

Section of Urology

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Nephro-Ureterectomy

PRESIDENT'S ADDRESS

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OF all the structures in the body it is difficult to think of one more useless than the ureter after nephrectomy. The purpose of this address is to discuss the problems connected with its removal.

There have been few, if any, discussions upon this subject in this country since the universal adoption of excretion urography.

INDICATIONS FOR NEPHRO-URETERECTOMY

In a fairly wide examination of the literature upon the subject of ureterectomy one finds that practically every paper seeks either to advocate the wider adoption of the operation or to prove it is unnecessary. The greatest divergence of opinion is found around tuberculosis, the least around tumours. The convincing contribution of J. Swift Joly to the Vth Congress of the International Society of Urology answered the latter question for all time. The following indications, therefore, may be included :—

I. Epithelial tumours of the kidney and ureter.

II. Tuberculosis.

III. Obstructions at the lower end of the ureter, where hydro- or pyo-ureter is the outcome of (a) impacted stones, (b) strictures in the ureter or its meatus, (c) the obstructive pressure of vesical origin, the result of cicatrices, neoplasms, diverticula, and the systolic bladder.

IV. Congenital defects, such as duplicated ureters or ectopic ureters, especially if obstructed by stones or other causes.

V. Laxity of the uretero-vesical sphincter mechanism responsible for reflux ureteromegaly, such as may be (a) from neuromuscular dysfunction (so-called idiopathic ureteromegaly); (b) traumatic, i.e. post-operative, or following the passage of a large stone; or (c) inflammatory, usually tuberculous.

I. *Epithelial Tumours of the Renal Pelvis and Ureter*

Joly classified those of the kidney into benign papillomata, papillary carcinomata, transitional and squamous-celled carcinomata. Of these the papillary tumours are the most likely to produce implantation growths in the ureter or bladder, and hence to require complete ureterectomy. The same classification is adopted in the case of the ureter. Primary nephro-ureterectomy is to be carried out when practicable. It is unusual to meet patients on whom it would be dangerous to perform the complete operation; where this is so the primary two-stage operation is carried out; one should not wait until secondary transplants develop. Joly considers it preferable to remove a button of the bladder wall surrounding the intramural ureter.

Results.—Of 120 cases of *benign papillomata* of the renal pelvis nephrectomy was done in 85, with 4 deaths, and nephro-ureterectomy in 8, with no mortality. Of the 50 available for analysis there was recurrence in 23, 18 being in the ureter and 11 in the bladder. Secondary ureterectomy was performed in 15 cases, of which 3 remained well while 4 had further recurrences in the bladder. In only one case was there a recurrence where primary nephro-ureterectomy was performed. Removal of the lower end of the ureter appears a most important factor in diminishing risk of recurrence, and the value of the complete operation cannot be too strongly emphasized. Of 217 cases of primary carcinoma of the renal pelvis studied, the results of nephro-ureterectomy were better than of nephrectomy, in the proportion of 33% as compared to 66% recurrences, an interesting and important observation. The *situation* of ureteric growths should be noted as it supports the appeal for total ureterectomy, the figures being, upper third 12 cases, middle third 6 cases, lower third 24 cases. In 18 the tumour projected through the vesical orifice.

The predilection of tumours, whether primary or by transplantation, for the *lower end* is universally recognized. Colston, agreeing this, has likewise advocated the removal of the intramural section or, alternatively, passing a fulgurating electrode down the lumen to coagulate any deposits which may be present.

A peri-ureteral vesical deposit is preferably removed in continuity with the ureter.

Here are three cases where I have performed nephro-ureterectomy :—

Case 1.—Female, aged 62 (fig. 1). Primary papillomatosis in the lower third of the ureter. A peri-ureteral vesical papilloma hiding the ureter was destroyed by fulguration prior to the radical operation.

Absence of an excretion urogram and an easily palpable painful kidney indicated the need for exploration of the kidney, which was hydronephrotic, but devoid of growth.

This patient died three years later from carcinoma of the liver. She had no bladder recurrence.

Case 2.—Male, aged 30 (fig. 2). Primary renal papillomatosis, with a ureter packed with growth in its whole length and a transplant an inch in diameter covering the ureter orifice. I performed a two-stage primary nephro-uretero-cystectomy in January 1929.

The patient, who is now 41 years of age, has recently developed vesical papillomata which are fortunately within the scope of cystoscopic fulguration.

Case 3.—Male, aged 40, had been treated by me at King's College Hospital for bladder papillomata for two years by partial cystectomy followed by cystoscopic fulguration, when he developed an acute pain in the kidney. Nephrectomy was performed at another hospital, only 3 in. of the ureter being taken. A year ago a carcinoma developed in the bladder near the orifice of the ureter stump. I performed uretero-cystectomy, which has so far been successful as to the carcinoma, but he still grows papillomata.

Before studying the remaining indications we must consider how the ureter reacts to disease while still in continuity or as a functionless stump.

Changes in the ureter after nephrectomy.—Fagerstrom, summarizing the results of the experimental and clinical investigations of Lorin, Latchem, Otto and others, reports that the following principles seem to be established in the transformation of the ureter after nephrectomy: (1) The lumen of the normal ureter does not become obliterated by atrophy of its mucous membrane, but there is a noticeable atrophy of the muscle layers. (2) The same holds true in cases of hydro- and pyoureter, providing there is adequate drainage. (3) With obstruction the muscle layers undergo hypertrophy. (4) Ureteral peristalsis may persist for years after nephrectomy. (5) The tuberculous ureter tends to become obliterated after nephrectomy, in contradistinction to ureters infected with non-specific bacteria, which tend to remain patent. During the first two years after nephrectomy permeability of the tuberculous ureter is the rule; thereafter obliteration is to be expected. (6) Absorption of the contents of a distended ureter is very limited if it occurs at all. (7) Infection of the ureteral contents may spread through the walls and cause peri-ureteral infection and abscess formation.



