

Section of Urology

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The Ureter, the Gynæcologist and the Urologist¹

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THERE are many problems in connexion with the surgery of the ureter in which team-work between the two specialties of urology and gynæcology is essential (and team-work is the key to good medicine to-day).

This paper is an attempt to bring to the notice of both urologists and gynæcologists some facts perhaps too little appreciated, some problems still awaiting solution, and to illustrate, when possible with case reports, procedures which we have adopted with varying degrees of success. *Our two specialties cannot remain watertight compartments when it is the patient we are endeavouring to make watertight.*

I propose to consider the following aspects of ureteric surgery:

- (a) Congenital abnormalities of the ureter important to the gynæcologist.
- (b) The ureter injured in gynæcological interventions.
- (c) The ureter in pregnancy.
- (d) The ureter in inflammations and benign tumour of the pelvis.
- (e) The ureter in genital prolapse.
- (f) The ureter in carcinoma of the cervix.
- (g) The ureter in anuria.

In considering some aspects of the normal anatomy and physiology of the ureter I shall deal briefly with two points: First, the distribution of the blood-vessels in relationship to the lower end of the ureter, for I find that most postgraduates are singularly untutored in this important piece of applied anatomy (fig. 1).

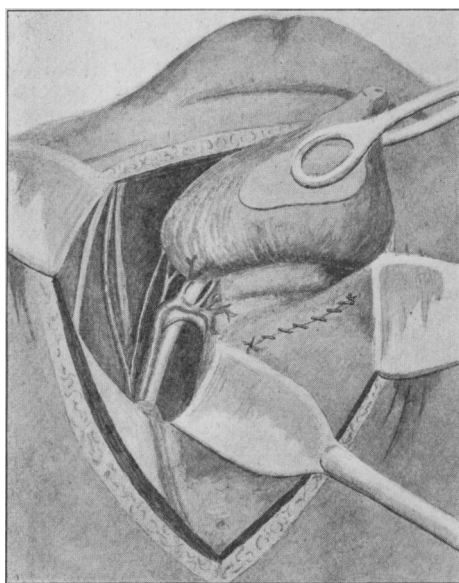


FIG. 1.—Operative exposure of lower end of ureter showing distribution of main vessels. (After Fey.)

Secondly, the other anatomical aspect of the normal ureter which I wish to mention is the postero-lateral pelvic curve. By mobilizing the ureter and straightening out this curve it is possible to shorten its course by several centimetres. Knowledge of this will often be useful when effecting a uretero-vesical anastomosis.

Turning to the applied physiology of the ureter, the well-known intrinsic neuromuscular mechanism and ample anastomosing blood supply allows for free surgical liberation without detriment. In my view, one of the most important aspects of ureteric physiology to the operating surgeon is the lowness of the intra-ureteric pressure, and the disastrous results in the shape of upper tract dilatation, stasis, infection and finally renal incompetence if surgical interference leads to compression of the tube. I know of three deaths from anuria proved at autopsy to have been due to extrinsic pressure on both ureters from a retroperitoneal hæmatoma following hysterectomy, presumably due to a slipped ligature. I shall deal later with the diagnosis and treatment of this type of case. For all surgery either directly on, or in the neighbourhood of the ureters the low intra-ureteric pressure must be kept constantly in mind.

I believe that more of the bad results of uretero-colic anastomosis are due to unduly tight suturing than to reflux. We now employ only a very short submucosal trough

¹The paper was illustrated by slides.

and a single row of sutures to bury the ureter in the colon, 4 or 5 interrupted to be precise. Others have departed even farther from the Coffey concept, and employ a direct anastomosis—end-to-side. Only the future can supply the answer to this problem of safe uretero-colic union.

Congenital Abnormalities of the Ureter

I propose to consider the congenital abnormalities of the ureter under two headings: First, those likely to be of diagnostic difficulty; secondly, those likely to confront the gynaecologist with hazards at operation. Of the former group, we have seen a number, such as, supernumerary or ectopic ureters opening into the urethra or vagina and causing persistent incontinence. Some we have met with have been labelled hysterics, others have undergone plastic operations on a bladder neck presumed to be incompetent, and the results have, of course, been unsatisfactory. All cases of persistent congenital urinary incontinence are in urgent need of full urological investigation, including intravenous urography and thorough endoscopic study.

The speaker here showed a slide of a kidney removed from a young woman who had undergone two laparotomies for right iliac fossa pain. At the first intervention she lost her appendix, at the second, a tube. An eminent gynaecologist saw her three times following a sudden profuse discharge of pus from the vagina, to find on all examinations no cause for the symptom. A third laparotomy disclosed a large pyo-ureter opening into the vagina; two ureters were present on the right side, one, relatively normal, leading into the bladder, the other ending in the vagina. Earlier co-operation between urologist and gynaecologist would have saved this patient much.

