VOLUME I — The Technique and Results of Reimplantation of the Ureter

VOLUME II — Ureteral Reflux: with special reference to Vesico-Ureteral Reflux and with a note on Colo-Ureteral Reflux

by

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C O N T E N T S

Volume I REIMPLANTATION of the URETER in the BLADDER

OBJECTS OF THE INVESTIGATION

Mr. Terence Millin, in his Presidential Address to the Section of Urology of the Royal Society of Medicine, on October 28th, 1948, on "The Ureter, the Gynaecologist and the Urologist", said "Careful follow-up studies of uretero-neo-cystostomy are badly required to assess end results."

This work commenced as an investigation of the methods and results of reimplantation of the ureter (uretero-neo-cystostomy) in 73 cases, with special reference to the renal function and the incidence of stricture and vesico-ureteral reflux (Volume I).

As the work progressed the almost constant occurrence of vesico-ureteral reflux and the very frequent association of chronic pyelonephritis led to investigation of reflux. This research (Volume II) deals with the protective mechanism of the uretero-vesical junction, the etiology of the condition, its classification, symptoms, signs, prognosis and treatment.

The lack of protection provided to the kidney by ureteric peristalsis alone suggested a concluding note on colo-ureteral reflux and its importance in direct end to side transplantation of the ureter to the colon.

REIMPLANTATION OF THE URETER IN THE BLADDER

INDICATIONS

I CONGENITAL

1. Megaloureter with stricturing of the lower end of the ureter
2. Ectopic ureter with incontinence
3. Congenital ureteric valve(s) near the ureteric orifice

II TRAUMA

1. Injury to the lower ureter with loss of tissue at operation rendering anastomosis impossible
2. Uretero-vaginal fistula following trauma during gynaecological operations
3. Ureteric fistula following operation on the pelvic ureter, e.g. uretero-lithotomy, or as a complication of pelvic surgery, e.g. excision of rectum
4. Disposal of ureter opening into a vesical diverticulum following diverticulectomy

III INFLAMMATION

1. Stricturing due to ureteritis or following uretero-lithotomy of lower third ureter
2. Involvement of the ureter in fibrous tissue, following radiotherapy to carcinoma of pelvic organs, or inflammatory processes

IV NEOPLASM

1. Carcinoma of the bladder amenable to partial cystectomy involving the ureteric orifice.

The operation has been advised in the treatment of vesico-ureteral reflux, but as reflux is possible following this operation its utilization in such conditions is ill-advised.

PART I

TECHNIQUE

BOVEE (1900) in "A Critical Survey of Ureteral Implantation" attributed the first uretero-cystostomy to TAUFFER in 1877 and the next to NOVARO in 1893, but BISSEL (1903) credits the first success to GUSTAVE SIMON in 1856.

Very many different methods (BISSELL gives a good review of these) are described, both extraperitoneal and intraperitoneal, but as the latter approach is usually unnecessary and obviously may be complicated by peritonitis, its use is not advised.

The extraperitoneal methods include a vaginal approach but review of the literature does not reveal that this has any advantages and in cases of uretero-vaginal fistulae where it has been adopted, the fistula has often recurred in the post-operative period. PETERSON (1918) quotes successes by this route (BAKER 1878, McARTHUR 1889 and DAVENPORT 1890), but SARGENT (1930) in a paper on ureteral ectopia, collected 26 vaginal operations of implantation into the bladder - 14 of these were successful, 8 failed, and in 4 cases the result was not stated; this compared with a suprapubic approach in 8 cases, successful in 7 and the result not stated in 1 case.

Bizarre operations for reimplantation such as COLZI'S (reported by BOVEE (1900)) have been described. This was performed in a case of ectopic ureter and involved separation of the labium majus from the pubic arch, cutting part of the

latter away and implanting the ureter, which had previously opened into the vagina, into the bladder.

MORRIS'S description (1901) of this operation varies, in that he does not mention excision of the pubic ramus. He describes an operation performed by BOARI (1896), and successfully by others later, utilizing a button similar to MURPHY'S intestinal button.

The abdominal incision varies in different hands - midline, paramedian, rectus splitting, pararectal, or oblique, parallel to the inguinal ligament, but BURNS (1928) uses two incisions, the first with the patient's hip elevated, parallel to the inguinal ligament to expose the ureter, and a second midline incision to carry out the implantation. This seems quite unnecessary, and probably a midline suprapubic incision is the most satisfactory.

Attempts have been made to preserve the oblique course of the ureter through the bladder wall, as only one of the cases to be described was treated in this manner no statement can be made from experience if it prevents reflux. The methods of securing an oblique course are varied:-

(a) Suturing the adventitia of the ureter to the incision in the bladder through which it passes in an oblique manner.

(b) Perforating the bladder with a sharp instrument in an oblique manner.

(c) Adaptation of the Coffey No. 1 technique (1911) as used in uretero-colic anastomosis.

(d) Bringing the ureter directly through the bladder musculature and then raising a mucosal flap and continuing its course beneath this. A similar procedure is described by HESS (1941) who performs an intravesical operation for ureteric stricture when the stricture is intramural or very close to this part. The ureteric orifice is slit up and the ureter freed proximally, the stricture and the area distal to it are excised and then the ureter is drawn down and the mucosa of the bladder is sutured over it to form a valve. A ureteric catheter is left in situ. (BAZY prior to 1894 carried out a similar intravesical operation but did not attempt valve formation, nor did he use an indwelling ureteric catheter)

(e) Making two extravesical parallel incisions about 0.75 cms. in length and about 1.25 cms. apart at right angles to the long axis of the bladder down to the mucosa; this bridge of tissue is then undermined leaving the mucosa intact except at the lower incision. The ureter is then carried by a suture beneath the bridge and into the bladder and fixed 1.25 cms. distal to its entrance into the bladder. The parallel incisions are then closed leaving a gap for the entry of the ureter;

(e) (continuation)

no sutures include the ureteric adventitia (MANN'S operation quoted by PETERSN (1918))

(f) After reimplantation the bladder wall may be sutured around the extravesical ureter in the manner of a Witzel's gastrostomy (WITZEL (1896), BOVEE (1900) and TORRANCE (1912))

The treatment of the ureteric orifice also varies:

(a) Some authors advise leaving about 1 - 2 cms. of ureter hanging freely within the bladder in the same manner as is advised in the treatment of the urethra following amputation of the penis (HYMAN and LEITER (1940)). FURNISS (1918) who recommends this procedure, states that stricture when it occurs, does not occur at the ureteric orifice but where the ureter passes through the bladder wall, thus splitting the end is not necessary.

(b) The ureter may be slit in such a manner as to furnish two flaps which are sutured to the vesical mucosa, and one author (TOULSON 1939) suggests that the vesical mucosa beneath these flaps be denuded of its epithelium, presumably to get early adhesion and prevent their sloughing.

(c) BURNS (1928) removes a wedge from each side of the ureter in an effort to obviate stricture.

(d) In the cases described, the ureter was slit on the ventral aspect for about 0.4 cm. A similar method was also used by BEER (1933).

(e) Some surgeons merely bevel the ureter (BISSELL (1903)).

(f) THOMSON-WALKER (1914) advised that an extravesical drain be brought out alongside the ureter through the new (bladder) ureteric orifice to secure a weak area in the subsequent scar but it seems possible that this might even increase fibrous tissue formation. BISSEL (1903) suggests removing a small ellipse of bladder where the ureter passes through, with the same object.

(g) PATTON (1939) has advised that the ureter, splinted with a catheter, be brought through the original ureteric orifice with the object of retaining its valvular effect. This is obviously of very limited application e.g. in cases where injury occurs at operation in the lowermost part of the ureter, or in cases of uretero-vaginal fistula, but even in some of the latter this may not be possible if the damage is far from the ureteric orifice. No personal experience is available to confirm that reflux is prevented by this manoeuvre.

The methods of suturing the ureter to the bladder also vary considerably.

(a) All the sutures may be extravesical, between the adventitia of the ureter and the extramucosal tissues of the bladder. In one method (FURNISS (1918)), an instrument is passed through the anterior and posterior walls of the bladder whilst they are held together, and the ureter withdrawn through them till it protrudes for a distance of about 1 cm. It is then secured by interrupted sutures where it enters the posterior wall and then the two walls are allowed to separate permitting the free end of the ureter to retract within the bladder when the opening in the anterior wall is closed, the bladder being drained by catheter.

(b) In some operations extravesical sutures are supported by intravesical ones between the ureteric flaps and the vesical mucosa.

An instrument may be made to protrude through the posterior wall of the bladder, having been introduced perurethrally (BISSELL), and after cutting down on it, two needles carrying sutures attached to two flaps fashioned from the lower ureter are introduced intravesically via this opening and brought out on each side of it when they are separately tied (Van HOOK quoted by BISSELL (1903)). The ureter is supported by further

(b) (continuation)

extravesical sutures and the bladder drained by catheter.

BURNS (1928) after removing small wedges from each side of the ureter passes a fine chromic suture through it at the apex of each wedge and a fine plain suture through the point of the ureteral flaps. The ureter is drawn into the open bladder by these sutures, the chromic are passed through the bladder wall and tied outside, whilst the plain are sutured to the vesical mucosa. No other extravesical sutures are used and he keeps a catheter in situ till the ureter is sutured to avoid constriction. It is then removed.

The methods utilized to prevent retraction of the ureter have in the past been rather extraordinary. BOVEE (1900) quotes the following methods in women. Traction sutures attached to the ureter are brought through the urethra and (a) sutured to the external urethral meatus, (b) attached to weights (200 gms. for 5 days), or (c) they were tied over a piece of tubing outside the external urethral meatus. PATON (1907) reports a case in which he used HAMMERSCHLAG'S (1905) method - silk sutures attached to the ureter are drawn into the bladder by forceps, brought through the external urethral meatus and tied to the thigh and allowed to slough free of the ureter. The ureter is further

supported by extravesical sutures.

There is uniform agreement that tension must be avoided in these operations. It may be prevented by mobilizing the appropriate side of the bladder, and this may be supported by suturing the mobilized bladder to the posterior abdominal wall (WITZEL, BOVEE). If this is impossible reimplantation may be accomplished by utilizing Boari's method (BOARI (1894), HENDERSON (1951)) in which a flap of bladder is turned back and formed into a tube which is anastomosed to the ureter, or by Mezö's method - this necessitates mobilizing about half the bladder and turning it up to bridge the gap. The former method was utilized in one case. Mobilization of the kidney, to bridge the gap has been recommended. BOVEE reported this had only been carried out experimentally but since then it has been performed and advocated by OCKERBLAD and CARLSON (1939) to allow ureteral anastomosis where there was loss of tissue between the two segments. DODSON (1946) advises freeing the ureter to gain extra length, proximal to its division and states there is no danger to its blood supply unless its loose fibrous coat is stripped. MILLIN (1949) also stresses the importance of mobilizing the posterolateral pelvic curve of the ureter and states that by straightening this it is possible to shorten its course by several centimetres.

Extravesical drainage in some form is universally recommended. BEER (1933),and HYMAN and LEITER (1940) suggest that if this is used for a protracted period resulting fibrosis may lead to stricturing of the ureter due to periureteritis with a poor post-operative result. The drain must not be placed in the immediate vicinity of the implant.

The bladder drainage may be suprapubic or by catheter. The former seems safer and less likely to be followed by extravesical extravasation which could so easily occur if the urethral catheter became blocked.

As a preliminary to operation, it has been advised that the ureter be catheterized. This has obviously very limited application; in strictures or uretero-vaginal fistulae it will probably be impossible and in cases necessitated by neoplasm the ureteric orifice may not be localized. Extraperitoneal dissection at the bifurcation of the common iliac artery should expose it without undue difficulty, except perhaps in cases where there has been a previous ureteric exploration when a transperitoneal approach may be necessary.

WARDEN and HIGGINS (1949) state, "Cystoscopic examination is important in detecting a suitable site for implantation in the bladder". This is nonsense.

Some advise leaving an indwelling ureteric catheter as a splint. A review of PETERSON'S results shows that three of his five cases with functionless kidneys had ureteral tubes which were brought out through the suprapubic cystostomy or the urethra. Of the 21 cases which he reported these were the only ones in which the use of ureteric tubes is mentioned apart from three of the four which subsequently died in the post-operative period. BEER (1933) occasionally utilized them and in two of his cases the results after 4 years were good, in another the catheter did not drain post-operatively, and he concluded this had been a functionless kidney. In a further two of his cases, where stricture developed, an indwelling ureteric catheter had been used. He concluded that it was not a helpful procedure. HYMAN and LEITER (1940) only use them if the ureter is small as they consider these are liable to block with oedema; HESS (1941) and DODSON (1946) use them, and WARDEN and HIGGINS (1949) who report 4 cases of reimplant leave indwelling ureteric catheters for 2 weeks. MILLIN (1949) advocates the use of a Cumming's nephrostomy catheter as a splint following uretero-neo-cystostomy for 10 days.

They have never been employed in the present series and when the difficulty that one may have in obtaining continuous drainage from a ureteric catheter for a short period is recalled, the improbability of securing it for 7 - 14 days is obvious. It seems certain that it will encourage ureteritis, and that, in

association with obstruction due to its failure to drain, can only harm the kidney. Most surgeons have ceased to employ ureteric catheters in transplantation of ureters and there appears to be no good reason for their use in reimplantation. HERRICK (1918) stated some used a solid bougie: this requires no comment.

CONTRAINDICATIONS

Dilatation of the ureter is regarded by some as a contra-indication to operation and likely to cause complications at a later date. HUNT (1925) showed a higher mortality following reimplantation compared with ligation, and considered that reimplantation of a dilated ureter invited ascending infection. McCARTHY (1930) stated that in new growths of the bladder most of these ureters are dilated, drain pyonephrotic kidneys and the patients are debilitated - this is too sweeping a statement - and that, "this knowledge will or should serve to curb any enthusiasm we may have for this procedure."

FURNISS (1918) called attention to the fact that in most ureteral ectopias the ureter and pelvis are dilated and infected, and considered it useless and harmful to reimplant them. JUDD (1918) reported reimplantation in such a case. In the post-operative period the patient had pain in the kidney with pyuria. This eventually settled but recurred from time to time after discharge from hospital. In this series several ureters were dilated when reimplanted.

TOULSON (1939) considered reimplantation was contraindicated in the elderly.

COMPLICATIONS

MORRIS points out that traction in the ureter, whilst being "hostile to good union" tends to diminish the calibre of its canal and thus induces hydronephrosis, and states that the other complications are stenosis and ascending infection.

Post-operative dilatation of the ureter is mentioned by BOVEE as having been observed by POZZI who attributed it to reflux from over-distension of the bladder, and by POLK who considered it was due to stricture at the point of union, which he considered must be the end result in all cases. Follow-up reports indicate that some degree of hydronephrosis is not unusual and that this may finally lead to pyonephrosis or failure of renal function. Stricture at the site of reimplantation is also recorded and this may lead to atrophy of the kidney due to complete ureteric occlusion. BLAND-SUTTON (1914) speaking of reimplantation of the ureter said - "Urologists do not approve of this; they insist that when a ureter is engrafted into the bladder it becomes sclerosed by chronic ureteritis, which narrows and finally obliterates its lumen. This sclerotic obstruction does not happen in every case." WEBB-JOHNSON (1935) stated that ureteric obstruction may be a gradual process and lead to serious hydronephrosis or pyonephrosis after an interval of years.

Hypertension due to unilateral renal disease is an obvious possibility and in a case described by FURNISS (1933) the blood pressure is recorded as 250/150 but unfortunately the pre-operative

reading is not available.

Regurgitation renal colic as originally described by BRANSFORD LEWIS (1926) has been reported following reimplantation in two cases by CAHILL (1933).

The fact that the patient is free from symptoms and has no abnormal physical signs is no indication of the success of the operation. This was originally pointed out by BEER.

In the immediate post-operative period, peritonitis due to leakage may occur, but of course is much less likely where an extraperitoneal approach has been adopted. That any of the major complications of urological surgery such as uraemia, pelvic cellulitis, and cardiac or pulmonary complications may arise, is evident, but those due to infection of the kidney on the reimplanted side are the most common.

M O R T A L I T Y - Published Figures

JUDD (1917) 17 partial cystectomies with reimplantation - 3 post-operative deaths - mortality 18%

HUNT (1925) 53 partial cystectomies with reimplantation - 16 post-operative deaths - mortality 30.1%

BEER (1933) 30 partial cystectomies with reimplantation - 4 post-operative deaths - mortality 13.3%

CAHILL (1933) Partial cystectomy with reimplantation - mortality 15%

HYMAN and LEITER (1940) state mortality in partial cystectomy with reimplantation is 13% to 20%

STEVENS and MARSHALL (1943) 9 partial cystectomies with reimplantation, and one reimplantation for ureteric obstruction 1 post-operative death - mortality 10%

LIGATURE AS AN ALTERNATIVE PROCEDURE

PETERSON (1918) advised ligation if marked ureteric dilatation was present, or if reimplantation was impossible without tension, in the presence of good function on the opposite side.

BEER (1933) stated that MARION and LEGUEU said the procedure (reimplantation) was of no value and in the succeeding discussion it was decided that ligature or nephrectomy was preferable.

Ligature is advocated by HUNT (1925) in view of the danger of ascending infection particularly in the presence of a dilated ureter. He reported 98 cases of segmental resection of the bladder; in 45 the ureter was ligated, and 6 of these died post-operatively, giving a mortality of 13.3%. Nephrectomy was required in 2 cases and one of these died, another case required nephrectomy 5 years later, 3 required drainage of hydronephrotic (sic) sacs and 2 of these died. In 53 cases, the ureter was reimplanted, there were 16 deaths within 3 - 56 days giving a mortality of 30.1%. Ascending infection was evident at post mortem in 11 cases. Nephrectomy was required 9 years later in 1 case for hydronephrosis.

CAHILL (1933) reported 5 cases in which he carried out ligation of the ureter - nephrectomy was required in 2 of them. DEMING (1934) also advised ligature in carcinoma of bladder cases and had seen no ill effects in 7 or 8 cases. He also suggested that implantation into the other ureter might be useful, but,

that this in the case of failure, may lead to damage to both kidneys and is an unnecessary risk is the view of the present writer, and it has also been expressed by MILLIN (1949).

KIRWIN (1934) was of the opinion that section of the ureter interfered with its intrinsic nerve supply and that the activity of its musculature was altered, thus ultimate dilatation on the side of the implant would occur.

PATTON (1939) suggested that reimplantation away from the base was not usually successful because constant contraction and dilatation of the remainder of the bladder, together with the interlacing arrangement of the muscle fibres led to constriction of the ureter - this does not appear to be correct.

TECHNIQUE IN THE PRESENT SERIES

In the cases described in this report several procedures were adopted.

In the majority, the ureter was reimplanted during a partial cystectomy and it was brought through the suture line, following excision, at a suitable site (this type of operation was originally described by Albarran in 1892); a linear incision was made in its anterior aspect for a distance of 0.4 cm. and the ureter was secured to the sides of the incision by 4 sutures (0000 chromic catgut). In some of the early cases Thomson-Walker's procedure was adopted but there appear to have been no advantages. In a few cases the ureter was brought through a separate stab incision as the suture line of the excision was inconvenient. No extravesical sutures were used.

In the case of ectopic ureter associated with incontinence the two ureters on the right were exposed extraperitoneally after opening the bladder to catheterize the normally situated one, and the ectopic one, after identification, was brought through a stab and fixed by 4 intravesical sutures. A similar procedure (without catheterization) was adopted in three of the uretero-vaginal fistulae but in one the ureter was exposed intravesically above the ureteric orifice, divided, mobilized and reimplanted with similar suturing.

In the case treated by Boari's method a flap measuring 5 cms. by 1.5 cms. was turned up, the ureter split as usual and

sutured to its mucosal aspect with one chromic 0000 catgut suture, and then the vesical flap was sutured as a tube with interrupted chromic 0000 catgut sutures, and its free end attached by a few interrupted sutures to the adventitia of the ureter. No ureteric catheter was utilized as a splint in this case.

In all the operations carried out in this series, except in case 71 where an indwelling urethral catheter was used, the bladder was drained suprapubically for 7 - 10 days, and extravesical drainage was maintained for at least 4 days.

PART II

ASSESSMENT OF THE RESULTS OF REIMPLANTATION OF THE URETER

Symptoms Persistence of bladder infection resultant of the suprapubic drainage may give rise to frequency and dysuria, and renal infection may result in loin pain. Regurgitant renal colic has been described by several authors, and originally by BRANSFORD LEWIS; this is typical renal colic, noted in the presence of reflux. In the presence of reflux, the patient may complain of pain in the loin prior to micturition when this is delayed, or on micturition, passing off as the bladder is emptied.

Signs Renal tenderness or a palpable mass indicative of hydronephrosis or pyonephrosis.

Cystoscopy The new ureteric orifice may be fairly normal in appearance or present as a small circular opening or in cases where retraction has occurred, the orifice may be wide and gaping. PETERSON suggested that both ureters be catheterized and a differential function test (phenolsulphonephthalein) be carried out. This has not been attempted in this series as it has been considered that a good indication of function is available on intravenous pyelography. The fact that an orifice is visible is no indication of the absence of stricture, and JUDD observed that although it might be open, it was not always possible to catheterize the ureter, however, as a fold of mucous membrane may prevent catheterization of an otherwise normal ureter, checking

of a catheter should not be accepted as evidence of a stricture and the results of cystography seem much more valuable as indicating its presence or absence.

Chromo-cystoscopy It has been said by JUDD (1917) that following reimplantation the efflux may be abnormal and the urine trickles out rather than spurting. He has suggested that a continuous trickle of urine is due to chronic infection of the ureter and absence of peristalsis due to thickening of the walls. In several of the cases reported here the pyelographic changes together with the findings on urine culture suggest the presence of chronic infection, but there is radiographic evidence of good peristalsis and the efflux has been normal. As two of his reported cystoscopies were carried out only two weeks post-operatively, it is possible that there may be an atonic phase in the early stages.

Intravenous Urography This may show normal function and outline, diminished function with or without hydronephrosis and hydroureter, or absence of function. It will be shown later that chronic pyelonephritis is the commonest sequel, although it is not recorded in the literature.

Cystography This is necessary to demonstrate reflux and a detailed method has been evolved. With the patient lying on his back the table is tilted 15° with the head downwards. A catheter is passed, the bladder emptied and approximately 280 c.c. of 10% sodium iodide is gradually instilled and the first exposure made.

A second is made whilst the patient micturates; if he fails to do so, it is taken whilst he strains, this may or may not be associated with increase of vesical tone, and a third is made immediately after micturition. In the earlier investigations, the third film was omitted and it was accidentally discovered when the patient commenced an intravenous pyelogram that the preliminary film showed a reflux not previously present; since then, if micturition does not take place on the table a total of three exposures is made. Since delay in exposure of the third film might result in a reflux being missed, it is felt that the second film, if the bladder does not remain flaccid will guard against this.

When the patient complains of vesical discomfort before 280 c.c. have been instilled, no further filling is carried out; but in the reimplantation cases, this was only necessary in one case when the capacity was limited to approximately 220 c.c. It is of interest to note in passing how the vesical capacity increases after extensive resections of the bladder, till normal levels are once more achieved.

Urine Repeated post-operative examination of the urine with reference to the presence or absence of pus cells and the result of culture is also desirable.

PART III

PUBLISHED LATE RESULTS OF REIMPLANTATION OF THE URETER

This has been investigated from two angles

1. The results of experimental surgery
2. The findings on follow-up examination

EXPERIMENTAL SURGERY

SAMPSON (1903) reimplanted the ureter directly in 9 dogs, and noted absence of reflux immediately after operation, but did not fill the bladder as he was avoiding leakage at the site of the anastomosis. 10 c.c. of a culture containing staphylococcus aureus was placed in the bladder.

1 dog died 14 days post-operatively with peritonitis due to leakage at site of operation and renal infection on the reimplanted side.

1 dog died of bilateral renal infection, gauze had been placed around the ureter on the other side to produce stricture formation.

7 dogs were examined between 4 days and 6 weeks after operation. Renal infection was present only in one case on the normal side, and there was associated stricturing. In 3 dogs there was renal infection on the operated side associated with stricturing at the site of

PETERSON (1918) carried out unilateral reimplantation in 18 dogs, and bilateral reimplantation in 3 dogs i.e. 24 reimplantations. Different methods were used:

Coffey No. 1 Technique - 8 operations

1 died peritonitis 6th day. Slight hydronephrosis. Leakage at anastomosis.

1 died 24 hours post-operatively. Ureter and pelvis dilated, miliary abscesses kidney and local abscess formation at site of reimplantation.

1 died - distemper 10th day - slight dilatation pelvis and ureter.

5 examined 3 to 23 weeks after operation - entirely normal kidney and ureter.

Stiles' Technique - 8 operations

1 died - ureter pulled out

1 examined 40 days after operation - pyonephrosis

6 complete success

Mann's Technique - 5 operations

1 examined 4 months after operation - hydronephrosis

4 complete success

Furniss' Technique - 3 operations

3 complete success

Cystoscopy was carried out post-operatively in 4 dogs and in two there was obstruction to a ureteric catheter.

Results - 24 experiments

15 normal kidneys and ureters

2 slight hydronephrosis

1 marked hydronephrosis

1 miliary abscesses kidney

1 pyonephrosis

2 normal kidney with hypertrophied ureter

2 ureter pulled out

Complete success	15	=	62.5%
Normally functioning kidney	19	=	80%
Complete failure (stenosis, infection and pulling out of ureter)	5	=	20%

He was of the opinion that the hypertrophied ureters were the result of compensatory hypertrophy to overcome partial stenosis at the site of reimplantation, and suggested dilatation of the pelvis

would not occur unless compensation was over balanced. The slight hydronephrosis noted in 2 cases at the 6th and 10th days he attributed to oedema at the site of reimplantation and considered that Stiles' technique, slightly modified, was the best.

MCKENNA (1929) reimplanting the ureter in dogs by Coffey No. 1 technique was troubled by stricture formation, but STEVENS and MARSHALL (1943) claimed good results with a valvular implant in 8 dogs.

VERMOOTEN, SPIES and NEUSWANGER (1934) reported the results following different types of operation. Three dogs died from peritonitis following Coffey No. 1 operation. In 10 dogs, the right ureter was brought directly through the bladder wall (the aperture in the wall was made by a large needle carrying 000 chromic sutures attached to the ureter) and then laid in a submucous trough, 1.0 - 1.5 cms. in length, whilst the left ureter was brought directly through the bladder with no attempt at valvular arrangement. Cystograms during life showed regurgitation on the right on one occasion and on the left on three. Examination between 2 weeks and 15 weeks (average 8½ weeks) after operation showed slight stricture in 5 out of 10 on the right, and on the left occlusion occurred twice, partial occlusion twice and retraction with slight leak on one occasion. Varying degrees of ureteral dilatation accompanied the obstructions whether the bladder, ureter, or kidney were infected or not. In one dog, a slight amount of ureteral dilatation and tortuosity

was present without demonstrable regurgitation from the bladder, hydronephrosis or obstruction at the site of the implant. They concluded this was due to ureteral infection (evidenced by small round cell infiltration of the tunica propria, which contained an increase of fibrous tissue, and by epithelial proliferation) which led to loss of elasticity constituting an obstruction with resultant hypertrophy and hyperplasia of the ureteral musculature. They concluded that:

(a) Regurgitation was less common after submucous implantation.

(b) Stricture is due to retraction of the ureter. If a ureteral bud remains in the bladder, no stricture or obstruction results, and thus no ureteral dilatation or hydronephrosis.

(c) If the ureteral wall is infected dilatation will follow.

NEUSWANGER (1934) reporting the results of reimplantation, claimed that ureters did not become infected in the presence of cystitis even although regurgitation was present. His operative mortality was 3.0%.

WEYRAUCH et al (1941) reported the results of bilateral reimplantation by the Coffey No. 1 technique in 6 dogs. Examination was carried out at one week (2 dogs); one month; two months; ten weeks; and six months, after operation. Two

examined at one week showed mild bilateral hydronephrosis and hydroureter - as this was not present in those examined later it was attributed to post-operative oedema. There was no gross evidence of infection but on microscopy mild bilateral ureteritis and pyelonephritis was present in dogs examined at one week and similar changes on one side only were noted in those sacrificed at two and six months. The results in all were much better than following uretero-colic anastomosis, where advanced degrees of late hydronephrosis, hydroureter and severe renal infection were encountered. They concluded that the degree of ascending infection and obstruction is directly attributable to the degree of contamination of the field into which the ureter is introduced.

In considering the results of animal experimentation the following factors must be remembered.