FIG. 1.—Primary papilloma of the middle third of the ureter with transplants at the vesical end. Removed by juxta-vesical nephro-ureterectomy from a woman aged 62.

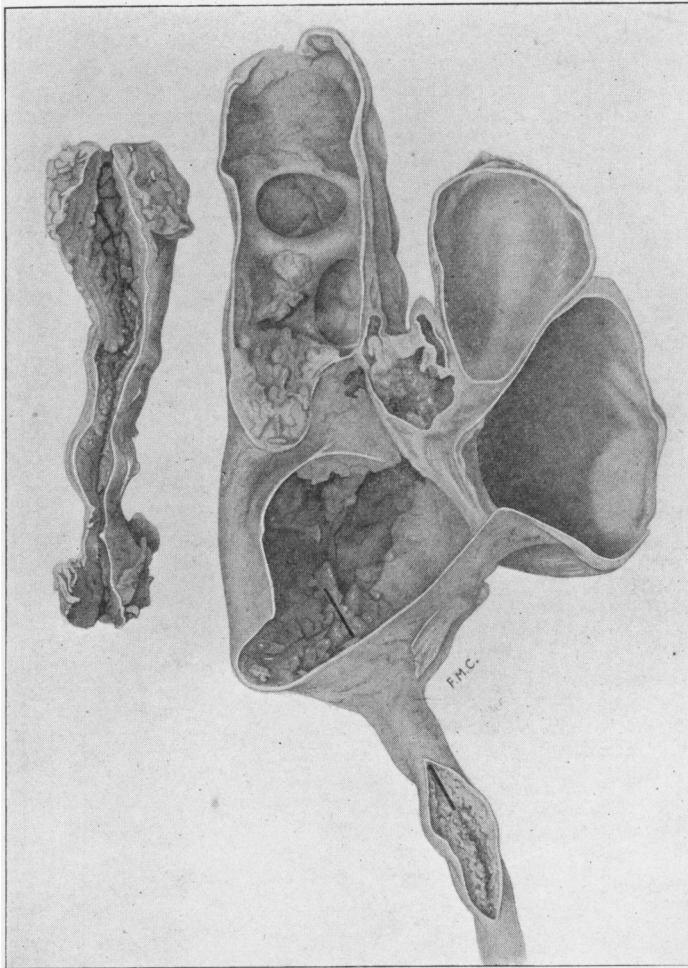


FIG. 2.—Diffuse papillomatosis of the kidney, ureter and bladder which had caused extreme hydronephrosis in a male, aged 30. Primary nephro-uretero-cystectomy was performed as a two-stage operation by the author eleven years ago. Bladder recurrence has only recently appeared.

II. *The Ureter in Tuberculosis*

Lett in his Bradshaw Lecture described the changes in a ureter *during* active tuberculosis. An early case shows little evidence beyond thickening and vascular congestion, but if it is laid open tubercles, ulceration, or granulomatous tissue may be seen. Later it becomes much thickened, rigid, and rod-like, its length is diminished and it becomes unduly straight; cystoscopically the orifices are circular and drawn up, and urography will often show a regular permanent lumen. Such ureters are palpable sometimes abdominally, usually on pelvic examination. Great dilatation is seen in a third variety and is due either to toxic atony or to obstruction from sphincter spasm or cedema; in the later stages it may arise from a stricture in the last two inches which may be demonstrated by X-rays or obstruction to the passage of a catheter. I have found these dilated ureters to be relatively more common in

children. Narrowing may also be caused by the extension of infection from a seminal vesicle or vas deferens. Lett also mentions an atrophic variety where the ureter becomes a thin cord with a very narrow lumen, which may be partially obliterated.

My own observations from examination of a number of ureters at primary nephro-ureterectomy have shown that changes tend to be more marked at the lower end,

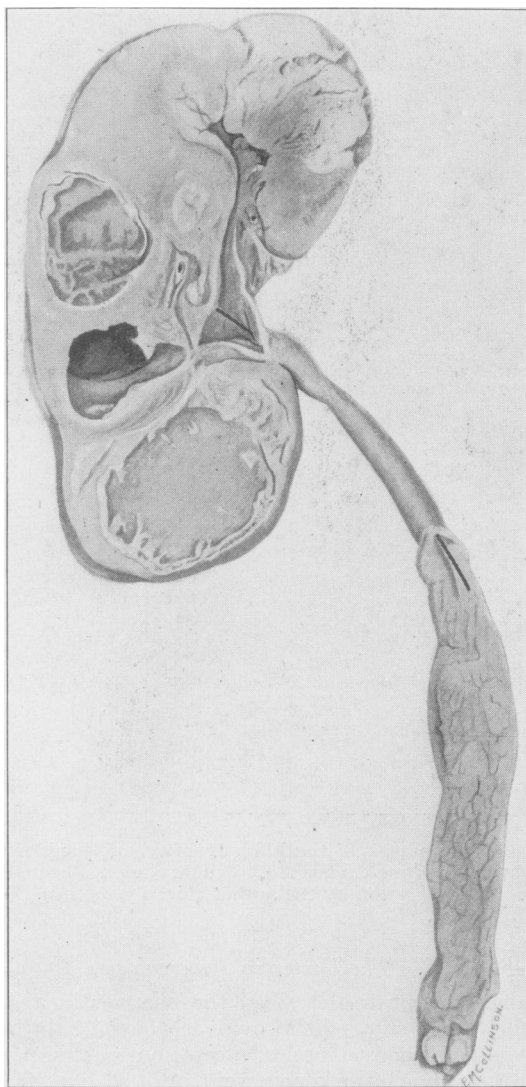


FIG. 3.—Advanced renal and ureteric tuberculosis with a breaking-down caseous focus at the vesical extremity (boy aged 17). Juxta-vesical nephro-ureterectomy performed by the author.