The congenital ureteric anomalies of interest or hazard to the gynaecologist at operation are the supernumerary ureter, the megaloureter and the retro-caval distribution. Supernumerary ureters are a relatively common anomaly, being present, in point of fact, in 3-5% of cases. They can prove of considerable importance in the execution of a Wertheim hysterectomy, as has been pointed out by Bonney and others. The megaloureter is usually redundant, and so tortuous, and may well come in for damage from a carelessly placed suture, or indeed be injured during dissection of a broad-ligament tumour where excessive bleeding may obscure the field. I have met with a number of such damaged ureters. The dilated and tortuous tube may pass unrecognized, especially if, by virtue of its tortuosity, it presents in an abnormal position.

Intravenous urograms.—Some radiologists employ compression in the iliac fossæ to effect stasis in the lower ureters, and so secure a denser urographic picture. These dense pictures may give misleading readings if control pictures are not taken without compression.

Congenital megaloureter.—If this condition is diagnosed early, i.e. before the age of 5, a pre-sacral neurectomy will effect a cure, as evidenced by marked diminution in the size of the ureter, a point stressed by Learmonth. If, however, the condition is only recognized later, when irreversible fibrotic changes have occurred, sympathetic surgery is unlikely to give lasting results, and we must seek other therapeutic measures. Louis Michon of Paris has recorded a very fine result lasting over ten years from a lateral anastomosis between ureter and bladder. I have employed this technique on some seven occasions with gratifying results, on the whole. 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.

A slide was then shown of a kidney removed for a persistent uretero-vaginal fistula three months after a hysterectomy:

The original operation was a difficult and bloody one, and some ten days post-operatively a uretero-vaginal fistula developed. Early intervention was decided against, and hopes were raised on two occasions by a temporary cessation of the leak. Intravenous urography two and a half months later showed a normal left upper tract, with a poorly functioning right kidney and evident tortuous and dilated ureter. Exploration was made through a lateral extraperitoneal abdominal approach, to be described later. After finding a hugely dilated ureter with acute kinking in its upper portion and marked pelvic dilatation, a nephrectomy was performed.

We were evidently dealing here with a congenital megaloureter damaged during a hysterectomy.

The true postcaval type of ureteric anomaly is of little interest to this Paper, but the variants of this congenital abnormality, in which the ureter lies behind the great veins of the pelvis, are of importance. I have met with two of these. One harboured a sizable and fixed calculus, requiring open operation. The other was discovered when we were called in to deal with a ureter ligatured during a hysterectomy. This latter case is instructive:

The operating surgeon was unaware of having damaged either ureter, but the development of severe right renal pain in the immediate post-operative period, and the finding of a tender enlarged right kidney, suggested the possibility. The pain was severe, not yielding to analgesics, and pyrexia was minimal. Intravenous urography showed a

normal left upper urinary tract, with no concentration of dye up to two hours on the right side. A ureteric catheter meeting impassable obstruction at 7 cm., exploration was decided upon. The ureter, exposed extraperitoneally, was found to be considerably dilated, and to pass under a large transversely disposed vein, which took the place of the right common iliac vein. The arterial distribution was normal. I have not been able to find an exact parallel in the literature, but it is easy to see from a consideration of the development of the abdominal veins how such a condition arose. Considerable plastic exudate rendered the dissection difficult, and it soon became apparent that to attempt to isolate the ureter medial to the venous anomaly would be hazardous. Accordingly, the ureter was sectioned lateral to its disappearance under the vein, and a uretero-neocystostomy was effected in the manner to be described later. In order to avoid tension on the anastomosis, the bladder was drawn up and fixed to the lateral pelvic wall with silk. The patient promptly became asymptomatic (despite some temporary urinary leakage). Unfortunately no subsequent urograms have been obtainable. It is a moot point whether the technique adopted was that of choice, or whether the bladder flap method of Boari, which I propose to discuss later, might not have been preferable in such a high ureteric section.

Another type of congenital abnormality of the ureter which might well come in for injury at the hands of the gynaecologist is that of the pelvic ectopic kidney. I have met with this variant six times. One patient had congenital absence of the vagina, complete urinary incontinence and a number of other congenital defects.

Operative Accidents

These resolve themselves into two main groups: (a) Those recognized at the time of operation. (b) Those only discovered late when renal pain, infective phenomena or the development of fistulae make the diagnosis plain.