1. The bladder in dogs is an intraperitoneal organ, thus there is an increased risk of peritonitis which is aggravated by the further difficulty of securing drainage of the bladder post-operatively.

2. In surgical practice there is likely to be damage to the kidney of which the ureter is being reimplanted, whereas in the experimental operations a normal kidney will almost certainly be present.

3. In experimental surgery the difficulty of bladder drainage - it is not clear in some cases if this was entirely dispensed

with, but it seems likely that it was - whilst increasing the risk of leakage diminishes the risks of infection, but such a risk seems unjustifiable in surgical practice.

FOLLOW-UP EXAMINATION

TORRANCE (1912) reported a successful operation for uretero-vaginal fistula at which reimplantation into the fundus of the bladder was performed. A No. 7 ureteric catheter was checked at 3 cms. but indigo carmine was excreted well two months after operation.

PETERSON (1918) quotes the results of FRANZ (1907) - 17 cases but only 4 had been cystoscoped and these functioned normally, and KRÖNIG (1907) - 9 cases - cystoscoped five to fifteen months post-operatively. Good function in 5 cases, 2 cases showed stenosis and slight hydronephrosis, and in 2 cases where the reimplantation was bilateral there was hydronephrosis on one side and good function on the other in one, whilst the second had good function on both sides.

Peterson's series (Mayo Clinic) amounted to 21 cases - 15 in cases of neoplasm, 4 for uretero-vaginal fistulae, 1 for ectopic ureter and 1 ureter opening into a diverticulum. Of the 21 cases, 17 were examined cystoscopically eighteen days to four and a half years after operation.

(a) 5 - Normal output of phenolsulphonephthalein and normal pyelogram - 30%

(b) 4 - Normal output of P.S.P. - 23% (together with (a) this gives 53% with normal kidney function)

(c) 3 - Small hydronephrosis with fair function - 18%

(d) 5 - Functionless kidneys - 30%. These included 2 cases where marked dilatation was present at operation (1 carcinoma bladder and 1 ectopic ureter) also two cases in which the reimplantation was carried out under tension.

Four cases died between four days and two months after operation - (a) 2 had slight dilatation on the reimplanted side and in one there were small cortical abscesses (b) the pelvis was three times the normal size in 1 case and (c) in the fourth there was no evidence of obstruction.

Ureteric catheterisation was possible in 8 cases (47%), the catheter was obstructed in 3 (18%)

Infection was present in 6 cases (35%) - microscopic examination.

He concluded "From experimental and clinical observations, it is obvious that a normal or almost normal kidney and ureter should result following reimplantation of the ureter into the bladder".

FURNISS (1933) - reimplantation for uretero-vaginal fistula twelve years previously. The patient was well apart from hypertension 250/150. The ureteric orifice admitted a No. 6 ureteric catheter and excreted indigo carmine in a normal manner. An ascending pyelogram showed slight dilatation of calyces, pelvis and ureter.

BEER (1933) reported 41 cases of reimplantation which he divided into 4 groups.

Group 1 - in association with resection of carcinoma bladder 30

Intravenous pyelograms were carried out in eight of these cases and five were considered excellent functional results - the longest interval since operation was 4 years and 8 months. There were also two cases of 4 years duration and the remainder were of shorter periods.

In five cases, the kidney was seen at a later operation or at post mortem examination. 1. Nephrectomy 6 years after operation for pyelonephritis - the kidney except for acute inflammation was almost undeformed. 2. Nephrectomy 5 years after operation - moderate hydronephrosis. 3. Nephrectomy - the kidney was large and "blocked", the ureter being the size of the thumb prior to reimplantation, and the second operation was performed in an attempt to secure closure of the suprapubic vesical fistula. At operation blue was injected successfully from the renal wound down the ureter to the bladder. 4. Nephrectomy for persistent post-operative pyrexia - the kidney was well preserved and very little dilated. 5. Post mortem in one of the cases demonstrated by I.V.P. to be a failure - infected hydronephrosis, the other kidney was also infected and pre-operatively there had been a reflux up both ureters.

The remaining cases were less adequately followed up but two excreted good blue whilst four showed evidence of temporary

or more serious renal injury.

He concluded that reimplantation in association with resection of the bladder was a satisfactory procedure in most cases, and suggested that if renal infection were present pre-operatively, the neostomy might drain it. He also considered that the unsatisfactory results might be related to pre-operative renal damage.

Group 2 Uretero-vaginal fistulae - 4

1. Normal function 2. Ureter twice normal size at operation and thickened - no indigo carmine excreted, but the ureter was readily catheterized and yielded clear urine - no I.V.P. 3. Pre-operatively hydronephrosis was present but seven months later function was good. 4. Twenty years after operation, which had been performed by the intraperitoneal route, patient complained of fever and chills and an ascending pyelogram showed moderate dilatation. Two years later, there was no function on I.V.P.

Three of these are considered ideal results.

Group 3 Peridiverticulitis necessitating sacrifice of ureter - 4

1. No I.V.P. 2. Good indigo carmine 3. No apparent function pre-operatively but it was present post-operatively, however, patient died and there was evidence of bilateral kidney infection 4. Part of the diverticulum carrying the orifice was reimplanted, so this case belongs to a different group. Good blue,

Group 4 Ureteric stricture - 3

In only one of these is the post-operative report useful - I.V.P. improvement in a case previously showing marked dilatation.

Ureteric catheter passed easily.

He noted that up till that time there were few cases in the literature checked by cystoscopy and fewer by intravenous pyelography.

CAHILL (1933) in the subsequent discussion reported 39 cases associated with tumour resections. Nine died within three months, eight within twelve months (three of them required nephrectomy) and twenty-two were living over 1 year free from symptoms. Four following gynaecological procedures were satisfactory.

DEMING (1933) reported 6 cases. Of these, two died of carcinoma one and two months respectively after operation and in both there was a stricture at the site of reimplantation. In two other cases the urine has remained infected and he considered it difficult to carry out reimplantation and leave the patient with a sterile urinary tract.

HYMAN and LEITER (1940) added 19 cases to Beer's series and reviewed 60 reimplantations. The distribution of these was 45 for carcinoma, 5 for uretero-vaginal fistulae, 6 for extensive peridiverticulitis, 4 for stricture of the lower ureter.

Twenty-seven had been controlled by I.V.P. following operation a few months to 17 years previously.

44.4% - Good functional results - normal or mild hydronephrosis

26% - Fair functional result - moderate hydronephrosis

29.6% - Definitely poor results - marked hydronephrosis, poor or no visualisation.

The notable successes were:- 1. Right neostomy and diverticulectomy, the ureter being thickened and dilated - 17 years later good function 2. Right hydronephrosis due to periureteritis - 6 years after operation hydronephrosis much less, almost a normal pyelogram. They also reported cases after 10, 8 and 6 years respectively.

They conclude that

(a) reimplantation will frequently result in a satisfactory functioning upper urinary tract

(b) good results follow neostomy in the absence of valvular formation

(c) a dilated kidney pelvis and ureter may show considerable improvement after reimplantation.

STEVENS and MARSHALL (1943) bring the ureter through a submucous channel. In 9 cases they reviewed the results by intravenous pyelography pre-operatively, about three weeks after operation and again three months later. The earlier post-operative examinations all indicated some ureteral obstruction. In 3 cases there was pre-operative ureteral or pelvic dilatation - two remained as before, dilatation was increased in the third. Of the remaining cases: 3 had no dilatation, 1 had hydroureter and hydronephrosis as late as eight months after operation but this had cleared up at sixteen months, and in 1 case there was no later pyelogram.

RITTER and KRAMER (1944) report two cases of hydronephrosis

due to stricture at the uretero-vesical junction treated by submucous reimplantation. In one case the result was satisfactory, but nephroureterectomy was necessary in the other due to repeated attacks of infection.

RUBIN and GOLDSTEIN (1950) state that ADAMS reported 2 cases of reimplantation of the ureter following injury with one good result; the other resulted in ureteral stricture and atrophy of the kidney. They also report a case where complete stricture followed reimplantation by an oblique method.

VESICO-URETERAL REFLUX

BISSELL (1903) quotes MORRIS (1901) as saying that this is more likely if the lower end of the ureter is slit as a precaution against stenosis, but his own view is that reflux will not occur if the ureter is reimplanted low in the bladder at a point just below the peritoneal reflection. He suggests that the intravesical pressure is least at the highest part of the bladder but implantation here would be associated with interference with the ureteric drainage; whilst intravesical pressure is greatest at the base, his choice of a point just below the peritoneal reflection is an attempt to get a medium pressure. This opinion is not acceptable of course, as intravesical pressure is now regarded as being the same at all points.

SAMPSON (1903) was unable to produce reflux in dogs after reimplantation of 19 ureters - he attempted to show it immediately after operation and his pressure must have been exceedingly low to avoid leakage. At a later stage he was able to produce a reflux in 6 cases but he does not state what proportion of later examinations this constituted.

GRAVES and DAVIDOFF (1925) reimplanted the ureter by the direct method in 2 dogs, and by the Coffey method in another 2; they found reflux in the former but not in the latter, even on filling to 850 c.c. compared with 250 c.c. in the others.

BEER carried out cystographic examinations in 6 patients after operation, and in no case did reflux occur, but it appears

that the examination was carried out after filling alone. From his review of the literature he was only able to find a record of one case (STOEKEL) where reflux proved by cystogram had occurred, and he was surprised this was so in the absence of a ureterovesical valve.

LOWSLEY (1933) expressed the opinion that the incidence of reflux was variable but that if the patient lived long enough it occurred.

VERMOOTEN et al, after reimplanting the right ureter by a submucous method and the left ureter directly in 10 dogs carried out cystograms and found reflux on the right once and on the left on three occasions and two other left reimplants proved later to be occluded.

TOULSON reported "In one of our cases, the new opening after a period of a year had developed a hypertrophy of the musculature of the bladder wall and these hypertrophied muscle bundles seemed to take on the function of a sphincter and opened and closed rhythmically. This would indicate that after a while bladder reflux does not occur." Such a phenomenon has not been noted by other observers and it seems strange that the bladder which normally has no sphincter action on the ureter should develop this following reimplantation. No reflux was present on cystography in the two cases which he investigated.

PATTON after reimplanting through the former ureteric orifice found no evidence of reflux six weeks after operation on "filling"

the bladder with 160 c.c. 10% sodium iodide.

HYMAN and LEITER in their series of direct reimplantations which included Beer's cases found no reflux in 8, reflux up both ureters in 1, and reflux up the opposite ureter in 2 (one of these cases had the original ureteric orifice reimplanted after diverticulectomy). They concluded that reflux is not as commonly found as it is in animals after similar surgery.

HESS found no reflux in his case reimplanted by a submucous method.

STEVENS and MARSHALL also performed a submucous operation; cystograms on four of their patients showed no reflux in 2 (15 months and 16 months respectively after operation), while it was present in the other 2 cases.

P A R T IV

REVIEW of 73 Cases of REIMPLANTATION of the URETER

The distribution of these is as follows:-

Reimplantation in association with partial cystectomy	67
Reimplantation for uretero-vaginal fistula	4
Reimplantation for ectopic ureter	1
Reimplantation for operation trauma by Boari's method	1

REIMPLANTATION in association with PARTIAL CYSTECTOMY - 67 cases

D E A D

At the time of review 26 cases were dead; 3 of these died prior to discharge from hospital: mortality 4.5%. The periods of survival of the remainder were:

0 - 6 months	-	3	
6 - 12 months	-	8	
12 - 18 months	-	6	
18 months - 2 years	-	2	
2 - 3 years	-	2	
3 - 4 years	-	Nil	
Over 4 years	-	2	(6 years 4 months 4 years 1 month)

Death was due to carcinoma in 18 (including the two surviving over four years); in 1 urinary infection (died within one year of operation); in 1 cardiac failure; and in the remaining 3, the cause of death is unknown.

Age at operation

40 - 50 years	-	3	
51 - 60 years	-	5	(2 females)
61 - 70 years	-	15	(4 females)
Over 70 years	-	3	(1 female)

Operation Technique

Direct reimplantation in all cases except three.

1. The ureter was brought indirectly beneath the mucosa to gain obliquity - subsequently failed to excrete blue.

2. The ureter was brought through an oblique stab - there is no note on post-operative function.

3. Thomson-Walker's method - no note on function.

Sequelae

Tenderness and enlargement of the kidney was present one month after operation in one case. On cystoscopy the ureter was catheterized with difficulty and suggested the presence of a ureteric stricture 1 cm. from the orifice; however, a No. 8 catheter was passed and the urine from it was noted as being "almost clear".

Hospitalisation

Omitting the three who died in hospital and two others transferred elsewhere during wartime, it was as follows:-

19 - 30 days	-	8	
31 - 40 days	-	3	
41 - 50 days	-	3	
51 - 60 days	-	4	
78 days	-	1	(anaemia and a heavy urinary infection pre-operatively ? ureteric stricture post-operatively (see below))
83 days	-	1	(delayed closure of the supra-pubic fistula and pyelonephritis of the opposite kidney)
129 days	-	1	(vesico-vaginal fistula)

Urinary Infection

Of the 21 cases where there is a record of urine culture prior to operation, 9 were infected.

In the 5 cases where there is a record of examination after operation all were infected. The ureter had been dilated at operation in two of these cases (in one infection had been present pre-operatively). Of the remaining three, two were uninfected before operation.

In 6 cases, the ureter was noted at operation to be dilated, and in two of these the urine was infected.

Pre-operative pyelograms were only carried out in 3 cases. In two of these early hydronephrosis with associated urinary infection was present.

Only one case was examined by intravenous pyelography in the post-operative period and this showed absence of function on the reimplanted side (Case 19 - see below)

In two cases where there is a record of chromocystoscopy no blue was seen to be excreted. In one case there is a note that the new ureteric orifice was seen to emit an efflux. In only one case is there a record of post-operative blood pressure and this was 190/120. The pre-operative reading is recorded as 124/70 but as there was a history of nephritis 13 years prior to the partial cystectomy, this may have been a false reading.

It is considered that no conclusions can be reached from the above data as the cases were incompletely followed up, and it is

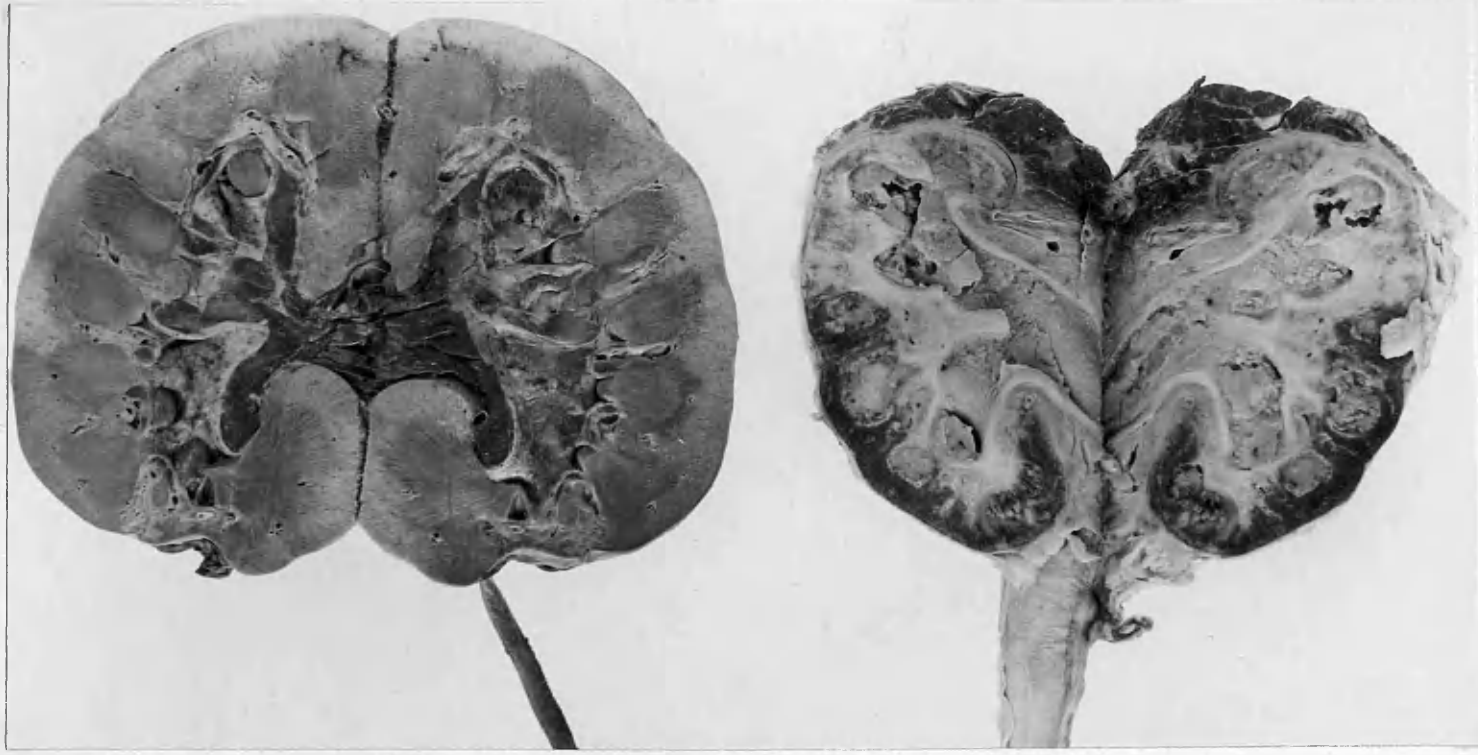


Fig. 1

Case 19. Operation 19.10.46. Male. Right reimplantation - carcinoma of bladder. Died 1.12.50. The kidneys are transposed; the right shows chronic pyelonephritis with gross dilatation and thickening of the ureter; the left is of normal size but is also infected

only included for the sake of completeness, but the following case is of interest.

Case 19 Operation 19.10.46. Reimplant right ureter. The pre-operative I.V.P. suggested the presence of early hydronephrosis of the right kidney but the function was good. The patient had a persistent urinary infection and I.V.P. on 10.11.50 showed good excretion from the left kidney with a normal pyelogram, but no excretion on the right. Death from recurrence of the growth occurred on 1.12.50 and post-mortem examination showed the right kidney to be the seat of chronic pyelonephritis and very much smaller than the left which was of normal size although infected (Fig. 1). There was marked stricturing of the lower right ureter at its junction with the bladder and it would not admit even a very fine probe. The right ureter was grossly thickened and dilated.

A L I V E

The periods of survival of the remaining 41 are:-

0 - 6 months	-	5
6 - 12 months	-	5
12 - 18 months	-	8
18 months - 2 years	-	5
2 - 3 years	-	5
3 - 4 years	-	7
Over 4 years	-	6 (9 years; 7 years; 6 years 4 months; 4 years 11 months; 4 years 10 months; 4 years 6 months)

Age at operation

31 - 40 years	-	4
41 - 50 years	-	6 (2 females)
51 - 60 years	-	18 (5 females)
61 - 70 years	-	11 (5 females)
Over 70 years	-	2

Operative Technique

Direct reimplantation in all cases except one.

Case 18 Thomson-Walker method. Eleven months after operation the kidney was functioning well and not dilated. A

Fig. 2 ←

Case 18. Operation 28.8.46 and again on 16.7.47. Female. Reimplantation of right ureter (carcinoma bladder) 14.2.51 I.V.P. showed good function on both sides and the calyces on the right side appear normal. (10 minutes)

Fig. 3 →

Same case as Fig. 2 14.2.51. Cystogram shows a filling reflux, the calyces being well cupped, but the calyceal necks are wider than normal. The pelvis is bifid.

Fig. 4

Case 22. Operation 21.4.47. Female. Reimplantation right ureter (neoplasm bladder) 12.10.49 I.V.P. Kidney shadows of normal size. Good excretion left kidney with normal pyelogram. Slight delay in right excretion with hydronephrosis and hydroureter. 27.5.51 No change. 1 hour 15 minutes.

Fig. 5

Case 29. Operation 13.11.47. Female. Reimplantation of dilated left ureter (neoplasm bladder) 11.10.50 I.V.P. Two small opacities in left kidney. Good excretion on the right, very poor on the left. 4.12.50 Cystogram. Filling reflux with flaccid bladder shows contracted kidney - chronic pyelonephritis.

recurrence of growth in the scar necessitated a further partial cystectomy with direct reimplantation. On this occasion and 3 years 7 months after the second operation, there is good function and the calyces are well cupped (Figs. 2 and 3)

Case 22 The ureter was reimplanted under tension. An I.V.P. 2½ years later shows delayed excretion with marked hydronephrosis (Fig. 4). A cystogram a year later shows no reflux on filling, straining or after micturition, suggesting that stricturing has occurred in this case. Although the urine was infected before operation, three examinations within the past 4 months have shown the absence of pus and no growth on culture.

Dilated Ureter noted at operation

Five cases (29, 42, 46, 64 and 66)

Case 29 Operation 13.11.47. Left reimplant. The urine was heavily infected with coliform organisms and contained pus on the three occasions it was examined in 1948 (mixed infection pre-operatively). In December 1950 - no pus; no growth. I.V.P. October 1950. Good excretion right, slight clubbing of calyces. Poor excretion on the left. Cystogram filling reflux December 1950, gives the impression of a small pyelonephritic kidney (Fig.5).

Case 42 Operation 1.1.49. Left reimplant. Now complains of dull pain in left loin, commenced eighteen months after operation. Easier after micturition but not worse just before or during. Heavy coliform infection (light B. coli pre-operatively).

Fig. 6 ←

Case 42. Operation 1.1.49. Male. Reimplantation of left ureter (carcinoma bladder). 30.11.49 I.V.P. shows a very large kidney with good excretion on the right, delayed excretion from the left. The left pyelogram is never well shown (30 minutes) - chronic pyelonephritis.

Fig. 7 →

Same case as Fig. 6. 1.12.50 Cystogram. On filling there was only a trickle of medium into the left ureter but on micturition a complete pyelogram with a dilated, tortuous ureter is shown. The calyceal outline is indicative of chronic pyelonephritis and there is only a narrow margin of renal tissue.

I.V.P. November 1949. Very large kidney on the right - good excretion. Delayed excretion on the left - poor pyelogram (Fig. 6). Cystogram - December 1950 - slight reflux on filling, complete on micturition (Fig. 7) pyelonephritic kidney.

Case 46 Operation 20.6.49. Right reimplant near apex bladder. Persistent pyocyaneas infection (sterile pre-operatively) I.V.P. September 1950. Good excretion and normal outline on left. The right kidney excretes well but calyces indicate chronic pyelonephritis.

Case 64 Operation 8.11.50. Left reimplant. Persistent staphylococcus - pyogenes infection (present pre-operatively). I.V.P. February 1951. Delayed excretion right, normal outline; very poor excretion left. Cystogram reflux February 1951 shows broadening and clubbing of the calyces.

Case 66 Operation 20.12.50. Left reimplant. Persistent staphylococcus albus infection (present pre-operatively). I.V.P. April 1951. Good function and probably normal outline.

Post-operative Complications

Pain in the loin accompanied by tenderness is recorded in 4 cases during the immediate post-operative period in hospital. (It is not suggested that these were the only cases which had symptoms).

Case 25 Operation 13.8.47. Left reimplant. Infected wound; bilateral epididymitis; tender palpable renal swelling. 8.10.47. I.V.P. showed good excretion with slight dilatation,

Fig. 8

Case 25. Operation 13.8.47. Male. Reimplantation left ureter (neoplasm bladder) 8.10.47 I.V.P. Good excretion both kidneys. Normal right pyelogram, the left shows slight dilatation compared with the right and the left ureter is dilated. (45 minutes)

urine infected with coliform organisms (Fig. 8) 30.4.51 Reflux on filling. I.V.P. 30.4.51 Good function both kidneys. Normal right pyelogram, left shows evidence of chronic pyelonephritis. Urine - no apparent pus; scanty growth B. coli.

Case 29 This case is described above under dilated ureter.

Case 30 Operation 16.2.48. Left reimplant. I.V.P. 17.5.49. Good excretion but outline not distinct. B. coli infection. No cystogram.

Case 59 Operation 3.4.50. Left reimplant. I.V.P. 2.11.50. Good excretion with clubbing of calyces. 18.11.50. Cystogram. Complete reflux on left and almost complete on right. Cystoscopy has shown slight prostatic obstruction in this case. Persistent staphylococcus pyogenes infection.

Hospitalisation

Under 20 days	-	3	
20 - 30 days	-	26	
31 - 40 days	-	8	
41 - 50 days	-	1	
51 - 60 days	-	1	
63 days	-	1	(case 25; infection of wound; bilateral epididymitis; tender palpable kidney)
95 days	-	1	(case 30; acute salpingitis with associated pelvic peritonitis necessitated laparotomy)

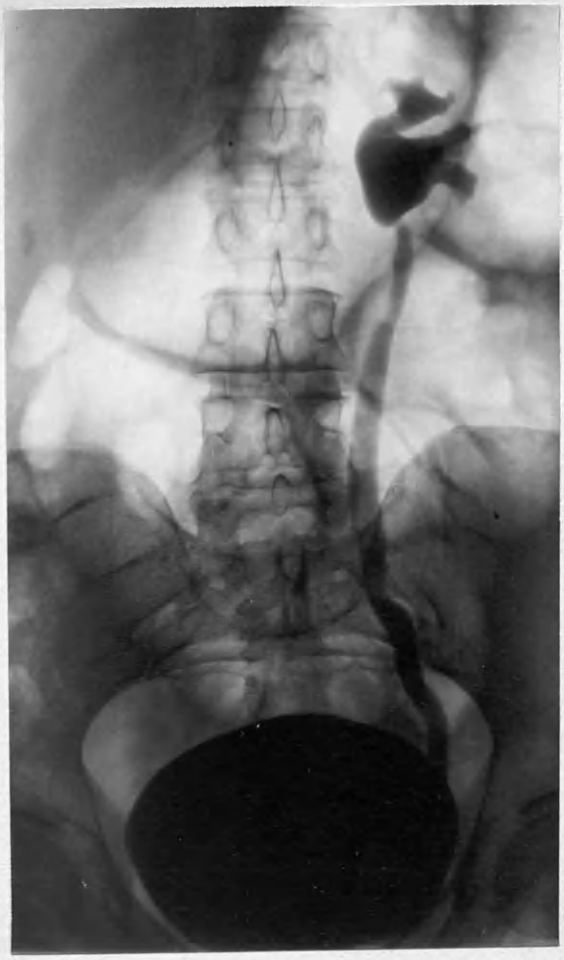


Fig. 9 ←

Case 10. Operation 29.11.44. Female. Reimplantation left ureter (carcinoma bladder). 11.8.48 I.V.P. showed poor function on the left side. 16.3.51. Filling cystogram shows a complete left reflux. The calyceal necks are broadened the pelvis bulky - chronic pyelonephritis - and the ureter dilated but not tortuous

Fig. 10 →

Same case as Fig. 9. Straining cystogram showing increased dilatation.

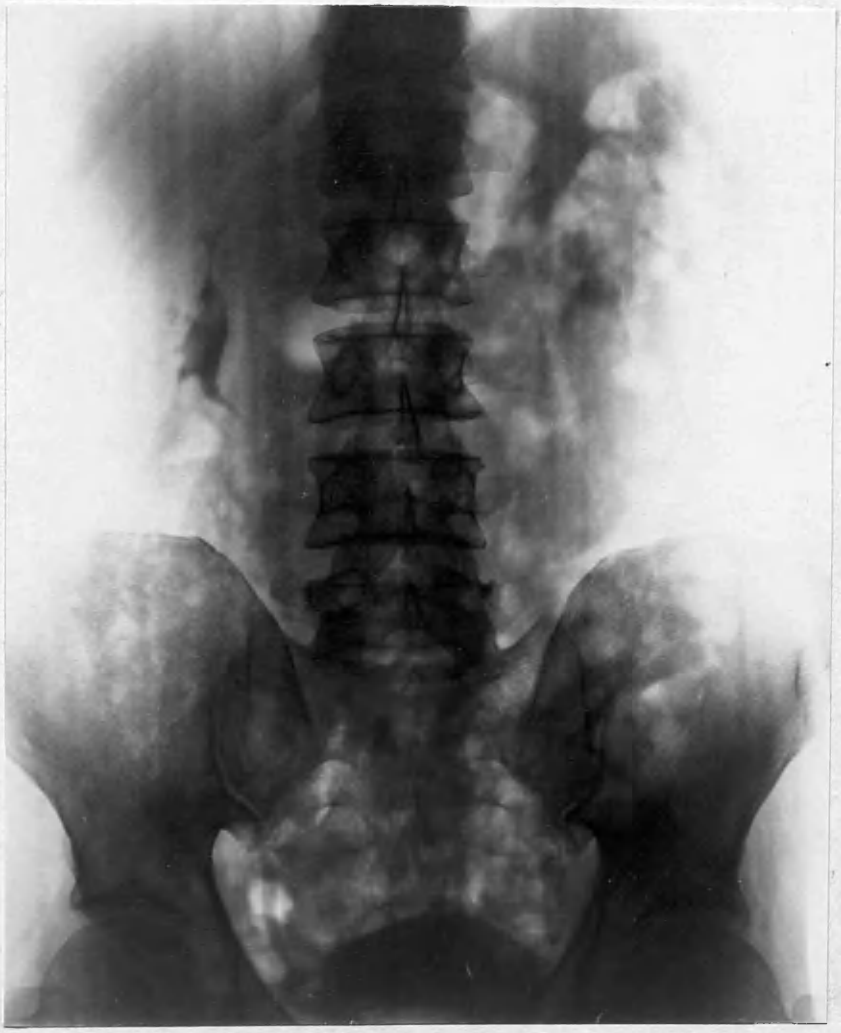


Fig. 11

Case 55. Operation 26.11.49. Male. Reimplantation right ureter (carcinoma bladder). 24.11.49 Pre-operative I.V.P. showed fairly good excretion on the right but the left is never well seen (30 minutes)

Fig. 12 ←

Same case as Fig. 11. 4.5.50. Post-operatively I.V.P. showed delayed excretion on the right, left excretion unaltered. 24.11.50 Cystogram. Complete right reflux on filling, dilatation of the pelvis but there is no definition of the calyces; the ureter is tortuous and grossly dilated; slight reflux into lower left ureter

Fig. 13 →

Same case as Fig. 11. On micturition increased dilatation on the right and reflux as far as pelvis has now occurred on the left.