the mucous coat is more thickened, tubercles are distributed more copiously ; one case showed a large caseous focus in the wall in the lowest inch (*see* fig. 3), and the majority exhibit a marked and massive thickening of the outer coats and a more or less severe degree of peri-ureteritis, causing adhesion to the peritoneum and to

the neighbouring vessels (the uterine and vesical arteries particularly). Several of my cases showed quite an innocent-looking ureter to the pelvic brim, and it is easy to see how one could be misled if basing an opinion upon the restricted length of the ureter coming within the scope of the lumbar field.

Changes in the ureter stump after nephrectomy for tuberculosis.—Those referred to by Fagerstrom I have already mentioned, they are catalogued in the majority of papers; others, however, may be added. In the early post-operative stages infection may spread to the surrounding structures, causing cellulitis and abscess formation. Disintegration of the walls may be responsible for slipping of the ligature, with resulting wound infection or a urinary fistula, especially in cases where the sphincter mechanism at the lower end has been already deranged by tuberculous inflammation allowing urinary reflux.

In the great majority of stumps the inflammatory process subsides after a variable lapse of time but in two, where I had need to perform late ureterectomy four and two and a half years after nephrectomies by other surgeons, the, approximately, 8 in. of duct I removed in either case revealed microscopically active tuberculous processes, the lumen of the former was patent in its whole length, and that of the latter in all but its highest 2 in., from which caseous debris could be expressed. Dossot refers to a ureter stump examined at autopsy by Verriotis ten years after nephrectomy; the ureter was small, the muscular tunics were atrophied, but the lumen was free and covered by epithelium. Lorin's estimation of the permeability or otherwise of the lumen was based upon the ability to catheterize at subsequent cystoscopy. In four so examined the ureter was only permeable in one, whereas after nephrectomy for calculi and hydronephrosis the lumen persisted.

Dossot has found the following complications to result from the tuberculous ureter stump: (1) Persistent cystitis. (2) Pains in the course of the ureter, which are usually recovered from in a few months. (3) Persistence of bacilluria. (4) A urinary fistula due to reflux. He refers to 10 such cases reported by Legueu and Papin. These fistulae are more common when the bladder is contracted and the ureter dilated. (Marion has obtained healing in these with the aid of a tied-in urethral catheter.) (5) A persistent purulent sinus. The last, however, may arise, according to Legueu, Marion, Thomson-Walker and Lett, from infection in the perinephric fat existent before nephrectomy.

Lett mentions further complications, and especially calls attention to the added risk of extension to the opposite kidney aggravated by the stump, in virtue of the persistent cystitis, whence ascending infection is promoted by bacilli travelling by the patent lumen of the opposite intramural ureter or by lymphatics. The opposite ureter may eventually become obstructed by a stricture or caseous deposits, and so death may ensue from renal failure, as in one of my own cases. Prolonged bladder systole may cause mechanical obstruction to the opposite ureter with hydronephrosis, as Wade and others have referred to. Lett cites three cases where he regretted leaving a ureter stump. In the first the wound broke down three weeks after operation and sinuses persisted until the stump was removed eighteen months later, when immediate healing took place. The second case had presented a practically normal bladder at the time of nephrectomy. Three months later ulceration was marked, particularly around the orifice of the stump. This persisted until ureterectomy fifteen months later, when it rapidly healed. In a third case severe colicky pains persisted up to the eighteenth month after nephrectomy, although the ureter at the time of nephrectomy appeared healthy.

It is clear from the variety of methods adopted in the past to eliminate the consequences of a retained tuberculous ureter stump that the surgeons employing them have been driven to these measures by their past experiences, thus some have attached the open ureter to the loin incision, e.g. Marion; Dor exteriorized it by ensheathing it in a gutta-percha tube. Others inject iodoform (Wildbolz), tincture of iodine (Kocher), sublimate (Kapsammer), carbolic acid (Israel). Mayo and Young

injected carbolic acid into the closed ureter stump. Legueu abandoned all such methods and relied upon division with thermo-cautery and ligature. The observation of Hunt is therefore all the more remarkable, that in the series of 574 cases where nephrectomy for tuberculosis was carried out at the Mayo Clinic in the years 1919-28, he did not find subsequent ureterectomy recorded. Occasionally the upper end of the ureter opened with contamination of the wound and subsequent indolent healing, but this was regarded as due to a technical error in the application of the ligature, and no such cases occurred in later years. Nor had any cases been observed where it seemed sufficiently certain that the persistence of cystitis and pyuria was due to persistence of infection from the ureter, and so justified ureterectomy. The only ureterectomy required in association with an infective condition of the kidney was in a single instance after non-tuberculous pyonephrosis due to a strictured ureter. Beer, on the other hand, was alive to the risk of the retained tuberculous ureter stump, and found that in 7% of his cases it was great enough to warrant primary ureterectomy. He actually performed primary nephro-ureterectomy in 24 cases for tuberculosis. It is interesting to note how nearly this corresponds with the experience of Sir John Thomson-Walker, who habitually adopted the conservative operation; he found that 8% of his cases subsequently required ureterectomy.