(a) In the operative group the commonest is the *cut ureter*. It has been customary with gynaecologists to ligate the proximal end of the tube should it be sectioned accidentally, and many proudly state that they have carried out this procedure on several occasions without ill-effects. Such a solution can very, very rarely be justifiable to-day, as was so ably emphasized by Lord Webb-Johnson in 1935. It can achieve its avowed object—namely an aseptic pressure necrosis of the corresponding kidney—only if that organ is initially undilated and uninfected, and that is precisely the kidney that should be preserved. Should it perchance be a solitary kidney the result would be calamitous. The correct procedure, I feel, should be an immediate anastomosis of the severed ureter over a No. 7 or 8 Ch. rubber catheter. The ureteric ends should be trimmed off obliquely, one end of the catheter passed upwards into the renal pelvis, the other downwards into the bladder, and the anastomosis effected by means of four interrupted sutures of 000 plain catgut on an atraumatic curved needle. These should be loosely tied over a small pad of fat. (All sutures in the ureter or renal pelvis should be very loosely tied.) After extraperitonealization of the suture line, a drain is placed appropriately. The bladder should be put at rest with an indwelling catheter, and both this and the splinting ureteric catheter left in ten to fourteen days. It is a simple matter for the urologist to remove the splinting catheter with cystoscopic forceps. I have met with two cases where this technique was successfully employed.

CASE I.—1941: Right nephrectomy for a calculous pyonephrosis. 1945: Admitted with anuria of two days' duration. Flat film disclosed a date-stone shadow in the line of the left upper ureter. Ureteric catheter impinged on this shadow but failed to pass. On exploration of left upper ureter, marked peri-nephritis and peri-ureteritis made exposure difficult. The ureter was isolated well below the level of the obstruction and elevated with tape. Whilst tracing the ureter upwards with sharp dissection, undue traction on the tape led to complete section of this solitary ureter. The patient was enormously stout, so uretero-ureteral anastomosis by the above technique was effected, not without difficulty. No post-operative urinary leakage occurred, and the catheters were removed in fourteen days. A subsequent urogram showed a relatively normal kidney. He was seen this week, three and a half years post-operatively, and unfortunately, though not unexpectedly, has developed a further calculus. The blood urea reading remains normal.

CASE II.—This was a case of an enormous retroperitoneal lipoma operated upon by a general surgeon. In the course of a difficult operation the left ureter was sectioned, and the accident recognized. Immediate anastomosis by the above technique was effected. The patient made an uninterrupted recovery, but no follow-up was possible as he soon left for foreign parts.

Where the ureter is sectioned low in the pelvis, as will usually be the case in gynaecological accidents, it may be preferable to reimplant the ureter into the bladder. A great variety of

techniques has been proposed and practised for this, but the following procedure has served me best; it is very similar to that recently described and advocated by Dodson. It must be appreciated that in performing a neo-cystostomy in the female, the submucosal trough method, so generally employed in uretero-colic anastomosis, is wellnigh impossible owing to the thinness of the bladder muscularis, and a short Witzel type of burying is necessary, due care being taken to avoid any compression of the ureter. The value of a splinting catheter for a minimum of ten days is now widely recognized in all reparative surgery of the ureter. The Cummings' nephrostomy catheter we have found most useful for this purpose. Its use is well illustrated in the sketch (fig. 2) and is, I think, original with us. Careful follow-up studies of uretero-neo-cystostomy are badly required to assess end-results.

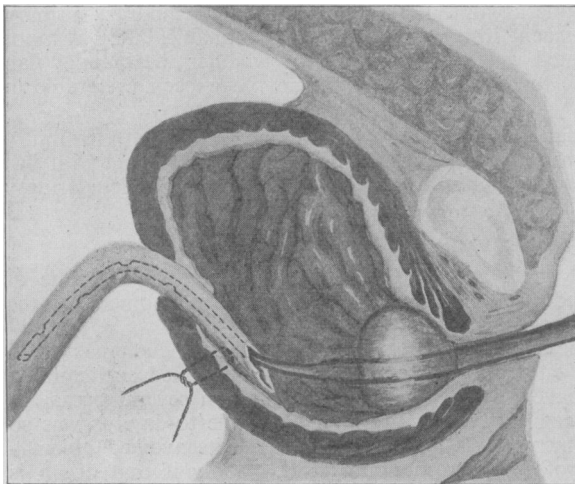


FIG. 2.—Author's use of Cummings' nephrostomy tube in neocystostomy.

of forms, e.g. painful hydronephroses due to aseptic ligature, pyonephroses due to infection developing in a ligated or otherwise damaged ureter, or, most commonly, as fistulae either uretero-vaginal or uretero-cutaneous.

Where a hydronephrosis has occurred due to ureteric ligature it is remarkable what recovery will take place when the ligature is removed even several weeks later. In one personal case dealt with three weeks after such a ligature, the ureter was the size of small gut. A uretero-neo-cystostomy was performed, and three months later the intravenous urograms were virtually normal.

An infected kidney will usually require a nephrectomy.

Fistulae

The commonest variety encountered is the uretero-vaginal. The diagnosis is easy, but the treatment offers certain problems. A small proportion will heal spontaneously, either without help or by means of an indwelling ureteric catheter. I have met with 3 cases of spontaneous closure, but one of these proceeded to stricture formation and infected hydronephrosis, necessitating a nephrectomy within eighteen months. The other two remain well with periodic ureteric dilatations. I have only once succeeded in passing a ureteric catheter on the affected side in such a case, and by leaving this in for ten days (with a change on the fifth day) effected a closure. The patient was later lost sight of.