Fig. 14 ←

Case 45. Operation 30.4.49. Male. Reimplantation of right ureter (carcinoma bladder) 7.12.49 I.V.P. Good excretion both kidneys. Normal left pyelogram. The right pelvis and ureter are dilated but the calyces appear within normal limits (25 minutes) 13.2.51 I.V.P. showed no appreciable change.

Fig. 15 →

Case 16. Operation 11.5.46. Male. Reimplantation of left ureter (neoplasm bladder). The pre-operative I.V.P. showed good function and normal outline both kidneys. On 14.12.49 I.V.P. showed no apparent function on the left. 1.3.51 Cystogram shows complete left reflux on filling, with further distension on micturition and the pyelogram of chronic pyelonephritis.

Late Symptoms of Reimplantation

Two cases complained of pain in the loin at various periods after operation and two of referred pain on micturition.

Case 10 Operation 29.11.44. Left reimplant. Complained of pain in left loin in 1946. I.V.P. 11.8.49 Poor excretion and cystography demonstrates a filling reflux - chronic pyelonephritis (Figs. 9 and 10) Persistent coliform infection.

Case 42 See note under dilated ureter.

Case 55 Operation 26.11.49. Right reimplant. There appeared to be a slight bladder neck obstruction (untreated) (Fig. 11). Since operation he always get pain to right of umbilicus as he passes urine, at no other time. Persistent infection with Morgan's bacillus. I.V.P. 29.8.50. Good excretion, slight dilatation of pelvis. Cystogram shows pelvic dilatation on filling (Fig. 12) with appreciable increase in size of pelvis and ureter on micturition (Fig. 13). Reflux is present to a lesser extent on the left side also.

Case 45 Operation 30.4.49. Right reimplant. Epididymitis. Urethral stricture present pre-operatively. I.V.P. 13.2.51 Good excretion both kidneys, left pyelogram normal, the right shows dilatation of the pelvis (Fig. 14). This patient complains of a sharp pain in the right renal angle at the start of micturition - as soon as urine commences to flow it disappears. This symptom has been present ever since operation. His urethral stricture (8/11) requires frequent dilatation.

It should be noted that there was evidence of lower urinary tract obstruction in the two cases in which referred pain occurred in association with micturition.

Chromocystoscopy

This has been carried out in 10 cases. Good excretion was seen in 7 cases; the efflux has been normal in appearance.

Blood Pressure

This has been recorded post-operatively in 8 cases and on only one occasion has there been the slightest suggestion of hypertension.

Case 10 Pre-operatively 160/90 - 26.11.44. 170/90 on 22.8.49 and I.V.P. shows poor function with an outline suggestive of chronic pyelonephritis (Figs. 9 and 10).

Case 13 B.P. 3 years after operation 140/80. I.V.P. shows moderate function with chronic pyelonephritis.

Case 16 Pre-operative B.P. 126/58 May 1946. In January 1951 140/75 (aged 70) I.V.P. shows no function and cystogram reflux shows chronic pyelonephritis (Fig. 15).

Case 18 Pre-operative B.P. 150/100. One year later 146/90. I.V.P. shows good renal function and the calyces are well cupped. (Figs. 2 and 3).

Case 35 Pre-operative B.P. 120/90. Three years later 145/85. I.V.P. 25.1.50 shows good function with normal outlines.

Case 43 Pre-operative B.P. 180/100. Two and a half years later 160/105. I.V.P. shows good function with slight dilatation of the pelvis.

Case 48 Pre-operative B.P. 120/70 in June 1949. 19.10.50 B.P. 130/70. I.V.P. shows good excretion and normal outline.

Case 58 Pre-operative B.P. 120/80. Fifteen months later 160/100. I.V.P. shows good function with widening of the calyceal necks.

Urinary Infection

The urine was infected in 15 cases before operation, sterile on culture in 19, and in 7 there is no record of an examination.

Infected Urine - 25 cases

After operation 7 cases have shown infection on one occasion, 5 on two and 13 on three or more.

The following cases not included above, are of interest.

Case 13 Operation 16.2.46. Uninfected urine pre-operatively. Examinations on 23.6.47, 27.10.47 and 16.2.48 showed pus ++. and and a heavy growth coliform organisms. Further examinations on 6.11.50 and 1.12.50 revealed no pus and no growth. Pyelography 8.11.50 shows the presence of chronic pyelonephritis with moderate function.

Case 29 Operation 13.11.47. Urine infected pre-operatively. Post-operative examinations: 17.3.48 - pus ++; fairly heavy growth coliform organisms. 28.4.48 pus ++ ; moderately heavy growth coliform organisms. 30.6.48 - pus +; moderately heavy growth coliform organisms. 4.12.50 No pus, no growth. I.V.P. 11.10.50 shows chronic pyelonephritis with poor function (Fig. 5).

Case 60 Operation 5.4.50. No pre-operative examination. Post-operative examinations: August and November 1950 pus ++ ; heavy growth coliform organisms. March 1951 pus ++; heavy growth coliform organisms. 23.4.51 No pus; no growth. I.V.P. 23.8.50. Slight dilatation is present with good function. Cystogram shows

Fig. 16 ←

Case 60. Operation 5.4.50.
Male. Reimplantation right ureter (carcinoma bladder). 23.8.50 I.V.P. showed good excretion on both sides but definition of the right pyelogram was never clear. 17.11.50. Cystogram. On filling, the dilated pelvis and upper ureter are well demonstrated.

Fig. 17 →

Same case as Fig. 16. On straining, there is further dilatation of the pelvis and calyceal necks; the ureter is seen to be dilated.

reflux on filling (Fig 16) with dilatation on straining (Fig. 17)

Sterile Urine - 10 cases

After operation 3 cases have had a sterile urine on one occasion, and 7 cases on two or more occasions (3 of these were infected before operation).

No post-operative urinary examination is available in 3 cases.

Fig. 18

Fig. 18

Case 31. Operation 2.3.48. Male. Reimplantation of left ureter (neoplasm bladder) 22.2.50 I.V.P. shows good excretion on both sides (10 minutes). The left kidney appears to be of normal size.

Fig. 19

Same case as Fig. 18. 11.1.51 Cystogram shows complete reflux with flaccid bladder on filling

Fig. 20

Same case as Fig. 18. Cystogram on straining. The bladder is tonic and further reflux has occurred - dilatation of the pelvis is well shown, but the calyces are well cupped; the ureter is dilated and tortuous.

Fig. 21

Same case as Fig. 18. Cystogram after micturition shows some residual urine and the pyelogram is still visible, but the dilatation is less.

Fig. 19

Fig. 20

Fig. 21

Fig. 22

Case 52. Operation 12.9.49. Male. Reimplantation of right ureter (carcinoma bladder) 18.10.50. I.V.P. Good excretion both sides. Slight dilatation of both lower ureters (45 minutes). Cystography on 20.11.50 showed no reflux on filling but on straining there was reflux into both lower ureters, greater on <u>left</u> than on right.

Incidence of Stricture as indicated by Cystography

In the second part of this paper it is shown that alteration of the normal anatomical uretero-vesical junction may result in reflux. In its complete absence, as in direct reimplantation of the ureter, reflux should be demonstrated by the cystography technique described earlier in all cases in the absence of stricture; the reflux on filling being increased on straining associated with tonic contraction of the bladder, or during micturition. The pyelogram demonstrated by reflux is frequently very different from that indicated by intravenous urography (Figs. 18 - 21)

Cystograms have been carried out in 31 cases - Appendix I. A primary reflux occurred on filling in 22, on straining in 1, and in association with micturition in 5 (in one of these no cystogram was made on straining). In the remaining 3 cases no reflux occurred.

Absence of reflux on filling is regarded as indicative of some degree of stricturing, moderate when reflux occurs on straining in the presence of a tonic bladder.

Case 52 Operation 12.9.49. Partial cystectomy, right reimplant and suprapubic loop resection of the prostate. 18.10.50 I.V.P. Good excretion both kidneys, no evidence of hydronephrosis but slight dilatation of both ureters (Fig. 22). 20.11.50. No reflux on filling; on straining bilateral reflux but left is greater than right. Urine uninfected.

This case supports the above contention as reflux is present

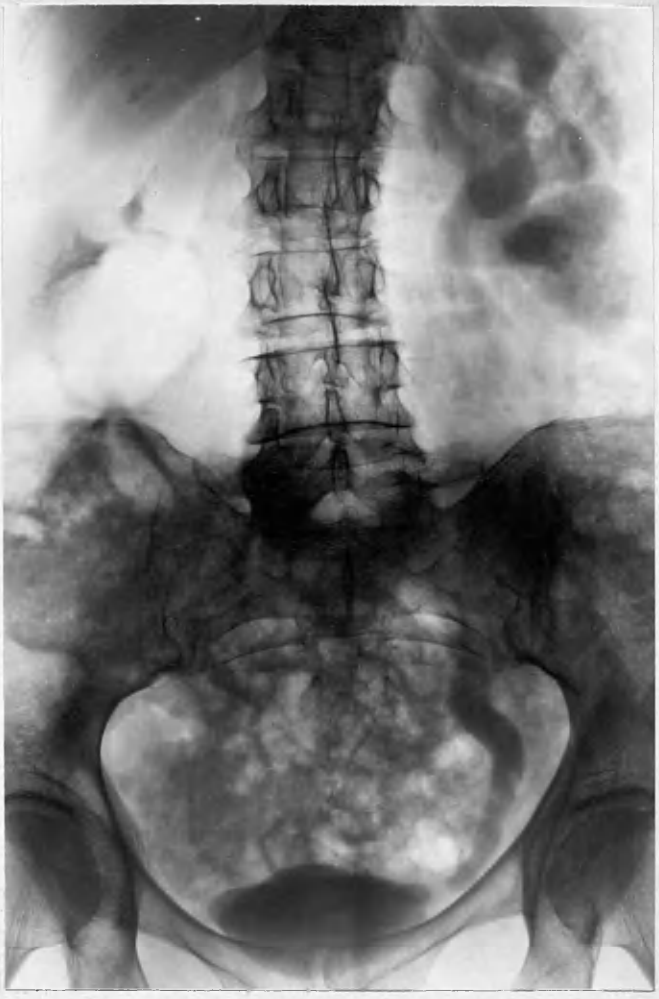


Fig. 23 ←

Case 4. Operation 2.12.41. Female. Reimplantation left ureter (neoplasm bladder) 8.12.50 I.V.P. Good excretion and normal outlines right kidney. Delayed excretion from the left kidney which is hydronephrotic with hydroureter (75 minutes)

Fig. 24 →

Same case as Fig. 23. 8.12.50 Cystogram. No reflux on filling or straining but after micturition reflux has occurred into the lower right ureter and also into the lower left which appears to be strictured distally. Residual bladder contents visible.

← Fig. 25

Case 28. Operation 29.10.47 Male. Reimplantation of left ureter (carcinoma bladder) 18.5.50 I.V.P. shows good renal function with no evidence of dilatation.

Fig. 26 →

Same case as Fig. 25. 4.12.50. Filling cystogram showed a <u>right</u> reflux without dilatation but on micturition there is a bilateral reflux with dilatation of both calyceal systems.

where no surgical disturbance of the uretero-vesical junction has occurred, to a greater extent, than on the side on which reimplantation has been performed.

Absence of reflux until micturition occurred in the following cases and indicates a more severe degree of stricturing.

Case 4 Operation 2.12.41. Left reimplant. 8.12.50 I.V.P. Good excretion and a normal outline on right. Poor excretion with hydronephrosis on the left (Fig. 23). Cystogram - no reflux on filling or straining, but after micturition partial bilateral reflux is present, more obvious on the right (Fig. 24). Persistent heavy coliform infection.

Case 28 Operation 29.10.47. Left reimplant following partial cystectomy together with excision of small subtrigonal middle lobe. 18.5.50 I.V.P. Good excretion both sides, outlines appear to be within normal limits (Fig. 25). 4.12.50. Cystogram. On filling right reflux, without dilatation, on micturition bilateral reflux with apparent dilatation of both systems (Fig. 26). Persistent heavy coliform infection (no straining film in this case).

The remarks following case 52 apply to these two cases also, and the hydronephrosis in case 4 is contributory evidence.

Case 43 Operation 5.1.49. Reimplant left ureter. 2.8.50. I.V.P. Slight delay in left excretion but no definite

Fig. 27

Case 43. Operation 5.1.49 Male
Reimplantation of left ureter (carcinoma bladder) 21.7.49. I.V.P. showed slight delay in left excretion with a normal outline, and on the right a bulky pelvis. 2.8.50 I.V.P. shows early right hydronephrosis, the left pyelogram appears normal (15 minutes). Cystography showed no reflux on filling or straining but it was present on micturition on the left.

Fig. 28 ←

Case 67. Operation 30.12.50 Male. Reimplantation right ureter (carcinoma bladder) 5.4.51 I.V.P. Good excretion and normal outlines both kidneys (15 minutes)

Fig. 29 →

Same case as Fig. 28. 5.4.51 Cystogram. On filling, no reflux, but on micturition complete pyelogram with normal outline on reimplanted side.

← Fig. 30

Case 8. Operation 3.11.43 Female. Reimplantation right ureter (neoplasm bladder) 2.11.48 I.V.P. (35 minute film) good excretion both kidneys. The right is small and indicates chronic pyelonephritis.

Fig. 31 →

Same case as Fig. 30. 2.11.50 I.V.P. (15 minutes) good excretion both kidneys, but the calyces of the right are more dilated.

dilatation. The right pelvis is dilated (Fig. 27). 26.4.51 Cystogram. No reflux on filling or straining, but after micturition, the left pelvis is seen to be bulky and the calyceal outline is not distinct. Coliform infection.

Case 65 Operation 16.12.50. Reimplant left ureter. I.V.P. 20.4.51. Good excretion and normal outlines both kidneys. Cystogram - no reflux on filling or straining but is complete on the left on micturition. Coliform infection.

Case 67 Operation 30.12.50. Reimplant right ureter. I.V.P. 5.4.51. Good excretion and normal outlines both kidneys (Fig. 28). Cystogram - no reflux on filling; occurred on micturition but no straining film was exposed (Fig. 29). Coliform infection.

The absence of abnormality in the pyelograms in cases 65 and 67 may be attributable to the short interval between operation and examination.

Where no reflux occurred on micturition a gross degree of stricturing must be present.

Case 8 Operation 3.11.43. Right reimplant. I.V.P. 22.11.50. Good excretion both kidneys but the right shows the changes of chronic pyelonephritis (Figs. 30 and 31). Cystogram - 3 films - no reflux. Urine - no pus, but persistent coliform infection.

Case 22 Operation 21.1.47. Right reimplant under some tension. I.V.P. 12.10.49. Good excretion left, slight delay

Fig. 32

Case 41. Operation 20.12.48. Male. Reimplantation of left ureter (carcinoma bladder) 14.9.50 I.V.P. shows good function both kidneys (10 minutes)

Fig. 33

Same case as Fig. 32. 4.1.51 Cystogram showed no reflux on filling or micturition, but there is a small diverticular projection on the latter film which probably marks the site of the implant.

Fig. 34

Case 35. Operation 24.7.48 Male. Reimplantation of right ureter (carcinoma bladder) Pre-operative I.V.P. shows good function and normal outline both sides (20 minutes)

Fig. 35

Same case as Fig. 34. 25.1.50 I.V.P. showed good excretion both kidneys, and a cystogram, 17.11.50 demonstrated slight right reflux on filling. A complete reflux on micturition with a pyelogram showing no appreciable change from the pre-operative film is seen.

right. The left pyelogram is normal but the right shows marked hydronephrosis. 27.4.51. - unchanged (Fig. 4). Cystogram - 3 films - no reflux. Urine uninfected (3 examinations).

Case 41 Operation 20.12.48. Left reimplant after partial cystectomy also excision of subtrigonal adenoma and division of median bar. A pre-operative I.V.P. showed good excretion and normal outlines apart from slight dilatation of the lower left ureter. 14.9.50. Good excretion and normal outlines. No hold-up in left ureter (Fig. 32). 4.1.51. Cystogram - no reflux on filling or micturition but in the latter film there is a small projection on the left side of the bladder which may be due to reflux into the extreme lower end of the ureter or indicate the presence of a small traction diverticulum at the site of reimplant (Fig. 33). Urine uninfected.

In 4 cases the reflux on filling has been merely a trickle or has only outlined the pelvic portion of the ureter, but on micturition a complete reflux has occurred. This is indicative of slight stricturing.

Case 35 Operation 24.7.48. Right reimplant (Fig. 34) I.V.P. 25.1.50. Good excretion and normal outlines. 17.11.50. Cystogram - on filling trickle into right ureter; on micturition complete reflux (Fig. 35). Urine examined on 4 occasions - moderate growth of coliforms on one occasion, otherwise uninfected.

Fig. 36

Case 44. Operation 27.4.49. Male. Reimplantation of right ureter (carcinoma bladder). 1.2.51 I.V.P. Left kidney excreted well and was within normal limits. Excretion from the right kidney was delayed, the calyces were clubbed, and the lower ureter dilated. 1.2.51 On cystography, slight right reflux with flaccid bladder on filling; on micturition there is a complete reflux, the ureter is dilated and tortuous and the calyceal system shows dilatation suggestive of inflammatory change and chronic pyelonephritis.

Case 42 Operation 1.1.49. Reimplant dilated left ureter through a stab. 29.11.49 I.V.P. Good excretion right, very large kidney. Left - moderate function, chronic pyelonephritis (Fig. 6). 1.12.50. Cystogram - on filling trickle in left ureter; complete reflux on micturition (Fig. 7). Heavy coliform infection.

Case 44 Operation 27.4.49. Reimplant right ureter. I.V.P. 1.2.51. Good excretion left with normal outline. Moderate function on right with chronic pyelonephritis. Cystogram - on filling, reflux into lower right ureter. On micturition complete reflux (Fig. 36). Uninfected.

Case 49 Operation 25.7.49. Reimplant right ureter. I.V.P. 18.3.50. Good excretion and normal outlines. 27.11.50 Cystogram. On filling, slight reflux on right. On micturition complete reflux and the lower ureter is noticeably dilated. Uninfected.

The following cases are also considered to show evidence of stricturing.

Case 13 Operation 16.2.46. Reimplant right ureter. Moderate function both kidneys; left pyelogram within normal limits; right shows chronic pyelonephritis. Cystogram 1.12.50. On filling reflux occurs on the right but the pelvis only shows faintly, on micturition only a slight increase on filling occurs. The urine was heavily infected with coliform organisms for a long period but more recently is sterile on culture.

Fig. 37

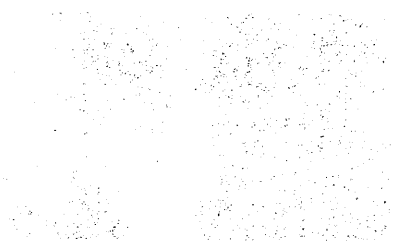
Case 50. Operation 27.7.49. Male.
Reimplantation right ureter (carcinoma bladder)
2.3.50 I.V.P. showed good excretion on right
but no pyelogram on the left till 40 minutes.
The right pyelogram shows chronic pyelonephritis;
detail on left was never distinct (25 minutes)

Fig. 38

Same case as Fig. 37. 17.11.50 Cystogram shows bilateral reflux on filling greater on the left, but on micturition it was equal on the two sides. The pyelograms show chronic pyelonephritis.

Case 50 Operation 27.7.49. Right reimplant. I.V.P. 2.3.50. Poor excretion on the left. Good excretion on the right but the pyelogram indicates chronic pyelonephritis (Fig. 37). 17.11.50. Cystogram. Bilateral reflux on filling, greater on the left (Fig. 38), but on micturition it is equal on the two sides. Persistent pyocyaneas infection.

These examinations indicate some degree of stricturing being present in 15 of the 31 cases investigated. In 8 of these a urinary infection was present. This compares with an infection incidence in the cases without evident stricture of 16 out of 20, this of course, includes the cases of more recent reimplantation.



← Fig. 39

Case 53. Operation 29.10.49. Male. Reimplantation of left ureter (bladder neoplasm) 1.7.49 Pre-operative I.V.P. shows good excretion and normal outlines (10 minutes)

Fig. 40 →

Same case as Fig. 39. 29.8.50 I.V.P. No appreciable change since operation. The lower left ureter is dilated (10 minutes)

Fig. 41

Case 61. Operation 24.4.50. Female.
Reimplantation right ureter (carcinoma bladder)
23.8.50 I.V.P. Good excretion and normal
outlines both kidneys (45 minutes)

Function and Outline

In 3 cases intravenous urography has not been possible; in the remaining 38, function has been described as good in 26, moderate in 5, poor in 5, and absent in 2.

Appendix II suggests that function decreases with time and it might be argued that function is particularly good in the 1950 series and is related to the post-operative management which included the administration of sulphamezathine, penicillin and streptomycin in an effort to combat infection, however, as all these cases, nine, are still infected compared with an incidence of infection at present of eight out of a total of thirteen in the 1949 series, this is probably not the answer.

Function is not necessarily related to outline and it will be seen that some of the cases have good function on intravenous urography in spite of the presence of an indisputable chronic pyelonephritis. The outline on intravenous pyelography may be deceptive and in many cases is only demonstrated accurately by cystographic reflux. (Figs. 18 - 21). In 16 cases, the pyelograms are within normal limits (Figs 39 - 41), in 10 (cases 8, 10, 13, 16, 25, 29, 42, 44, 46, 50) the changes of chronic pyelonephritis are present and in 2 (cases 4 and 22) hydronephrotic changes are visible. In 1 (case 57) the outline is not known as the kidney is functionless and cystography has not been possible. In the remaining 9 cases, in which an interval of less than 3 years has elapsed since operation, changes indicative of chronic infection

Fig. 42

Case 62. Operation 21.6.50 Male. Reimplantation left ureter (carcinoma bladder). 7.9.50 I.V.P. Good excretion both kidneys. The left pelvis is dilated but the calyces are well defined.

Fig. 43

Case 58. Operation 1.3.50. Male. Reimplantation left ureter (carcinoma bladder) 27.2.50. Pre-operative I.V.P. showed good excretion and normal outlines, both kidneys, slight hold-up lower left ureter above a filling defect. 8.6.50. I.V.P. after operation shows good excretion and normal outline of the right calyceal system, but the necks of those on the left are widened. Due to bladder distortion the lower right ureter is seen crossing to the left side of the bladder (10 minutes)

Fig. 44

Same case as Fig. 43. 20.11.50. Cystogram. On filling the pelvis is well shown and although the minor calyces are well cupped their necks are dilated and suggest early changes of chronic pyelonephritis.

are present, in 6 (cases 31, 43, 45, 55, 60, 62 (Fig. 42)) these involve the pelvis chiefly and in 3 (cases 58 (Figs. 43 and 44), 59, 64) the calyces.

A.	Cases with normal outlines:	16	Stricture in 7 3 infected Infected - 10 Uninfected - 6
B.	Chronic pyelonephritis:	10	Stricture in 5 3 infected Infected - 6 Uninfected - 3 (1 no record)
C.	Hydronephrosis:	2	Stricture in 2 1 infected
D.	Functionless kidney:	1	Infected
E.	Calyceal changes (infection)	3	Stricture - nil 3 infected
F.	Pelvic changes (infection)	6	Stricture in 1 (infected) Infected 4 Uninfected - 2

It is very noticeable from Appendix II that the chronic pyelonephritis cases are those followed up for the longest periods. The hydronephrotic cases were operated on 9 years and 4 years 1 month ago respectively. The cases with normal outlines are the more recent

as are those with inflammatory changes confined to the pelvis or calyces. It is considered that the latter changes are the precursors of the typical pyelogram of chronic pyelonephritis. The interpretation of these transitional stages is difficult and it might be argued that some pyelograms described as normal are also showing early evidence of the chronic infective condition.

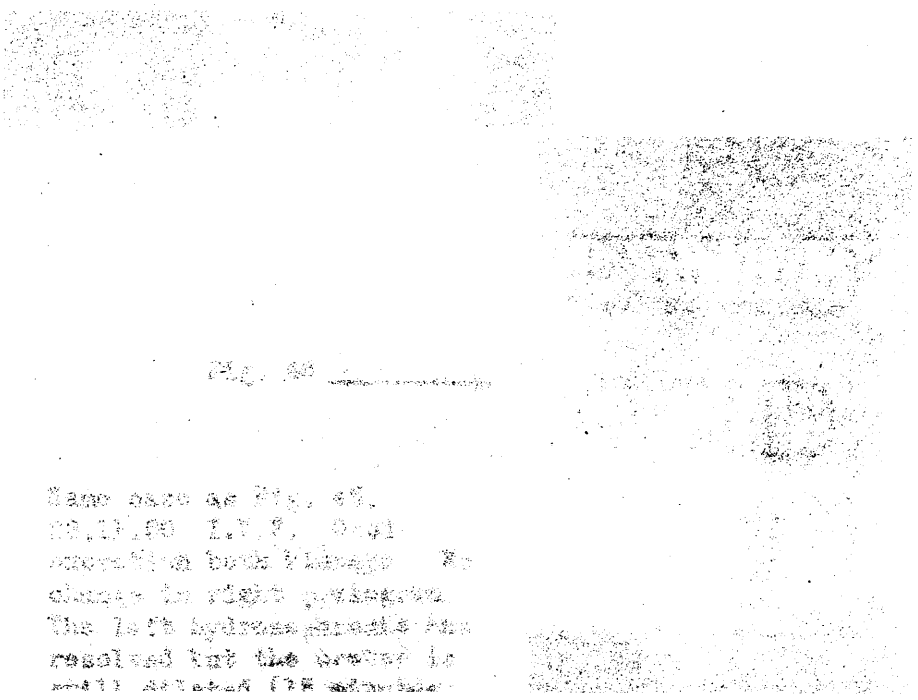


Fig. 45

Case 70. Operation 20.5.50. Female. Reimplantation left ureter (uretero-vaginal fistula following hysterectomy). 19.5.50. Pre-operative I.V.P. Good excretion and normal outline on the right and on the left excretion is good but there is definite hydronephrosis with clubbing of the calyces (50 minutes)

Fig. 46

Same case as Fig. 45. 28.11.50 I.V.P. Good excretion both kidneys. No change in right pyelogram. The left hydronephrosis has resolved but the ureter is still dilated (15 minutes)

REIMPLANTATION for URETERO-VAGINAL FISTULAE - 4 cases

Case 68 The result is not known as it has been impossible to trace the patient.

Case 69 Operation 31.12.49. Reimplantation of right ureter. Hysterectomy four months previously. No pre-operative I.V.P. was carried out, but at operation, the ureter was dilated.

13.11.50. Symptomless. General health good. I.V.Ps. were largely obscured by gas but the outlines appeared to be within normal limits. Urine: no pus; scanty growth of coliform organisms. No cystogram.

Case 70 Operation 20.5.50. Reimplantation of left ureter. Hysterectomy one month previously. A pre-operative I.V.P. showed good excretion from both kidneys but the left showed hydronephrosis with clubbing of the calyces (Fig. 45)

28.11.50. Symptomless. General health good. Good excretion both kidneys on intravenous pyelography. Marked improvement in the hydronephrosis (Fig. 46). Cystography showed no reflux on filling, but it occurred on straining. Urine: pus cells; heavy growth coliform organisms.