III. *The Ureter Stump in the Presence of a Non-tuberculous Obstruction at the Lower End*

Kidd described in detail 12 cases demanding ureterectomy where the obstruction was due to a variety of causes other than tubercle. In infective conditions if no obstruction existed the ureter stump seldom gave trouble, and tended to sterilize itself. In the presence of a stricture attacks of colic may be caused or aggravated by the hypertrophying ureter muscle; an infected pouch becomes an empyema causing fever and pyuria. Peri-ureteritis and abscess may result. Dourmashkin called attention to the absence of symptoms other than pyuria, where a stone was impacted in a stump; one case, however, developed a ureteral and peri-ureteral abscess around a stone at the lumbar end of a stump twenty-five years after nephrectomy. Opinions based upon the experience of stone impacted in the lower end of the stump have shown considerable variation. No doubt the effects differ according to whether the stone causes complete or only partial obstruction. In his vast experience Marion was only twice forced to remove such a stone and thought ureterectomy unnecessary unless the stone were very large. The majority of surgeons, however, share the apprehension felt by Kidd, that the stone would act like a stricture causing empyema with its consequences. Where endoscopic or transvesical operations failed ureterectomy would probably be the wiser course, although a difficult undertaking. Hunt has found cases of this nature among the few indications for ureterectomy at the Mayo Clinic. I performed primary nephro-ureterectomy in the case illustrated in fig. 4 to avoid untoward consequences in the stump.

Troubles also occasionally arise from the stump in the following conditions:—

IV. *Congenital Defects*

Hydro-ureter, with ureterocele and atresia of the ureteral meatus in extreme cases, may require ureterectomy if the ureter approaches the size of a coil of small intestine, as in two cases described by Gibson. Duplicated ureters, especially if their orifices are ectopic, are liable to great dilatation and to calculus formation, and should be similarly dealt with, especially if infected. I have had one such case and performed primary nephro-ureterectomy rather than heminephrectomy, on account of severe sepsis.

V. *The Ureter with Incompetent Uretero-vesical Sphincter*

Hydro- or pyo-ureter in the presence of a lax ureter meatus may be of idiopathic or traumatic origin, and, unless the ureter is removed with the kidney, reflux with

ureteral fistula has been known to occur. Kimbrough has called attention to cases of incompetence of the uretero-vesical sphincter requiring the major operation. Plastic operations upon the meatus have been included in the ætiology, but I have not met with this condition either in these cases or after implantations of the ureter

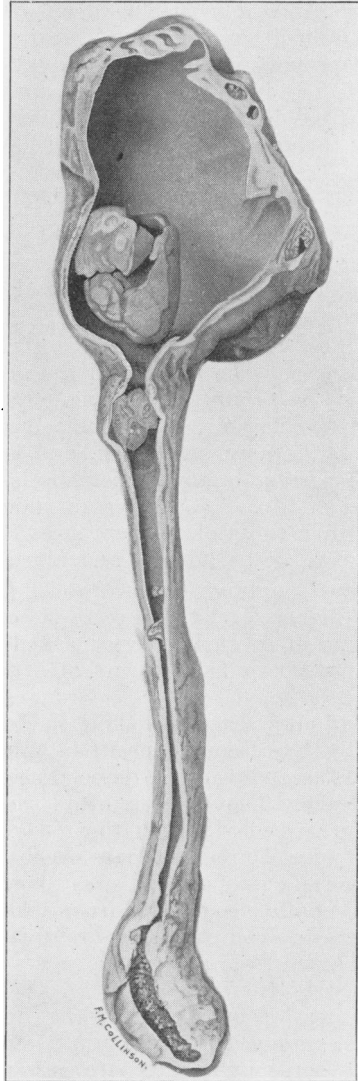


FIG. 4.—Diffuse lithiasis, with calculi in the renal pelvis, upper and lower ureter. Marked ureteritis and peri-ureteritis at the lower end of the duct (woman aged 42). Juxta-vesical nephro-ureterectomy performed by the author.

following excisions of vesical tumours and diverticula. My personal cases of idiopathic ureteromegaly have been bilateral and outside the scope of surgery.

Empyema of the ureter stump.—This may be found whether obstruction exists at the lower end or not. Dourmashkin reported four and Hyman in detail three cases in the last 2 in. following subtotal ureterectomy (according to Papin's definition)

where the ureters were infected but not obstructed. The clinical course and the surgical treatment presented the same problems as are met with in infected bladder diverticula, persistent pyuria and cystitis being the main symptoms. Hyman found that excision of such stumps presents surgical difficulties so great as to induce the surgeon, when carrying out a primary ureterectomy for pyo-ureter, to excise the entire length down to its entrance into the bladder. As he says, a primary total ureterectomy may be quite difficult enough but the scar tissue of a former operation multiplies the problems disproportionately. Hence endoscopic measures, incision or dilatation of the orifice if there is a stricture, and a prolonged course of irrigation of the sac, should first be carried out in the hope of obviating the need for secondary excision, in accordance with the doctrines of Kidd and Fagerstrom.

PRE-OPERATIVE INVESTIGATIONS

Clinical examination.—After a full urine report the routine bedside examination is undertaken. A tender ureter, a thickened ureter, and sometimes a stone in the ureter will be apparent on abdominal palpation. Rectal and vaginal palpation are even more likely to give positive results.

Cystoscopic inferences.—The vesical pathology is studied. The ureter meatus may show characteristic changes. The passage of the ureteric catheter may reveal an obstruction at any level or produce excessive bleeding. If allowed, further passage of the catheter may tap clear urine, when blood was drawn at a lower level. This is the so-called sign of Chevassu and Mock, and is said to indicate a ureter papilloma. A check to the passage of the catheter is less often due to an organic obstruction than to spasms or kinks. Catheters or bougies of firmer consistence are often more informative than those of different sizes. Spasms may be overcome by anaesthesia, local or general, or belladonna and allied drugs.