Realizing then that some of such fistulae will close spontaneously, the first problem is *when to advise operation*, and I can but state that I now advise operation early, i.e. before stenosis has occurred leading to upper tract dilatation and infection. It is usually possible to pass a catheter through the fistula and carry out bacteriological and pyelographic studies of the kidney. It has been estimated by Merenyi that 75% of uretero-vaginal fistulae lead ultimately to a nephrectomy, but one cannot help feeling that with modern methods of diagnosis, the use of antibiotics, blood transfusion, &c., and earlier surgical attack on these cases, a high proportion of these kidneys can be saved. The one reservation I maintain to early reparative surgery is the patient who has developed a unilateral uretero-vaginal fistula following a Wertheim hysterectomy. Such a patient may not be fit for further major surgery

Where the ureter has been accidentally ligatured and the situation is recognized during operation, probably all that is necessary is to untie the ligature and place an extraperitoneal drain down to the site lest subsequent leakage occur.

Where the ureter has been caught in a clamp, the treatment will depend on the extent of the clamping. If it is but partial, it will probably only be necessary to place an extraperitoneal drain as though a ureterotomy had been performed, as late sloughing will probably lead to temporary urinary leakage. If the clamping has been complete, it will be best to excise the crushed area and, trimming off each end obliquely, perform an end-to-end anastomosis, as already described.

(b) *Late cases.*—These may present themselves in a variety

for some time, and technically the reparative procedure is difficult with the inevitable plastic exudate following the extensive stripping of the posterior abdominal wall. Considerable oozing is the rule, and moreover these tissues are in no fit state to deal with even minimal infection. Some authorities advise waiting six months before attempting reparative ureteric surgery in such cases, others say three months. My experience suggests that where one has to wait such a period the chances of securing a satisfactorily functioning uninfected kidney are remote, and that, provided intravenous urography reveals a good contralateral kidney, a nephrectomy as soon as the patient's condition warrants it will be the best procedure. It will rid her earlier of the intolerable dampness, and permit a speedier and more comfortable convalescence.

In those cases of fistulae following pelvic operations other than the Wertheim procedure, having decided on early intervention, the next problem besetting the surgeon is the type of operation to employ, and whether the ureter should be exposed intra- or extra-peritoneally. Some earlier authorities, notably Legueu and Thomson-Walker, advocated a routine intra-peritoneal approach, but to-day the consensus of opinion is for the extraperitoneal route. The damage to the ureter has usually occurred 3-6 cm. from the bladder when it has followed abdominal surgery, and closer to the bladder when it has ensued from a vaginal hysterectomy. Theoretically, in the higher lesions it might appear more practical to effect a uretero-ureteral anastomosis, but in practice the lower distal portion of the ureter is usually embedded in scar tissue resulting from the fistulous track, and the best procedure in most cases will be a reimplantation into the bladder. Where the ureter reaches the juxta-trigonal portion of the bladder without tension, the technique already outlined may be adopted. An alternative procedure, and one that appeals to me even more on theoretical grounds, is the transmeatal technique used successfully by Patton (fig. 3).

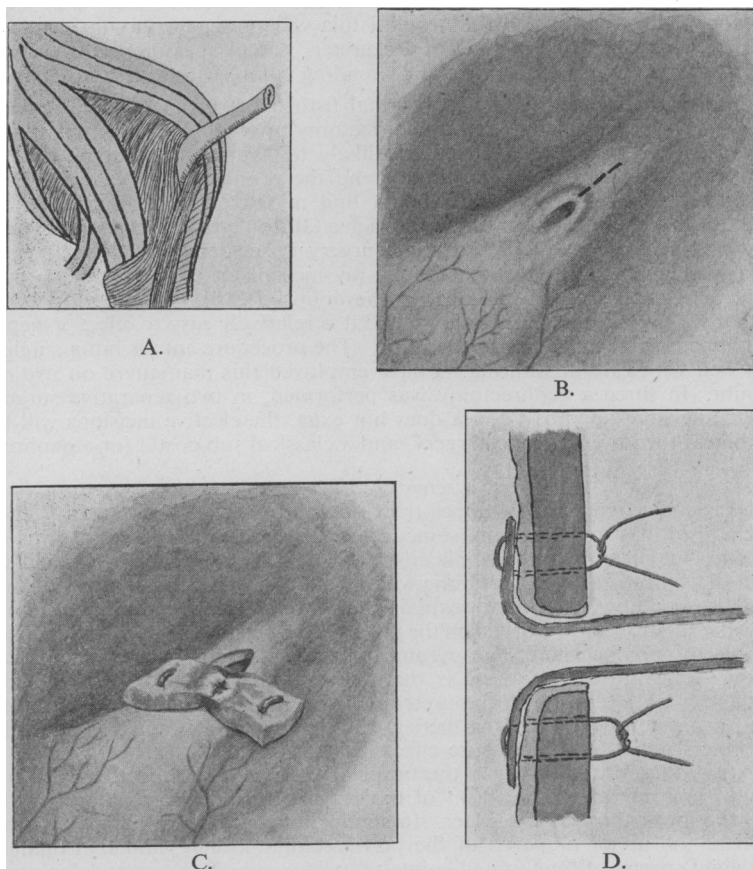


FIG. 3.—Transmeatal neocystostomy. (After Patton.)