Case 71 Operation 6.1.51. Reimplantation right ureter. Hysterectomy September 1950. On 1.10.50 an I.V.P. demonstrated good function on the left with normal outline, on the right there was some delay and early dilatation of the calyces, pelvis and ureter. (Fig. 47). Note that operation took place two months later.

12.4.51. Symptomless. General health good. I.V.P. good

← Fig. 47

Case 71. Operation 6.1.51 Female. Reimplantation right ureter (uretero-vaginal fistula following hysterectomy) 1.10.50 I.V.P. Good excretion and normal outline on the left. On the right, there is some delay and early dilatation of the calyces, pelvis and ureter. The first good picture on this side is at 60 minutes.

Fig. 48 →

Same case as Fig. 47. 12.4.51 I.V.P. Good excretion both sides. Normal outline on left. A good pyelogram is visible on the right at 10 minutes, but there is no change in its outline (25 minutes)

excretion both sides, normal outline on the left. There is no change in the right pyelographic outline compared with the October film but the function is much improved (Fig. 48) Cystography showed a filling reflux into the lower right ureter, unchanged on straining. After micturition no evidence of reflux is visible but this is probably due to delay in exposure. Urine: no pus; scanty non-significant growth.

COMMENT

1. The average period of hospitalisation for the four cases was 20.25 days.

2. Good function was present on intravenous pyelography in the three cases reviewed.

3. Two of the three cases were infected when reviewed and in neither had an infection been present in the bladder pre-operatively.

4. Reflux occurred in both cases in which it was investigated by cystography, once on filling and once on straining.

5. In one case there has been improvement in a hydronephrosis in spite of the presence of reflux. In another there was delay between operation and the previous pyelogram; thus accurate assessment is impossible.

Fig. 49

Case 72. Operation 30.7.49. Female. Reimplantation ectopic right ureter. The pre-operative I.V.P. did not show excretion from the upper renal segment. 8.12.50. Cystogram. There was no reflux on filling or straining but it appeared after micturition and confused the interpretation of the subsequent I.V.P. as far as excretion of the upper pelvis was concerned - probably it is not appreciable.

REIMPLANTATION for ECTOPIC URETER

Case 72 Operation 30.7.49. Reimplantation of ureter draining upper right pelvis. Pre-operative I.V.P. showed no function from the kidney segment of the ectopic ureter.

8.12.50. Has had three or four attacks of discomfort in the right loin lasting two or three days. No associated constitutional upset. Cystography. Reflux did not occur on filling or straining but appeared after micturition showing a bulbous pelvis with incomplete ureteric filling (Fig. 49). This did not drain satisfactorily and obscured the subsequent I.V.P. but the impression was given that function was poor. At 1½ hours medium is still present. The absence of reflux till micturition indicates stricture formation. Urine: no pus; no growth.

COMMENT

1. The period of hospitalisation was 21 days.

2. The result is not satisfactory (renal discomfort) and confirms the inadvisability of reimplantation in these cases, but the urine is not infected.

3. The delayed reflux is related to stricture formation.

REIMPLANTATION by a BLADDER FLAP (Boari's Operation)

Case 73 This case has already been reported (HENDERSON 1951) Operation 30.6.48. Reimplantation of left ureter by bladder flap. I.V.P. 25.8.48 showed early hydronephrosis and hydroureter with opacities in lower left ureter. I.V.P. 7.12.48 (Fig. 41 - Volume II). Increase of hydronephrosis and hydroureter. Uretero-lithotomy was carried out and a post-operative I.V.P. on 10.1.49 showed marked improvement of the hydronephrosis (Fig. 42 - Volume II) which was maintained in September 1950. 23.2.51 B.P. 170/94. Cystogram - complete left reflux on filling. Urine uninfected.

COMMENT

This case is of interest as showing improvement following uretero-lithotomy in a hydronephrosis due to ureteric obstruction, in the presence of vesico-ureteral reflux. The pre-operative B.P. was 150/90. In November 1948 it is recorded as 124/70; in December 1948 as 150/80 (these two readings were recorded in hospital); and in September 1950 as an outpatient it was 170/94.

CONCLUSIONS

1. MORTALITY

In this series of 73 cases, it was 4.1%, but in the 64 cases dealt with by Mr. H. Donovan it was nil.

2. SURVIVAL

Only in one case of the 26 which have died since operation was death attributed to urinary infection and as no post-mortem was performed no information is available regarding recurrence of the growth.

3. AGE

This factor alone is no contraindication to the operation and 31 cases were in their sixth or seventh decade.

4. HOSPITALISATION

The average period of hospitalisation was between 20 and 30 days (less in cases not associated with partial cystectomy)

5. OPERATIVE TECHNIQUE

(a) Direct reimplantation is a satisfactory technical procedure and splinting by ureteric catheter is unnecessary.

(b) In the only case in which an effort was made to gain obliquity of insertion by bringing the ureter indirectly beneath the vesical mucosa, the kidney subsequently failed to excrete indigo carmine.

(c) In only one case does the operation note state that the reimplanted ureter was under tension and this kidney has subsequently been shown to be hydronephrotic.

6. DILATATION OF THE URETER AT OPERATION

This was noted in 11 cases - six of these are dead and in two cases in which a post-operative examination was carried out infection was present. In the five surviving cases urinary infection was present before operation in three and since operation in all, but in one it has become sterile after three years. The function is good in two, one showing chronic pyelonephritis but the other, a recent case, has a normal outline. It is moderate in two, one showing chronic pyelonephritis and the other, a recent case, clubbing of the calyces. In the fifth case function is poor and there is evidence of chronic pyelonephritis. Dilatation is not a contra-indication to operation.

7. ECTOPIC URETER

The ureter has been transplanted in one case of ectopic insertion and the result is unsuccessful. This supports FURNISS' (1918) contention that the operation is not worth while in this group. Heminephrectomy would have been a better procedure.

8. COMPLICATIONS OF OPERATION

These have not been common and in only 5 cases have local renal signs been recorded during hospitalisation.

9. LATE SYMPTOMS DIRECTLY RELATED TO REIMPLANTATION

These have only been encountered in five cases. In three

cases pain in the loin unrelated to micturition has been noted; in the remaining two, relation to micturition is present and reflux, in association with lower urinary tract obstruction, appears to be the etiological factor. In one, the pain is present immediately prior to actual micturition and as soon as the flow commences it passes off; this case has a complicating urethral stricture. In the second case the pain only occurs whilst the patient is passing urine; he was noted at operation to have a slight bladder neck obstruction which was not treated.

No case of regurgitation renal colic has been observed.

10. CHROMO-CYSTOSCOPY

The efflux has been normal in all cases in which it has been investigated.

11. BLOOD PRESSURE

Observations have been limited to 9 cases and in six no abnormality has been noted. In the seventh, a dead patient, the pre-operative reading was 124/70 whilst after operation it is recorded as 190/120 but as there is a history of nephritis 13 years before operation - the pre-operative reading may be false. In the remaining two there has been a slight rise but as the post-operative readings are isolated, they are inconclusive.

12. URINARY INFECTION

In the group of dead patients only five examinations are recorded and all these showed the presence of infection. In the remainder the urine was uninfected in 16 - in three of these, a

considerable period elapsed before the urine became sterile. In 27 cases the urine was infected and in 4 cases no examination has been carried out.

13. REFLUX

One of the most interesting results of this enquiry has been the finding of reflux as an almost constant sequel of direct reimplantation of the ureter. It is apparent from the literature that this may also be a sequel of operations attempting to obtain an oblique insertion. Its demonstration requires a special cystographic technique.

14. STRICTURE

A method of demonstrating its presence and assessing its degree by cystography is presented. Examinations in 35 cases have noted its presence in 17; of a slight degree in 7; moderate in 7; and severe in 3.

15. FUNCTION AND OUTLINE

Intravenous pyelography has been carried out in 43 cases and the function has been good in 30, moderate in 5, poor in 6 (probably absent in 1) and absent in 2. This compares very favourably with the Mayo Clinic series (PETERSON 1918) where 5 kidneys were functionless (30%). In outlining the calyceal system and pelvis, cystography in the presence of reflux is a valuable adjunct to intravenous pyelography. In 18 cases the pyelograms are within normal limits, in 10 the changes of chronic pyelonephritis are present, in 3 definite hydronephrosis (present pre-operatively in one) and in 2 slight

hydronephrosis (present before operation in both). In 9 cases, in which the interval since operation is less than three years, changes indicative of chronic infection are present, calyceal in two and pelvic in seven. In one case the outline is not known as the kidney is functionless and cystography has not been carried out. The ureter is shown to be dilated on cystography in all cases whether stricture is present or absent.

These figures illustrate that the commonest late effect on the kidney of reimplantation is not hydronephrosis as the literature suggests. It is chronic pyelonephritis, and this has hitherto not been appreciated and it appears likely that the earlier inflammatory changes seen on pyelography have been incorrectly interpreted as hydronephrotic. This opinion is supported by review of the illustrations in BEER'S and also HYMAN and LEITER'S articles - many of these radiographs have not reproduced well, but in some which have, the changes of chronic pyelonephritis are visible.

In animals the operative technique is likely to be associated with less post-operative infection and the survival periods in infected cases have been insufficiently long for the condition to become manifest.

Hydronephrosis present before operation, if not of long duration, may improve following reimplantation of the ureter if this operation is associated with relief of the previous obstruction, e.g. uretero-vaginal fistula.

In 1900 BOVEE said "It is impossible to make an anastomosis between ureter and bladder as good as the natural one, because the small muscles attached to the ends of the ureters and lost in the wall of the bladder near the internal meatus cannot be utilized."

This is still true and perhaps explains the occurrence of ascending infection in spite of valvular formation in both reimplantation of the ureter and transplantation, and as is indicated in the second part of this paper trigonal dysfunction gives rise to one type of vesico-ureteral reflux.

APPENDIX I

INCIDENCE OF REFLUX

No.	Sex	URINE Inf.	URINE Ster.	FILLING reflux	BLADDER Flaccid	BLADDER Tonic	STRAINING reflux	BLADDER Flaccid	BLADDER Tonic	MICTURITION reflux	STRICTURE
4	F	+		Nil	Yes	-	Nil	Yes	-	After - bilateral - slight	Yes
8	F	+		Nil	Yes	-	Nil	Indef.		After - nil	Yes
10	F	+		Yes	Probably	-	Greater	-	Yes	After - less	No
13	M	→	→	Yes poor	Yes	-	-	-	-	During: slight increase	Slight
16	M	+		Yes	-	Yes	-	-	-	During - complete	No
18	F	+		Yes	Indefinite		Greater		Yes	After - less plus slight opposite side	No
22	F		+	Nil	Yes	-	Nil	Yes	-	Nil	Yes
25	M		+	Yes	Yes	-	Greater	-	Yes	After I.S.Q.	?

APPENDIX I (continued)

No.	Sex	URINE Inf.	URINE Ster.	FILLING reflux	BLADDER Flaccid	BLADDER Tonic	STRAINING reflux	BLADDER Flaccid	BLADDER Tonic	MICTURITION reflux	STRICTURE
28	M	+		Yes opp.	Yes	-	-	-	-	During - complete bilateral	Yes
29	F	→		Yes	Yes	-	I.S.Q.	Yes	-	-	No
31	M		+	Yes	Yes	-	Greater	-	Yes	After - less	No
35	M		+	Yes slight	Yes	-	-	-	-	During - complete	Slight
41	M		+	Nil	-	Yes	-	-	-	During - nil	Yes
42	M	+		Yes slight	Yes	-	-	-	-	During - complete	Slight
43	M	+		Nil	Yes	-	Nil	-	Yes	After - complete	Yes
44	M		+	Yes slight	Yes	-	-	-	-	During - complete	Slight

APPENDIX I (continued)

No.	Sex	URINE Inf.	URINE Ster.	FILLING reflux	BLADDER Flaccid	BLADDER Tonic	STRAINING reflux	BLADDER Flaccid	BLADDER Tonic	MICTURITION reflux	STRICTURE
45	M	+		Yes	Yes	-	-	-	-	During - greater	No
46	M	+		Yes	Indef.		Greater	Indef.		-	No
48	F	+		Yes	Yes	-	-	-	-	-	No
49	M		+	Yes slight	Yes	-	-	-	-	During - complete	Slight
50	M	+		Yes bilateral	-	Yes	-	-	-	During - greater implant	Slight
52	M		+	Nil	Yes	-	Yes slight bilateral	-	Yes	-	Yes
53	M		+	Yes	Yes	-		-	-	During - less	No
55	M	+		Yes bilateral	Yes	-	-	-	-	During - greater	No

APPENDIX I (continued)

No.	Sex	URINE Inf.	URINE Ster.	FILLING reflux	BLADDER Flaccid	BLADDER Tonic	STRAINING reflux	BLADDER Flaccid	BLADDER Tonic	MICTURITION reflux	STRICTURE
58	M	+		Yes	Yes	-	-	-	-	During - greater	No
59	M	+		Yes bilat-eral	Yes	-	-	-	-	-	No
60	M	——→		Yes	Indef.		Greater	-	Yes	-	No
64	M	+		Yes	-	Prob-ably	Greater	-	Yes	After - greater	No
65	M	+		Nil	Yes	-	Nil	Indef.		After - com-plete	Yes
66	M	+		Yes	-	Yes	I.S.Q	-	Yes	After - greater	No
67	M	+		Nil	Yes	-	-	-	-	During - com-plete	Yes

APPENDIX II

FUNCTION AND OUTLINE OF THE KIDNEY AS INDICATED BY I.V.P. (latter aided by cystogram reflux)

NO.	OPERATION date	I.V.P. date	FUNCTION AND OUTLINE	STRICTURE Yes or No	URINE Infected/ Sterile
4	2.12.41	8.12.50	Poor - hydronephrosis	Yes	Infected
8	3.11.43	22.11.50	Good - chronic pyelonephritis	Yes	Infected
10	29.11.44	11.8.48	Poor - chronic pyelonephritis	No	Infected
13	16.2.46	8.11.50	Moderate - chronic pyelonephritis	Yes	Infected
16	11.5.46	14.12.49	Functionless - chronic pyelonephritis	No	Infected
18	12.8.46	14.2.51	Good - calyces well cupped	No	Infected
22	21.4.47	27.4.51	Moderate - hydronephrosis	Yes	Sterile
24	28.5.47	1.3.49	Good - poor definition (report)	?	Infected
25	13.8.47	30.4.51	Good - chronic pyelonephritis	No	Infected
28	29.10.47	18.5.50	Good - normal outline	Yes	Infected

APPENDIX II (continued)

NO.	OPERATION date	I.V.P. date	FUNCTION AND OUTLINE	STRICTURE Yes or No	URINE Infected/ Sterile
29	13.11.47	11.10.50	Poor - chronic pyelonephritis	No	Infected initially
30	16.2.48	17.5.49	Good - normal outline	?	Infected
31	2.3.48	22.2.50	Good - slight dilatation of pelvis (cystogram)	No	Sterile
35	24.7.48	25.1.50	Good - normal outline	Yes	Sterile
38	27.10.48	15.11.49	Moderate - probably normal outline	?	Infected
41	20.12.48	14.9.50	Good - normal outline	Yes	Sterile
42	1.1.49	30.11.49	Moderate - chronic pyelonephritis	Yes	Infected
43	5.1.49	2.8.50	Good - slight dilatation pelvis (cystogram)	Yes	Infected
44	27.4.49	1.2.51	Moderate - chronic pyelonephritis (cystogram)	Yes	Sterile
45	30.4.49	13.2.51	Good - slight dilatation pelvis	No	Infected
46	20.6.49	11.9.50	Good - chronic pyelonephritis	No	Infected

APPENDIX II (continued)

NO.	OPERATION date	I.V.P. date	FUNCTION AND OUTLINE	STRICTURE Yes or No	URINE Infected/ Sterile
48	23.7.49	6.7.50	Good - normal outline	No	Infected
49	25.7.49	18.3.50	Good - normal outline	Yes	Sterile
50	27.7.49	2.3.50	Good - chronic pyelonephritis	Yes	Infected
52	12.9.49	18.10.50	Good - normal outline with dilatation of ureter	Yes	Sterile
53	29.10.49	29.8.50	Good - normal outline	No	Sterile
54	16.11.49	24.1.51	Good - normal outline, dilated ureter	?	Sterile
55	26.11.49	4.5.50	Poor - dilatation of pelvis	No	Infected
57	21.12.49	14.7.50	Functionless - no cystogram	?	Infected
58	1.3.50	8.6.50	Good - widening of calyceal necks	No	Infected
59	3.4.50	2.11.50	Good - slight clubbing calyces	No	Infected
60	5.4.50	23.8.50	Good - slight dilatation of pelvis	No	Infected
61	24.4.50	23.8.50	Good - normal outline	?	Infected

APPENDIX II (continued)

NO.	OPERATION date	I.V.P. date	FUNCTION AND OUTLINE	STRICTURE Yes or No	URINE Infected/ Sterile
62	21.6.50	7.9.50	Good - dilatation of pelvis but not calyces	?	Infected
64	8.11.50	7.2.51	Poor - clubbing of calyces (cystogram)	No	Infected
65	16.12.50	20.4.51	Good - normal outline	Yes	Infected
66	20.12.50	25.4.51	Good - normal outline	No	Infected
67	30.12.50	5.4.51	Good - normal outline	Yes	Infected

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VOLUME II

Ureteral Reflux: with special reference to Vesico-Ureteral Reflux and with a note on Colo-Ureteral Reflux

by

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C O N T E N T S

Volume II VESICO-URETERAL REFLUX

Etiology (continued)

COLO-URETERAL REFLUX

VESICO-URETERAL REFLUX

DEFINITION

Some authors (GRAVES 1925B, O'CONOR 1925, LEWIS 1932) attempt to differentiate between reflux and regurgitation. They suggest that reflux takes place as a passive process when the uretero-vesical junction is damaged, whilst regurgitation is an active process, in which the bladder contracts in the presence of an obstruction and forces fluid back up the ureters in spite of a normal uretero-vesical junction. This definition of course assumes that vesical contents can enter the ureters in the presence of a normal junction, an occurrence which at first sight seems very unlikely, except possibly in the case of children (see below), however, it does appear that regurgitation can take place in spite of a normal anatomical junction if the uretero-vesical mechanism is at fault.

The French (PAPIN (1930),GAYET (1930), FEY et al (1949)) differentiate reflux into active and passive types (active reflux is the equivalent of regurgitation as defined above and is also described as "uretère forcé"). PAPIN is of the opinion that active reflux may be curable but in passive the prognosis is less certain,

whilst FEY et al suggest that the first stage is "reflux actif accidental", later ureteral peristalsis becomes fatigued and finally conquered when "reflux passif et permanent" is present.

RAVASINI (1927) quotes LASIO of Milan as describing reflux cases as being either nephrogenic or cystogenic and treatment as being less difficult in the latter.

In this paper the terms reflux and regurgitation are regarded as synonymous; no useful purpose is served by their differentiation, their pathological results are likely to be similar, and in practice their differentiation is not always possible.

HISTOLOGY OF THE URETER

The best account is given by SATANI (1919) who examined multiple sections at different levels, of the ureters of pigs, dogs, cats and humans, both adult and infant. He described the outer fibrous coat, the muscle coat and the epithelial lining.

At the lower end of the fibrous coat are a group of longitudinal muscle fibres - Waldeyer's Sheath. The original description of this sheath is quoted by DRAPER and BRAASCH (1913). "The last 18 mm. of the renal duct are imbedded (sic) within the vesical wall; the muscular tissue of the latter is seemingly prolonged over the ureter outside the bladder for some 5 mm. as a distinct sheath. Beginning several centimetres above the bladder the adventitia of the ureter is strengthened by longitudinal bundles of involuntary muscle, that follow the duct to its vesical orifice and in conjunction with the fibrous tissue in which they are imbedded (sic) form the ureteral sheath." SATANI claims that these fibres are situated on the medial side only, that they increase in number from above down, some changing their course to become transverse, and that they join the muscle fibres of the bladder at the intra-parietal part of the ureter. Note that they are separated from the muscle coat of the ureter by a fibrous layer.

The muscle coat varies in thickness as does the direction of the fibres at different levels. In the middle part of the ureter three layers are visible - two longitudinal separated by a circular which decreases in size as the ureter approaches the bladder.

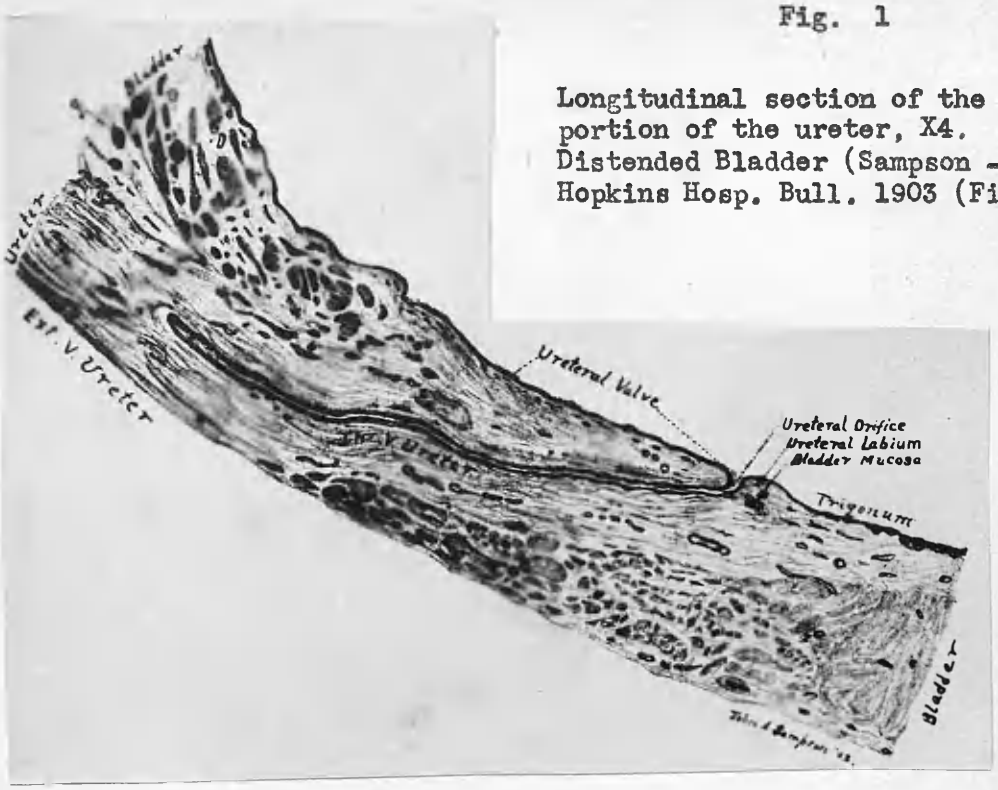
The site of commencement of the outer longitudinal coat varies in different animals e.g. in the dog it is markedly developed at the lower end of the upper third, in the adult human it begins at the upper end of the middle third, whilst in the infant, it is not even present at the beginning of the lower third. At the lower end (excluding the intraparietal ureter) there are a large number of longitudinal fibres with a few weak circular fibres. In the intraparietal part there are no circular fibres, only a strong longitudinal layer which soon disappears on the medial side leaving a half circle of muscle on the outer side of the tube. Satani considered that contraction of this effected a decrease in size of the orifice.

WESSON (1920) in his study of the trigone confirmed that it arose from the longitudinal coat of the ureters, was superimposed on the muscle of the bladder wall, and that its action must be to open mechanically the internal urethral orifice.

It should be noted that there is nothing of the nature of a sphincter at the lower end of the ureter.

Fig. 1

Longitudinal section of the vesical portion of the ureter, X4. Distended Bladder (Sampson - Johns Hopkins Hosp. Bull. 1903 (Fig.1))



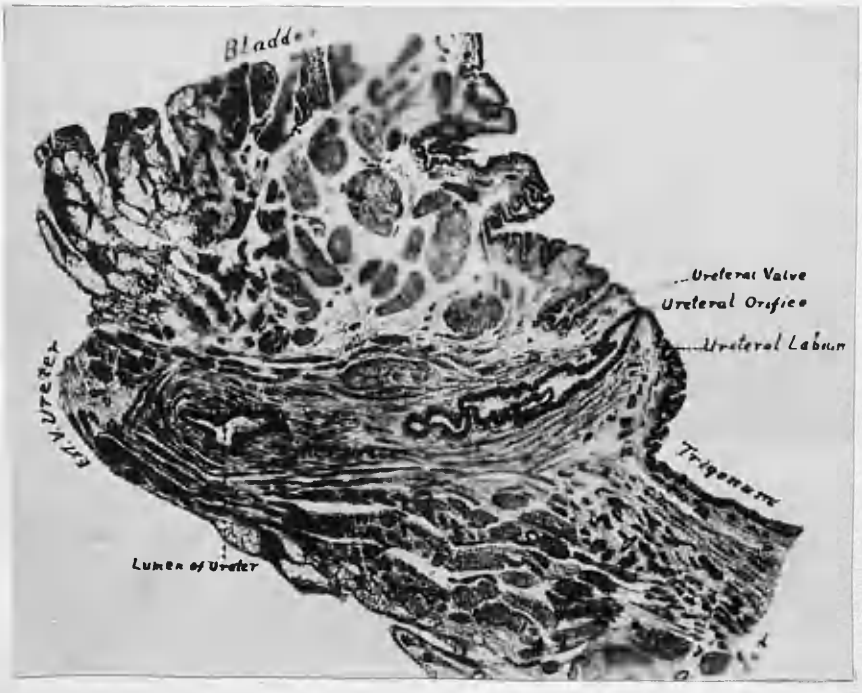


Fig. 2

Longitudinal Section of the vesical portion of ureter, X4. Contracted Bladder (Sampson - Johns Hopkins Hosp. Bull. 1903 (Fig. 2))

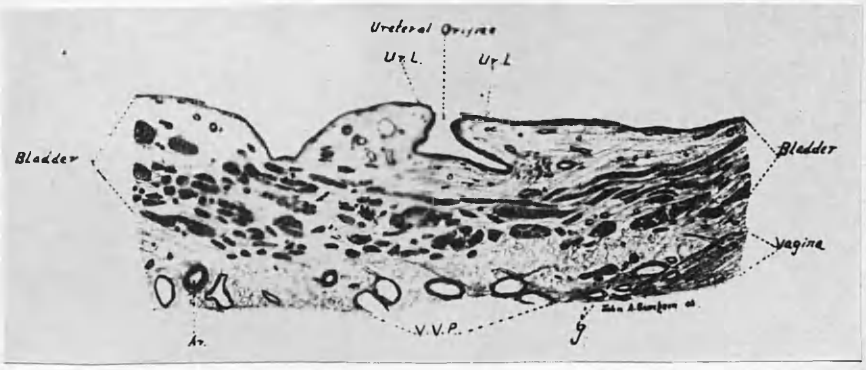


Fig. 3

Transverse section through the ureteral orifice, X4. Distended Bladder (Sampson - Johns Hopkins Hosp. Bull. 1903 (Fig. 3))

Fig. 4

Transverse Section through the ureteral orifice, X4. Contracted Bladder (Sampson - Johns Hopkins Hosp. Bull. 1903 (Fig. 4))

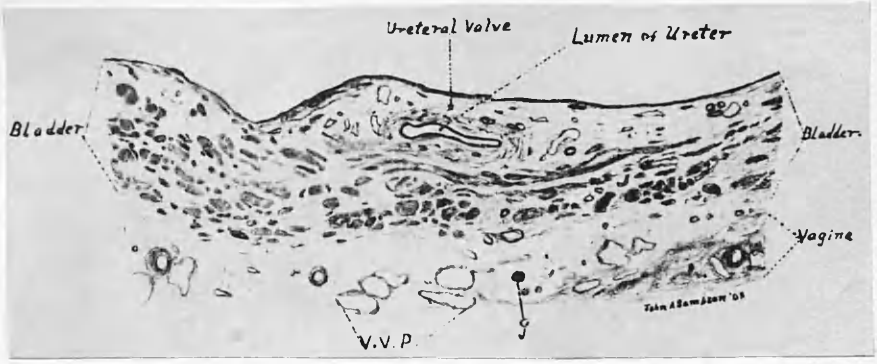


Fig. 5

Transverse Section through the vesical portion of the ureter, taken just above the ureteral orifice, X4. Distended Bladder (Sampson - Johns Hopkins Hosp. Bull. 1903 (Fig. 5))

Fig. 6

Transverse Section through the vesical portion of the ureter, taken just above the ureteral orifice X4. Contracted Bladder (Sampson - Johns Hopkins Hosp. Bull. 1903 (Fig. 6))

PROTECTIVE MECHANISM of the URETERO-VESICAL JUNCTION

At least three factors are concerned, obliquity, the ureterovesical valve and the formation of the trigonal muscle by the longitudinal coat of the ureter, and MORRIS (1901) details them all.