While it is recognized that the drawn-up or "golf hole" ureter orifice indicates advanced tuberculosis at a higher level the reverse is certainly not the case, for I have in many instances found at operation very marked changes in the duct, even in the lower inches where cystoscopy had shown but little, if any, alteration of the orifice.

Radiography may show an altered renal outline, shadows in the renal or ureteric regions due to calculi and to the caseous deposits of tubercle.

Pyelo-ureterography by the ascending or the descending route defines most precisely the existing pathological states. The latter is often used to reinforce the former, except where tuberculosis is suspected, when the risk of dissemination cannot be ignored. The degrees and types of ureteromegaly can be well studied and note will be taken of the resiliency or rigidity of the tube, as to whether it has varied in size at different exposures, and the influence of such drugs as morphia, atropine, pituitrin, and especially eserine. The *diastolic* ureter if rigid indicates tuberculosis, the *resilient* ureter one *mechanically* distended from any of the causes already given, notably the systolic bladder. The tuberculous ureter offers a variety of appearances. Rigid ureteromegaly I have seen most often in children (fig. 5), but of course a degree of it, the "gas-pipe" ureter, is common enough in adults, no physiological systole ever being visible. In other cases there may be alternate areas of constriction or dilatation, with nowhere clearly defined edges—a worm-eaten appearance (fig. 6). The intensity of the ureterographic shadow depends upon the functional capacity of the kidney.

The ureterograph in papillomatosis would typically show areas of dilatation with filling defects placed according to the disposition of the growths. Such a ureter is better displayed by retrograde pyelography.

Identification of the ureter stump as a focus of disease.—This question frequently arises after nephrectomy for tuberculosis, when there is persistent cystitis and tubercle bacilluria. Exclusion of disease in the remaining kidney is accepted as incriminating the stump, but this is not always so, as a tuberculous bladder may not clear up even

when a descending source of infection is removed. It is clear that the problem would not have arisen had primary nephro-ureterectomy been adopted.

Apart from tubercle and papillomatosis, which have already been considered, recognition of the features of a diseased stump depends upon the clinical syndrome of an encysted focus of sepsis, rectal or vaginal palpation of a significant swelling,



FIG. 5.—Rigid megaloureter in a tuberculous ureter, from a boy aged 10.

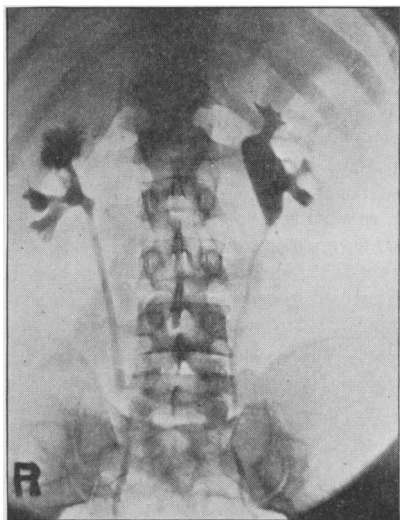


FIG. 6.—The typical worm-eaten rigid tuberculous ureter of an adult. The right ureter is here affected, and the urogram demonstrates a cavernous focus in the corresponding kidney.

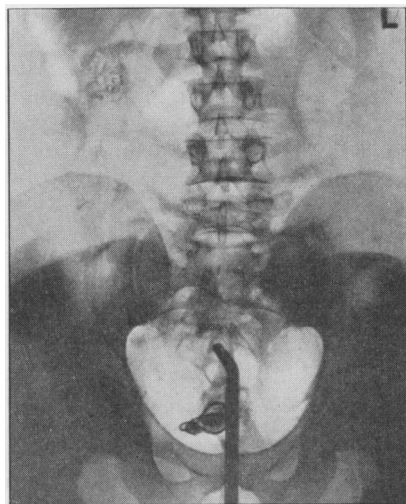


FIG. 7.—Demonstration of a ureter stump by passage of an opaque catheter through which sodium iodide solution was introduced.

persistent cystitis and pyuria with non-specific organisms. The cystoscopic appearance and the probing of the orifice with a ureteric catheter will determine whether it be stenosed or unduly patent. The best method of proof is to define the cavity with the aid of radiography, making use of the opaque catheter or, better, of an opaque medium introduced through it into the cavity (fig. 7). During the cystoscopic examination pus or blood may be seen to escape.

THE DEVELOPMENT OF NEPHRO-URETERECTOMY.

The first removal of the kidney was carried out by Simon in 1869. Twenty-three years later, in 1892, Reynier successfully performed what is generally considered to be the first ureterectomy, removing an infected ureter responsible for severe symptoms after nephrectomy for pyonephrosis. This case was fully reported in Rousseau's Paris Thesis published in 1893. The following year Poncet (described in Riaudet's Thesis) also successfully excised the whole length of the ureter two and a half years after nephrectomy for tuberculosis, the ureter this time being removed to cure a tuberculous sinus which had remained since the nephrectomy, repeated curettings having failed to heal it. However, Papin refers to a uretero-nephrectomy performed by Pozzi in 1891, where the ureter was removed as a preliminary step, the proximal end being implanted into the skin of the loin; subsequently the kidney and upper segment of the ureter were removed successfully.