A. Diagram showing decussation of detrusor muscle fibres about ureteric insertion. B. Transvesical enlargement of meatus. C. Transvesical view of ureteric fixation. D. Diagram of ureteric fixation.

I have never had occasion to employ this technique,¹ but bearing in mind the decussation of the muscular fibres of the detrusor in the neighbourhood of the ureteric orifices, and the minimal risk of fibrosis from scarring, the method would appear to be sound. In either of these techniques it is essential to have the ureter reaching the bladder without tension, and the device advocated by Dodson of mobilizing the ureter and straightening its course, i.e. obliterating the pelvic curve, already mentioned, is worthy of note.

Where the ureteric damage is high, or sloughing has occurred, some other manœuvre must be employed, and the vesical flap method first described by Boari in 1894 experimenting on dogs, and subsequently successfully used in man by Demel, Rohde, Ockerblad, Flocks and Caughlan, can give most satisfactory results.

Another technique which has been successfully employed in a few cases, e.g. by Neuswanger and Higgins, is an end-to-side uretero-ureteral anastomosis, i.e. suturing the proximal end of the damaged ureter into the side of its fellow. This would appear to carry the risk of jeopardizing the good ureter and kidney and should be condemned. An intestinal transplantation would be preferable. I have not had occasion to resort to such a transplant in a case of uretero-vaginal fistula, but the procedure has been adopted in America for a uretero-vaginal fistula following a vaginal hysterectomy. I cannot help thinking that the indications for such a transplant in these fistulae must be rare.

On one occasion only have I resorted to a uretero-colic anastomosis for a ureteric lesion following gynæcological intervention. An inexperienced surgeon performed a supravaginal hysterectomy for a broad ligament fibroid, and damaged the ureter in the region of the infundibulo-pelvic ligament. Appreciating his error he repaired the ureter and lapped it with peritoneum. Faulty drainage was employed, and an intraperitoneal urinary leakage ensued, necessitating the reopening of the abdomen and the establishment of extraperitoneal drainage some days later. When the case was seen some weeks afterwards in consultation, a uretero-cutaneous fistula was present with considerable ureteric dilatation. Owing to high sloughing of the ureter, vesical anastomosis was not feasible, and the ureter was transplanted into the descending colon, with a satisfactory result.

In a number of these cases of uretero-vaginal fistula the urologist may find himself in some doubt as to whether to carry out a nephrectomy or whether to attempt some form of reparative surgery. This will be particularly likely to happen when some time has been allowed to elapse between the original injury and the proposed intervention, and ureteric and pelvic dilatation have occurred. When I find myself in such doubt I resort to the following tactics. I expose the lower ureter through a Gibson type of incision extraperitoneally and study the area of damage. If reparative surgery is decided upon this can be perfectly well effected through such an incision, though my incision of election for exposure of the lower end of the ureter is a mid-line one. In the doubtful case, this lateral incision has the advantage that with a minimal enlarging upward it is relatively easy to effect a nephrectomy should such appear to be indicated at operation. The procedure entails but a single incision, which heals well with careful suturing. I have employed this manœuvre on five occasions, when in doubt. In three a nephrectomy was performed, in two reparative surgery of the ureter. When such pre-operative doubt does not exist, the elective incisions will be a mid-line sub-umbilical for lower ureteric surgery, and a classical sub-costal for a nephrectomy.

The Ureters in Pregnancy

It has long been recognized that upper tract dilatation occurs in pregnancy though the precise mechanism has remained in some doubt. The earliest concept was a purely mechanical one, but such is not the whole answer. The hormone theory next held sway, and it was shown that injection of progesterone would lead to softening and atony of the ureters. The hormone theory, however, did not explain the common increased dilatation on the right side. Many investigators have worked on the problem, and using Trattner's hydrophorograph have been able to demonstrate the atony and diminished peristaltic movements antedating the dilatation. The present-day view is that, as a rule, during the first two months of pregnancy there is no alteration in the ureters. From the third month onwards, thanks to the increased progesterone circulating, there is a softening and a diminished peristalsis which render the ureters liable to the pressure effects of the gravid uterus. Owing to the more common dextro-rotation of this organ the brunt of the pressure is on the right ureter, and the dilatation is mainly above the brim of the pelvis. In most cases there is little or no dilatation of the lower third of the ureter. In support of this is the observation that there is no dilatation of the ureter or pelvis of the pelvic ectopic kidney, and that dilatation does not occur in eight species of four-footed animals studied. van Wagenen and Jenkins working on Rhesus monkeys found that the upper tract dilatation did not subside when the fetus

¹Since writing the above I have employed the transmeatal technique with extreme satisfaction in a case of uretero-vaginal fistula following an abdominal hysterectomy.

was removed by hysterotomy leaving the placenta in situ. As soon as the placenta separated and came away there occurred a prompt subsidence of the ureteric dilatation.