Obliquity

KELLY (1899) quotes PETIT (1674 - 1750) as stating that escape of urine from the bladder up the ureter is impossible due to the obliquity of its course through the bladder wall.

BELL (1812) noted that the obliquity of the intramural ureter diminished as the bladder contracted.

SAMPSON (1903) examined bladders which were distended, collapsed, and contracted, cutting longitudinal, transverse and tangential sections of the intravesical portions of the ureter and made the following observations:

Distended Bladder

1. Ureter becomes more oblique (Fig. 1)
2. Bladder mucosa above the ureteric orifice is stretched, and as the ureteric orifice is fixed, the ureteral valve is elongated (Figs. 1 and 3).
3. The lumen of the ureter is flattened (Fig. 5)

Contracted Bladder

1. Ureter passes through wall less obliquely (Fig. 2)
2. It is more or less occluded by rugae or folds of mucous membrane (Figs 4 and 6)

Collapsed Bladder

Conditions resemble those of the distended bladder more closely than those of the contracted bladder.

COMMENT

The fact that the mucous membrane is adherent to the trigone appears to have been ignored by all writers on this subject, but this is obviously of great importance in maintaining the integrity of the ureteric orifice on dilatation of the bladder.

Uretero-vesical Valve

In man this is thicker than in most animals and is composed of two layers of mucous membrane separated by a few longitudinal muscle fibres, a few elastic fibres and a large amount of white fibrous tissue (GRUBER (1929)).

COMMENT

Damage to this it will be shown, is not usually followed by reflux in man and under normal circumstances with a bladder of average capacity it is probably not a very important safeguard against reflux.

Trigone

BELL (1812) drew attention to the fact that the trigone was merely a continuation of the longitudinal muscle fibres of the ureter. He considered that "The use of these muscles is to assist in the contraction of the bladder, and at the same time to close

and support the mouths of the ureters", and also "It will be observed that the orifices of the ureters are not closed by the contraction of the muscular fibres around them. They are defended against the return of the urine by the obliquity of their passage through the coats of the bladder". He also considered that the sensitivity of the trigone was intended to act as a guard to the ureteric orifices. WESSON and YOUNG (1921) elucidated the function of the trigone, namely, to open the internal urethral meatus, mechanically, at the commencement of micturition.

COMMENT

Consideration of these anatomical contributions in association with SATANI'S (1919A) observation that the intramural ureter is only supported by its longitudinal coat on its lateral aspect shows the importance of the longitudinal fibres in maintaining the obliquity of the ureter during micturition, when trigonal contraction will also lead to flattening of the ureter. As its upper fibres run transversely these too will aid in ensuring competency of the ureteric orifices.

GRUBER (1929B) also came to the conclusion that contraction of the trigone would pull on the ureteric orifices and thus prevent regurgitation.

Attempts to produce reflux in the cadaver have been unsuccessful (YOUNG 1898) and such evidence supports the great importance of mechanical prevention of reflux.

REFLUX IN CHILDREN

The majority of authors consider that reflux does not occur in children with a normal urinary tract but

1. KRETSCHMER (1916B) carried out cystography under ether anaesthesia in 10 normal children and unilateral reflux occurred in 3 of them.
2. BUMPUS (1924) stated that he had never known reflux occur in a normal bladder except in children.
3. QUINBY (1930) in a discussion in a paper on diseases of the urinary tract during infancy and childhood stated "In the children, if the urinary tract as a whole is essentially normal, it is very frequently possible (I can't give you the figures as to how possible) to make a pyeloureterogram by filling the bladder with an opaque solution and tipping the child's head down."
4. GIBSON (1949) carried out cystography without anaesthesia in 43 children under 12 years with no urinary complaints. Reflux occurred in 4 of these:-

    1. Male, 10 weeks - small diverticulum + reflux
    2. Male, 10 years - fair sized diverticulum + reflux
    3. Male, 13 months - right reflux
    4. Female, 16 months - right reflux

One of the diverticulum cases had a small bar but the other was not cystoscoped and excluding these two cases there is an incidence of ureteral reflux in apparently normal children of 4.6%,

and as these films were apparently only taken on filling it might be even higher.

CAMPBELL (1937) claimed that reflux does not occur in normal children and suggested that reflux in Kretschmer's cases was related to anaesthesia.

COMMENT

If prevention of reflux is unrelated to nerve supply as is suggested by experimental work (see below) this argument is untenable, apart from the fact that Gibson showed reflux in the absence of anaesthesia in normal children.

GIBSON (1949) observes that GRUBER (1929) reported that the incidence of reflux varied inversely in his experiments with the thickness of the bladder wall.

COMMENT

It has already been noted that development of the longitudinal coat of the ureter is not complete at birth (SATANI) and this may be the main factor responsible for the occurrence of reflux in some normal children.

In addition, the high incidence of reflux in Campbell's series of cystograms in children, 12%, compared with other published series suggests that children may start at a disadvantage (Bumpus 8.59% and Eisendrath et al 5.4%) (see below).

CONDITIONS IN WHICH VESICO-URETERAL REFLUX OCCURS

Congenital It has been suggested that some cases of megaloureter are the result of a congenital incompetence of the uretero-vesical mechanism (EISENSTAEDT (1926), KRETSCHMER (1926) CAMPBELL (1948)). In bilateral cases with reflux it may be secondary to a bladder neck obstruction. If reflux does in fact occur in some normal children due, as has been suggested, to delayed development of the ureteric muscle coat, megaloureter might result.

Inflammation It occurs in some cases of chronic cystitis including Hunner's interstitial cystitis (HEPBURN 1919), tuberculous disease of the urinary tract, and Bilharziasis (MAKAR 1948) and it has been reported following accidental instillation of caustic solutions into the bladder (VERRIÈRE).

Lower urinary tract obstruction It may be associated with prostatic and other forms of bladder neck obstruction, also urethral stricture.

Neurogenic bladders It may be present in these cases.

Trauma It may occur following reimplantation of the ureter, perurethral resection of bladder tumours, ureteric meatotomy and diathermy treatment of ureterocoeles. Perurethral diathermy and suprapubic diathermy are also causes.

INCIDENCE OF REFLUX IN REPORTED SERIES OF CYSTOGRAMS

BUMPUS (1924) reported the results of 1036 cystograms. Reflux occurred in 89 (8.59%) bilateral in 33, on the left in 29 and on the right in 27.

Simple Enlargement Prostate - 527 cases. Reflux in 25 (4.74%) and he noted a close relation between the incidence of reflux and infection.

Tuberculosis	reflux in 38.88%
Following resection of bladder	" " 33.33%
Pyelonephritis	" " 18.96%
Urethral stricture	" " 11.62%
Post-prostatectomy	" " 11.42%
Disease of the central nervous system	" " 11.34%
Tumours of the bladder	" " 7.54%
Diverticulum of bladder	" " 2.38%

He calls attention to the high incidence of reflux in tuberculous infections of the urinary tract and also in pyelonephritis. Bumpus does not mention his technique but if cystograms were not taken on straining or micturition incidence is probably minimal. (This also applies to CAMPBELL'S series).

EISENDRATH et al (1925) reported the results of cystography in 91 cases where the incidence of reflux was 5.4%. Cystograms were taken after filling and there was a negative result in 41 cases of

pregnancy (100%).

ASCHNER (1928) reviewed 202 cystograms, by the same technique and showed an incidence of reflux of 14%.

CAMPBELL (1937). Cystography in 722 children showed a reflux in 12% which was bilateral in half of these and in two thirds the entire upper renal tract was filled. He does not describe his technique except to state that the children were not anaesthetised, and that reflux was not present in the absence of uropathy.

CLASSIFICATION of REFLUX

Before discussing the causes of reflux further, it is advantageous to classify the three types of reflux which may be observed.

1. Reflux may occur on filling - Filling Reflux
2. Reflux may occur for the first time on straining or be aggravated by straining - Straining Reflux (Primary and Secondary)
3. Reflux may occur for the first time on micturition or be aggravated by micturition - Micturition Reflux (Primary and Secondary)

Filling Reflux may be anticipated in cases where the entire mechanism has broken down or is absent, as in direct reimplantation of the ureter (without stricture), but probably if the slightest degree of obliquity remains and the bladder is not contracted, it may not occur till straining if this is associated with bladder contraction - Primary Straining Reflux; or even micturition - Primary Micturition Reflux, when the bladder becomes smaller, and the course of the ureter through its wall is direct.

Damage to the valve alone may give rise to Filling Reflux but if the other factors are competent this will not increase on straining due to obliquity of the intramural ureter on vesical distension or on micturition due to the longitudinal coat-trigone arrangement.

ETIOLOGY

1. Neurogenic Theory

The evidence against this is great.

(a) Experiments affecting the nerve supply of the ureter

BARKSDALE and BAKER (1930) studied the incidence of reflux in dogs after denervation of the lower ureter. Preliminary cystograms at noted pressures showed no reflux in any of the dogs.

Group I 9 dogs. Lower third of one ureter was freed, and its sheath infiltrated with 95% alcohol and then stripped. Cystograms were carried out 5 days later and repeated at 4 or 5 day intervals.

Group II 4 dogs. Large doses of atropine sulphate followed by cystograms.

Group III 4 dogs. Repeated cystograms alone.

In 7 dogs of Group I there was no reflux; in 2 dogs there was bilateral reflux. Groups II and III did not develop a reflux. They considered the development of bilateral reflux in two dogs of Group I was probably due to dense adhesions around the bladder interfering with the normal uretero-vesical relations.

POTTER (1926). Reflux did not occur in dogs after bilateral division of the sacral nerves when cystograms were carried out two to six weeks after operation.

BARTRINA (1935) quotes BELUCCI as claiming that paralysis of the bladder by narcosis, spinal or topical anaesthesia leads to

Fig. 7

Case 74. Carcinoma prostate. 19.1.51
I.V.P. shows small contracted bladder with dilatation of both lower ureters and slight dilatation of the calyces on the right side (1 hour 20 minutes). Cystography under spinal anaesthesia showed no evidence of reflux.

reflux but goes on to say that others claim it does not, including CAPORALE, who extirpated the hypogastric plexus and resected a circular fragment of the ureteral adventitia in dogs, and failed to produce reflux, but LEPOUTRE apparently claims that spinal anaesthesia by rendering the bladder flaccid encourages reflux.

(b) Cystography has only been carried out in one case in this series under anaesthesia and that was Case 74 This man had carcinoma of the prostate subsequently associated with marked frequency and dysuria in the absence of infection. An I.V.P. revealed a small contracted bladder with dilatation of both ureters and slight dilatation of the right calyces compared with the left. (Fig. 7). The combination of a contracted bladder and lower ureteral dilatation, it will later be shown, is frequently associated with the occurrence of reflux and a cystogram was made immediately after cystoscopy had taken place under spinal anaesthesia. The bladder capacity was very limited and the film was exposed whilst the sodium iodide was running back alongside the catheter. No reflux was apparent.

COMMENT

Whilst it is admitted that the I.V.P. changes might be due to obstruction this could only be slight and if nervous control of the ureteric orifice is important its paralysis would surely have resulted in reflux.

(c) The occurrence of reflux in some paraplegic patients would appear to support this theory, but it is not generally present.

BRAASCH (1925) called attention to the fact that regurgitation in cord bladder only occurs in the presence of cystitis. TALBOT and BUNTS (1949) carried out cystography in more than 100 paraplegics and reflux was present in only 10 and its occurrence was not related to the level of the cord lesion. The cause of reflux in these cases is discussed later.

(d) TRATTNER (1928) found no evidence of interference with ureteral activity in early cases of cord bladder in the absence of infection.

2. Antiperistalsis or Retroperistalsis

LEWIN and GOLDSCHMIDT (1893) demonstrated reflux in unanaesthetised rabbits and considered it was due to antiperistalsis. They stated that they had seen flakes in the urine pass up the ureter on cystoscopy in a case with a very irritable bladder, be extruded and re-enter again, and attributed this to antiperistalsis.

COMMENT

Flakes may be seen to enter a diverticulum and be extruded later; this is obviously not due to any change in capacity of the diverticulum due to muscular action of its wall and may be due to changes in intra-abdominal pressure associated with respiration; the phenomenon observed by Lewin and Goldschmidt was perhaps of a similar nature.

PEACOCK (1923) claimed that reflux is due to reverse peristalsis and that disease of the uretero-vesical orifice is not a necessary accompaniment. WARING (1929) reported a case in which a renal calculus formed on a piece of grass inserted in the bladder per urethram. On cystoscopy the ureteric orifice was normal and he claimed that the foreign body had been carried to the kidney by antiperistalsis.

WISLOCK and O'CONOR (1920) concluded that regurgitation was not due to antiperistalsis. QUINBY (1922) stated that reflux was not due to a retroperistaltic wave, as the upward wave accompanying the reflux of bladder contents travelled three times as fast as a retroperistaltic wave produced by stimulation of the ureter.

GRAVES and DAVIDOFF (1923) noted that on regurgitation in rabbits, the vesical pressure was transmitted directly to the renal pelvis and thus was not due to antiperistalsis.

COMMENT

It seems doubtful if antiperistaltic waves occur in the ureter unless produced by mechanical stimulation, e.g. presence of a calculus or irritation of the exposed ureter at operation. This view is supported by QUINBY (1920).

[illegible] not reflux nearly always occurred

[illegible] is possible that the barium chloride effect [illegible] Waldeyer Sheath and if this is only stimulated [illegible] contraction in the absence of contraction [illegible] readily lead to reflux by straightening the [illegible] the other hand, if the ureteric longitudinal [illegible] its abnormal contractions may have some [illegible] relationship (see below).

3. Uretère Forcé

This theory is supported by several authors and assumes that the ureteric orifice is surprised by a bladder contraction whilst it is open to emit an efflux (LEPOUTRE (1930), GAYET (1930), PAPIN (1930), FEY et al (1949)). BARTRINA quotes BLUM and von LICHTENBERG as describing a "physiological reflux" due to a contraction of hyperexcitable vesical muscle whilst the ureteric orifice is open.

WISLOCKI and O'CONOR support this theory - in animals with the urethra obstructed, if the ureter was quiescent reflux was difficult to produce but if ureteric stimulation by barium chloride was carried out reflux nearly always occurred.

COMMENT

It is possible that the barium chloride effect was limited to the Waldeyer Sheath and if this is only situated on the medial side its contraction in the absence of contraction of the trigone could readily lead to reflux by straightening the intramural ureter.

On the other hand, if the ureteric longitudinal coat was stimulated, its abnormal contractions may have upset the trigonal-detrusor relationship (see below).

4. Overdistension and Atony of the Bladder

GRUBER (1929B) claimed that GRAVES and DAVIDOFF had a high incidence of reflux in their experimental work as a result of overdistension of the bladder. (a) The anaesthetic used was a muscle relaxant. (b) He compared the surface areas of a cat's bladder containing 32 c.c. (his normal) to that of one containing 134 c.c. (their average filling), calculating them as spheres, the areas were 50 sq. cms. and 129 sq. cms. respectively. In dogs the figures were 90 sq. cms. and 310 sq. cms. He concluded this would give incompetence of the ureteric orifices.

COMMENT

It is doubtful if this argument is acceptable and in man at any rate it is not, as the mucosa of the bladder is firmly adherent to the trigone; consequently the increase in surface area is most limited in the vicinity of the ureteric orifices and most marked in the fundus.

CAMPBELL (1937) stated that increased intracystic pressure may damage the mechanism of the valve but he has also stated that he had seen children with enormous bladders and no reflux; and RICHES (1943) considered reflux less common in atonic distended bladders than in hypertonic contracted ones. He did not illustrate a reflux in a distended bladder and in reviewing published cases one is struck by the fact that reflux is very rarely illustrated in a case with gross distension of the bladder and in view of the mechanical safeguards mentioned above it is not surprising.

BARTRINA quotes GRIPEKOVEN as finding no evidence of reflux in 85 prostatic cases with retention and it is likely that some of these bladders were distended.

In animal experimental surgery LEWIN and GOLDSCHMIDT (1893) observed that, in the presence of overdistension, reflux did not take place, and COURTADE and GUYON (1894) and later GRAVES and DAVIDOFF showed that flaccid bladders did not reflux, but ASCHNER (1925) claimed that he had seen reflux in children and adults with atonic and incompetent bladders.

These theories (2 - 4) assume that reflux can occur in the presence of a normal anatomical uretero-vesical junction and when one considers the three factors, the uretero-vesical valve, the obliquity, and the continuation of the longitudinal ureteric muscle into the trigone, it seems most unlikely.

GRAVES and DAVIDOFF (1925) claim that the lesser incidence of reflux in dogs compared with cats and rabbits is due not to the structure of the uretero-vesical junction, nor to lack of tone of the vesical musculature but to failure of the bladder contractions to be sustained in the presence of continually increasing distension. They make no mention of the trigonal effect but it will be shown later that lack of synergism between the trigonal contraction and the detrusor contraction may result in reflux.

5. Valve Damage

Much experimental work on animals has shown that the incidence of reflux at normal intravesical pressures is increased after the valve has been either slit or cut away.

This was first shown by COURTADE and GUYON (1894) who secured reflux in dogs after cutting the uretero-vesical valve and concluded that the lower incidence of reflux in normal dogs compared with normal rabbits had an anatomical basis.

In 1913, DRAPER and BRAASCH slit the uretero-vesical valve in 10 dogs and produced cystitis in these by introducing an infected foreign body into the bladder at operation. The animals were later examined and there was no evidence of renal infection, and they were unable to produce reflux. They concluded that prevention of reflux depended on the physiological mechanism of the ureter rather than the anatomical obliquity of its lower end. BUMPUS (1924) suggested that after slitting the intravesical ureter to remove a stone the only factor preventing reflux was ureteral peristalsis. GRAVES and DAVIDOFF (1925) were unable to produce reflux in dogs after cutting the uretero-vesical flap but concluded that the absence of reflux was not due to mechanical factors but to atonicity of the bladder as they had obtained cystometrogram curves, similar to those now obtained, in rabbits in which reflux did not occur. In rabbits in which it did occur, the curve showed sustained contraction of the bladder.

GRUBER (1929a) studied the anatomical construction of the

lower ureter in a variety of animals and related the high incidence of reflux in rabbits to the shortness of the valve flap and the poor development of Bell's muscle, and considered that the valve is the most important factor in prevention of reflux.

GRUBER (1929B) in a series of excised bladders (rabbits, cats, dogs, pigs, monkeys and humans) cut away the ventral aspect of the right intravesical ureter in a variety of specimens and secured a reflux. He noted that he failed in one very thick human bladder. He concluded that the prevention mechanism was purely passive, depending mainly on the flap but considered that the oblique course of the intraparietal ureter also helped, but had a minor role and suggested that it is usually only 3 mm. in length in the human; however, he does not state in what condition of the bladder he measured its length.

COMMENT

The disparity between the findings of these authors suggests that the completeness with which "the valve" was removed must be related to the incidence of reflux and GRUBER (1930) studying the effect of reflux in 18 animals found it absent in 3 due to incomplete removal of the valve. It seems likely that in some cases the valve has been removed whilst in others the ventral part of the oblique course of the intramural ureter has also been removed. This appears even more certain when it is recalled that peritonitis may follow the operation. (VERMOOTEN and NEUSWANGER (1934)).

DRAPER and BRAASCH (1913) concluded from their experiments

that slitting the ureteric orifice in the treatment of ureteric calculi was a safe procedure, and MOORE (1931), investigating the results of ureteral meatotomy by cystography in an unstated number of cases found no evidence of regurgitation, but his technique is open to criticism. He filled the bladder with 8% iodide to extreme discomfort and exposed films with the patient straining to micturate against obstruction in recumbency and the extreme Trendelenberg position. BARTRINA states that PAPIN is of the opinion that operations which may damage the ureteral orifice do not result in reflux. CORDONNIER (1945) has reported reflux following slitting the ureteric orifice for calculus.

In this investigation cystography has been carried out in a number of cases in which the ureteric orifice had been surgically assaulted.

1. Ureteral meatotomy for ureteric calculus

   2 cases (75 and 76) - no reflux

2. Ureteral meatotomy followed by perurethral diathermy to papilloma within the orifice

   4 cases (77 - 80) - 1 reflux

The case in which reflux occurred (case 77) was one of papillomata of the bladder treated by suprapubic diathermy (1943) and later by perurethral diathermy. In 1946 a papilloma was seen protruding from the right ureteric orifice, an electrode was inserted within the orifice and diathermy applied. An I.V.P.

revealed no evidence of renal or ureteric neoplasm but the pictures were not very good; however, a subsequent ascending pyelogram revealed a normal pelvis and ureter. Perurethral diathermy was again applied to a papilloma at the same site on two further occasions and later deep X-ray therapy. In June 1950 it was still present and the orifice was slit with the meatatome, to expose the growth completely, and further perurethral diathermy applied. There was no evidence of recurrence in December 1950 when cystography was performed.

1. On filling - a small amount of contrast medium was present in the right pelvis.
2. On straining - less medium in the pelvis
3. After micturition - no medium in the pelvis

COMMENT

Due to the fact that initial treatment in this case was by inserting the electrode up the ureter, it is admitted that the effects of meatotomy may be complicated by changes similar to those of healed ureteritis of the intramural ureter and the repeated diathermy treatment may have led to destruction of part of the intramural ureter. The slight reflux on filling demonstrates that the degree of incompetence is minor and suggests that it may have only taken place during the initial stages of filling before the ureter became oblique. This appears to be confirmed by the fact that it was less and finally disappeared when the trigone effect came into action, and although the ureter had to pass through

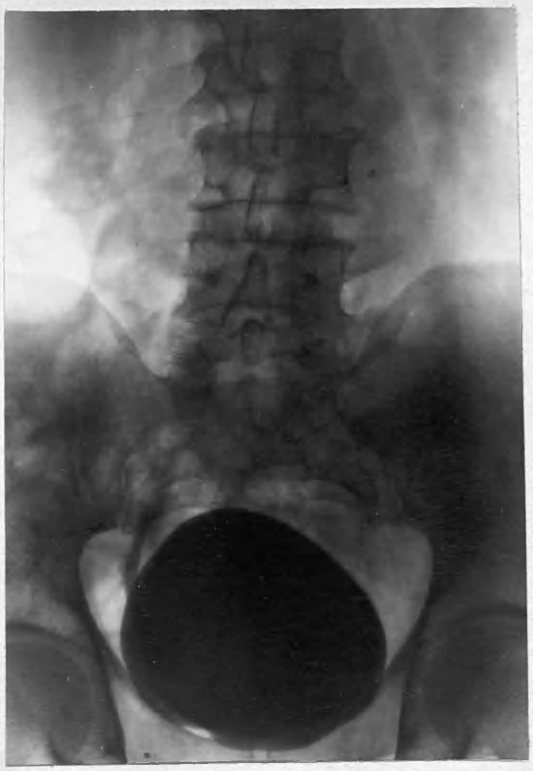


Fig. 8 ←

Case 90. Suprapubic diathermy to papillomata of bladder; subsequent diathermy to papilloma within R.U.O. Cystogram 22.2.51. On filling, the bladder is flaccid and no reflux present, but on straining it is tonic and there is slight reflux into the lower right ureter.

Fig. 9 →

Same case as Fig. 8. The cystogram after micturition shows complete reflux - details not visible due to movement

the same stage of diminished obliquity, it was now adequately guarded.

In case 90 papillomata of the right side of the bladder were treated by suprapubic diathermy (1942) and repeated perurethral diathermy. In 1946 a papilloma within the right ureteric orifice was destroyed by pushing the electrode up the ureter and applying diathermy.

Cystography now shows

1. Filling - no reflux
2. Straining - slight reflux into lower 4 cms. right ureter (Fig. 8)
3. Micturition - the right renal pelvis is filled (Fig. 9)

COMMENT

In this case it would appear that the valve and obliquity have prevented reflux on filling, which was at a low pressure but on straining slight reflux has occurred which became complete on micturition. If this is so, the trigonal effect appears to be lacking and fails to maintain competence of the mechanism when ureteric obliquity is diminished in the presence of a raised intravesical pressure compared with that of filling, but it may be that although the mechanism is completely incompetent stricture formation has prevented reflux (compare with reimplanted ureter with stricture) on filling. Is this the ureteritis effect in which the lower ureter is stated to become rigid and virtually a sinus in the more severe

Fig. 10

Case 81. Right ureterocele with a history of pain in the right loin. I.V.P. 9.2.40 Good excretion both sides. Slight dilatation of the right calyces and there is constant filling of the lower right ureter.

degrees of the condition (SAMPSON 1903)? This appears a reasonable view.

3. Perurethral diathermy or slitting of ureteroceles

6 cases (81 - 86) - 1 reflux

The case in which reflux occurred (case 81) attended in 1940 complaining of back-ache for 1 year and pain in the right loin and dysuria for 3 months, with more recent rigors. Intravenous pyelography showed good excretion from both kidneys, with slight dilatation of the right pelvis and calyces and constant filling of the lower right ureter, which was also dilated (Fig. 10). A ureterocele was treated by perurethral diathermy following which the patient developed temporary pain in the right loin associated with renal infection due to coliform organisms. A further I.V.P. one year later showed good excretion from both kidneys, no dilatation of the right pelvis or calyces and the lower ureteric hold up had disappeared. She continued to have pain intermittently in the right loin and complained of pyrexial attacks, but cystoscopy, urinary analysis and intravenous pyelography revealed no abnormality and her condition was regarded as a functional disturbance.

Cystography 2.12.50

1. Filling - complete filling of the right pelvis and calyces with a dilated ureter (Fig. 11)

← Fig. 11

Same case as Fig. 10. After perurethral diathermy to ureterocele (13.2.40) the early hydronephrosis and the hold-up in the lower right ureter disappeared. Cystogram 21.12.50. On filling, complete right reflux

Fig. 12 →

Same case as Fig. 10. The straining cystogram shows much less filling of the pelvis and ureter.

Fig. 13

Case 82. Left ureterocele. I.V.P. 31.5.48. Good excretion both kidneys with very slight dilatation of the left pelvis and dilatation and hold-up in left lower ureter (40 minutes)

Fig. 14

Same case as Fig. 13. Ureterocele slit by cystoscopic scissors 25.2.49. I.V.P. 12.5.49. The left pelvis is now normal and the ureter is less dilated and is only visible on the 10 min. film. Cystogram on 15.2.51 showed no reflux on 3 films

2. Straining - the calyces, pelvis and ureter are less well filled. (Fig. 12)
3. After micturition - practically all medium is evacuated from the pelvis and ureter.

COMMENT

This presents a similar picture to case 77 described above after meatotomy combined with perurethral diathermy. The greater initial reflux is due to the presence of ureteric dilatation which has allowed greater regurgitation in the absence of the ureterovesical valve during filling. The value of obliquity and the trigone effect are well demonstrated.

Case 82. Ureterocele associated with slight dilatation of the left pelvis and dilatation of the lower left ureter with hold up (Fig. 13). 25.2.49. The ureterocele was slit with scissors. 12.5.49. The left pelvis is now normal, the ureter less dilated and only shows in one film (Fig. 14). 15.2.51. No reflux on cystography.

COMMENT

There is still slight dilatation in the lower ureter but reflux has not occurred. This may be the result of partial conservation of the ureteral valve as a result of slitting the ureterocele with cystoscopic scissors rather than treating it by perurethral diathermy.

4. Attempted manipulation of ureteric calculus by Councill's ureteral calculus dilator and extractor.

3 cases (87 - 89) - no reflux.

← Fig 15

Case 91. Male. Papillomatosis of bladder originally treated by deep X-ray therapy. 20.11.50 Residual papilloma in region of L.U.O. resected with McCarthy resectoscope. 15.1.51 L.U.O. noted to be deformed and gaping. Cystogram 22.2.51. Complete left reflux on filling.

Fig. 16 →

Same case as Fig. 15. Micturition reflux shows dilatation of pelvis and calyces compared with that on filling.

Fig. 17

Same case as Fig. 15. 12.3.51 I.V.P. Good excretion both kidneys; the outlines of the pelvis and calyces are not clearly shown (10 minutes)

6. Loss of Obliquity

Review of the cystographic results of direct reimplantation of the ureter into the bladder demonstrates the effect of loss of obliquity in the absence of the uretero-vesical valve and also the trigonal muscle effect. In a series of 31 cystograms following direct reimplantation of the ureter, reflux occurred on filling in 22 cases which was aggravated by straining or micturition in 18 (of the remaining 4 cases, in two there was only one exposure, in one case the results were the same, and in the fourth it was less, perhaps due to fortuitous obliquity of insertion). In the remaining 9 cases reflux did not occur until straining in one, micturition in five (in one no straining film was exposed) and not at all in three.