The first planned nephro-ureterectomy appears to have been performed by H. A. Kelly in 1893. In his original paper published in the *Johns Hopkins Hospital Bulletin*, February-March 1896, pp. 31-37, he gives full accounts of three cases upon whom he endeavoured to perform the complete operation. All were females suffering from renal and ureteric tuberculosis. With the aid of his cystoscope or bladder speculum he was able to prove the side by ureteral catheterization. In the first case a stout, otherwise healthy, girl, he removed the kidney and all but the last 3 in. of the ureter through a lumbo-ilio-inguinal incision, ligating the ureter posterior to the broad ligament. Two months later he tried to remove the ureter stump through the vaginal fornix, but found that adhesions and scar tissue could not be dealt with through the very constricted space available, and so failed to achieve his object. In his second case he removed the whole of the ureter through the abdominal incision, this time being helped by his assistant's finger which pushed up the vaginal vault and so made the ureter come within easier reach. In the third case, a stout female of 30, the same abdominal incision was made and the ureter was ligated at the broad ligament. The operation was completed bimanually, the fingers of the right hand pushed up the vaginal vault and made contact with the left hand, the vaginal wall alone intervening. The anterior fornix was then punctured with sharp scissors, and forceps, introduced through the hole so made, seized the ureter stump. The abdominal wound was closed and the ureter was dissected to the bladder through the vaginal incision, ligated, divided, and cauterized. The result in each case was successful.

Albarrañ in 1898 successfully performed nephro-ureterectomy for papillomatosis of the kidney, ureter, and bladder, also by the retroperitoneal route, in one sitting.

In spite of these successes it cannot be said that the operation of primary nephro-ureterectomy, at any rate for tuberculosis, gained acceptance, for in 1911 Lilienthal alluded to the strange unwillingness of most surgeons to dispose of the divided ureter after nephrectomy in a scientific and radical manner, and quoted the expressed opinions of several unnamed authorities, e.g. "The ureter seldom gives rise to any trouble even when diseased", "When infected the ureter should be stitched into the wound", and many others.

Having seen several examples, especially in tuberculosis, of lumbar sinuses and abscesses and retrovesical suppuration, he was convinced of the necessity for complete removal of the ureter, if this could be made rapid and easy. The method he devised was, after having removed the kidney, to pass a flexible urethral bougie down the ureter. This was then palpated and exposed extraperitoneally through a $1\frac{1}{2}$ to 3 in. incision in the iliac fossa. The bougie was withdrawn through the loin and this allowed the ureter to be delivered through the fresh incision. He claimed that the ureter could then be easily traced by the finger down to the bladder, firmly ligated, divided, and disinfected with phenol. He mentioned the risk of ulceration of the

great vessels from the pressure of the drainage tube, unavoidable with this incision for exposure of the ureter.

It is noteworthy that the two-way abdominal approach of Lilienthal introduces the modern method of whole-length exposure of the kidney and ureter by combined, but separate, incisions. Hitherto the single long incision used by Kelly, Albarran and Israel was standardized, with sporadic appearances in the literature of novel methods for approaching the vesical end; Kelly's vaginal method has been mentioned—others tried an approach through the perineum with or without the additional exposure gained by removal of the coccyx or part of the sacrum, somewhat similar to the Kraske approach to the rectum. Needless to say these methods found little favour. The over-long lumbo-ilio-inguinal incision jeopardized the musculature and no doubt was responsible for many herniæ. These deficiencies in surgical technique evidently partly explain the lag in progress of ureteral surgery, so that Lilienthal's method, designed for preservation of the abdominal wall, marked a valuable advance.

In 1913 Kidd suggested a modification of the lower or inguinal incision for exploring the pelvic ureter, also with the object of conserving the abdominal musculature. It was horizontally placed, 3 in. in length, of which the inner third lay over the rectus muscle and the central point of the outer two-thirds immediately above the internal abdominal ring. This incision allowed internal retraction of the rectus muscle; the muscular and tendinous structures of the outer two-thirds were split in the direction of their fibres. Kidd claimed that he could approach the pelvic ureter satisfactorily in this way. Swift Joly, commenting upon this method a week or two later, stated that he had found a vertical hypogastric incision, extending from the umbilicus to the symphysis pubis, to give a very adequate approach to the base of the bladder and to either or both ureters, as might be required for removal of stones or for palpation of thickening of either ureter as an aid to the recognition of the side of a tuberculous focus. This appears to be the first allusion to a vertical mid-line incision, so that Joly's name might justifiably be attached to it. The following year Judd advocated the same incision, observing that he was not aware that it had been employed previously. One of the advantages he named was the better opportunity it offered for elevating the bladder and so raising the intramural section of the ureter when the peritoneum was separated to allow of easier mobilization. The majority of urological surgeons have adopted this incision. Others have preferred to use an oblique inguinal incision either of the muscle-splitting "grid-iron" type, or one similar to the Astley Cooper or Abernethy incision for ligature of the external iliac artery. A rectus-splitting or pararectal incision is also frequently employed, and either is of especial advantage in a secondary ureterectomy, where some length of the abdominal ureter additionally requires removal. The high Trendelenburg position is necessary whichever of these incisions is chosen.

The present-day method of nephro-ureterectomy evolved out of trial and error has shown no striking developments in recent years, merely improvements in details of surgical technique, notably the "extraperitonization" method of Papin to which I shall allude.

The majority of surgeons prefer to remove the kidney first, its exposure may reveal a ureter less diseased than suspected and whose entire removal is obviously unnecessary. It is easier to curtail the operation if surgical shock demands. There is less risk of wound infection if the opened ureter is free in the wound momentarily, for in nephro-ureterectomy division of the ureter is the last step. The most difficult part of the operation, the separation of the ureter from the bladder, is easier in the later stages of the operation with better muscle relaxation. Finally, it is simpler and quicker to transfer the patient on the table from the lateral to the dorsal posture, than vice versa. Gutierrez is one of the few advocates of the reverse operation, mainly on the grounds that the severed ureter may be used as a guide to the vascular pedicle and so facilitate separation and removal of a large adherent kidney.

