acceptable intervals for prothrombin time determinations have usually fallen within the range of one to four weeks. Satisfactory levels for maintenance of therapeutic anticoagulation are 1.5 to 2.5 times the normal prothrombin time (e.g. 18 to 30 seconds, with a control of 12 seconds).

Induction – Induction may be initiated with 10 to 15mg daily and thereafter (usually 2 or 3 days) adjusted according to prothrombin time response. The basis for the no-loading dose regimen is that the depression of Factors II, IX, and X is not accelerated by the administration of a loading dose. Avoidance of a large priming dose may minimize the possibility of excessive increases in prothrombin time.

Maintenance – Most patients are satisfactorily maintained at a dose of 2 to 10mg daily. Flexibility is provided by breaking scored tablets in half. The individual dose and interval should be gauged by the patient's prothrombin response. Alternatively, 40 to 60mg for average adult or 20 to 30mg for elderly and/or debilitated patients for one dose only.

Duration of therapy – The duration of therapy in each patient should be individualized. In general, anticoagulant therapy should be continued until the danger of thrombosis and embolism has passed.

Treatment during dentistry and surgery – Management of patients requires close liaison between attending physicians, surgeons and dentists. Interruption of anticoagulant therapy may precipitate thromboembolism, conversely, at full doses, some patients may hemorrhage excessively. If it is elected to administer anticoagulants prior to, during, or immediately following dental or surgical procedures, it is recommended the dosage be adjusted to maintain the prothrombin time at approximately 1.5 to 2.5 times the control level. The operative site should be limited to permit the effective use of local procedures for hemostasis including absorbable hemostatic agents, sutures, and pressure dressings if necessary. Under these conditions dental and surgical procedures may be performed without undue risk of hemorrhage.

COUMADIN® with heparin – Since a delay intervenes between the administration of the initial dose and therapeutic prolongation of prothrombin time, it may be advisable in emergency situations to administer sodium heparin initially along with COUMADIN.® Heparin may affect the prothrombin time, and therefore, when patients are receiving both heparin and COUMADIN,® the blood sample for prothrombin time determination should be drawn just prior to the next heparin dosage, at least 5 hours after the last intravenous injection or 24 hours after the last subcutaneous injection.

SYMPTOMS AND TREATMENT OF OVERDOSAGE Excessive prothrombinopenia, with or without bleeding, is readily controlled by discontinuing COUMADIN,® and if necessary, by the oral or parenteral administration of vitamin K_1. The appearance of microscopic hematuria, excessive menstrual bleeding, melena, petechiae or oozing from nicks made while shaving are early manifestations of hypoprothrombinemia beyond a safe and satisfactory level. In excessive prothrombinopenia with mild or no bleeding, omission of one or more doses of COUMADIN® may suffice, and if necessary, small doses of vitamin K_1 orally, 2.5 to 10mg will usually correct the problem. If minor bleeding persists, or progresses to frank bleeding, vitamin K_1 in doses of 5 to 25mg may be given parenterally (please note recommendations accompanying vitamin K_1 preparations prior to use.) Fresh whole blood transfusions should be considered in cases of severe bleeding or prothrombinopenic states unresponsive to vitamin K_1. Resumption of COUMADIN® administration reverses the effect of vitamin K_1 and a therapeutic hypoprothrombinemia can again be obtained.

DOSAGE FORMS COUMADIN® TABLETS are single-scored, and are imprinted as follows:

SIZE:	2mg	2.5mg	5mg	10mg
CODE:	0101	0201	0301	0401
COLOR:	lavender	orange	peach	white
IMPRINT:				
Side 1:	COUMADIN bisected 2	COUMADIN bisected 2½	COUMADIN bisected 5	COUMADIN bisected 10
Side 2:	Du Pont	Du Pont	Du Pont	Du Pont

Supplied in bottles of 100.

†Increased and decreased prothrombin time responses have been reported.

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DU PONT CANADA

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New Options in the Surgical Management of Crohn's Disease

Conventional surgical treatment of Crohn's disease involves multiple or extensive resections or bypass procedures. These contribute to the morbidity and mortality of the disease. Minimal resection with appropriate "strictureplasty" is proposed as an alternative approach. Strictureplasty is analogous to pyloroplasty. The authors performed 15 strictureplasties in three patients, all of whom had previously undergone small-bowel resection for Crohn's disease. They presented with symptoms of chronic bowel obstruction resistant to medical therapy. There were two minor postoperative complications. Two patients were asymptomatic 20 months postoperatively; the third required reoperation for recurrent enterovesical fistula. The technique is safe. Its efficacy will be determined by long-term follow-up.

Le traitement chirurgical traditionnel de la maladie de Cröhn comprend des résections larges ou multiples ou des opérations de dérivation. Ces interventions contribuent à la morbidité et à la mortalité rattachées à la maladie. On propose comme choix d'approche une résection minimale avec "sténoplastie" appropriée. La sténoplastie est analogue à la pyloroplastie. Les auteurs ont effectué 15 sténoplasties chez trois patients qui avaient tous subi préalablement une résection du grêle pour maladie de Cröhn. Ils présentaient des symptômes d'obstruction intestinale chronique résistant au traitement médical. Ils ont enregistré deux complications postopératoires mineures. Deux patients demeuraient asymptomatiques 20 mois après l'intervention; le troisième a dû être réopéré pour récidive d'une fistule entérovésicale. Cette technique est sûre. Son efficacité sera établie par une surveillance à long terme.

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The surgical treatment of Crohn's disease has passed through several distinct stages since it was first considered in the 1930s.[1] Initially, bypass was favoured. Two methods were used. Bypass in continuity was popularized in the 1950s in the United States because it was so effective in the late President Eisenhower; however, the outcome was poor in the majority of patients. Not only did the disease fail to settle down, but the postoperative course was often stormy and complicated by fistulas and abscesses. It was recognized that diversion of the fecal stream away from the site of inflammation was critical to the success of such surgery. Thus, bypass with exclusion became the procedure of choice. Later, as surgical technique and perioperative care improved, resection was preferred, except in patients with complicated inflammatory masses. Physicians and surgeons then became preoccupied with the resection margins, some[2] advocating wide resection, others[3] dwelling on disease-free frozen sections. Such considerations proved to be irrelevant,[4] giving early support to the concept of Crohn's disease as a panenteric problem. Meanwhile, reports of the development of carcinoma in bypassed segments made it clear that exclusion surgery should not be considered further.[5]

The Present

The natural history of Crohn's disease does not conform to a set pattern, but the majority of patients will eventually require laparotomy.[6] Surgery should be undertaken only for complications resistant to medical management, such as recurrent obstruction or extraintestinal fistulization. There are two groups of patients with Crohn's disease in whom surgical therapy may create at least as many problems as it solves: patients with at least one previous small-bowel resection, who require another and patients with extensive (more than 100 cm) small-bowel disease, having resection for the first time.

It is established that most patients who lose 100 cm or more of ileum will have steatorrhea,[7] which is often difficult to manage. The resulting malnutrition adds to that inherent in the primary disease when it recurs clinically. The morbidity in this group is high.

It is because of these patients that the concept of minimal surgery has evolved.[8] Minimal surgery takes one of two forms — "strictureplasty" and minimal resection. The former is analogous to pyloroplasty, from which the technique and nomenclature have been adapted. Strictureplasty was introduced in India,[9] in order to avoid extensive resection and relieve obstruction in patients with burned-out tuberculosis, which mimics Crohn's disease of the small bowel. In fact, patients with Crohn's disease were included and seemed to fare as well as the patients with tuberculosis. Within a short time the technique was introduced to the Western world by two British surgeons working independently.[10,11]

Alexander-Williams[11] has demonstrated this technique in many parts of the world and did so at our hospital in March 1985 (case 1). We have since performed the procedure on two patients* and report our experience.

Patients and Methods

All three patients had previously undergone resection for Crohn's disease of the small bowel. The total duration of symptoms from the time of original diagnosis was 8, 16 and 23 years, and the intervals between the resection and strictureplasty

*Since submission of the manuscript, six additional patients have undergone a total of 53 strictureplasties.

were 2, 4 and 21 years respectively, with recurrent symptoms having been present for 6 months, 3 years and 2 years. All were evaluated preoperatively by two of us (F.G.S. and A.W.H.). One patient (case 1) had been followed up for 7 years, and the other two were referred specifically for strictureplasty. All three had symptoms of chronic small-bowel obstruction, and multiple strictures were demonstrated on barium studies of the small bowel. An enterovesical fistula was present in case 1. Pancolonoscopy demonstrated a macroscopically normal large bowel in each case.