In the complete absence of obliquity with no valve, filling must certainly result in reflux, with dilatation on straining or micturition. The fact that reflux did not occur in eight cases on filling is attributed to some degree of stricturing as explained in the first part of this paper.

In case 91 the ureteric orifice was damaged in resecting a papilloma in its vicinity and subsequent cystoscopy showed it to be deformed and gaping. Cystography demonstrated a reflux on filling which extended to the pelvis (Fig. 15), and was increased by straining (Fig. 16). Intravenous pyelography shows good function (Fig. 17).

Fig. 18 ←

Case 95. Female. Repeated perurethral diathermy to papillomata in region of R.U.O. The ureteric orifice is gaping and situated in an area of scar tissue. Cystogram 25.1.51. This was carried out immediately after an I.V.P. and in consequence contrast medium is visible in the left kidney pelvis. On filling, complete right reflux has occurred.

Fig. 19 →

Same case as Fig. 18. Cystogram on straining shows increased filling of the ureter on the right. Contrast medium on left presumably residual from I.V.P.

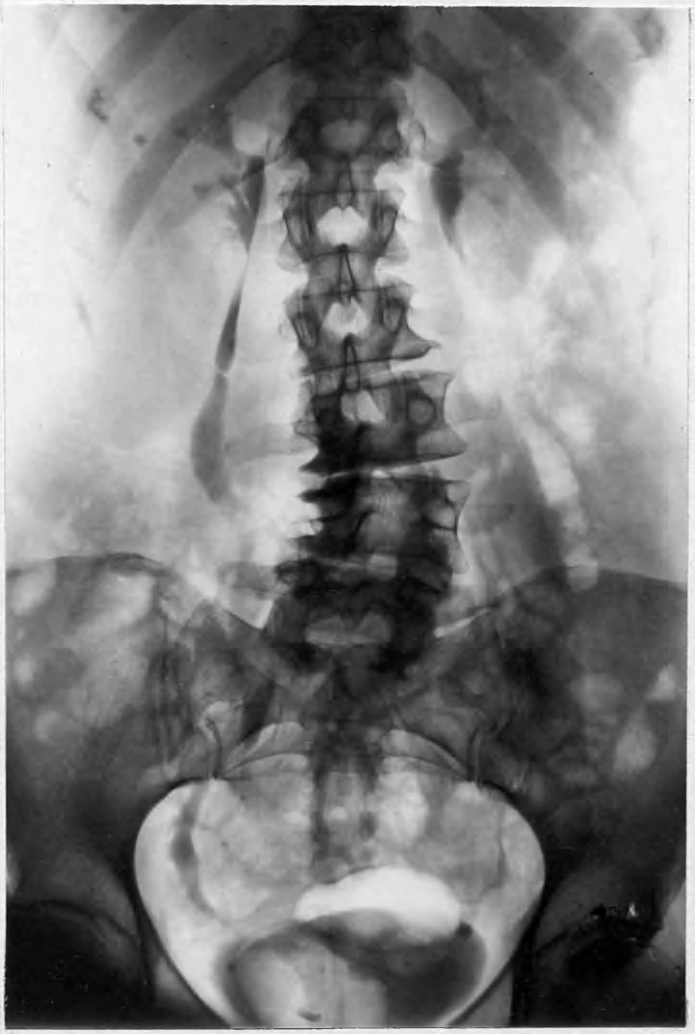


Fig. 20

Same case as Fig. 18. I.V.P. 23.1.51 shows good function both kidneys. The calyces on the right are coarse and the right ureter is dilated (45 minutes)

COMMENT

This appears to be due to damage to the intramural ureter, as if valve damage alone had occurred, reflux, although occurring on filling would not be increased on straining, as the intramural ureter in the distended bladder is oblique.

This explanation is supported by 3 other cases (92 - 94) where after diathermy treatment, although the orifice was involved in scar tissue and gaping, reflux was not apparently present. It is suggested that in these cases the damage was probably limited to the uretero-vesical valve or at most to only a small part of the intramural ureter. DONOVAN (1951) has pointed out that the depth of diathermy penetration is very limited.

Further corroboration is presented by case 95 where recurrent papillomata in the region of the right ureteric orifice necessitated perurethral diathermy to this area on four separate occasions and eventually it was noted that the gaping orifice was situated in the midst of a scarred area. Reflux was present on filling (Fig. 18) aggravated by straining (Fig. 19) and present after micturition. Intravenous urography shows evidence of chronic pyelonephritis (Fig.20).

COMMENT

It appears likely that the repeated diathermy has resulted in trauma to the intramural ureter.

The present writer considers that reflux in infections may also be due largely to loss of obliquity, particularly in the case of tuberculous infection of the urinary tract. In the latter condition

Fig. 21

Case 96. 8.8.42. Nephrectomy for tuberculous right kidney. I.V.P. 2.6.50 shows dilatation of the left calyces, pelvis and ureter with a contracted bladder (2 hours)

Fig. 22

Same case as Fig. 21. 4.8.50. Cystography showed complete reflux on filling, with further dilatation on micturition. Note lack of tortuosity of the ureter.

reflux is relatively common and occurred in two of the five cases (96 - 100) in which it was investigated in this series. In this condition the ureteric orifice may appear normal with varying degrees of abnormality up to the stage of "golf-hole" orifice and this may be associated with rhythmic movement on respiration (it is admitted that this is rare), and Young in 1918 reported two cases of tuberculous renal infection in which invagination of the neighbouring trigone had occurred through the ureteric orifice. The more extreme changes are obviously dependent on fibrotic change with resultant traction and suggest that "golf-hole" alone results from lesser degrees of this.

POZZI (1893) (quoted by GRUBER (1929B)) injured a ureter during removal of a broad ligament cyst and brought both ends to the surface and later urine was found to come from both ends. There must have been considerable tension on the ureter and this may have led to straightening out of the intramural ureter in the absence of other pathological abnormalities.

That alteration in the direction of the intramural ureter may occur in the absence of abnormality of the ureteric orifice is confirmed by the following observation in case 96. This patient had undergone right nephrectomy for renal tuberculosis (8.8.42) and subsequently developed marked hydroureter and hydronephrosis of the remaining kidney - 2.6.50 (Fig. 21). This dilatation had been progressive. Tuberculous ulceration of the bladder was present in October 1943 and later responded to streptomycin and P.A.S.

but the vesical capacity did not improve. It was considered that the dilatation might be due to stricturing of the distal ureter and this suspicion appeared to be confirmed by inability to catheterize it on cystoscopy. It was decided to attempt dilatation using the McCarthy panendoscope when it was found that the change in the angle at which the ureteric bougie was inserted allowed its passage with absolutely no evidence of stricturing, and a subsequent cystogram revealed a complete filling reflux (Fig.22) with further dilatation on micturition; no straining film was exposed. In this case there was extreme incompetence of the uretero-vesical valve although the ureteric orifice appeared normal and the mechanism of its production is supported by the straightness of the ureter in spite of its dilatation.

ASCHNER (1928) reporting cystoscopic appearances in cases of reflux, said the orifices were of two types, in one they were wide open, and in the other they were normal looking but could not be catheterized for more than 1 cm. As he does not state the related vesical capacities, one cannot conclude definitely that the intravesical ureters were less oblique than normal, but this is a possibility.

In case 97 following right nephrectomy for tuberculous infection and in the presence of cystitis with a patulous left ureteric orifice a slight reflux (lower ureter) occurred on filling, capacity 4 ozs., but was not evident on straining or after micturition.

COMMENT

This indicates a slight loss of obliquity in the presence of an incompetent valve and is comparable to case 81 in which reflux followed diathermy treatment to a ureterocele.

PASTEAU (1930) stated that if small bladders were filled with large amounts, there was a risk of active reflux (i.e. reflux occurring in the presence of a normal uretero-vesical junction). Small bladders are usually associated with infection and the obliquity of the ureter is minimal and in the presence of infection the uretero-vesical valve, now an important safeguard, may become incompetent.

The evidence in favour of this interpretation is weighty. KELLY (1899) in carrying out cystoscopies in the knee elbow position in the air-filled bladder, which it is presumed could not be very distended (this is supported by the fact that in carrying out air cystograms the bladder capacity is found to be very small - Fey et al.), noted that air might enter the ureters and as it became heated by the body it escaped in bubbles with the urine. This phenomenon had proved helpful in locating the orifice in an inflamed bladder and he noted that it occurred more frequently into an inflamed ureteral orifice on a side which was discharging pus. He had witnessed this on at least twelve occasions but presumed that evidence of lack of airtightness did not indicate the orifice was not watertight under physiological conditions.

In inflammatory conditions affecting the ureteric orifice and

the surrounding mucosa it is obvious that the angle at which the flap is related to the vesical mucosa will become less and less acute until it could be a right angle and with loss of obliquity of the ureter consequent on the diminished capacity, reflux is readily understandable.

Experiments to simulate oedema in the region of the uretero-vesical valve have been carried out by AUER and SEAGER (1937). In living anaesthetised animals they infiltrated the intravesical ureter with a solution of either magnesium sulphate or sodium chloride. Reflux followed this in 6 out of 18 guinea pigs; 22 out of 27 rabbits and 14 out of 17 dogs. This was achieved with intravesical pressures as low as 2 - 12 mm. H.g. After an experimental reflux they found that raising the intravesical pressure higher did not drive the reflux higher and they assumed that the incompetent valve became competent. The amount of the injection varied from 0.2 c.c. in guinea pig to 0.5 - 2.0 c.c. in the dog. The incidence of spontaneous reflux in their series prior to injection was 4 guinea pigs, 4 rabbits and 2 dogs. Biopsy showed oedema of the uretero-vesical valve with submucosal haemorrhages in some. They concluded that the oedema rendered the flap valve more rigid than normally, thus reflux occurred at low pressure but the valve became competent at higher pressures. Some of the failures they considered to be due to too large an injection which had caused obstruction of the ureteric orifice. Antiperistalsis was never seen and the reflux occurred whilst the

Fig. 23

Case 101. 1st degree prolapse complicated by vesical calculus. Suprapubic lithotomy 23.6.50. I.V.P. 25.10.50 Poor function no excretion from right kidney up to 90 minutes. Excretion from the left is delayed and there is gross hydronephrosis and a suggestion of hydroureter (90 minutes)

Fig. 24

Same case as Fig. 23. Cystogram 29.11.50. On filling gross dilatation of the lower right ureter is visible and on micturition there is marked descent of the bladder and lower right ureter

Fig. 25

Same case as Fig. 23. I.V.P. 1.5.51. Considerable improvement in renal function after fitting pessary. Good excretion on the left at 10 minutes, calyces less dilated and pelvis smaller and excretion is now visible on the right at 25 minutes.

Fig. 26

Same case as Fig. 23. Cystography 7.6.51. Reflux is still present on filling but the ureter is much less dilated although reflux is seen to reach the pelvis (same scale as Fig. 24)

Fig. 27

Same case as Fig. 23. After micturition reflux is unaltered, there is practically no residual urine.

bladder wall was firm, moderately soft or well relaxed.

COMMENT

Their suggestion that the valve becomes competent as the intravesical pressure becomes greater is less acceptable than the assumption that the intramural ureter becomes more oblique with distension of the bladder and thus counteracts the loss of competence of the ureteral valve.

Two other cases in this series illustrate reflux in the absence of obliquity.

Case 101, a female patient with first degree prolapse complicated by a large vesical calculus, 23.6.50, with gross cystitis, underwent suprapubic lithotomy.

A subsequent I.V.P. (25.10.50), 14 weeks after the suprapubic fistula had healed, showed no function on the right side but excretion was apparent on the left at 10 minutes, the kidney showing gross hydronephrosis and hydroureter (Fig. 23 (90 minutes)). Cystography 29.11.50, revealed reflux on the non-functioning side filling a grossly dilated ureter in its pelvic portion (Fig. 24). Further intravenous pyelography after the patient had been fitted with a ring pessary, 1.5.51, showed considerable improvement in the renal function. Excretion was good on the left at 10 minutes and on the right at 25 minutes. Both kidneys showed marked hydronephrosis but the dilatation on the left shows considerable improvement (Fig. 25 (60 minutes)). Cystography, 7.6.51, shows on filling (Fig. 26) and during and after micturition (Fig. 27),

that reflux is still present on the right side - on this occasion it is visible as far as the pelvis, but the dilatation of the ureter is very much less. The patient is emptying her bladder completely and her frequency is normal, although a urinary infection is still present.

COMMENT

It is interesting to speculate if earlier cystography would have demonstrated the reflux on the left side also, this possibility is supported by the subsequent improved outlines on the left.

Reflux on the right is still present, but the ureter is only about half the diameter it was and associated with this change, function is now apparent on this side. The urine is still infected but with the insertion of a pessary this is much improved as there is no residual urine, and her frequency is within normal limits.

It seems that the pessary by eliminating residual urine has improved the urinary infection It does not appear likely that it has relieved an obstructive lesion of the ureter, as the earlier cystograms shows free passage into the right pelvic ureter.

The other factor is that tension on the pelvic ureter, secondary to the bladder displacement and resulting in straightening of its course through the thinned out bladder wall, is now relieved with return of the normal obliquity to the intramural portion. This alteration in its direction is supported by failure to catheterise the ureters on 25.11.50; the pessary had not been inserted at that time.

It is possible that further cystography at a later date may show evidence of return of some degree of competence to the right uretero-vesical mechanism with associated improvement of the hydronephrosis on that side.

Case 102, admitted with permanent suprapubic drainage of some years duration following diverticulectomy elsewhere without attention to the bladder neck, and now complicated by a large vesical calculus. Cystography showed a very contracted bladder with reflux up the left ureter. Pre-operatively the blood urea was 125 mgr/100 c.c. and after operation it ran to 266 mgr/100 c.c. and finally the patient died. Both kidneys were grossly infected but the left kidney was smaller. The ureteric orifices were both dilated.

COMMENT

Why reflux should only occur on one side could be explained by the stone lying over the other ureteric orifice and occluding it at the time of cystography, and this could have been confirmed by altering the patient's position no doubt, but he was a very sick man and the cystogram was carried out essentially to demonstrate the presence or absence of a diverticulum. This is a case of reflux secondary to chronic cystitis.

GRAVES and DAVIDOFF (1925) studying the incidence of reflux in dogs showed an incidence of 27% in one series of dogs but in a second where the bladder had been rendered irritable by the presence

of calculus the incidence was 40%. They chose to ignore the diminished obliquity of the ureter in these cases, due to diminished capacity, and attributed the higher incidence to the presence of sustained tonus. They concluded that in its presence the obliquity of the intravesical ureter and the presence of the uretero-vesical valve were insufficient protection.

LEWIN and GOLDSCHMIDT (1893) found that if reflux did not occur at the commencement of filling in their dog experiments, it did not occur at all. COURTADE and GUYON (1894) found no reflux in rabbits or dogs unless the bladder resisted the injection at the commencement of filling. Bladders remaining flaccid or distending passively, did not reflux. This supports the importance of obliquity.

Further evidence of the importance of obliquity is furnished by BARRINGER (1908). Following inability to demonstrate reflux in a dog, he passed a probe up the ureter but was still unable to elicit reflux on distension; however, he could produce it by manipulation of the bladder, but this became more difficult as the bladder was further distended.

Regurgitation alongside a Ureteric Catheter

CATHELIN (1908) reported a case in which death followed nephrectomy where ureteric catheterization pre-operatively had given the incorrect impression that a second functioning kidney was present. HAGNER (1912) reported 4 cases in which similar regurgitation had occurred - 2 of these were urinary tuberculosis, 1 case of bilateral renal calculi and 1 case of enlarged prostate. His method of demonstrating the occurrence was to fill the bladder after ureteric catheterization with 5% argyrol and recover this from the ureteric specimen. In the prostate case, he noted that the ureteric orifices were of the "golf-hole" type but in the calculus case there was no appreciable difference between them and yet the regurgitation only occurred on one side.

COMMENT

It may be that this is related to straightening out by the catheter of the oblique course of the intramural ureter, but as reflux may occur in all the conditions described by HAGNER it would probably occur in the absence of the catheter.

7. Trigonal Factor

GRUBER (1929) in his investigations in a variety of animals found that the trigone was most poorly developed in the rabbit and most highly in man and found a relationship between its development and the incidence of reflux.

Reflux is described in cases of prostatic enlargement and other causes of bladder neck obstruction. In the presence of infection with a small contracted bladder following drainage this is understandable on the interpretation stated above.

MORRIS (1901) postulated reflux in distended bladders due to stretching of the longitudinal ureteric fibres going to form the trigone and concluded that this led to loss of obliquity of the intramural ureter. In acute cystitis he considered that the muscle fibres of the bladder and ureter became "contractured" (= persistent shortening) and that this led to shortening of the intramural ureter.

KRETSCHMER (1916B) reported reflux in one case of enlarged prostate and one case with a contracted bladder neck. In both the ureteric orifices appeared normal but tenesmus was so marked that compression of the urethra was necessary to obtain a cystogram. These can be explained on the above basis.

BUMPUS (1924) showed an incidence of reflux of 4.74% in 527 cases of enlarged prostate and noted a close relation between it and infection. In cases in which prostatectomy had been performed, the incidence was 11.42% and in urethral stricture 11.62%.

EISENDRATH et al (1925) did not find a reflux in 12 cases of bladder neck obstruction - (prostatic adenoma, contracted bladder neck, carcinoma prostate, vesical calculus, multiple diverticula and ureteral stricture) and in 6 cases following prostatectomy (one with associated suprapubic diathermy) there was no evidence of reflux.

ASCHNER (1928) reported reflux in 3 cases of prostatic obstruction; 4 vesical diverticula; 5 vesical neoplasm; 11 cases of vesical neck and urethral obstruction (5 adults and 6 children).

LEPOUTRE (1930) reported reflux in a prostatic patient giving rise to lumbar pain and stated that PAPIN has drawn attention to its occurrence. In the subsequent discussion MARION said it was not uncommon in these cases.

BARTRINA (1935) quotes GRIPEKOVEN as failing to demonstrate reflux in 85 cases of prostatic obstruction with retention.

STEINBERG (1948) reported a case of bladder neck obstruction in a girl aged 14 years with 250 c.c. infected residual urine and bilateral regurgitation. After resection, the reflux, residual urine and infection all cleared up.

Cystography in 3 cases (103 - 105) with diverticula has not demonstrated a reflux. Cases of enlarged prostate have not been investigated as the practice at this clinic is only to instrument cases as an immediate preliminary to operation, but review of the relevant literature indicates that reflux can occur in these cases in the absence of infection and the presence of apparently normal ureteric orifices.

FRONTZ and LANDES (1932) reviewed the reaction of the bladder musculature to mechanical obstruction and concluded that overdevelopment of the detrusor and trigone occurred in combination or separately according to the type of obstruction.

They stated that the following changes might occur:-

1. Hypertrophy of the trigone without hypertrophy of the detrusor
2. Hypertrophy of the trigone with hypertrophy of the detrusor
3. Hypertrophy of the detrusor with a normal trigone
4. Absence of hypertrophy of both detrusor and trigone
5. Atrophy of the detrusor and trigone

They concluded, quoting YOUNG and WESSON'S work, that hypertrophy of the trigone, "is the compensatory mechanism which follows the development of pathological conditions involving the vesical orifice which interfere with the normal opening of the sphincter. It thus becomes the clinical expression of a very particular type of obstructive lesion - namely, one impairing the elasticity of the posterior 90° of the sphincter and its absence in the obstructed bladder makes possible the certain elimination of obstructive lesions involving the posterior quadrant of the orifice". They concluded that it was associated with contractions of the vesical orifice secondary to chronic prostatitis, carcinomatous infiltration of the posterior 90° of the sphincter and median lobe hypertrophies. In pure lateral lobe prostatic hypertrophies they found varying degrees of detrusor trabeculation,

and trigonal hypertrophy was conspicuously absent. Trigonal hypertrophy was not present in uncomplicated urethral stricture cases although detrusor hypertrophy was.

MUSCHAT (1933) carried out further investigations on the response of the trigone and detrusor muscle to vesical neck obstruction and confirmed their findings. In his investigation he grouped obstructive lesions of the bladder neck into 3 subdivisions.

A. Median bar, commissural hypertrophy and small middle lobe enlargements.

B. Lateral lobe prostatic hypertrophy.

C. Lateral lobe plus commissural hypertrophy

Trigonal hypertrophy was greatest in A (in early cases no increase in detrusor muscle, but there is later); negligible in B (hypertrophy of detrusor). Cases in subdivision C represent an end stage and here the detrusor is thinned or normal but the trigone is still thicker than normal.

Whilst reflux in cases with bladder neck obstruction in the absence of infection may be related to alteration in the course of the intramural ureter as a result of trabeculation, this does not seem a very satisfactory explanation and these studies of trigonal changes suggest that its threatening failure or lack of synergism between it and the detrusor may be a factor in the production of reflux in these conditions.

Cases 77 and 81 described above support the conception that the continuation of the ureteric longitudinal coat as the trigone is an important factor in prevention of reflux during either straining or micturition. If this hypothesis is correct, one might at first consider that there should be a high incidence of reflux following operations such as Wilson Hey's method of prostatectomy where a liberal wedge is removed from the trigone or after perurethral resection or indeed any form of prostatectomy. This is not supported by BUMPUS' incidence of reflux, 11.42% after prostatectomy compared with 8.59% before operation, post-operative infection will explain this increased incidence, but if cystograms are taken during or after micturition this incidence will probably be much higher. Although the insertion of the trigone has been interfered with at operation, the remnants presumably gain a new attachment and thus its relation to the uretero-vesical orifice is not grossly disturbed.

It may well be that the pyrexial attacks which may coincide with the commencement of micturition after prostatectomy are due to reflux as suggested by some authors and that this trigonal damage is an important etiological factor.

The importance of Bell's muscles has been stressed by GRUBER (1929A) who demonstrated that normal rabbits, which show a high incidence of reflux have a short valve flap and poorly developed Bell's muscles; but in dogs, in which the incidence is much lower (at normal capacities and pressures, he had an even lower incidence

than that of GRAVES and DAVIDOFF - 27% in one series), Bell's muscles are well developed and the valves are comparatively thick and flexible. In man the uretero-vesical valve is thicker than in most animals and of course Bell's muscles are very well developed. His final conclusion with which the present writer is in entire agreement was that the incidence of reflux is related to differences in the length of the uretero-vesical valve, development of the trigone (most poorly in the rabbit and most highly in man), and the thickness of the bladder wall. Perhaps he does not make his point about the thickness of the bladder wall clear, but this will obviously give a greater length of intramural ureter in the contracted state of the bladder and thus more competent obliquity in the distended state.

In a later paper (1929B) he stated that the mechanism of prevention is purely passive, but on this point I disagree. In the normal bladder this is virtually so, but in the presence of alteration in the trigonal musculature, secondary to an infra-vesical obstruction lack of synergism between the detrusor contraction and that of the trigone can lead to loss of the longitudinal coat - trigone protective factor with consequent reflux.

This trigonal effect has been greatly neglected by most authors but PEREZ CASTRO (1950) seems to be aware of its importance although his explanation is rather involved and probably incorrect. He postulates a nervous mechanism, claiming that in prostatic cases the adenoma irritates the vesical sphincter and that this

secondarily acts on the detrusor muscle. - "In this manner, the equilibrium of the physiological mechanism between the detrusor and sphincter action is lost and this alteration in function must interfere with the synergy of uretero-vesical dynamics."

8. Infection of the upper urinary tract

This includes cases which LASIO would group together as nephrogenic e.g. some case of tuberculosis of the urinary tract.

BUMPUS (1924) considered that some cases of reflux were due to renal infection having spread down the ureter with consequent ureteritis which rendered the lower ureter the site of fibrotic change and converted it into a rigid non-collapsible tube. SAMPSON (1903) also suggested that this occurred and illustrated the condition by applying formalin to the intramural ureter of an excised bladder in which he had been unable to produce reflux, and following this manoeuvre it occurred.

9. Neurogenic Bladders

TALBOT and BUNTS (1949) reviewing 331 paraplegic patients found 15 with hydronephrosis without renal calculi.

The important points from their paper are:-

(a) Patients with similar neurological lesions had not developed hydronephrosis

(b) Unilateral dilatation occurred with complete transection lesions

(c) Cystography showed a reflux in 10 of the 15 cases. The bladder was filled with medium - not more than 150 c.c. were required - and one film was exposed immediately after filling, a second 20 minutes later and on some occasions a third on straining or on micturition, but in no patient had reflux only become evident in this film. Although cystography was carried out in over 100 cases these were the only ones to show reflux.

(d) Hydronephrosis was bilateral in 7 cases, and in 6 of these the reflux was also bilateral, in the seventh reflux was unilateral but with improvement of the hydronephrosis, this disappeared, to reappear with recurrence of the dilatation. Improvement on the side which did not reflux was maintained.

(e) Hydronephrosis and reflux were unilateral in the other three cases.

(f) Reflux was absent in 5 cases. In four of these the hydronephrosis was bilateral - one showed a spontaneous remission for several months. The fifth was unilateral and cleared up spontaneously and had remained normal for 1 year.

(g) Preliminary dilatation of the lower ureter was noted in two cases which developed whilst under observation (in one bilateral, in the other on the same side)

(h) In 6 of the 10 cases with reflux, hydronephrosis developed during suprapubic drainage - this was the proportion of all cases on suprapubic drainage, so the fact is not considered important except as excluding obstruction as the cause, however, in 2 other cases the patients had more or less constant catheter drainage and the remaining 2 voided with little or no residual urine.

(i) Opinion - Primary etiologic agent is reflux, and as all cases were infected, they considered that, an important secondary factor. If renal infection was the primary agent, initial changes should appear in the calyces and pelvis and not in the lower ureter. Cystoscopy revealed abnormality of the ureteric orifice in these cases; thus reflux is the result of anatomical changes following infection. "The X-ray finding of a trabeculated contracted bladder was characteristic."

(j) Conclusion - chronic cystitis and hypertonicity favour the development of reflux.

COMMENT

The facts that patients with corresponding neurological lesions did not have similar dilatation, that unilateral hydronephrosis occurred with complete transections and the low incidence in the total series deny a neurogenic cause for the reflux. The smallness of the bladder (trabeculated and contracted, and never held more than 150 c.c.) in association with the constant infection suggest an explanation for the reflux - cystitis rendering the uretero-vesical valve incompetent with a ureter entering directly rather than obliquely.

It is known that blockage even of a temporary nature of catheters in these cases may lead to severe attacks of pyelonephritis and DONOVAN (1949), drawing attention to this, states that after development of a reflex bladder and closure of the fistula, "the patient no longer suffers from constant reinfection, attacks of pyelonephritis become rarer ...."

It is unfortunate that TALBOT and BUNTS do not state how long was the period of drainage in these cases, suprapubic in 6, urethral catheter in 2, as compared with other cases in their series on drainage, but not exhibiting the phenomenon, and also if the other 5 cases exhibiting dilatation without reflux were or were not on drainage.

The present writer considers that (1) the reflux may

disappear if the vesical capacity can be increased; (2) if suprapubic drainage is continued for too long a period, irreversible damage to the uretero-vesical mechanism as a result of infection will render it permanent; (3) the decreased incidence of attacks of pyelonephritis following closure of the bladder with establishment of reflex micturition is not due to prevention of reinfection but to return of competence to the uretero-vesical valve; (4) hydronephrosis may develop in spite of drainage in these cases due to repeated minor obstructions to drainage in the presence of an incompetent uretero-vesical mechanism - instanced by occasional squirts of urine through the penis whilst on "free drainage" - and almost certainly in some instances as a result of too energetic vesical irrigation, because it must be remembered the bladder capacity is often less than 30 c.c. The fact that this is unilateral in some cases is fortuitous and due to failure of the mechanism on one side to stand up to the infection. The association of hydronephrosis and a neurogenic bladder is not invariably accompanied by reflux.

RICHES (1943) speaking of neurogenic bladder in spinal injuries stated that the ureter is dilated in some cases showing a reflux, but this is commoner in the hypertonic and contracted bladder, and observes that in these cases the intramural ureter is less oblique.