This upper tract dilatation in pregnancy is of great clinical importance in that the stasis predisposes to urinary tract infections, which are sometimes, even with modern antiseptics, difficult to clear up until after term. In pre-mandelic and pre-sulphonamide days the indwelling ureteric catheter could be virtually life-saving, and certainly saved many a foetus, but I have not had occasion to use this method during the past ten years.

The Ureter in Pelvic Inflammations and Benign Tumours

I have been unable to find any exhaustive statistics on the incidence of upper tract dilatation in this connexion, but a perusal of several small series would appear to show the following approximate figures:

Pelvic inflammatory conditions	60%
Fibroids	{ large, i.e. above pelvic brim	..	66%
		..	30%
Ovarian cyst	40%

What improvement occurs when the pelvic lesion has been dealt with appropriately? Of 30 reported cases exhibiting previous upper tract dilatation and studied post-operatively, only 43.3% showed return to complete normality, 30% partial regression and 26.7% no change. A high proportion of those in which failure to regress was noted were in the inflammatory group.

From a consideration of these facts I would make a plea for more extensive use of intravenous urography pre- and post-operatively in gynaecological pelvic lesions, for a selective use of ureteric dilatation may save many a kidney, or prevent recurrent renal infections.

The Ureter in Genital Prolapse

Several investigators have reported on the incidence of upper urinary tract dilatation in this connexion. The figures vary from 50–80% in severe degrees of prolapse. Such an incidence would appear to call for an invariable intravenous urogram in all cases of extensive prolapse. If dilatation is present, a repeat urogram should be made three months post-operatively to ascertain if the urinary tract has returned to normal. If not, urological treatment may be indicated. The ureter is occasionally injured during the performance of a vaginal repair for prolapse. One or both ureters may be caught in carelessly placed sutures, or the development of a hæmatoma may compress the lower end of both ureters, and lead to anuria. In one well-known case in which an anuria followed a colporrhaphy, reopening of the wound and removal of sutures led to a prompt re-establishment of the urinary flow. I shall detail later a personal case in which a similar accident occurred, and in which a different procedure was adopted (Case II, p. 44).

The Ureter in Carcinoma of the Cervix

Williams in 1895 showed that autopsies of patients dying of Ca. cervicis showed an 85% incidence of dilated upper urinary tracts. Graves and Kickham in 1936 reported that of 257 patients suffering from carcinoma of the cervix, 123 or 50% were found either on urological investigation or at autopsy to have dilated upper tracts. Of 87 patients autopsied, 79% were found to have sufficient dilatation to produce renal insufficiency. Jaffe, Meigs and co-workers reported in 1940 that of 390 such patients from their clinic, 70% had obstruction to one or both ureters. Despite such findings too few gynaecologists seem to appreciate the desirability of urological investigation in these cases. The pre-operative presence of ureteric dilatation would appear to be of grave prognostic significance, as indeed it is in vesical neoplasms. It indicates a lateral spread of the growth into the broad ligaments. The post-operative finding of ureteric dilatation may betoken either a recurrence of the growth or peri-ureteric fibrosis. The latter may be amenable to periodic ureteric stretching. Dilatation occurring during radiation therapy may be merely a reactionary oedema and be temporary. Post-radiation dilatation is apparently relatively common, as I have come across many such cases. There are several reported cases from the post-mortem rooms where death has been due to renal failure caused by ureteric obstruction from post-radiation fibrosis, with no evidence of a recurrence of the malignant process.

In such cases where increasing ureteric obstruction is developing, urological help is indicated. Ureteric dilatation, neo-cystostomy, ureterostomy, nephrostomy and intestinal transplantation all have their place.

I have already stressed the advantage in being aware of the presence of a supernumerary ureter before embarking on a Wertheim's hysterectomy.

It would appear then that all cases of carcinoma of the cervix should be investigated urologically pre- and post-operatively. Closer co-operation between the two specialties should lead to improved results in dealing with this all too common disease.