Because of a right paramedian scar in each case, our approach was through a midline incision. After exploration, the entire small bowel was mobilized. Each patient had more strictures than were identified radiologically. A longitudinal enterotomy was performed through one of the strictures and others were identified by anterograde and retrograde passage of a Foley catheter, after the method of Alexander-Williams.[12] As he reported, this is necessary because areas of stenosis are not always evident on inspection of the serosal aspect of the gut. Strictureplasties were then performed sequentially, starting with the site of the initial enterotomy. Strictures were opened longitudinally on the antimesenteric border. Single strictures separated by more than 3 cm, or two closely spaced strictures, were repaired after the method of Heineke–Mikulicz with a single layer of continuous 3–0 Maxon suture (Fig. 1). Areas of multiple (three or more), closely spaced strictures were repaired after the method of Finney, again using a continuous suture (Fig. 2).

In case 1, an area of stricture was found just distal to a small abscess and fistulous tract into bladder. The induration around the fistula was broken down by blunt dissection. The opening into the bladder was closed with absorbable Lembert sutures. The opening into the small bowel was extended longitudinally through the stricture and closed by the Finney technique.

No drains were left in the abdomen. Nasogastric suction was maintained until the patients passed gas, and progress to a full diet was intentionally slow.

Case Reports

Case 1

This man first experienced symptoms of Crohn's disease, with abdominal pain and fever, in 1969, at the age of 17 years. After 4 years of intermittent therapy with steroids and sulfasalazine, he was hospitalized with a mid-small-bowel obstruction that failed to respond to medical management. Laparotomy was said to have revealed extensive segmental Crohn's disease of the entire small bowel. An exclusion bypass was performed at the site of obstruction in the jejunum. He did well for several years, being maintained on sulfasalazine. In March 1981, an episode of partial small-bowel obstruction was treated by giving clear fluids only. In May 1981, barium studies of the small and large bowel gave normal findings; the excluded intestine was, of course, not visualized.

Because of intermittent left-sided abdominal pain, recurrent iron-deficiency anemia and concern about the possibility of carcinoma in the excluded loop, laparotomy was performed in April 1983. This revealed active disease within the bypassed segment and obstruction at the previous anastomosis. The bowel other-

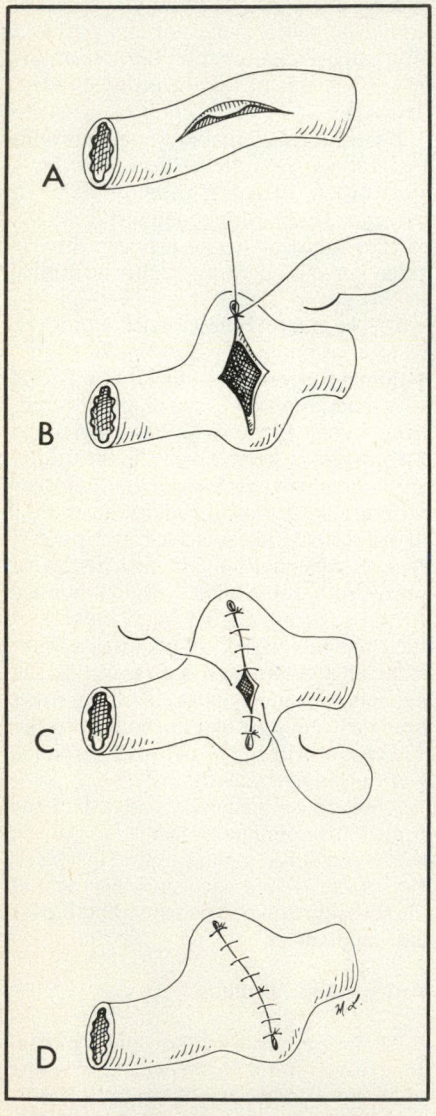

FIG. 1—Strictureplasty for short strictures. Stricture is opened longitudinally on antimesenteric border (A). Running simple sutures are begun laterally at midpoint of enterotomy. Alignment for closure is demonstrated by tension on these knots (B,C). Enterotomy is closed by tying sutures across apex (D).

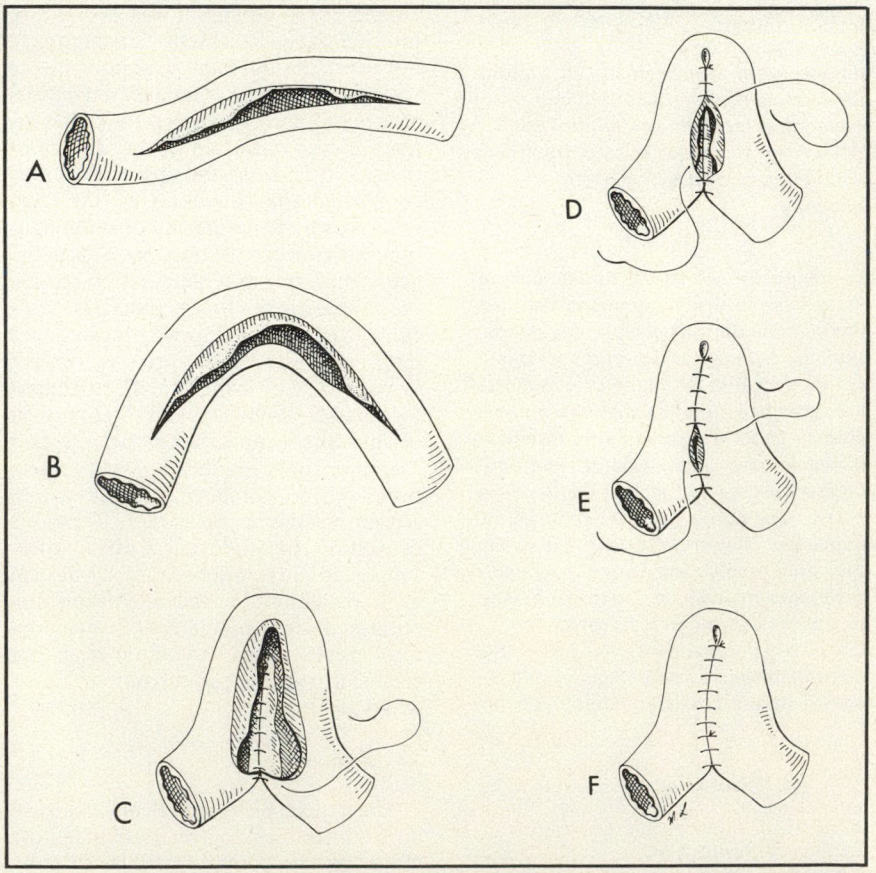

FIG. 2—Strictureplasty for multiple or long strictures. Area is opened longitudinally and about 2 cm past strictures on each end (A). Bowel is folded at midline of enterotomy (B). Running simple suture is begun at angle of inner or posterior wall. First knot is inside lumen. This suture is brought outside lumen at apex (C). Running simple suture is begun at anterior angle and continued to meet first suture which has been continued onto anterior wall of strictureplasty to avoid tying at apex (D,E). Enterotomy is closed by tying these sutures across anterior wall (F).

wise appeared normal, except for a short segment of "burnt-out" terminal ileitis. He was well for 3 months and then complained of a variety of nonspecific symptoms suggestive of reactivation of his Crohn's disease. In 1984, he had a severe exacerbation of the disease and an enterovesical fistula developed. He complained of abdominal bloating, crampy pain after eating solid food and diarrhea. He required a course of total parenteral nutrition, and steroid therapy was begun. He responded to treatment but could not tolerate a reduction of prednisone below 20 mg/d. His obstructive and urinary tract symptoms progressed and anemia developed. The symptoms were totally controlled only when he was on a zero-residue liquid diet, consisting of Ensure and clear fluids.

In March 1985, he underwent laparotomy, having been maintained on the liquid diet for 4 weeks. Three discrete strictures were identified in the last 20 cm of ileum. The distal stricture was tightest and 1 cm proximal to this a fistula entered the bladder. Three Heineke–Mikulicz strictureplasties were performed. On postoperative day 5 the patient had symptoms and signs suggestive of a small intestinal leak; they settled with conservative management. He was discharged home 3½ weeks postoperatively. He was weaned off prednisone and gained 3 kg eating a full diet. Two months after the operation he complained of marked fatigue, and very mild, occasional, right lower abdominal discomfort. One month later he was clearly having a flare-up of his ileitis, with right lower quadrant pain and anorexia. After another month, he was readmitted with a recurrent abscess between the ileum and the bladder. Excellent control of symptoms was achieved with total parenteral nutrition, steroids and antibiotics, and he was discharged. Five months after strictureplasty, he experienced an episode of gastrointestinal bleeding, apparently due to Crohn's disease.