The following cases support this hypothesis but it must be stated that the presence of reflux before operation was not

Fig. 28

Case 107. Neurogenic bladder, disseminated sclerosis, suprapubic drainage of 12 months duration. I.V.P. 19.9.50. Prostatic calculi. The right pelvis does not show till 10 minutes and is hydronephrotic. No excretion on the left is visible till 35 minutes. In later films both kidneys are seen to be hydronephrotic and the ureters are dilated (2 hours)

Fig. 29

Same case as Fig. 28. 20.9.50. Resection of bladder neck and closure of suprapubic fistula on 11.10.50 I.V.P. 16.3.51. Both kidneys excrete well at 5 minutes and there is no dilatation. The calyces are well cupped and it is only in the 25 minute film that the ureters are well shown (25 minutes) Cystogram on 2.3.51 showed no reflux

investigated in any of these exhibiting hydronephrotic changes at that time but it has to be admitted that the only alterations present in the patients are

(a) an increased bladder capacity and

(b) an increased resistance to drainage

Urinary infection is still present in all.

Case 107 12.9.50. Male. 53 years, with a fifteen year history of disseminated sclerosis, admitted with a neurogenic bladder, treated by suprapubic drainage one year previously. Intravenous pyelography revealed prostatic calculi; at 10 minutes the right kidney begins to show up and is hydronephrotic but there is no excretion on the left till 35 minutes. In the later films bilateral hydronephrosis and hydroureter with a small contracted bladder are seen (Fig. 28). Perurethral resection (20.9.50) followed by closure of the suprapubic fistula (11.10.50) was accomplished.

Follow-up examination in March 1951 revealed

(a) Intravenous pyelography. Good excretion from both kidneys at 5 minutes with no dilatation. The calyces are beautifully cupped and it is only in the 25 min. film that the ureters are well shown (Fig. 29).

(b) Cystography - shows an irregular bladder but no reflux

(c) Urine - heavy coliform infection.

Fig. 30

Case 108. Neurogenic bladder with suprapubic drainage - old fracture lumbar spine. I.V.P. 3.3.50. Good excretion both kidneys; the left pyelogram is within normal limits but the right shows early dilatation and hydroureter. Small contracted bladder (30 minutes)

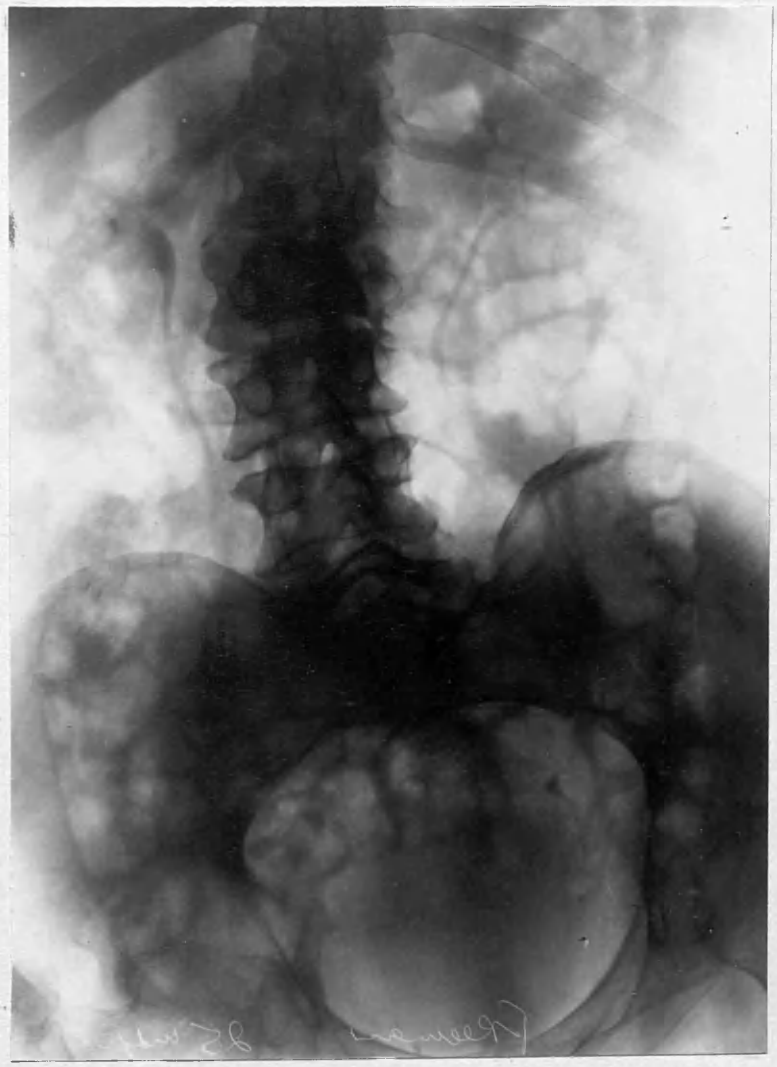


Fig. 31

Same case as Fig. 30. 19.3.50. Resection of bladder neck; the suprapubic fistula closed with catheter drainage. I.V.P. 18.4.50. Satisfactory excretion both kidneys. The dilatation of the right pelvis and ureter is no longer present (25 minutes)

COMMENT

The reflux theory is supported by this case. He had daily bladder lavage through a tube and funnel during the period of suprapubic drainage, and this was sometimes associated with pain in the back. He also passed urine per urethram and pain in both loins was a frequent occurrence apart from lavage.

Case 108 3.3.50. Male. 38 years; admitted with a neurogenic bladder, treated by suprapubic drainage 3½ years previously, due to an old fracture of the lumbar spine with paraplegia and partial sensory loss below L. 1. Operative treatment for a vesical calculus was necessary in October 1948. Intravenous pyelography revealed good excretion on both sides, but whilst the left pyelogram was normal, the right showed early hydronephrosis and hydroureter, and the bladder was contracted (Fig. 30). Perurethral resection (19.3.50) followed by closure of the suprapubic fistula.

A further I.V.P. on 18.4.50 showed good excretion on both sides and both pyelograms were now normal (Fig. 31). Cystography has not been possible; his urine when last examined was still infected.

COMMENT

This patient had bladder washouts twice daily whilst he wore a suprapubic apparatus and these were associated with pain in the back. He never passed urine per urethram but rigors occurred from time to time.

In both these neurogenic bladder cases hydronephrosis present during suprapubic drainage disappeared following perurethral

Fig. 32

Case 109. Neurogenic bladder. G.S.W. sacrum July 1944. I.V.P. 12.1.45. Good excretion on both sides, slight dilatation of the right calyces and ureter whilst the left side shows definite hydronephrosis and hydroureter (45 minutes)

Fig. 33

Same case as Fig. 32 I.V.P. 19.9.50 Good excretion on both sides. There is clubbing of the calyces, greater on the left (20 mimutes). The left ureter is grossly dilated and a lesser degree of dilatation is seen on the right in later films.

Fig. 34

Same case as Fig. 32. Cystography shows on filling a small trabeculated bladder with grossly dilated ureters and pelvis particularly on the left.

Fig. 35

Same case as Fig. 32. Cystography shows on straining a lesser degree of dilatation of the pelves and the right ureter. The resected bladder neck is well shown.

Fig. 36

Same case as Fig. 32. Cystography after micturition shows a small amount of residual urine, contrast medium is present in the lower right ureter and also in the left pelvis and ureter which are less dilated.

Fig. 34

Fig. 35

Fig. 36

resection of the bladder neck and closure of the suprapubic fistula.

Case 109 July 1944. G.S.W. 1st sacral vertebra followed by numbness in saddle area and retention. Suprapubic cystostomy. Bowel control returned 6 months later. December 1944 - exploration showed the cauda equina involved in fibrous tissue. Intravenous pyelography showed a left renal calculus with good excretion on both sides, slight dilatation of the right calyces and ureter whilst the left side showed definite hydronephrosis and hydroureter (Fig. 32). February 1945. Left nephrolithotomy. May 1945 - right ureterolithotomy. June 1947 - intravenous pyelography showed aggravation of the hydronephrosis and hydroureter on the left. This led to exploration of the lower ureter for stricture in December 1947 - it is not clear from the notes if this actually was present. January 1949. Perurethral resection followed by closure of the suprapubic fistula.

19.9.50. Intravenous pyelography shows good excretion on both sides. There is clubbing of the calyces - greater on the left. The left ureter is grossly dilated and a lesser degree of dilatation is seen on the right in later films (Fig. 33).

2.3.51 Cystography. (1) On filling a small trabeculated bladder with grossly dilated ureters and pelves, especially on the left, is seen (Fig. 34) (2) On straining there is a lesser degree of dilatation of the pelves and the right ureter is less

well filled (Fig. 35). (3) After micturition there is some residual urine, the lower right ureter is still indicated and contrast medium is also present in the left pelvis and ureter. Obviously there has been marked contraction of the ureters and they are certainly not atonic (Fig. 36).

The urine is still infected.

COMMENT

1. A long period of drainage (4½ years) preceded perurethral resection and closure of the suprapubic fistula.
2. Operation on the lower left ureter may have been an error - the etiological factor being reflux.
3. There is a very slight suggestion of competency of the ureterovesical mechanism on the left, in spite of the operative interference and on the right there is also a slight degree of competency indicated by less dilatation of the pelvis and failure of the complete ureter to show in the straining film compared with that in the filling exposure.
4. The bladder is still of very small capacity.

In case 110, also a cauda equina lesion, the bladder was drained for an equally long period but it now has a greater capacity. This raises the question if gross reflux such as this can in any reflex manner prevent increase in bladder capacity.

Fig. 37

Case 110. Neurogenic bladder with supra-pubic drainage; G.S.W. cauda equina. I.V.P. 24.10.47. Calculus right upper calyx. Good excretion both kidneys; both ureters are dilated (25 minutes)

Fig. 38

Same case as Fig. 37. 4.10.48. Resection of bladder neck and closure of suprapubic fistula on 29.10.48. I.V.P. 12.3.51. Good excretion both kidneys, the left pyelogram appears more nearly normal, the right is unchanged. The left ureter is much less obvious and is also less dilated (35 minutes)

← Fig 39

Same case as Fig. 37. Cystogram 16.3.51. On filling slight trabeculation is shown and the right pelvis is filled.

Fig. 40 →

Same case as Fig. 37. The straining film shows the resected bladder neck. Contraction of the right pelvis is shown and the ureter is seen to be dilated.

Case 110 (Reported by DONOVAN (1949)) 1944 G.S.W. cauda equina, treated by suprapubic drainage. October 1947 I.V.P. Calculus upper calyx right kidney. Good excretion both sides. Lower calyces of the right kidney are crowded together, normal left pyelogram but both ureters are dilated (Fig. 37). Several admissions for litholapaxy and also removal of calculus from right kidney associated with perinephric abscess and necessitating temporary nephrostomy. October 1948. Perurethral resection and closure of suprapubic fistula.

March 1951.

(a) Intravenous pyelography. Good excretion both sides, the left pyelogram is normal but the right suggests chronic pyelonephritis, and the right ureter is dilated (Fig. 38).

(b) Cystography. 1. Filling - slight trabeculation of the bladder, the right pelvis is filled but ureteric filling is incomplete (Fig. 39). 2. Straining - the resected bladder neck is well shown; the ureter is seen to be dilated but the renal pelvis has contracted (Fig. 40). 3. After micturition the bladder contains a small amount of residual urine.

(c) Urine - heavy growth of atypical proteus Morgani.

COMMENT

1. A long period of drainage (over 4 years), the repeated formation of vesical calculi suggests it was imperfect, preceded perurethral resection and closure of the suprapubic fistula.

2. The dilated ureters seen in 1947 suggest that reflux might have been present at that date on both sides.

3. The pelvic contraction present in the straining cystogram suggests that some degree of competency of the uretero-vesical mechanism is present, as this phenomenon has not been observed in other cystograms such as the reimplantation ones where there is complete absence of the uretero-vesical mechanism.

Case 111 Familial spastic paralysis. Neurogenic bladder with suprapubic drainage of two years duration. Intravenous pyelography showed good function and no evidence of dilatation before or after perurethral resection with closure of the suprapubic fistula. Bladder lavage in this case was carried out twice weekly during the period of drainage and was never associated with pain in the back nor did the patient ever have rigors. Recent cystography - no reflux. Urine - infected.

Case 112 Spastic diplegia with incontinence. Pyelograms before and after perurethral resection have been normal; at no time has he had a suprapubic cystostomy. Recent cystography shows no evidence of reflux. The patient carries a large amount of residual infected urine.

In the discussion on TALBOT and BUNT'S paper, EMMETT suggested

that the incidence of hydronephrosis in the absence of renal calculi in paraplegics was higher than the 5% in their series. He also suggested that the cause might be hypertrophy of the detrusor muscle obstructing the ureteric orifice.

JACOBSON (1945) following experiments on dogs concluded that dilatation of the upper urinary tract was due to obstruction probably from the detrusor and not to reflux as the latter was frequently absent.

COMMENT

If this conception were correct it surely means that the reflux is secondary to the hydronephrosis and hydroureter, and no evidence is available that primary hydronephrosis and hydroureter do result in secondary reflux.

Two recent cases, one a cauda equina lesion with an autonomous bladder and the other a cord lesion with an automatic bladder, have both had gross, bilateral hydronephrosis without reflux. Perurethral resection in the first has been carried out but it is too early to assess the result on renal outline, and the second is still under treatment. These cases indicate that reflux is not a necessary accompaniment of hydronephrosis.

In 1948 TALBOT suggested that in neurogenic bladder cases one should aim at a vesical capacity of 8 or 10 ounces and considered that a greater distension than 12 ounces might encourage ureteral reflux.

COMMENT

This is probably incorrect.

1. If the ureteral orifice is incompetent reflux will occur irrespective of the amount the bladder holds.

2. Over-distension in man does not appear to lead to reflux in the presence of a competent mechanism and can only increase the obliquity of the ureter.

[illegible] noted at operation but not dealt with, is [illegible], whilst the fifth shows no evidence of obstruction.

Of the 18 cases showing unilateral reflux, fifteen showed no evidence of obstruction; one had a loop resection at operation; one had evidence of a bladder neck obstruction and one had a urethral stricture under treatment. The one bilateral reflux also had a loop resection.

Reflux became apparent on the "normal side" on the [illegible] case and after straining in one.

[illegible] cases

One has a persistent urinary infection, the other

10. Bilateral Reflux following partial cystectomy with unilateral reimplantation

Cystography was performed in 31 cases and the reflux was bilateral in 7 (5 men, 2 women), unilateral in 21 (18 men, 3 women) absent in 3 (1 man, 2 women).

Men - 5 cases

The urine was infected in 4 of these and sterile in the fifth. This compared with an incidence of infection among the 18 cases showing unilateral reflux of 11, whilst 7 were sterile.

Loop resection of the prostate was performed at the time of operation in two (includes the case with sterile urine) and an obstruction noted at operation but not dealt with, is present in two, whilst the fifth shows no evidence of obstruction.

Of the 18 cases showing unilateral reflux, fifteen have no evidence of obstruction; one had a loop resection at the original operation; one has evidence of a bladder neck obstruction, and one has a urethral strioture under treatment. The case showing no reflux also had a loop resection.

Reflux became apparent on the "normal side" on filling in 4 cases and after straining in one.

Women - 2 cases

One has a persistent urinary infection, the other although now sterile had a fairly persistent pyocyaneus infection.

In both cases the reflux became apparent on the "normal side" after micturition.

COMMENT

No conclusive statement can be made regarding the cause of reflux in these cases but the incidence of infection was higher and bladder neck obstruction treated or untreated was more frequent in the group with bilateral reflux than in that with unilateral.

It is probably due to a combination of the following factors:

(a) In some of the partial cystectomies, and this is not always clear from the records, the line of excision passed very close to the remaining ureteric orifice.

(b) In BARKSDALE and BAKER'S work on dogs, they attributed reflux on the non-operated side in some experiments to distortion of the ureter by scar tissue at the base of the bladder.

As trigonal damage is present in all cases of partial cystectomy with reimplantation this cannot be the main factor in these cases.

The damage appears to be severe in that the reflux occurred on filling in four of the five male cases and was greater or as great in later films. Reflux, presumably of similar origin has been noted in at least 2 cases of partial cystectomy without reimplantation of the ureter.

11. Reflux after Operative Procedures in the Vicinity of the Uretero-Vesical Junction

MILLIN (1949) reported a case of congenital megaloureter in a child, aged 5 years, treated by lateral anastomosis between the ureter and the bladder, after its failure to respond to pre-sacral neurectomy. He states "The ureter does not appear to become completely normal but the renal function is improved and pain disappears. Reflux, too, is non-existent or minimal". In view of the cystographic findings in this series of reimplantation of the ureter the latter statement is surprising and suggests that either the anastomotic channel is strictured or that the cystographic technique was inadequate. RITTER and KRAMER (1944) advise a transvesical meatotomy in cases of hydronephrosis due to meatal stricturing and state that after lateral anastomosis the ostium frequently closes over.

No cases of lateral vesico-ureteral anastomosis have been reviewed, but in case 114, meatal stricture of the ureter necessitated a transvesical meatotomy with suture of the mucosa of the ureter to that of the bladder, and in this case reflux is present on cystography on filling and shows increased dilatation on straining as one would expect.

ORR (1950) reports two cases in which he carried out a similar procedure and in both vesico-ureteral reflux followed operation. It is amusing to note that indwelling urethral catheters size 26F to prevent stenosis of the new orifice were left in situ for three weeks.

PAPIN has stated that operations damaging the ureteric orifice do not allow reflux, but obviously from the foregoing case reports this statement is much too sweeping and if the intramural ureter is damaged, reflux occurs.

In view of the frequency with which megaloureter is associated with reflux it is desirable to exclude this prior to operation on the ureteric orifice in these cases; however, even if reflux is present the efficiency with which the ureter and pelvis empty must be assessed, as if this is delayed, some form of local operation might still be justifiable.

12. Reflux in Pregnancy

Reports in the literature are contradictory.

Experimental Evidence

BARKSDALE (1931) was unable to demonstrate reflux in seven dogs which were not pregnant, but in six pregnant dogs he demonstrated bilateral reflux at similar pressures in five; in three of these further examination, after the uterus was emptied naturally, revealed that the reflux was no longer present; the remaining two were not re-examined.

He suggested that reflux was due to change in the angle at which the ureter entered the bladder.

Clinical Evidence

EISENDRATH et al (1925) found no evidence of reflux on cystography, after filling, in 41 pregnant women.

DUNCAN and SENG (1928) were unable to demonstrate it in 78 cases examined at various stages of pregnancy and the puerperium, but their technique is open to criticism. The bladder was filled to capacity with sodium iodide solution and the patient placed in the exaggerated Trendelenburg position for 10 minutes when a cystogram was exposed. They state that reflux had been demonstrated by GAUSS (1906) and STOEKEL (1924, 1925).

They drew attention to trigonal changes in pregnancy, claiming that it is broadened, elongated and elevated and that prominence of the interureteric bar leads to a bas fond. These changes have disappeared by the 9th post partum day.

CORDONNIER (1945) quotes DIETEL as being unable to demonstrate reflux in 50 cases.

LUCHS (1927) reviewed 60 healthy pregnant women and noted reflux in three of four cases with marked dilatation of the ureter. It is not clear from his account what proportion of cystographic examinations this constituted. He considered the reflux was secondary to the ureteral dilatation.

HOFBAUER (1928), who had previously demonstrated the presence of reflux in the later months of pregnancy, reported the following changes in pregnancy from post-mortem examinations.

Hyperplastic and hypertrophic changes were present in the ureter, much less in the abdominal portion than in the pelvic, and most pronounced in the juxtavesical ureter, where there was excessive hypertrophy of the ureteral sheath. Its diameter alone often exceeded that of the ureter itself, and he considered that it led to rigidity of the lower ureter.

He also noted hypertrophy and hyperplasia in the groups of ganglion cells between the muscle bundles of the bladder and also at its periphery where the ureter traversed it.

He found definite thickening of the trigone muscle with marked interureteric bar formation and considerable development of the external sphincter which he considered was part of the hypertrophic changes in the entire muscle structure of the pelvic floor which occur in pregnancy. All these changes disappeared in the puerperium.

He concluded that the ureteral muscle changes contributed to

obstruction of the upper urinary tract and that the trigonal changes might lead to bladder neck obstruction. The frequent occurrence of residual urine in pregnant women was regarded as complementary evidence of this. "In searching for an adequate explanation for the insufficiency of the ureteral orifice, I would refer to the peculiar structural changes occurring in the intravesical portion of the ureter and in the ganglion-apparatus as well."

BAIRD (1936) was unable to demonstrate reflux in 7 women during the puerperium but he succeeded in demonstrating it in one other case.

COMMENT

1. Review of the literature suggests that cystography with an adequate technique will demonstrate reflux in a small proportion of pregnant women and that this may be expected to disappear in the puerperium.

2. It is not the cause of hydronephrosis and hydroureter in pregnancy, as the bladder capacity is undiminished, and in the absence of infection no abnormal frequency is present, thus dilatation would not occur secondarily to reflux.

3. It presents a route for ascending infection.

4. The mechanism of its production is unlikely to be secondary to ureteric dilatation as apart from the fact that this is not a usual cause of reflux, the juxtavesical ureter is not involved in the dilatation.

5. The trigonal hypertrophy suggests that loss of synergism with detrusor contraction may be the etiological factor. This would

be aided by cystitis and the hypertrophied Waldeyer's Sheath may be partly responsible.

13. Other Views on Reflux

STOPPATO, quoted by BARTRINA, has suggested that a deficiency of certain muscle bundles on the inferior wall of the ureter prevents it flattening - this is the tightening bundle - and leads to reflux.

CAMPBELL (1937) has suggested that neuro-muscular disease of the vesical outlet is a cuase. He also states that some think that spastic contracture of the bladder is a common cause of reflux and that "the uretero-vesical valves are held open by the spastic vesical musculature", but considers that this is disproved by the occurrence of reflux in atonic bladders, however, he goes on to say that he has seen children with enormous bladders and no evidence of reflux. This suggested mechanism seems rather extravagant.

HERBST (1925) suggested that inability to get fluid from the bladder through a vesico-colic fistula, except in the case of those situated on the posterior wall near the neck, indicated that the muscular coat of the bladder plays an important part in the prevention of reflux.

FEY et al (1949) appear to be of the opinion that ureteral peristalsis is a large protection against reflux and that so-called passive reflux occurs through a gaping meatus in the presence of an atonic ureter.

COMMENT

It is obvious from this series that ureteral peristalsis is no protection against reflux.

SYMPTOMS

The following are attributed to cases exhibiting vesico-ureteral reflux but there is no doubt that only a small proportion demonstrate them.

Pain in the loin, which may be worse immediately prior to micturition, especially if the act be postponed when the desire has manifested itself, and it is sometimes said to be worse when the patient is in bed, perhaps for the reason that desire is ignored. The patient may complain of pain passing from the iliac region up into the loin on micturition; this sign when present is probably pathognomonic.

Case 115 This patient complained of pain of some months duration in the left loin on micturition, and had been investigated elsewhere by both a urologist and a physician who had ascribed his symptoms to fibrositis. 22.7.51. Cystoscopy showed slight bladder neck obstruction; both ureteric orifices appeared normal. Subsequent cystography showed a complete left reflux on straining. This was not visible on the filling film. Intravenous pyelography shows good function and normal outline of both kidneys.

The disappearance of these symptoms is no indication that the reflux has discontinued.

Case 116 Male. 30.9.50. Cystoscopy showed two papillomatous tumours, clinically malignant, but biopsy did not confirm this, however, a course of deep X-ray therapy was given. As the neoplasms did not respond, partial cystectomy was performed on 24.3.51

without disturbance of the ureters. The subsequent report was adenocarcinoma. A pre-operative intravenous pyelography showed diminished function on the right side with some lengthening of the calyces and loss of cupping and although compression had been applied there was no dilatation on this side, but on the left side where the outline was normal, dilatation secondary to compression could be easily detected. 25.6.51. Follow-up cystoscopy showed a gaping R.U.O. and the patient stated that after discharge from hospital he had noted pain in the right side when the bladder was full, which disappeared with micturition. Further intravenous pyelography confirms the presence of early chronic pyelonephritis on the right. Cystography shows primary filling reflux with increased dilatation on micturition. The urine before partial cystectomy was free from pus and sterile on culture on two occasions, but now contains an occasional pus cell and a heavy growth of coliform organisms.

COMMENT

This case demonstrates that disappearance of "reflux pain" does not indicate that the reflux has disappeared. Changes suggestive of chronic pyelonephritis were present with a sterile urine prior to operation. It is not known if reflux was present at this time but it seems very likely that it was, thus indicating the pyelographic picture given by reflux in the absence of infection.

The pain may be associated with a rise of temperature or even rigors.

Case 81 This patient has occasional pyrexial attacks with pain in the kidney on the regurgitating side; normally her urine is uninfected.

COMMENT

This may be due to fresh attacks of ascending infection, but is more likely due to recurrent bouts of chronic pyelonephritis.

BARTRINA has claimed that reflux may give rise to retention in some cases, and in others to frequency or even incontinence. It seems much more likely that these disorders are symptomatic of the condition giving rise to reflux, than due to it.

REGURGITATION RENAL COLIC

LEWIS (1926) drew attention to colic occurring in the presence of lower urinary tract obstruction, such as enlarged prostate, bladder neck obstructions or urethral stricture. He claimed that this was alleviated by removal of the obstruction and that it was due to reflux. In 1932 he reported a further 9 cases but the condition was still unsupported by cystographic evidence and it was suggested that passage of a catheter to demonstrate it by cystography would be unsuccessful as the obstruction would then have been relieved! BUMPUS (1932) in the succeeding discussion disagreed and considered the colic was due to intramural ureteric obstruction. LEWIS (1934) reported further cases, some supported by X-ray evidence, and suggested that the colic was due to ureteral and pelvic distension secondary to the reflux which he claimed could occur in the presence of either a pathological or normal ureterovesical mechanism. CORDONNIER (1945) reported two cases of renal colic in the presence of reflux.

COMMENT

In none of the cases in this series either reimplants or other reflux cases, has there been a history of renal colic and if it does occur it must be rare. It is admitted that patients may complain of the other symptoms described above but they are not a usual accompaniment of reflux and although practically all the cystograms show further distension of the pelvis on straining or micturition compared with the filling film, this has not been associated with

pain during the examinations at any time. PAPIN (1930) has also observed that "active reflux" can be quite painless.

Against this evidence, it must be admitted that colic may follow ascending pyelography (with a competent valve) when over-distension of the pelvis has taken place, but in this case the intra pelvic pressure is probably higher as backflow is usually visible.

[illegible] passed all her urine through a lumbar fistu[illegible] nephrectomy for pyonephrosis and [illegible] (1916) quot[illegible] following nephrectomy for a tuberculous kidney.

[illegible] (1939) and [illegible] (1941) advise neph[illegible] in all cases with hydroureter and an incompetent ureter[illegible] relief in view of this risk.

URETERIC FISTULAE due to REFLUX

POZZI (1893) reported a case of ureteric fistula following damage to the ureter during removal of a broad ligament cyst in which all urine from both kidneys passed through the fistula. MODLINSKY (1894) injured a ureter during hysterectomy and the patient subsequently passed all her urine through the resulting fistula. At a subsequent post-mortem examination the urinary tract appeared quite normal with the exception of the ureteral injury.

Several cases have been reported of ureteric fistulae following nephrectomy, usually for pyonephrosis, and LEGUEU and PAPIN (1914) list several of these. MODLINSKY (1911) had a patient who passed all her urine through a lumbar fistula following nephrectomy for pyonephrosis and KRETSCHMER (1916) quoted a case following nephrectomy for a tuberculous kidney.

KIMBROUGH (1939) and GUTIERRIEZ (1941) advise nephroureterectomy in all cases with hydroureter and an incompetent uretero-vesical valve in view of this risk.

S I G N S

There may be none, or tenderness may be elicited over the affected kidney, which in the presence of hydronephrosis or pyonephrosis may be palpable, or over the ureter on abdominal examination or pelvic examination.

Blood pressure estimation to exclude the possibility of hypertension due to unilateral renal disease is desirable.

CYSTOSCOPY

This has been mentioned already. The orifice may gape, suggesting the possibility of reflux, but not all gaping orifices exhibit the phenomenon (cases 92, 93, 94 and 106) or, it may appear entirely normal. Indigo carmine excretion shows a normal type of efflux but of course its excretion is related to the kidney function.

UROGRAPHY

Intravenous urograms may show an entirely normal picture; there may be diminished function on the affected side; the kidney may be hydronephrotic with hydroureter or the pelvis may be contracted and show the changes of chronic pyelonephritis; the lower ureter alone may be dilated but this can occur of course without the presence of reflux.

CYSTOGRAPHY

It is essential that exposures be made on filling, and during or immediately after micturition - an exposure on straining does not replace the micturition picture.