In my first three radical operations for tubercle I removed the ureter first, rather by accident. My first case was a mistaken diagnosis. I exposed the vesical end of the ureter expecting to find a stone. The true condition, namely tuberculosis, was at once obvious, and so I continued the radical removal as a uretero-nephrectomy. The satisfactory outcome encouraged me to do my next two cases in similar fashion. These early cases were before the introduction of excretion urography, and in the first case, where impacted stone was suspected, retrograde pyelography was prevented by inability to pass a ureteric catheter. The sounder arguments in favour of removal of the kidney first influenced me to reverse my procedure.

Of the various operations for removal of the ureter supplemental to nephrectomy, choice will be made from the following methods :—

I.—*Nephro-ureterectomy.*

(1) *Primary one-piece operation.*

(2) *Primary two-piece operation* (deferred ureterectomy; this is a two-stage primary nephro-ureterectomy).

(3) *Secondary ureterectomy*, i.e. late ureterectomy, performed in consequence of persistence or development of indicative symptoms.

II.—*Uretero-nephrectomy.*

Definition of ureterectomy.—According to Papin, *radical* or “total” ureterectomy must include the intramural section; thus to complete the operation a disc of bladder wall surrounding it must be removed, as may be required in certain cases of tuberculosis and neoplasm. “Juxta-vesical” ureterectomy indicates removal flush with the bladder. “Subtotal ureterectomy” is understood by Papin, and may be accepted to mean removal in the male to the point where the duct is crossed by the vas deferens, in the female to the base of the broad ligament, or, more precisely, to the point where it lies below the uterine artery, called by Papin “the uterine pedicle”. More limited removal Papin calls “partial” ureterectomy.

The titles of the various operations indicate their nature; thus the primary one-piece operation is self-explanatory. Deferred ureterectomy is the method adopted when it is considered that the whole operation at one sitting would be beyond the capacity of the patient's endurance. The kidney and ureter to the pelvic brim are removed at the first stage, the upper end of the stump being freed, as far as possible, from the great vessels at the pelvic brim and displaced downwards in order to render easier the securing of the upper extremity, one of the difficulties of a subsequent ureterectomy. An example of the necessity of this operation is seen in a case of diffuse papillomatosis of the kidney, ureter, and bladder which I have already cited, and represented in fig. 2.

I. *Technique of Extraperitoneal Nephro-ureterectomy.*

Step 1.—The kidney is exposed through a curved lumbar incision which extends from over the last rib at the outer border of the erector spinæ to usually 2 in. above and behind the anterior superior iliac spine (fig. 8). The vascular pedicle is ligated and the ureter is freed as low as the incision permits, i.e. usually just below the pelvic brim. The kidney is left suspended from the lowest part of the wound by the ureter, and the muscles and skin are sutured. The lowest sutures of muscle and skin are emplaced, but not tied until after the kidney is removed, the space temporarily left may be of value in separating anchoring adhesions overlooked in the initial stages of the operation (fig. 9).

Step 2. Approach to the pelvic ureter.—I prefer Joly's vertical incision half an inch to one or other side of the mid-line, as I believe a better scar results than from one

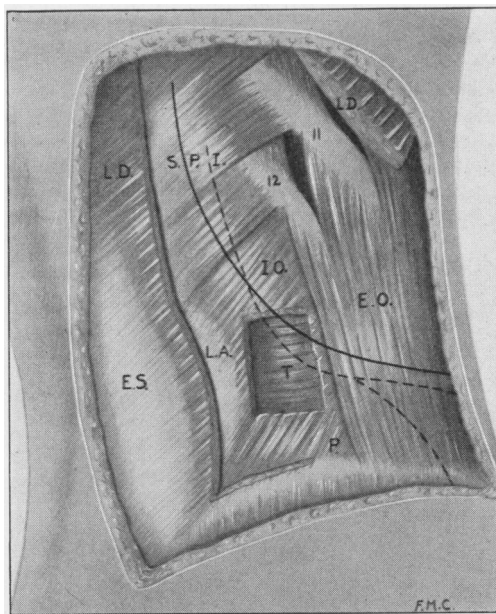


FIG. 8.—Semi-diagrammatic representation of muscle strata, &c., concerned in exposure of the kidney through the curved lumbar incision adopted by the author. A broad window in the latissimus dorsi (L.D.) exposes the lowest ribs (11 and 12), the serratus posticus inferior (S.P.I.), the external oblique (E.O.), the internal oblique (I.O.), and lumbar aponeurosis (L.A.). A window in the internal oblique shows the transversalis (T.). The erector spinae (E.S.) is seen through the fibres of the latissimus dorsi. P. represents the position of Petit's triangle. The incision crosses the course of the last dorsal nerve (broken line) which, when seen, is displaced downwards, the approach to the kidney being effected above the nerve.

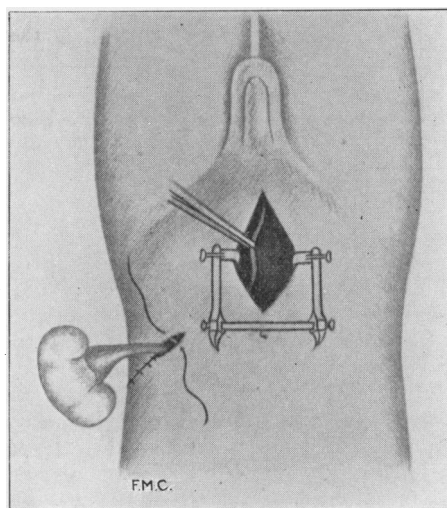


FIG. 9.—The pelvic ureter is exposed through the incision originally recommended by J. Swift Joly. The lowest deep and superficial sutures of the lumbar incision are emplaced but not tied until the kidney and ureter are removed.

in the linea-alba (fig. 10). If there is difficulty in separating the ureter in its lower *abdominal* course I make my incision still more lateral so that it can be continued by splitting the rectus to above the umbilicus if necessary, thus giving opportunity for better exposure of the ureter at and above the pelvic brim. I also prefer to make the incision at least $\frac{3}{4}$ in. from the mid-line in stout patients, and in a secondary ureterectomy where the length of the ureter stump is doubtful.