During the next 5 months, he did reasonably well on a gradually reduced dosage of prednisone, in combination with 5-aminosalicylate (Salofalk tablets; Interfalk Canada, Inc., Montreal, PQ). However, 10 months after his last surgery, the enterovesical fistula recurred and

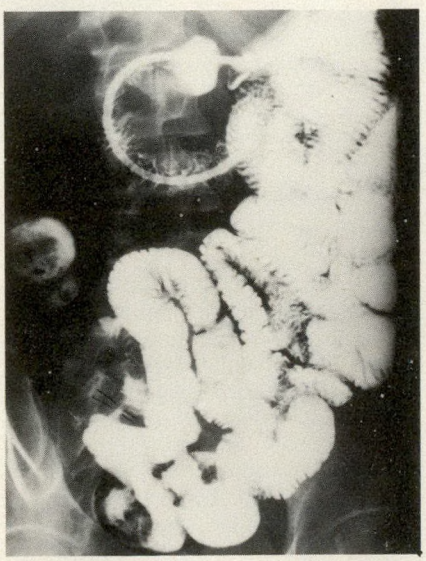

FIG. 3—Case 3. Appearance of small bowel. At laparotomy, 17 discrete strictures were found.

12 months postoperatively he underwent laparotomy and ileocecal resection. The operative and pathological findings will be the subject of a separate report.

Case 2

A 49-year-old woman was well until, at the age of 26 years, she had her first symptoms of ileitis while pregnant. Eighteen months later, she suffered small-bowel obstruction which necessitated ileocecal resection, with removal of approximately 100 cm of terminal ileum. She was then well for 19 years, until 1983, when she experienced symptoms of recurrent disease in her small bowel. After 2 years of medical management, she was hospitalized again with small-bowel obstruction. An upper gastrointestinal and small-bowel series demonstrated at least four small-bowel strictures with dilated bowel proximally. One month later, she became intolerant of solid food, but was otherwise well. This intolerance was not relieved by a period of bowel rest combined with total parenteral nutrition, so she was referred to us for strictureplasty.

Laparotomy in May 1985 revealed 120 cm of normal proximal small bowel. Distal to this was an inflammatory mass of diseased small-bowel loops. Within this segment, approximately 75 cm long, were five strictures. Distally, an additional 120 cm of grossly normal small bowel was identified.

The inflamed segment contained dilated jejunum, two closely spaced short strictures, another area of dilatation, two more closely spaced strictures and one hard stricture about 20 cm long which was opened with a Finney strictureplasty. The two pairs of short strictures were opened by the Heineke–Mikulicz technique. Apart from a slightly prolonged ileus, the postoperative course was uncomplicated and she was discharged on a full diet 14 days postoperatively. Currently, 21 months after operation, she has gained 6 kg and is on no medication or dietary restriction.

Case 3

This 25-year-old man was well until the age of 17 years when he presented with diarrhea, abdominal pain and an anal fissure. A short segment of ileitis was demonstrated radiologically. He was managed medically until 1981, when laparotomy was performed because of intractable symptoms and an extensive jejunoileitis was found. Thirty centimetres of ileum and a small segment of right colon were resected. A stenotic lesion 200 cm from the ligament of Treitz was bypassed by enteroenterostomy and the remaining diseased portion left in situ. He was well for 1 year but then anemia, pain and diarrhea not responsive to steroids developed. A small-bowel enema revealed numerous strictures (Fig. 3). Because of progressive symptoms of partial small-bowel obstruction, he was referred for strictureplasty.

At laparotomy there were 17 discrete strictures, the most proximal being 100 cm from the ligament of Treitz. Seven Heineke-Mikulicz and two Finney strictureplasties were performed. One of the latter included several strictures in a 40-cm segment of bowel and the other included the previous bypass.

Postoperatively he had a prolonged ileus, but was discharged on a low-residue diet 3 weeks after operation. He was readmitted 1 week later with what appeared to be a small-bowel obstruction. This resolved quickly with nasogastric suction, and he was discharged 6 days later. At the time of writing, 19 months after operation, he is on a full diet, has gained 15 kg and is on no medication. In August 1986, he underwent an elective cholecystectomy after several attacks of biliary colic. His only medication is iron.

Discussion

Strictureplasty is used to decrease the incidence of short-bowel syndrome secondary to multiple resections for Crohn's disease. It may not, however, reduce the frequency of clinical recurrence.[13] One must remember that the technique was developed not to reduce recurrence, but to reduce the frequency of resection. In our patients, resection was delayed and may have been prevented. Long-term follow-up is required.

The technique contravenes conventional surgical teaching. Areas of inflammation are left in situ, opened and sutured. Contrary to popular belief, the inflamed bowel wall holds sutures well and complications are no more common than after any other procedure involving enterotomy.[13] This durability of the inflamed bowel may be due to the fibrosis of the bowel wall seen with long-standing Crohn's disease. It may be, therefore, that obstruction from early Crohn's disease would be less amenable to strictureplasty, but some surgeons are now using this as a primary procedure.[14]

The patient in our first case has required reoperation for recurrent enterovesical fistula and obstructive symptoms. This may be the earliest reported recurrence of obstruction in an area of previous strictureplasty (Alexander-Williams J: Personal communication, 1985). At present, we cannot tell what factors would have allowed us to predict this unfortunate course. The patient did seem to have more active disease at operation, and was steroid-dependent preoperatively, but these factors have not been contraindications to strictureplasty in other series. The patient also had a suspected postoperative intestinal leak, but thus far this has not been considered a prognostic factor. Most patients who undergo this procedure have had chronic obstruction without other complications of Crohn's disease. It may be that abscess and fistula represent relative contraindications to the operation. In keeping with the concept of minimal surgery, it would be reasonable to combine segmental resection with strictureplasty in selected cases, as has been suggested.[10]

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Transient Focal Cerebral Ischemia Resulting From Digital Palpation of the Carotid Artery in the Neck

Complications of digital palpation of the carotid artery in the neck are uncommon. They include cardiac arrhythmias and cerebral ischemic events. A 65-year-old woman experienced transient paralysis of the left arm immediately after palpation of the right carotid artery; at surgery, a friable, atherosclerotic plaque was removed from the bifurcation of the artery. The most likely cause of a transient neurologic deficit after digital manipulation of the carotid artery in the neck is an embolus from an atherosclerotic carotid plaque. The authors review the literature on the frequency and pathogenetic mechanism of this complication.

Les complications de la palpation digitale de l'artère carotidienne au niveau du cou sont fréquentes. L'arythmie cardiaque et l'ischémie cérébrale en font partie. Une femme de 65 ans a souffert d'une paralysie transitoire du bras gauche immédiatement après la palpation de la carotide droite; à la chirurgie, une plaque d'athérome friable a été retirée de la bifurcation carotidienne. La cause la plus probable du déficit neurologique transitoire après manipulation de la carotide avec les doigts est une embolie originant de la plaque d'athérome. Les auteurs passent en revue des publications sur la fréquence et le mécanisme pathogénétique de cette complication.

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Although digital palpation of the carotid artery in the neck is commonly used for both diagnostic and therapeutic reasons, complications attributable to carotid manipulation are rare. They consist mainly of cerebral ischemic events and cardiac arrhythmias. This report describes a case of transient cerebral ischemia that followed digital palpation of the carotid artery. We review the appropriate literature regarding the frequency and possible pathogenesis of this iatrogenic event.

Case Report

A 65-year-old right-handed woman was referred to an otolaryngologist because of dysphagia associated with a painful mass in the right side of the neck, present for 1 year. The patient was a cigarette smoker with no history of diabetes, hypertension, angina or leg claudication. There was a family history of hypertension and stroke. There were no episodes of amaurosis fugax or symptoms of transient cerebral ischemia. Oropharyngeal examination gave negative findings. A 2 × 2-cm firm, mobile, pulsatile mass was palpable in the right submandibular area, but no accompanying bruit was heard. Minutes after repeated digital examination of the region by a number of physicians, the patient experienced a dense monoparesis of the left arm that resolved completely in 2 hours. Cardiac examination revealed normal heart rate and rhythm and no murmurs; an electrocardiogram was normal.

Computerized tomography of the head revealed no abnormality. Transfemoral carotid arteriography demonstrated a 40% stenosis of the right internal carotid artery near its origin (Fig. 1). The left internal carotid artery appeared normal.

The patient underwent right carotid endarterectomy as prophylaxis against cerebral infarction. The carotid bifurcation was found to be quite bulbous and firm to palpation. Arteriotomy exposed a large, extremely friable plaque which was removed. Pathologically, the specimen consisted of an atheromatous plaque with no evidence of dissection (Fig. 2). The patient's postoperative course was uncomplicated and she remains symptom-free 3 years later.