The technique adopted in this investigation has already been described. KRETSCHMER (1916B) drew attention to the fact that regurgitation might be absent on filling and present on straining. EISENDRATH et al (1925) in their series took two films, one after 5 ozs. (150 c.c.) and a second after 8 ozs. (240 c.c.) but do not mention if films were taken on straining or micturition. ASCHNER (1928) adopted the same technique as EISENDRATH with the addition of a further film after emptying the bladder and inflating it with 5 ozs. (150 c.c.) air. It is of interest to note that he found that the occurrence of reflux was not constant and that it might be present at one examination and not at another - perhaps this was due to the patient straining on one occasion and not on another.

DOURMASHKIN (1925) stated that 50 - 75 c.c. was a sufficient volume to demonstrate reflux. Although a very small amount may be sufficient to demonstrate the phenomenon in some cases (e.g. PRATHER'S (1944) case, where regurgitation occurred on urethrography with lipiodal), it is considered that the bladder should be more distended so that a film can be taken during micturition, which is much more likely to be possible with a reasonably well-filled bladder and in practice no ill effects have been observed from 10% sodium iodide in a volume of 10 ozs. BARTRINA advised that a cystogram

be taken on micturition.

LEPOUTRE (1930) suggests that cystography may cause an ascending infection and even death. If fresh infection is not introduced at the examination no danger should attend the examination as if reflux is present it must be occurring regularly.

REFLUX FUGAX

GRAVES (1927) drew attention to the fact that reflux may be missed by the usual type of cystography and said that he had observed it on screening, and de SOUZA (1949) in his article on radiokymography illustrates a technique by which repeated exposures are made on a moving film, and claims that by this method this type of reflux can be observed.

In this investigation, it has been obvious that in patients who have been unable to micturate whilst on the table, there has been every possibility of missing a reflux between the time of the patient emptying the bladder and the succeeding film being exposed.

URINE

Examination should include repeated cultures as probably the presence or absence of infection is the deciding factor in prognosis.

PROGNOSIS IN THE PRESENCE OF REFLUX

Experimental Surgery

DRAPER and BRAASCH (1913) slit the ureteric meatus in dogs and in some introduced insoluble foreign bodies, infected with autogenous b. coli, into the bladder before closing it. Their histological findings were negative in the kidneys of both groups although the bladder urine contained pus cells and organisms.

COMMENT

As they were unable to produce reflux after destruction of the animals their operation on the meatus was inadequate.

QUINBY (1922B) quotes LEWIN and GOLDSCHMIDT having filled the bladder with a solution containing hydroxylaminechlorhydrate. This produces methaemoglobin, and 8 minutes after reflux this was present in the blood in the mesenteric vessels and the animal died 10 minutes after injection of the fluid into the bladder.

GRAVES and DAVIDOFF (1923) carried out some of their reflux experiments with Indian ink in the bladder solution and later found traces of it in the lungs, liver and spleen as well as the kidneys.

GRUBER (1930) excised the ventral part of the uretero-vesical valve in 16 dogs and 2 cats. They were examined 45 to 228 days later. He concluded that as a result of this procedure hydroureter developed, but the activity of the ureter did not appear to be altered by dilatation. He considered that the lack of agreement with the findings of BRAASCH and DRAPER was due to their examinations

having been carried out too soon and considered that in female dogs, where emptying occurs at a lesser pressure than in male dogs, due to the urethral differences, a longer interval was necessary for the changes to develop. In males marked changes were present at 2 months, compared with 5 months in females. He also considered that their excisions might have been inadequate.

GRUBER and RABINOVITCH (1930). The ventral part of the uretero-vesical valve was excised and the animals preserved for 41 to 228 days and in the interval B. coli were introduced into the bladder repeatedly under pressures of from 22 to 100 mm Hg (quite sufficient to produce reflux). The animals were examined 24 hours after the last injection. Blood cultures were always negative.

Changes in the Bladder

15 animals	11	-	patent ureteral orifice
	1	-	complete obstruction
	1	-	partial obstruction
	2	-	incomplete severance of uretero-vesical valve

In many cases the bladder wall was oedematous.

Changes in the Ureters

11 animals	-	dilatation on side of excised valve. Marked in 6, moderate in 3, and slight in 2.
4 animals	-	normal diameter - 2 of these had incompletely severed valves

Little change noted on microscopy of the ureter.

Changes in the Kidneys

Multiple pinpoint cortical abscesses were present in 6 on the side of the cut valve, and in 4 of these on both sides. Microscopy showed severe pyelitis in 11 cases on cut side and a milder infection in 3. The case with the obstructed ureter was excluded from this examination.

Summary

There was a 100% incidence of pyelitis on the side of the ureteral flap excision, severe in 78%. On the other side mild pyelitis was present in 9 cases (60%). Microscopic abscesses were present on the cut side in 7 (50%) and inflammatory changes in a further 3, i.e. kidney infection in 71%, pus and B. coli present in all. On the normal side abscesses were present in 4 cases and inflammatory changes in 1 i.e. kidney infection in 33%, B. coli present in 4 cases.

VERMOOTEN and NEUSWANGER (1934). 10 dogs. Left valve incised in its full length by scissors and the right excised around forceps byscalpel. 1 dog died of peritonitis. Cystograms seven to eight weeks after operation showed reflux in all cases. Ureteral dilatation was present in 2 dogs and in 1 dog it was unilateral. The dilated ureters showed evidence of infection, the undilated did not. They concluded that

(a) regurgitation of uninfected urine did not lead to ureteral dilatation

(b) regurgitation of infected urine up a normal ureter - no change

(c) infection of the ureter may occur from ulceration of the epithelium with spread in the tunica propria and this may reach the pelvis but does not usually extend to the ureteral muscle.

COMMENT

The interval between operation and examination appears to have been too short for ureteral dilatation to have become apparent in a greater number of cases.

Published Clinical Observations

BUMPUS (1924) observed that pyrexia on closure of the bladder following suprapubic cystostomy is attributed to reflux by some (QUINBY 1922B). He concluded from his series of cases that chronic urinary reflux does not in itself impair renal function - this opinion was quite unjustifiable. BARTRINA (1935) gives a poor prognosis in cases of bilateral reflux. CAMPBELL (1937) states that reflux from an infected bladder does not always cause immediate infection. KIMBROUGH (1939) reported nephroureterectomy in a functionless kidney showing reflux. The ureter was 2 cms. in diameter and the kidney was half the normal size.

Personal Observations

The reimplanted ureter cases particularly demonstrate the changes resulting from reflux, and these observations are supported by cases described in this section of the paper.

URETER

Dilatation of the lower ureter occurs pretty constantly and eventually the whole ureter is affected and in some cases there is marked tortuosity.

KIDNEY

In cases where reflux has been present for a considerable time in association with infection and a bladder of normal capacity the kidney is small and shows chronic pyelonephritis; the calyces being blunted, their necks broadened but no marked dilatation of the pelvis occurs. Hydronephrosis occurring in reimplanted ureters where the bladder is of normal capacity is probably the result of stricturing secondary to tension at operation as described by MORRIS (1901) and illustrated by case 22, as hydronephrosis present prior to operation, if of short duration, may improve following it.

Case 70 Reimplantation of the left ureter for ureterovaginal fistula. Prior to operation definite hydronephrosis but six months after operation this was no longer evident. There was a similar improvement in case 81 where a ureterocele was associated with hydronephrosis which improved in spite of reflux following operation.

Hydronephrosis due to obstruction in a ureter exhibiting

Fig. 41

Case 73. 15.6.48. Ligation of ureters at pelvic brim during hysterectomy followed by left nephrostomy 30.6.48. Reimplant of left ureter into bladder by Boari's method. 7.12.48 I.V.P. shows hydronephrosis and hydroureter on reimplanted side secondary to ureteric calculi at site of implant. 45 minutes.

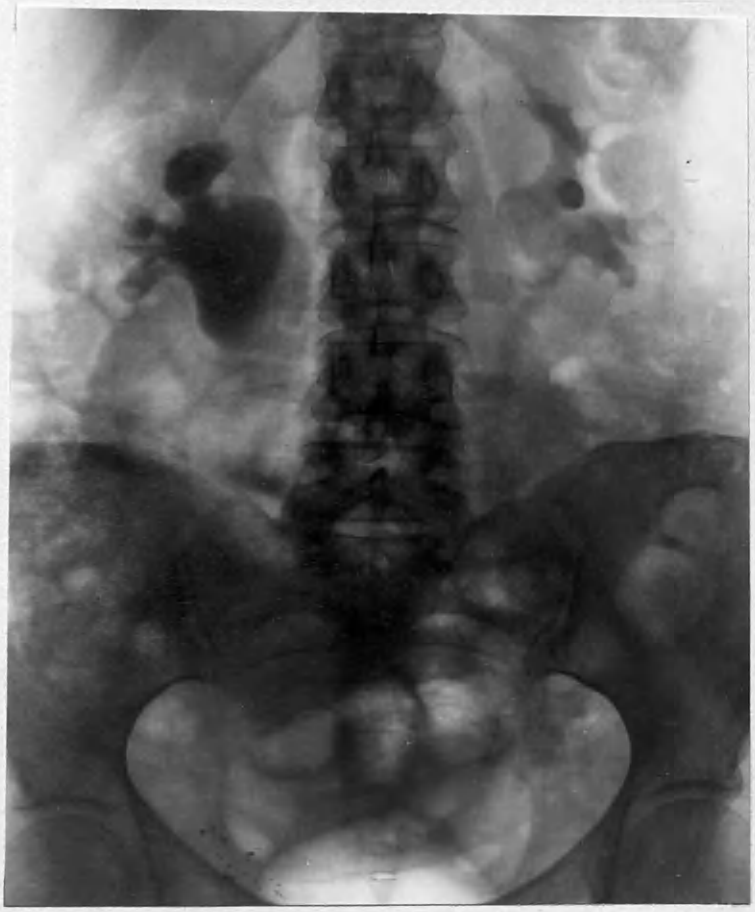


Fig. 42

Same case as Fig. 41. 12.12.48. Left ureterolithotomy. 10.1.49 I.V.P. shows considerable improvement in the hydronephrosis and hydroureter previously present (12 minutes)

reflux may improve following relief of the obstruction although the reflux persists.

Case 73 Reimplantation of the left ureter in the bladder by Boari's method (30.6.48) was followed by calculus formation in the lower ureter complicated by gross hydronephrosis and hydroureter 7.12.48 (Fig. 41). This responded to a considerable degree following uretero-lithotomy (12.12.48). I.V.P. 10.1.49 (Fig. 42).

It has been suggested by Talbot and Bunts that hydronephrosis in the absence of calculus in paraplegic cases is due to reflux and improves if the latter disappears. Although this has not been proved by pre-operative cystograms in this series of cases there is strong circumstantial evidence to support it.

Whilst the etiology of the hydronephrosis may be urinary infection it is most unlikely that this is the real cause as almost all the reimplanted ureter cases have a urinary infection. The main factor seems to be that whilst the latter have had a bladder of normal capacity - practically all held 10 ozs (280 c.c.) the neurogenic bladders with drainage in which hydronephrosis has been evident, have had a very small capacity, and intermittent obstruction of the suprapubic tube is the probable cause. This seems likely when it is recalled that compression in intravenous pyelography leads to temporary dilatation whilst in use and presumably repeated obstructive insults may give permanent change.

In the neurogenic bladder case 109 in this series in which

Fig. 43

Case 117. Tuberculosis right kidney - nephrectomy 31.3.49. 7.5.51 shows small contracted bladder and commencing left hydronephrosis

Fig. 44

Same case as Fig. 43. Partial cystectomy with reimplantation of left ureter. 2.5.51 I.V.P. 9.7.51 shows increased hydronephrosis

bilateral reflux with gross hydronephrosis and hydroureter is present following closure, it is noteworthy that the vesical capacity is limited.

In the tuberculous case (96) with gross hydronephrosis and hydroureter in the presence of reflux, the bladder is also small.

In these cases it seems likely that frequent attempts at micturition result in repeated distension of the upper renal tract with resultant permanent dilatation. This is supported by the fact that case 110 whilst showing a reflux in the presence of a neurogenic bladder does not show gross hydronephrosis; both his bladder capacity and his frequency of micturition are within normal limits. It must be admitted, however, that the incompetence of the mechanism appears to be incomplete in this case.

Case 117 also supports this theory. This boy underwent right nephrectomy for renal tuberculosis on 31.3.49. He subsequently developed a small contracted bladder with commencing hydronephrosis and hydroureter on the left side (I.V.P. 7.5.51 (Fig. 43)) in spite of the fact that streptomycin and P.A.S. had succeeded in clearing tubercle bacilli from his urine. His frequency at that time was every 30 minutes. Cystography was not carried out. Partial cystectomy designed to remove the abnormal portion of his bladder was performed on 10.5.51 and necessitated reimplantation of his ureter. Subsequent intravenous pyelography, 9.7.51, showed some increase in dilatation of the left hydronephrosis (Fig. 44).

Fig. 45

Case 118. Extensive partial cystectomy for carcinoma of bladder with reimplantation of left ureter. The bladder was exceedingly small after operation. I.V.P. 26.7.51 shows bilateral hydronephrosis.

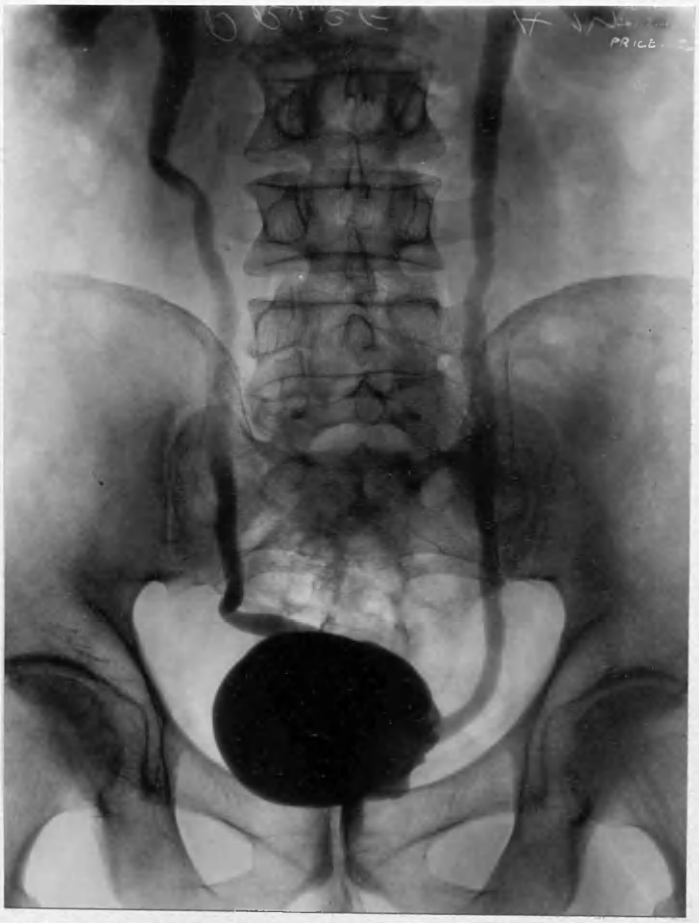


Fig. 46

Same case as Fig. 45. Cystogram 26.7.51. Bilateral reflux on filling with dilatation of both ureters; unfortunately the kidneys are not included in the film. The bladder only held about 170 c.cs.

Fig. 47

Same case as Fig. 45. On micturition bilateral hydronephrosis is apparent.

COMMENT

It is of interest to note that the degree of hydronephrosis now present is very little greater than that present with compression prior to operation, but shows considerable aggravation compared with the condition after relief of compression.

It must be admitted that the interval since operation is short and the further dilatation may be a temporary result of operation but I consider that if the capacity of the bladder does not increase it will be aggravated.

Frequency has been improved in this case but comparison of the bladder shadows suggests that the ureter and pelvis now give the increase in capacity.

Case 118 Carcinoma of bladder, 29.1.51. Extensive partial cystectomy with reimplantation of the left ureter. Following operation the bladder was the size of a finger cot. His convalescence was uneventful apart from some delay in closure of his suprapubic fistula. Discharged 9.4.51. Cystoscopy 23.7.51 showed no evidence of recurrence. The orifice of the reimplanted ureter gaped and the other orifice was not localized. Urine: no pus; no growth.

I.V.P. showed marked hydronephrosis and on cystography there was a bilateral reflux on filling with increased dilatation on micturition. (Figs. 45 - 47)

COMMENT

Unfortunately, a pre-operative I.V.P. was not carried out but as cystoscopy prior to operation showed no residual urine it is unlikely that the growth had given rise to bilateral hydronephrosis. The combination of a small bladder - on cystography it held about 170 c.c. - and the presence of reflux with hydronephrosis lends further support to this theory.

A review of published cases indicates that gross degrees of upper tract dilatation in the presence of reflux are usually associated with a bladder of small capacity. (HEPBURN, (1919), LAWRIE (1922), GUTIERREZ (1941) and PRATHER (1944)).

In assessing the prognosis in cases with reflux it must be noted that renal function as indicated by intravenous urography is often good in cases where the kidney is small and contracted but obviously its reserve is limited, if existent.

Hydraulic Distension

YOUNG (1898) advocated this in the treatment of urinary infection associated with reduced vesical capacity (30 - 140 c.c. in 6 reported cases). He concluded that as ascending infection had not supervened following therapy, that the uretero-vesical valves were competent and reflux had not occurred and supported this with his failure to produce reflux in human cadavers and dogs on forced distension. Later, in a discussion on SAMPSON'S paper (1903), the latter had warned against this treatment, he said that his clinical experience in the past 5 years had shown conclusively that reflux did not occur even on very forced distension of the bladder.

COMMENT

In view of the facts that (a) reflux is not uncommon in bladders of small capacity; (b) clinical evidence of reflux is usually absent; and (c) reflux of infected urine is not necessarily associated with clinical evidence of ascending infection, Young's evidence is invalid, and the wisdom of this form of therapy, if high intravesical pressures are attained and the urine is infected, is doubtful to say the least, in spite of his claims. GAYET (1930) and PASTEAU (1930) also pointed out that the introduction of large amounts of fluid into small bladders may be followed by reflux.

TREATMENT

If the uretero-vesical mechanism is severely damaged as in cases due to surgical trauma, some cases of tubercle and other infections, probably no treatment will prevent occurrence of vesico-ureteral reflux.

Urinary infection must be energetically treated and lower urinary tract obstructions such as enlarged prostate, other forms of bladder neck obstruction and urethral stricture require the appropriate surgical procedures. Complicating conditions such as vesical diverticulum or calculus must also be eliminated. Urinary antiseptics, sulphonamides and antibiotics should be utilized, according to the sensitivity of the organisms, but experience in treating the infection present after reimplantation suggests that these will not always succeed, perhaps because the infection is entrenched in the prostate or the kidneys. BRAASCH (1939) has pointed out that elimination of pus from the urine in cases of chronic pyelonephritis is no indication of cure. Repeated cultures are necessary to assess the results of treatment.

Bilharziasis should be treated with antimony preparations. No published report on its effect on reflux has been traced, but obviously in later cases with associated calcification it will be ineffective.

Tuberculous bladder infection after nephrectomy in cases with unilateral renal disease requires long-continued therapy with streptomycin and P.A.S., but this may still leave the patient with

a small contracted bladder exhibiting reflux. In some cases the dilatation of the ureter may suggest stricture formation at the uretero-vesical junction and bouginage be considered. As this can only aggravate reflux, cystography should be carried out prior to its performance. Plastic operations such as anastomosis of an ileal loop or a caecal segment to the bladder in an attempt to gain increased capacity have been recommended. It seems likely that these will also diminish the ill effects of reflux by decreasing the frequency of micturition, and their utilization may be justifiable in other cases exhibiting reflux, complicated by hydronephrosis, in the presence of a bladder of limited capacity, but if long delayed the renal changes will almost certainly fail to respond. JACOBS (1949) has reported favourably on transplantation of the ureter of the solitary kidney in tuberculous cases with upper tract dilatation, where the ureter is not infiltrated. He states that neither a minor lesion of the kidney nor dilatation of the ureter are deterrents.

In neurogenic bladder cases closure of suprapubic fistulae with perurethral resection of the bladder neck as advocated by EMMETT appears to be desirable at a fairly early period after the establishment of a reflex bladder.

Reimplantation of the ureter has been recommended but the findings reported in the first part of this paper illustrate the uselessness of the direct type of operation with this object in view, and review of the literature reveals that indirect

implantation may also be complicated by reflux apart from the fact that stricturing has been reported following it. SAMPSON (1903) reimplanted the ureter in such cases, but stated that the results were uncertain and attributed this to the "diseased" condition of the lower ureter. TALBOT and BUNTS (1949) have also tried reimplantation but do not report their results.

Transplantation of the ureter to the colon may be considered but the long term results of this operation, except in cases of ectopia vesicae perhaps, do not appear to be very impressive.

HIGGINS (1934) has reported a case of unilateral regurgitation colic associated with hydronephrosis and hydroureter treated by transplantation of the affected ureter into the normal ureter (transuretero-ureteral anastomosis) and MOORE (1948) has also advised it. This is heroic treatment and there appears to be every possibility in the event of failure of ruining both kidneys.

Cutaneous ureterostomy is another alternative, and TALBOT and BUNTS (1949) have carried out nephrostomy in some of their paraplegic cases but they state the results were unimpressive.

Plastic procedures on the ureteric orifice seem unlikely to be successful but it is possible that by sliding a mucous membrane strip over the orifice, the reflux, if the strip did not slough, might be diminished, but no doubt the risk of stricture would then be present.

The published programme for the Annual Meeting of the American Urological Association (Journal of Urology, May 1951) includes a

paper on "Vesico-ureteral reflux in the Paraplegic: Cause and Correction", (John A. HUTCH), but this has not yet been published.

In cases necessitating nephrectomy in the presence of ureterovesical reflux, it appears to be desirable to carry out nephroureterectomy, as some cases have been complicated by persistent lumbar fistulae, whilst in others reflux into the blind-ending ureter has led to persistent urinary infection (KIMBROUGH (1939)).

[illegible] ureter and the trigone leads to reflux - this is probably not due to a nervous disturbance but to alteration in their respective attachments as a result of stress.

2. VESICAL PERISTALSIS

This, alone, is not the slightest protection against

3. REFLUX in the NEUROGENIC BLADDER

Circumstantial evidence suggests that this disappears [illegible] increased vesical capacity with establishment of sinuses

CONCLUSIONS

1. CAUSE

Prevention of vesico-ureteral reflux is dependent on the integrity of the protective mechanism of the uretero-vesical junction: uretero-vesical valve, obliquity of insertion, longitudinal coat - trigone structure.

The valve itself is of minor importance. Loss of obliquity leads to reflux in the presence of an inefficient valve.
Disturbance of the synergistic action of the detrusor and the trigone leads to reflux - this is probably not due to a nervous disturbance but to alteration in their respective efficiency as a result of stress.

2. URETERAL PERISTALSIS

This, alone, is not the slightest protection against reflux.

3. REFLUX in the NEUROGENIC BLADDER

Circumstantial evidence suggests that this disappears following increased vesical capacity with establishment of micturition by the normal channel and perurethral resection as described by EMMET, or with the cold punch, is recommended. The period of suprapubic drainage preceding this should be minimal. It is not considered

to be a direct result of injury to the nerve supply of the bladder, and it is not present in all cases showing hydronephrosis.

4. OPERATIVE PROCEDURES in the vicinity of the URETERO-VESICAL ORIFICE

Trauma to the protective mechanism may lead to reflux - repeated perurethral diathermy, suprapubic diathermy or open operations - and operations by-passing it - lateral uretero-vesical anastomosis - result in reflux. Lesser degree of injury, meatotomy with the diathermy meatatome or cystoscopic scissors, is unlikely to be followed by reflux. This is also true of perurethral diathermy on one or probably two occasions but repeated treatment will give reflux. There is some evidence that slitting ureteroceles with cystoscopic scissors is less likely to be followed by reflux than perurethral diathermy destruction in the presence of dilatation of the lower ureter.

5. CYSTOGRAPHY

A definite technique to demonstrate reflux is necessary. Reflux fugax is an entity.

6. CLASSIFICATION

Reflux has been classified - Primary Filling Reflux, Primary and Secondary Straining Reflux, and Primary and Secondary Micturition Reflux.

7. REFLUX PAIN

This is not a common symptom and is usually absent. Its

disappearance in the event of it having been present is no indication that reflux has disappeared.

8. REGURGITATION RENAL COLIC

It seems doubtful if this is an actual entity.

9. URETERIC FISTULA

This may complicate nephrectomy in the presence of vesico-ureteral reflux.

10. HYPERTENSION

The possibility of this condition secondary to unilateral renal disease in the presence of unilateral reflux has not been excluded.

11. URETERAL CHANGES

Reflux leads to hypertrophy and dilatation of the ureter, and eventually, tortuosity.

12. RENAL CHANGES

These may not be apparent in the early stages, but eventually the characteristic changes associated with chronic pyelonephritis become apparent, and I think this is so even in the absence of infection. These are the changes occurring in the presence of a bladder of normal capacity, but if this is diminished hydronephrosis and hydroureter will occur.

13. HYDRONEPHROSIS secondary to URETERIC OBSTRUCTION in the presence of REFLUX

Hydronephrosis present prior to reimplantation of the ureter may improve in spite of the subsequent reflux; and hydronephrosis developing in a kidney exhibiting reflux, secondary to an obstructive lesion, such as stone, if not neglected, will respond to removal of the obstruction.

14. HYDRAULIC DISTENSION of the BLADDER

This is an ill-advised form of treatment in the presence of infection.

15. PROGNOSIS

It is dependent on the presence and severity of urinary infection, and the vesical capacity.

16. NEPHROURETERECTOMY

This is the treatment of choice in the presence of reflux and infection, where removal of the kidney is necessary, as the ureteral remnant may remain as a vesical "diverticulum" leading to persistent urinary infection. Ureteric fistula may complicate simple nephrectomy.

17. TREATMENT

Infection must be controlled. Increase of bladder capacity where this is diminished is advisable. Reimplantation of the ureter by a direct method will certainly fail to cure the condition

and if an oblique method is adopted, there is a possibility that stricture may develop apart from the fact that reflux may still occur. Plastic operations on the orifice are unlikely to be successful. Suprapubic drainage may still be attended by reflux and thus if the renal function is markedly deficient either ureterostomy or nephrostomy appears to be the best line of treatment.

O'CONOR (1925) said that reflux is not new or very interesting. "This is effected by loss of bladder and ureteral muscle as occurs in spinal cord disease or injury or prolonged back pressure from bladder neck obstruction". He goes on to state that regurgitation is the term to use when the bladder and ureteral musculature is obviously normal.

De SOUZA (1949) states "La pathogénie du reflux vésico-rénal est comme chacun le sait des plus complexes, et la littérature sur cette mattière des plus étendues".

Fig. 48

Case 73. Transplantation of right ureter to colon subsequently necessitating operation to relieve stricture of the uretero-colic stoma. 15.2.50. Straight X-ray shows flatus pyelogram - confirmed by subsequent I.V.P. The function of this kidney is relatively good.

COLO-URETERAL REFLUX

Direct anastomosis of the ureter to the colon has been advised by CORDONNIER (1949) and NESBIT (1949) and recently WELLS (1951) has advised against it.

Case 73. The right ureter was transplanted into the colon by Riches' method and subsequent stricture formation led to the performance of a plastic operation on the uretero-colic stoma. Follow-up I.V.P. 15.2.50 showed a flatus pyelogram indicating the occurrence of colo-ureteral reflux (Fig. 48). The ureter was grossly dilated before operation and this is obviously one of the most important factors leading to this finding (this case is being published in an article describing plastic operations in strictured uretero-colic stomata at present in the press - HENDERSON).

WHISENEAND and MOORE (1951) have reported a case where nephrostomy fistulae following direct anastomosis between the ureter and sigmoid discharged faeces and gas.

YOUNG, J. N. (1951) reports a case in which direct anastomosis in the presence of a minor degree of ureteral dilatation was followed by death from uraemia about three weeks after discharge from hospital, in which faeces were present in the kidney pelvis at post mortem.

CONCLUSIONS

These cases and others not yet published (R.S.M. and Jacobs (1951) Annual Meeting of the British Association of Urological

Surgeons) indicate that not even in the colon is the intra-ureteral pressure sufficient to withstand reflux and demonstrate that non-valvular transplantation is probably unwise, if not positively dangerous, in the presence of ureteral dilatation at any rate.

WILKINSON'S (1951) report on biochemical disturbance following transplantation of the ureters in the presence of continence, and the KEKWICK et al (1951) report on Renal Failure following right ureterocaecostomy and left ureterosigmoidostomy relieved by caecostomy suggest that reflux may be responsible for further pathological disturbances.

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