Anuria

This group represents one of the most interesting in the whole range of that "No Man's Land" between urology and gynaecology. Many of these cases are in young people doomed to die from renal failure if not adequately treated. As mentioned earlier we know personally of 3 who succumbed and proved *post mortem* to have been amenable to surgical cure. We count certain survivals following intervention, after being given up as hopeless by eminent medical authorities, as amongst our greatest surgical triumphs. Certain groups are, of course, now well known, chiefly those following excessive sulphathiazole therapy, and the treatment is established: search of any urine procurable, even a c.c. or two, for evidence of the tell-tale crystals; early cystoscopy with careful examination of the ureteric orifices for evidence of the sulphathiazole sludge; catheterization of the ureters to dislodge this sludge and allow pelvic drainage with prompt administration of alkaline intravenous therapy. These measures may re-establish the renal flow and avert uræmia. Where ureteric catheterization is impossible, pyelostomy should be carried out, combined, I believe, with renal decapsulation lest intrarenal tubular blockage has occurred, or alternatively a shunt, as described by Trueta, which may well be helped by the partial sympathetic block resulting from the decapsulation.

Lesser-known varieties of anuria are even more important in this present Paper and a careful history-taking will, as ever, be amply repaid. One has to determine whether the cessation of urinary output is pre-renal or post-renal. The nature of the supposed underlying cause will be helpful in attempting to establish this differentiation. Where doubt exists after history-taking and clinical examination, a prompt recourse to surgery will often be warranted, as will be instanced presently. A rapid examination of the upper ureter will be the key to the problem. If it is dilated, then we are dealing with a post-renal obstructive phenomenon; if it is not dilated, then we have a pre-renal lesion to contend with. In the former a ureterostomy or nephrostomy will relieve the obstruction and be life-saving; in the latter, a prompt decapsulation is most likely to yield satisfactory dividends, though beneficial results have on occasion followed splanchnic block, spinal analgesia, &c. The tactics adopted in a variety of anuric cases may be interesting and instructive.

CASE I.—This lady was seen in consultation twenty-eight hours after a straightforward supra-vaginal hysterectomy. No urine had been secreted since the operation, and the patient exhibited the clinical picture of a concealed hæmorrhage. No tenderness was present in either loin. The most probable diagnosis was a retroperitoneal hæmatoma compressing the ureters. This was confirmed by cystoscopy—the large blue mass of the hæmatoma being visible through the thin-walled bladder. Incidentally I have never seen this method of diagnosis mentioned in the literature. The abdomen was reopened, the hæmatoma evacuated and drained, and urinary secretion promptly restarted with complete recovery.

I have already mentioned three similar cases of retroperitoneal hæmatoma due to slipped ligature causing anuria, and only discovered at autopsy.

CASE II.—This case I saw in consultation three days following an anterior and posterior repair. No urine had been passed since the operation. The attendant observers had diagnosed anuria twenty-four hours post-operatively, and intravenous therapy was instituted. When seen, there was profound anorexia, dry tongue and an enlarged and tender right kidney; no abnormal findings in the left renal region. No hæmatoma was palpable on vaginal or rectal examination, nor was any detected on cystoscopy. The marked distortion and œdema of the trigone precluded a view of either orifice, so ureteric catheterization was impossible. The blood urea reading was 97 mg.%. The choice here lay between removing the anterior vaginal sutures in the hope of freeing the ureters, presumably compressed, without a certainty of success, or of relieving the right kidney, evidently blocked, by direct approach. The second alternative was selected. The right loin was explored, and a hugely dilated ureter containing dark blood-stained urine was found. This was opened, and the urine escaped under great pressure. An 18 F. rubber urethral catheter was introduced along the ureter into the renal pelvis and brought out on to the skin. Urinary excretion being re-established, the blood urea dropped to 23 mg.% in forty-eight hours. Two weeks later, as no urine had as yet entered the bladder, a further cystoscopy was made to ascertain if ureteric catheterization was yet possible, but neither orifice could be visualized. The following day the lower end of both ureters was exposed by a mid-line extraperitoneal approach. The left ureter appeared normal. It was incised, no urine escaped, and a catheter readily passed through the orifice. The right ureter was still markedly dilated, and a ligature was found encircling the tube in its juxta-vesical portion. This ureter was cut across proximally and re-implanted into the bladder. The ligature of the right ureter had evidently caused a reflex anuria on the left side. Intravenous urography, four months later, showed a completely normal left upper urinary tract and but slight dilatation of the right renal pelvis.

Cystography revealed no reflux. It is remarkable what complete recovery the left kidney has made when one realizes that it secreted no urine for fifteen days. It also raises the possibility of a reflex anuria developing after the commonly adopted practice of tying off a severed ureter.

CASE III.—This illustrates another type of anuria, evidently reflex in character, of which I have met quite a number of examples.

A young woman of 28 had an incomplete miscarriage at the fourth month. The remnants were curetted. Following this, complete anuria developed. Intravenous therapy, splanchnic block, spinal anaesthesia, &c., were all tried without avail. Her life was despaired of. I saw her five and a half days after the onset of the anuria. The blood urea was over 200 mg. %; she was comatose, with parched tongue, sordes around lips, &c. The picture was very grave. A rapid decapsulation of one kidney was carried out, and renal secretion restarted with ultimate complete recovery. Not unexpectedly a parotitis developed during the post-operative period. This patient, a young and valuable life, was literally snatched from the jaws of death.