Discussion

The first neurologic complication attributable to carotid manipulation was reported in 1941 by Marmor and Sapirstein.[1] The patient, a 53-year-old man with generalized arteriosclerosis, experienced bilateral thrombosis of the anterior cerebral arteries shortly after serial compression of both carotid bifurcations. Total right hemiparesis occurred within minutes of the procedure, preceded by a syncopal episode, bradycardia and a generalized seizure. The largest series of hemiplegia following carotid manipulation was reported by Askey[2] in 1946,

who described eight cases. Six patients suffered cerebral infarction, one had a deficit resolving within 24 hours and one patient experienced two transient ischemic attacks, both occurring shortly after carotid sinus stimulation. Generalized vascular disease was clinically evident in six of these patients. In seven instances the hemiplegia followed routine diagnostic testing for carotid hypersensitivity, and in one it followed compression of the neck during a chiropractic maneuver. The authors attributed the six cases of cerebral infarction to either thrombosis or small hemorrhage, and the transient events to reflex vasoconstriction of the ipsilateral cerebral circulation, a theory no longer in favour.[3] No mention was made of the possibility of embolism. In a series of 188 elderly patients tested for carotid sinus hypersensitivity, Zeman and Siegal[4] described an 83-year-old man who experienced fixed right-arm paralysis after serial bilateral carotid compressions. Webster and Gurdjian[5] examined a group of patients with pre-existing hemiparesis or hemiplegia from a variety of causes. Of 100 patients exposed to carotid artery compression, worsening of an existing hemiparesis was observed in 1. Others[3,6,7] have reported hemiplegia related to carotid palpation.

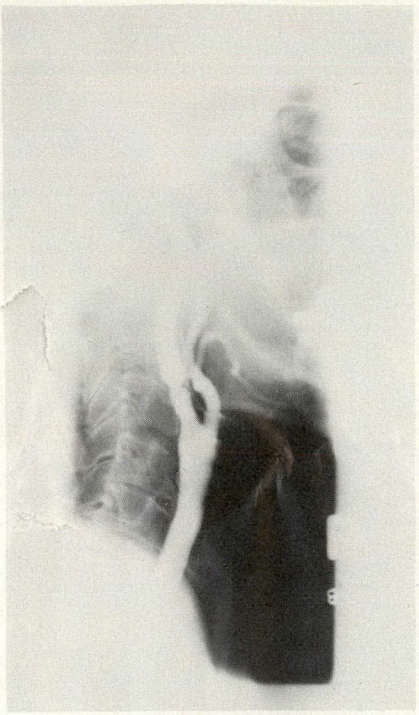

Fig. 1a

Fig. 1b

FIG. 1—Right carotid angiogram — (a) lateral and (b) anteroposterior views — demonstrating atherosclerotic plaque of internal carotid artery without hemodynamically significant stenosis.

In their series of four patients, Calverley and Millikan[8] reported on a 35-year-old man, the youngest such patient in the literature, who had contralateral hemiplegia during neck massage to relieve muscle tension. The authors speculated that a hemodynamic cerebral infarction was caused by decreased flow to the ipsilateral cerebral circulation secondary to manual occlusion of the artery. Conversely, it was proposed that another patient who suffered cerebral infarction after intraoperative manipulation of the carotid artery suffered either an in-situ thrombosis or an embolism of atherosclerotic debris. More recent reports have implicated carotid compression ocular tonography[9] and carotid massage for the termination of supraventricular tachycardia[10] in causing cerebral infarction. Several[2,11] have described a delayed onset of hemiparesis, approximately 24 hours after initial carotid manipulation. This time lapse is compatible with local arterial trauma producing delayed embolism, as opposed to immediate embolism or thrombosis, or cardiac dysfunction.

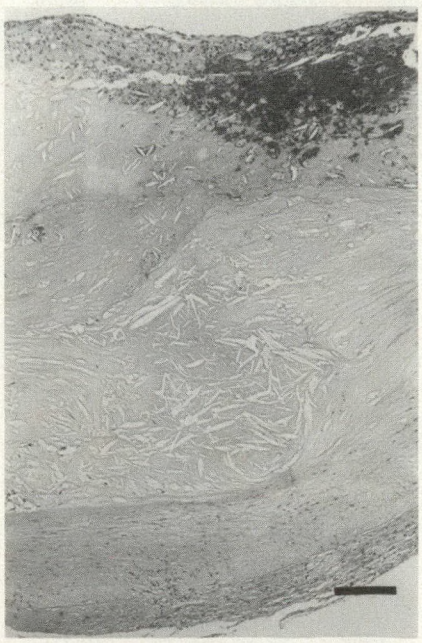

FIG. 2—Photomicrograph of surgical specimen showing atherosclerotic plaque with subintimal lipid-laden macrophages (top), cholesterol clefts, and media (bottom) (hematoxylin and eosin, bar = 200 μm).

Pathological verification of cerebral ischemia precipitated by digital carotid artery compression has been reported infrequently. Marmor and Sapirstein's original paper clearly described anterior cerebral artery thrombosis at autopsy. In one of Calverley and Millikan's patients, examined post mortem, marked atherosclerotic changes were found in both carotid arteries associated with thrombosis of the previously palpated vessel. Nelson and Mahru[12] confirmed a case of massive hemispheric infarction secondary to internal carotid artery thrombosis after digital occlusion of the carotid artery in the neck. Pathological evidence of an artery-to-artery embolism after carotid artery compression is documented by Beal and colleagues.[13] A 79-year-old man suffered right hemiplegia 1 minute after left carotid sinus pressure was applied; autopsy disclosed an intraluminal mass of atherosclerotic material at the bifurcation of the left middle cerebral artery and an ulcerated atherosclerotic plaque in the left internal carotid artery in the neck. Further support for an embolic cause of transient cerebral ischemia after carotid artery compression is inferred by the report of Cohen and Jacobson.[14] They described a 50-year-old physician who experienced a transient ischemic attack while demonstrating carotid massage to a patient with paroxysmal atrial tachycardia; at carotid endarterectomy an ulcerated plaque containing loose fibrinous material was removed.

Despite the reported adverse consequences, carotid artery palpation appears to carry a low morbidity. In an attempt to ascertain the relative frequency of neurologic complications, it is worthwhile examining the cardiology and neurology literature pertaining to routine carotid massage or compression. Sigler[15] evaluated 1193 patients with carotid sinus massage and encountered no complications attributable to focal cerebral ischemia. Lown and Levine[16] reported just one brief episode of transient facial weakness in several thousand such tests. Smiddy and colleagues[17] confined their study to

healthy men over 65 years of age without evidence of cardiac arrhythmia or myocardial infarction; in 58 instances of carotid sinus massage no neurologic events were observed. Deaths have been attributed to induced cardiac arrhythmias following carotid sinus massage;[18,19] however, this occurrence is also rare. In the neurologic examination of patients, carotid compression to assess cerebrovascular insufficiency used to be routine;[20] Toole and Bevilacqua[21] performed over 250 carotid compressions and reported no neurologic events. In another study, 2 of 479 patients so tested suffered cerebral infarction.[22] Janeway[23] used carotid compression as a screening test to evaluate cerebral collateral reserve; of 2800 compressions in 336 patients there was one cerebral infarction. Fieschi and colleagues[24] performed carotid sinus massage in 274 patients who had previously experienced one or more transient ischemic attacks. No cerebral ischemic events were attributed to these maneuvers even though 148 of these patients had stenotic or complicated carotid plaques demonstrated on angiography. Precipitation of hemiplegia ipsilateral to the carotid artery compressed has also been recorded[25] and explained on the basis of hemodynamic ischemia of the contralateral hemisphere due to impaired collateral flow to the hemisphere above a totally blocked carotid artery.

Possible mechanisms to explain the occurrence of cerebral ischemia following carotid artery palpation include the following: (a) embolism from an atheromatous plaque of the internal carotid artery, (b) local trauma to the arterial wall with resultant thrombosis or intimal dissection, (c) manual compressive occlusion of the internal carotid artery with resultant decreased flow to the hemisphere, (d) decreased cardiac output from an arrhythmia, causing thrombosis of the internal carotid artery or hemodynamic focal cerebral ischemia and (e) mural thrombus in the heart with distal embolization precipitated by cardiac arrhythmia. The likely cause of our patient's transient ischemic attack was an atheromatous embolus dislodged from her friable internal carotid artery plaque by firm digital palpation. This theory is supported by the observation that bright retinal plaques indicative of cholesterol emboli have been seen immediately after carotid palpation and surgical manipulation.[23,26,27] It is puzzling, however, that cerebral ischemic symptoms are infrequently reported after palpation of the carotid artery, a maneuver that is often done in older individuals. The friable nature of carotid artery atherosclerotic plaques seen at surgery or autopsy suggest that traumatic dislodgement of emboli from firm digital manipulation should be more common. Perhaps this does happen but the emboli are too small to cause clinically recognizable neurologic deficits. Alternatively, such deficits may be common but are infrequently reported.

Regarding the relative safety of digital manipulation of the carotid artery in the neck, most authors[1,2,4,9,10,13] recommend caution when performing carotid sinus massage on elderly, atherosclerotic, hypertensive patients. However, the literature offers no firm predictors of the occurrence of cerebral ischemia as a result of carotid palpation.

In patients already experiencing transient ischemic symptoms (i.e., amaurosis fugax or a transient ischemic attack), digital palpation of the artery in the neck is contraindicated; it provides little clinically useful information that cannot be provided more anatomically and accurately by carotid angiography or digital intravenous subtraction angiography. In asymptomatic older patients, routine digital palpation of the artery in the neck is also unlikely to give much information regarding the cerebrovascular status and therefore is not indicated. In younger patients with supraventricular tachyarrhythmias, carotid sinus massage remains an important therapeutic and diagnostic modality and the risk of precipitating artery-to-artery embolism in this population is low. Carotid massage for supraventricular tachyarrhythmias in elderly patients would carry a higher risk, but the relative benefits of this procedure would outweigh the apparently small risk of precipitating neurologic problems. Perhaps auscultation of the neck for bruits would be a prudent screening test in these patients, although the relation of cervical bruits to the risk of embolic cerebral infarction is uncertain.[28]

When a transient ischemic attack is apparently precipitated by digital palpation of the neck for whatever reason, the clinician must investigate the patient thoroughly, and that includes a search for a surgically significant atherosclerotic lesion in the internal carotid artery in the neck.

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William Harvey, 1. That Incomparable Invention of Dr. Harvey's

Harvey's discovery of the circulation had its roots far back in his early studies in medicine at the University of Padua where he was a pupil of the famed anatomist Fabricius, who was very interested in the valves of the veins. The difference between his teacher and Harvey was Harvey's dedication to the modern concept "scientific method". Other influences on his findings included the earlier work of Erasistratus and Galen. Harvey, after a long period of experimentation, published his findings on the circulation of the blood in his famous treatise *De Motu Cordis* in 1628. It is noteworthy that Harvey as a clinical practitioner failed thereafter to apply his discoveries to his work as a physician. The first of two articles on Harvey, this is concerned with his work as a scientist and discoverer. The second article is devoted to his work as a medical doctor.

La découverte de Harvey sur la circulation prit naissance loin, dans ses premières études médicales à l'Université de Padoue où il fut l'élève du célèbre anatomiste Fabricius, lequel s'intéressait de près aux valvules et aux veines. Contrairement à son maître, Harvey s'en remettait au concept moderne de la "méthode scientifique". Parmi les autres influences sur ses recherches, on note les travaux antérieurs d'Erasistrate et de Galien. Après une longue période d'expérimentation, Harvey publia ses résultats sur la circulation du sang dans le traité bien connu *De Motu Cordis* en 1628. Il faut remarquer que, tout praticien clinique qu'il fut, Harvey négligea par la suite d'appliquer ses découvertes à son travail comme médecin. Le premier de deux articles sur Harvey est consacré à ses travaux en tant que scientifique et chercheur. Le second se penche sur son travail de médecin.

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The title of this article was suggested by a quote from Henry Power, a student of Glisson's at Cambridge and an interesting example of Harvey's influence exerted at a distance. In the late 1640s, Power followed his friend Thomas Browne's advice to learn anatomy by *autopsia*, and most especially, to make himself master of Harvey's *De Motu Cordis*. The tract he published in 1652, *Circulatio Sanguinis*, brought to light over 50 experiments, both dissectional and vivisectional, to support "our Reverend and Worthy Dr. Harvey" and "that Incomparable Invention of his, the Circulation of the Blood". (In the 17th century, the word "invention" was used synonymously with our term "discovery".)

Through his discovery of the circulation of the blood, William Harvey (1578–1657) laid the foundation of modern physiology and made possible the development of medicine as an applied science. In the 14th chapter of his famous treatise, *De Motu Cordis* (1628), Harvey gave a brief restatement or summary of the new doctrine, concluding that "in animals the blood is driven round in a circuit with an unceasing, circular sort of movement, that this is an activity or function of the heart which it carries out by virtue of its pulsation, and that in sum it constitutes the sole reason for that heart's pulsative movement".

Nothing could be clearer and no scientific treatise contains a more conclusive demonstration of the truth of the doctrine propounded in it. Yet Harvey's great contribution to our knowledge of anatomy and physiology does not represent the totality of his achievement. That is to be found in his sound empiricism, his moving from an idea, a premise, through dissection and experimentation, to establish "scientific" proof of his hypothesis. In employing this approach, he not only founded a branch of modern science and made possible its application to other sciences, in particular medicine, but he is now recognized as the true pioneer in the modern conception — the "scientific method". Argument from known facts, supported by experiments on living animals and autopsies on humans, had shown once and for all the validity of a fundamental physiological truth that had escaped every previous anatomist. "Clear reasoning and perfect scientific method with quantitative measurements had set a pattern initiating advances in the biological sciences and was destined to influence all scientific investigation for the rest of time."[1]

Origins of the Circulation Doctrine From Plato to Galen

The doctrine of the circulation of the blood, it has been claimed, had been known to antiquity. Knowledge of it has been credited to ancient Chinese and Hindu civilizations. However, if there were any real foundation to these claims, it seems likely that Plato and Aristotle would have had a more accurate conception of the heart and its functions than can be found in their writings.[2]

Plato, writing in the fourth century, described the heart as protected by the lungs and as being the origin of the blood vessels. He made no distinction between arteries and veins. This distinction was first made by Praxagoras of Cos (circa 320 BC), although he thought the function of the arteries was to carry air. Plato's pupil Aristotle subscribed to this delusion and was responsible for perpetuating it.

Erasistratus of Alexandria, a little later than Praxagoras, shared the belief that the arteries were designed to carry air, explaining the issue of blood from a severed artery as due to blood "passing through free anastomoses from the veins" to fill the vacancy caused by the arterial lesion.

Some 400 years after Erasistratus, in the second century AD, Galen, the last of the great Greeks, set about making a comprehensive synthesis of body structure and functions. Although Galen may not have anticipated the central truth of the movements of the blood, he believed implicitly in the value of experimentation in elucidating anatomical and physiological problems. By dissections and experiments on animals, he defined their organs, watched them work and thus arrived at a synthesis, combining his findings with those of authorities of his day. These findings are summarized in a book on the uses of the parts (*De Usu Partium*). His conception of the movements of the blood is contained in scattered passages of his writings. His syncretic blend of anatomical structure and function was so closely knit and authoritative that it remained unchallenged for the next 1400 years. After Galen's time, his teaching acquired an almost divine authority, so that things stood as he left them until Harvey's remarkable discovery published in 1628. Galen is considered to be Harvey's "true father in science", not so much for what he achieved, but for how he achieved it.[3]

Harvey at Padua and the Influence of Fabricius

Harvey was born in Kent, educated at Canterbury School and went on to hold the Parker scholarship at Gonville and Caius College, Cambridge. This college, originally known as Gonville Hall, was refounded by Dr. John Caius, sometimes regarded as the father of the study of anatomy in England, as a seat of learning for young men with a particular scientific bent. Its reputation as a place where medical studies were encouraged was widely known. This college must have had a special attraction for Harvey, a youth with identifiable scientific and medical leanings. Probably he received a better medical education there than is generally conceded, for as we shall see, he spent little more than 2 years at Padua before graduating with an MD degree, although there were no formal medical lectures during this time.