I have employed renal decapsulation for anuria on 14 occasions, with 10 successes and 4 deaths. 2 of the latter were hopeless when seen, one grossly septic following a criminal abortion, the other grossly cachectic from extensive gastric carcinoma for which a palliative gastrectomy was performed with resulting anuria. Of the other 2 deaths, one followed post-partum bleeding for which many transfusions had been given, and she succumbed within a few hours of a bilateral decapsulation, her pre-operative condition being very serious. The fourth death was in a woman who developed a secondary hæmorrhage following a colpo-perineorrhaphy. She was given a transfusion and anuria followed. The usual medical measures for blood incompatibility failing, I carried out a decapsulation which resulted in a recommencement of urinary secretion, but after two days of evident improvement urinary output again stopped, and she succumbed. Subsequent investigation suggested the probability that we were dealing here with a Rhesus incompatibility.

I am aware that my proportion of successes with decapsulation in anuria is higher than those reported by most, though not all, other writers, but I attribute this largely to the technique adopted enabling us to carry out a rapid operation with minimal shock. The patient is laid face downwards with the table broken or bridge slightly elevated. Either local or light general anaesthesia is employed. The lower pole of each kidney is exposed in turn through an incision along the outer border of each erector spinæ. The aponeurosis incised, the fatty capsule is opened, revealing the lower pole of the kidney. No attempt is made to deliver the kidney, but the true capsule is nicked, the opening enlarged with scissors and rapidly stripped back from the parenchyma with the finger. As much as possible is resected to prevent the development of a "Goldblatt kidney" by compression of the renal vessels by the rolled back capsule. A small corrugated drain is left down to the kidney to take care of the ooze; the aponeurosis is approximated with 4 points of catgut and the skin closed. The bilateral procedure can be completed in ten to twelve minutes.

Two points I would mention in connexion with this operation: It is noteworthy in these cases how the renal parenchyma will bulge through the nick in the true capsule, showing clearly the strangulating effect of the inelastic capsule. I saw this particularly well in 2 cases of post-scarlatinal glomerulo-nephritis treated thus successfully for anuria. Whether the relief of the intrarenal tension by this manœuvre, or the partial sympathectomy effected by the decortication causes the re-establishment of the urinary secretion, is not certain.

The second point I should like to make in this connexion is the fact that I most strongly advocate a bilateral decortication. In 3 cases in which we carried out a unilateral procedure, though the urinary output promptly recommenced, the diuresis was not so marked, and consequently the uræmic manifestations disappeared less quickly than in the cases in which we carried out a bilateral operation.

To summarize the care of these most important anuric cases:

- (1) Take an accurate case-history from attendant observers, paying particular attention to the possibility of damage to one or both ureters.
- (2) Have complete blood chemistry estimations in the hope of being able to correct faulty electrolytic balance, and also of assessing the urgency with which intervention need be counselled.
- (3) Do not flood the patient with intravenous fluids and overtax the poorly functioning kidney.
- (4) Search for any evidence of ureteric obstruction, e.g. tender, enlarged kidney.
- (5) Do not waste time if conservative measures are failing, but advocate early exploration of the upper ureters and kidneys. Proceed then *secundum artem*.

SUMMARY

The ureter is worthy of more careful attention by the gynaecologist than it has hitherto been accorded. Urologists must advocate a more widespread use of intravenous urography, both pre- and post-operatively, in cases of large benign pelvic tumours, pelvic inflammations, genital prolapse and cervical carcinomata. By pre-operative employment, the gynaecologist will obtain much useful information as to the disposition and configuration of that elusive tube, the ureter, and so the better avoid its operative injury. He will also improve his ability to prognosticate in cases of cervical carcinoma. The post-operative use of intravenous urography will enable him to assess whether his urological colleague should be called in to assist in expediting the recovery of a damaged kidney, or, indeed, of saving such an organ. Our own urological house, too, must be put in order. Urologists should, by a more careful follow-up of cases, assess better the end-results of the various types of ureteric anastomoses, and so put on a sounder basis the treatment of ureteric lesions, traumatic and otherwise.

In operative injuries of the ureter which are recognized at the time, conservative surgery is best, with uretero-ureteral, uretero-vesical or uretero-colic anastomosis, in that order of preference, rather than a proximal ureteric ligature.

In uretero-vaginal and uretero-cutaneous fistulae early operation should usually be entertained, as procrastination leads frequently to stenosis, dilatation, infection and irreparable damage to the corresponding kidney, necessitating a probable later nephrectomy. Even in cases of spontaneous closure of such fistulae, follow-up ureteric dilatations will usually be necessary.

The treatment of anuria has been briefly discussed, and the role played by the ureter, in deciding between ureterostomy and renal decapsulation, has been considered.

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The following cases and specimens were shown:

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