Following in the footsteps of Caius and Linacre, Harvey chose to complete his medical education at Padua, a medical school famous for its anatomical and clinical training. A statute of 1558 at Gonville and Caius College, proposed by Caius, recognized that the medical instruction then available at Cambridge was not adequate for full training as a doctor. Bachelors of arts wishing to pursue a medical career were allowed to leave Cambridge and go to Padua, Bologna, Montpellier or Paris. It is thought that Harvey was attracted to Padua in the first place by the celebrity of the medical school and the excellence of the teaching provided there. In anatomy the sequence of Vesalius, Columbus, Fallopius and Fabricius in the professorial chair had indeed given the school a quite dazzling distinction.[4,5] Beginning with the influence of the physician Montanus (under whom John Caius had studied), the Clinical School of Padua for more than half a century had provided a unique form of teaching. In this milieu Harvey had the opportunity to study anatomy with the best teachers, and here he was also able to acquire clinical knowledge and bedside experience in the hospitals. Harvey was profoundly influenced, through his teachers at Padua, by Aristotle. Many reasons can be listed to explain Harvey's loyalty to Aristotle. Paduan Aristotelianism must have made a deep impression on him in his formative years, personified as it was in his teacher, Fabricius. Harvey calls him his guide next to Aristotle himself.[6,7] His real teacher Fabricius of Aquapendente was at this time completing the work for his treatise on the valves of the veins (*De Venarum Ostiolis*). Although it has often been assumed that a fast friendship sprang up between master and pupil, this has never been firmly established, nor did Harvey ever serve as a special assistant to Fabricius. We can be sure, however, that the venal structures were demonstrated by the famous master to students in Padua's anatomy theatre during Harvey's first year of residence there. Fabricius was himself saturated in Aristotelian philosophy and scientific concepts. His example, in the wide range of his investigations into the cardiovascular system and into the entire field of animal biology and generation, had a profound effect on Harvey's thinking and methods of work, more than any other teacher he is likely to have met at Padua or elsewhere.

At the beginning of chapter 13 in *De Motu Cordis,* Harvey makes reference to "the discovery of the valves" by Fabricius. This chapter and the two previous ones are of particular interest for they show how Harvey had come to appreciate the true purpose of valves in veins. These chapters include observations describing Harvey's dissections of the veins in the limbs and his attempt to pass a probe downwards. Invariably the valves provided a complete obstacle, though the probe passed easily in the other direction toward the heart. Then comes the celebrated demonstration of the valves in the veins of the forearm, for which Harvey used figures copied from the drawings published by Fabricius in 1603 in his book *De Venarum Ostiolis.* These were the only illustrations Harvey included in the first edition of *De Motu Cordis,* and they appeared in virtually every subsequent edition of the book except the English version of 1653.

A glance back at Fabricius's discovery in its relation to Harvey's later findings is revealing. Hitherto, Fabricius claimed, the valves of the veins had escaped the notice of anatomists of his own and earlier generations. Never had they been mentioned. No one had even set eyes on them until 1574 when he first noticed them in the course of his dissection. In point of fact, they were known to Vesalius at Ferrara in 1545, and earlier still to Giambattista Canano (circa 1536). Neither of these two men, however, had ever published his observations. Both understood the function of the valves no better than Fabricius did.

The Latin word *ostiolum,* correctly translated, means little door. Translating it to mean valve is questionable. Whether or not Fabricius correctly named the valves, it is plain that he completely misunderstood their function. He was aware that they opened upward and accepted the established idea that the function of the veins was to afford a passage of blood to the extremities, but he had no notion that the blood might be moving in the opposition direction, toward the heart. To his way of thinking, the *ostiola* were placed where he found them to delay the passage of blood downward in the lower limbs and not to act as valves preventing it. Little doors they were, partly opened to perform their function, in his construct.[8]

In his dedication of *De Motu Cordis,* Harvey takes pains to profess his profound faith in the philosophic love of truth and wisdom, from whomsoever it might come. At the same time he deprecates making attacks on the errors of his predecessors and teachers; he was loathe to provoke his contemporaries, anticipating how controversial his discoveries would be. And yet, he found it impossible entirely to avoid making these attacks. More than once he is found naming his old teacher, Fabricius, as the propagator of erroneous doctrines. It is pertinent to note that in chapter 13 he designated the valves by the Latin word *valvula,* not *ostiola.* He proceeded to point out that "the discoverer of the valves did not rightly understand their real function, and others went no further".

Evidence in the Lumleian Lectures

Evidence in Harvey's early anatomy lecture notes suggests that even he did not, as early as 1616, fully understand the implications of the venous valves, or the fact that they gave free passage to the blood toward the heart, but opposed its passage the other way. The notes Harvey prepared for his lectures, now in the British Museum, were written on folded fool-

scap paper. In the opinion of Keynes and other experts, folio 80, including the terse passage which at last clearly comprehends and explains the circulation of the blood, was inserted much later than 1616, the date at which it is arranged in chronologic order with the other folios. The rest of the lecture notes do not appear to have taken the discovery of the circulation into account. He certainly did not realize the point when he witnessed the demonstration by Fabricius, and a long interval, perhaps until 1627, elapsed before he dared to question his teacher's interpretation, at least in public discussions. Harvey waited to demonstrate the truth in his book published 25 years after the appearance of the treatise by Fabricius.

In the seventh chapter of *De Motu Cordis,* Harvey argues closely, with the supporting passages from Galen, how the blood finds its way from the right ventricle through the parenchyma of the lungs into the pulmonary vein and left ventricle. He never did see the capillary vessels giving passage to the blood; lack of refined optical apparatus prevented him from seeing and demonstrating them. Galen's errors are corrected, but Harvey credits him with having provided conclusive evidence for a pulmonary circulation by his description of the valves of the heart and the passage of blood through the lungs. Nowhere in his writings did Galen provide a clear statement of it. Harvey provides his own arguments, using Galen, as far as he went, to support them. His interest was in demonstrating a general systemic circulation, not in proving the existence of the lesser circulation.

Geoffrey Keynes, in his life of Harvey, has subjected *De Motu Cordis,* chapter by chapter, to a thorough textual analysis. There is far too much of interest in his biography to discuss within the space of a short article.[9] Strangely, however, his study does not mention Harvey's failure to apply his discoveries to his clinical practice. Harvey eventually came to realize many of the consequences that would follow from the illuminating truth he had revealed with his discovery of the circulation, affecting every part of medicine — physiology, pathology, therapeutics. It is surprising, therefore, that Harvey never made any direct application of his findings on the circulation to his clinical practice of medicine, although he had examined closely and in full detail the structure of the heart and disclosed many new findings on its mechanical efficiency.

Harvey's mind did not work like Francis Bacon's. He was more like Galileo or Gilbert, engrossed in his particular problem, and sometimes unaware of the possible repercussions of what he was discovering. In spite of his advanced views on the circulation of the blood, Harvey was still Artistotelian in his practice of medicine. And yet his work had an influence on the development of the scientific method wide and universal enough to have satisfied even a mind like Bacon's.

Conclusions

The continuing fascination with Harvey derives mainly from his work and influence as the discoverer of the circulation of the blood. As a scientist he was *sui generis.* It is often overlooked, however, that he chiefly made his way in life by filling a more conventional role, that of the practising physician. It is not unnatural to think of Harvey as having devoted the bulk of his attention to anatomy, dissection and scientific experiment, but this view of him loses a sense of proportion. While still a student at Padua, he was studying medicine in its widest possible meaning. In 1662 Sir Charles Scarburgh characterized him as "one not to be bound by the laws of a single discipline". He had gathered professional knowledge from experience in hospital wards and autopsy chambers as well as in lecture theatres that would later be applied to a wide range of patients in private as well as public practice, and that would include two kings of the realm, James I and Charles I. Harvey in fact was to distinguish himself by busily developing an uncanny capacity for observation of everything that concerned him as a doctor.

It is with that role as fellow of the College of Physicians in London and as a medical practitioner during the years he worked at St. Bartholomew's Hospital that a second article will be concerned. From 1609 onwards, Harvey's time was divided between his hospital duties, his private practice, his anatomical and physiological research, and his various duties at the College of Physicians, in which he held every office available to a fellow between 1607 and 1628 except that of president. In September 1654 the College of Physicians elected Harvey president, an honour he declined for reasons of old age and failing health. He was intensely loyal to its status and dignity for the remaining years of his life.

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NOTICES

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Progress in Vascular Surgery

"Progress in Vascular Surgery" is the title of a course being sponsored by the University of Minnesota Medical School. The course will be held June 17–19, 1987 in Minneapolis. Write to Office of CME, University of Minnesota, Box 202 UMHC, 420 Delaware St. SE, Minneapolis MN 55455 for information or call (612) 626-5525.

Institutional Program Guidelines

Health and Welfare Canada's publication "Cardiovascular Services in Hospitals" has been approved by the Federal/Provincial Advisory Committee on Institutional and Medical Services and is available for distribution. A copy of these guidelines may be obtained by writing to: Mr. D.F. Moffatt, Chairman, Sub-Committee on Institutional Program Guidelines, Health Services Directorate, Health Services and Promotion Branch, Department of National Health and Welfare, Ottawa, Ont. K1A 1B4.

American Back Society

A Symposium on Back Pain will be held in Anaheim, Calif., Apr. 29–May 2, 1987, sponsored by the American Back Society and St. Rose Hospital. The program is approved for 18 hours Category I continuing medical education credit. Contact Dr. René Cailliet or Dr. Aubrey A. Swartz, American Back Society, 2647 East 14th St., Ste. 401, Oakland, CA 94601; (415) 536-9929 for information.

Applied Basic Science Course

"Behaviour of the Growth Plate" is the title of the title of the 14th annual applied basic science course sponsored by the Division of Orthopaedic Surgery of the University of Ottawa, together with the Pediatric Orthopaedic Society of North America. The course will be held May 13–15, 1987 at the Health Sciences Complex; more information can be obtained by contacting Dr. Hans K. Uhthoff, Division of Orthopaedics, Ottawa General Hospital, 501 Smyth Rd., Ottawa, Ont. K1H 8L6; (613) 737-8377.

BOOK REVIEWS

GREENHILL'S SURGICAL GYNECOLOGY. 5th ed. Edited by Stephen L. Corson, Thomas V. Sedlacek and Jerome J. Hoffman. 376 pp. Illust. Year Book Medical Publishers, Inc., Chicago, 1986. Price not stated. ISBN 0-8151-1863-5.

This edition of *Greenhill's Surgical Gynecology* has been revised considerably from the last version which appeared 17 years ago. As with its predecessors, it is an atlas of monochromatic drawings and photographs with a minimum of text. It attempts to describe and illustrate the majority of surgical gynecologic procedures.

Brief initial chapters are presented on the handling of surgical instruments, basic fluid and electrolyte metabolism, abdominal incisions and wound healing and pre- versus postoperative care. The information contained in these chapters might be of use to a surgeon-to-be in the first days of training but is in no way comprehensive.

The following chapters are divided by topic into vulvar operations, urinary stress incontinence, vaginal, abdominal and obstetric operations, sterilization and hysteroscopy. The illustrations are clear and easy to follow, but are necessarily limited by simplification of detail, two dimensional character and lack of colour. Normal anatomy is presumed and portrayed for the most part, and the accompanying descriptive text is sparse.

The majority of the text is devoted to depicting gynecologic procedures. This might be of use to a student, surgeon in training or "old hand" who needs a quick reference illustration for teaching or personal review. Although the chapters on obstetrics and sterilization might interest a student, they are too brief and simplified to benefit an experienced surgeon.

In summary, this reference text in its latest edition might be suitable for a university hospital or operating-room library. Whether or not it would be of value in one's personal library is best left to individual preference.

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INFECTION IN THE FEMALE. 2nd ed. William J. Ledger. 293 pp. Illust. Lea & Febiger, Philadelphia, 1986. $51.25. ISBN 0-8121-0992-9.

Few aspects of obstetrics and gynecology have undergone more recent change than those concerned with infections. Examples of such changes are the appreciation of the significance of organisms (papillomavirus, *Chlamydia*), the improved technology that now allows routine culture of potentially virulent organisms (anaerobic bacteria), the necessity of using combinations of antibiotics (clindamycin and aminoglycosides) when treating postoperative soft-tissue infection and the augmentation of antibiotic choice (second and third generation cephalosporins, ureidopenicillins). There is a need to bring the whole subject together and to put the new information into perspective.

This book's 12 chapters are arranged in a logical format. The first seven discuss such basic topics as microorganisms, their laboratory handling, the host response and antibiotic therapy; the clinical portion consists of four chapters that separately discuss obstetrical and gynecologic infections as acquired in either community or hospital; there is also a section on adverse fetal outcomes.

The first chapter is a brief historical outline, the second a perhaps too sketchy bacteriologic overview. The third chapter pertains to the collection of specimens for microbiologic culture, and it was disappointing. Whereas I had hoped to find clear guidelines for the investigation of patients with postoperative fever, I found the advice to be confusing. For example, one page advocated culdocentesis, the next page suggested that the procedure was of little value. The chapter on the laboratory testing of antibiotics is especially involved with measuring serum levels of aminoglycosides. Toxic levels of this drug are rarely reached in obstetrical and gynecologic patients because renal function of our more youthful patients is generally good. Ledger points out that the levels may not be therapeutic.

The chapter on the host response to infection was excellent. For a brief moment I understood helper, suppressor and cytolytic T cells and the role of T cells in the secretion of lymphokines (lymphokines stimulate monocyte phagocytosis). In acquired immune deficiency syndrome (AIDS) the T cell's lymphokine secretion is suppressed; patients thus become subject to diseases that are controlled by monocyte phagocytosis (i.e., fungi, viruses).

The chief interest in the chapter on a "clinical overview" was the evaluation of journal articles; although it was interesting, I am not certain why it was included. The prophylactic use of antibiotics is an important subject, but I thought the discussion was outdated. For instance, I examined all references cited in chapters 7 to 10 and found that 48% of them dated to 1977 or before.

There is a fine discussion on the animal model of mixed bacterial infection, which is the basis of our present understanding of soft-tissue infections and peritonitis. It was personal and the author's long experience and familiarity with the subject allowed a critical review. The chapter on community acquired gynecologic infections was not up to expectations. There seemed to be undue emphasis on herpes infections. Clinical experience would suggest that more information on recurrent yeast infections is needed. Biopsy for condyloma of the vulva, culture of the vagina for ureaplasma urealyticum or draining the peritoneal cavity through the vagina should rarely be required as opposed to the frequency recommended in this chapter. Further, the indifferent results that apparently follow subcuticular sutures with appendectomy are not reasons to discontinue their use with abdominal hysterectomy, and the advocation of colpotomy was not convincing. Much of the chapter on hospital-acquired gynecologic infections concerns postoperative fever but since no information was given of the relative importance of each etiologic factor, the chapter was not very helpful clinically.

Maternal infections with adverse fetal outcomes would have been better served by including AIDS and reducing the information related to syphilis; the whole chapter seemed strangely dated. The last two chapters were unsatisfactory, much was unrelated to obstetrics and gynecology or was repetitive, with the exception perhaps of the sections on soft-tissue infections and endometritis.

There is certainly a need for a book of this sort. Should this be your first choice? I think not.

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PROGRESS IN PEDIATRIC SURGERY. Volume 19. Long-gap Esophageal Atresia. Prenatal Diagnosis of Congenital Malformations. Edited by P. Wurnig. 205 pp. Illust. Springer-Verlag New York, Inc., New York, 1986. $55.50 (US). ISBN 0-387-15881-2.

This volume of *Progress in Pediatric Surgery* covers primarily the treatment of long-gap esophageal atresia and to a secondary degree the prenatal diagnosis of congenital malformations and their possible treatment.

The problems of long-gap esophageal atresia for which primary anastomosis is difficult or impossible are dealt with in 12 papers that review the world literature fully. In most cases they also report the individual author's personal experience. Earlier methods of bridging the gap between the two ends of the esophagus are discussed, including colonic or jejunal grafts on a vascular pedicle. More recently, a reversed gastric tube has been used. The dictum of Nathan Myers that the patient's own esophagus is the best is generally held and there have been many attempts to find a method of repair that avoids the use of transplanted intestine or stomach. Various stretching procedures that have been used in attempts to elongate both the upper and lower pouches are covered. The circular or spiral myotomy of Livadites, which has been used extensively, particularly

in the upper pouch, is also described. These myotomies are generally considered to be of value in elongating the esophagus. Various tension methods of drawing the two ends of the esophagus together using variants on Rehbein's Olive technique are described. So also are attempts to create a fistula between the two pouches using suture material to pass across the gap between them after high-tension approximation. There is still considerable discussion as to the efficacy of these methods. Although reconstruction of the thoracic esophagus using autotransplantation of small intestine has been carried out in an experimental model in piglets, it has not been used in humans. Moreover, it is unlikely to be used in the neonate because of problems in vascular anastomosis. Interesting experimental work in animals has been done using jejunal mucosa and submucosa alone. But, in general, extensive dissection of the upper pouch combined with Livadites myotomy appears likely to offer the best chance of a primary anastomosis. Although gastric tube replacements have their own problems they are probably superior to colonic replacements. Interest in this section will be limited mainly to pediatric surgeons, although it may be of interest to thoracic surgeons working with caustic burns of the esophagus.

The second part of the volume concerns antenatal ultrasonographic diagnosis of congenital malformations. All the papers in this section originate from Europe. The advantages to the child include biochemical and genetic screening. If the diagnosis is accurate — and the accuracy rate for many abnormalities is really very high — the information may allow choices as to the best time for delivery, the best type of delivery, the possibility of intrauterine surgery and considerations as to whether the pregnancy should be terminated. The possibilities for intrauterine surgery are extremely limited, and these articles clearly indicate that unreasonable expectations of success have been raised. The knowledge of an antenatal diagnosis can, however, be valuable. For example, gastroschisis, an abnormality of the abdominal wall, is commonly the only abnormality present, so the outlook for such children, if treated promptly at birth, is good. Primary closure of the abdomen in an otherwise healthy child can be successfully carried out in more than 80% of cases. On the other hand, a diagnosis of omphalocele suggests the likelihood of multiple congenital abnormalities, so the prognosis would be much more guarded. Chromosomal examination of the amniotic fluid may give more information, allowing a more informed decision as to the treatment of the infant.

This second part is particularly valuable in that it raises in a most logical way the problems and advantages of being able to make an antenatal diagnosis of the congenital lesions. However, it often does not and cannot offer a life-saving solution for the individual child.

This book should be in the libraries of all major hospitals and medical schools.

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As a further service to its readers the *Canadian Journal of Surgery* is pleased to accept suitable classified advertisements. The deadline is 1 month before issue date. Regular classified rates (for each insertion): $40.00 for the first 40 words or less, additional words 50¢ each (additional $16.00 for frame). Special Display under 75 words, 2¼″ × 2″ $100.00. $6.00 charge (first insertion only) for CJS box numbers. Display rates available on request.

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HEAD, MULTI-ORGAN TRANSPLANTATION PROGRAM — The University of Toronto, Department of Surgery is seeking Head of its Multi-Organ Transplantation Program. The incumbent will be expected to integrate the existing renal, liver, lung and heart transplant program and to develop a pancreas transplant program. He/she would be expected to develop a training program in transplantation and facilitate the development of research in parallel with the clinical program. Applicants will be expected to have an established reputation in organ transplantation as well as in teaching and research. Applications and curriculum vitae should be sent to: **Dr. B. Langer, Chairman, Department of Surgery, University of Toronto, 100 College St., Toronto, ON M5G 1L5.** Closing date for receipt of applications is May 30, 1987. Effective date of appointment as early as September 1, 1987. In accordance with Canadian immigration requirements this advertisement is directed to Canadian citizens and permanent residents of Canada. —S87-44

ADVERTISERS' INDEX

GENERAL SURGEON: BC — locum required for the month of July in the Cariboo, for a full accredited 80-bed active surgical hospital with two ORs and one endoscopy, drawing from a catchment area of approximately 40 000. Current medical staff includes one other general surgeon to share call with three other specialists and more than 14 general practitioners. The summer can be very busy. Apply to: **Dr. P.A. Cullum, 203 — 143 Fourth Ave. South, Williams Lake, BC V2G 1J8.** —S87-42

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ACADEMIC APPOINTMENT: ON — Queen's University, Department of Surgery geographic full-time position in general surgery. Applicants should be licensed to practise in Ontario and be Fellows of The Royal College of Physicians and Surgeons of Canada. The successful candidate will be expected to teach at undergraduate and postgraduate levels and engage in research. He/She will be expected to have specialized training and interest in critical care/trauma. The closing date for application is March 31, 1987. In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. Candidates of both sexes will be given equal consideration. Applications with a curriculum vitae and the names of three referees should be sent to: **Dr. Charles Sorbie, Head, Department of Surgery, Queen's University, Kingston, ON K7L 3N6.** —S87-39

MICROSURGICAL COURSE: — The Department of Surgery, McMaster University is now offering one week, on-going courses in microsurgery, using animal facilities and videotapes. These courses are for anyone interested in small vessel anastomosis, nerve repairs, vas and fallopian tube reconstructions. The laboratory is organized to guide you through the basic microsurgical techniques to more advanced tasks with the help of an assistant on a one-to-one basis. Please call: **Dr. A. Thoma at (416) 523-0019 for further information.** —S86-23

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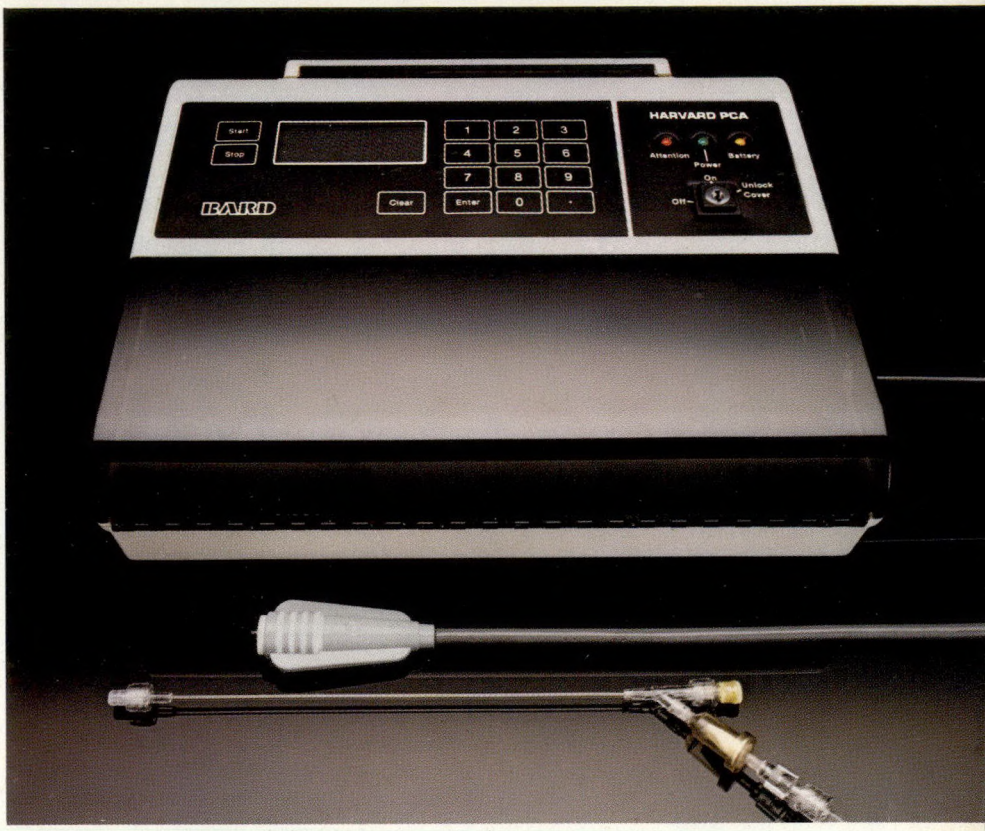

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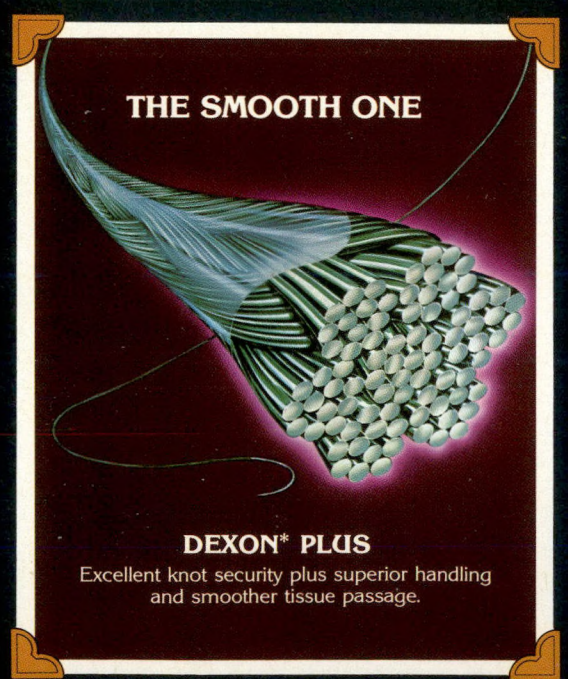

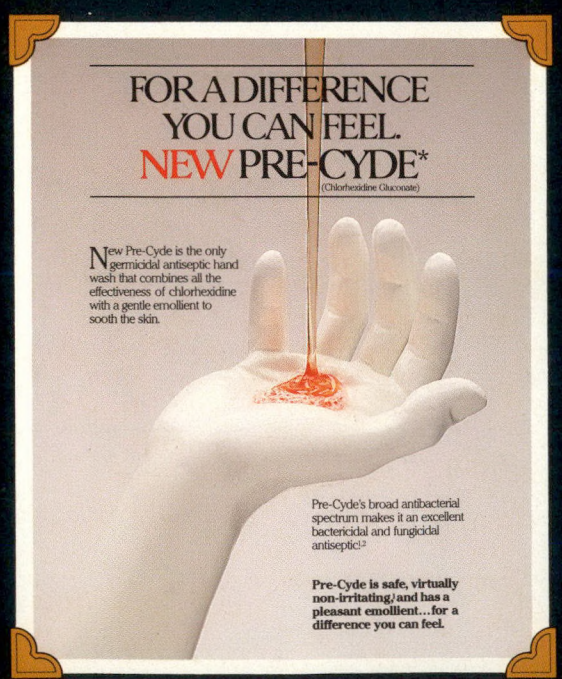

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