Anatomy of the pelvic ureter.—The extremities of the pelvic ureter are fixed points and present no great difficulty in exposure, with the aid of the well-known anatomical landmarks, and provided that plenty of room is permitted by the adequacy of surface

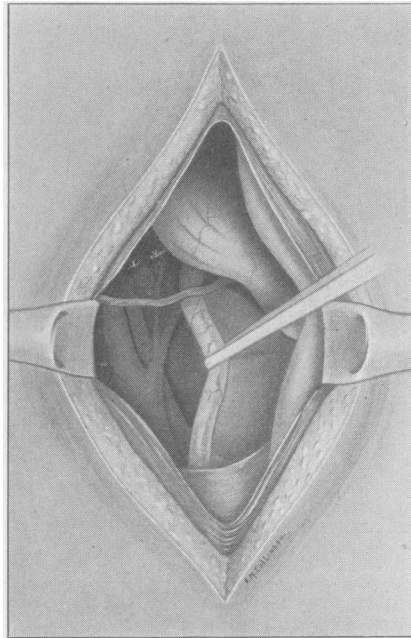


FIG. 10.—Separation of the lower third of the ureter. The superior vesical artery has been divided and ligated to allow displacement and elevation of the bladder. The relation to the vas and great vessels is seen. The vertical Joly incision is used and the ureter is supported on a gauze sling.

approach. The course of the duct, since it is attached to the peritoneum, must vary with the position of the peritoneum, which lies loosely on its fatty bed and shifts according to the degree of distension and movements of the bowel and bladder. A distended ureter increases in length as well as in calibre and, therefore, it becomes tortuous to be accommodated in the space available when its recognition may, at first, be difficult, especially if the walls have become stretched and thin. If there is no thickening or impacted stone as a guide, it may be necessary to pick and up roll the peritoneum between the finger and thumb to aid in the search. Peritoneum held by a retractor may shift the ureter far from its normal position; it may be drawn up to the anterior abdominal wall or forced into the depth of the wound. Post-operative scar tissue, uterine or ovarian tumours and fat add to the difficulties of exposure.

When the ureter reaches the pelvic floor its forward course bears important relations :—

(a) *In the male.*—(i) The *vas deferens* rising up from the prostatic region mesial to the ureter arches over it passing in an upward and outward course. It crosses the ureter about $1\frac{1}{2}$ in. above the entrance to the bladder. Kidd describes the relations of the vesical arteries and the vas to the ureter as comparable to the position of the fingers and thumb holding a pen preparatory to writing, the pen representing the ureter, the fingers the vesical arteries, and the thumb the vas. The pen is held in the right hand in the case of the right ureter.

(ii) *Arteries.*—The termination or terminal branches of the internal iliac lie postero-external, and the vesical arteries to reach the bladder cross the ureter anteriorly from without inwards. The superior and middle vesical arteries are branches of the hypogastric and the relation of these to the ureter is variable. The

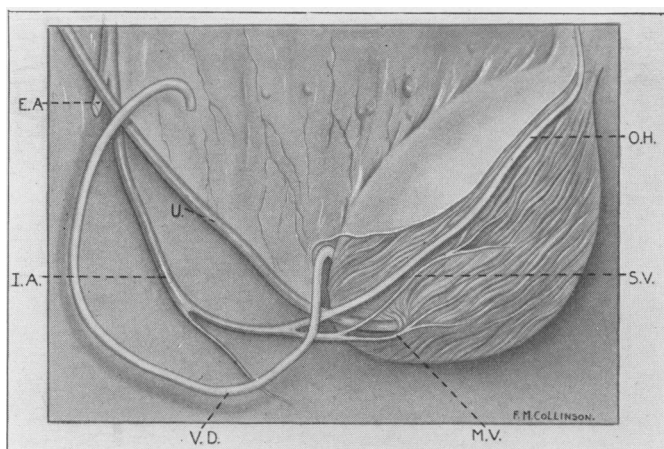


FIG. 11.—Relations of the pelvic ureter in the male. There are shown the crossing of the ureter (U.) by the vas (V.D.), the superior and middle vesical arteries (S.V. and M.V.), and obliterated hypogastric (O.H.). The vas has been divided. The area of peritoneal attachment to the bladder is seen. I.A. and E.A., internal and external iliac arteries.

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three vessels may cross the ureter independently or in a common stem, the vesical arteries not leaving the unobliterated section of the hypogastric until after the latter has crossed the ureter (fig. 11).

(b) *In the female.*—In separating peritoneum from the lateral wall of the pelvis the round ligament will at once stand out prominently, its firm attachment at the internal ring and its fixation to the peritoneum preventing mobilization of the serous sac. (Division of this ligament simplifies the subsequent procedures and seems to give no resultant disability.) The trans-pelvic course of the ureter differs in no respect from that in the male until the broad ligament is reached. Here there is the relationship of the uterine vessels (fig. 12). The uterine artery has a long course from its origin to its disappearance into the base of the broad ligament, and it may be torn if too much traction is made in displacing the peritoneal sac towards the opposite side.

In addition to the uterine, vesical arteries, and those to the ureter itself, a plexus of veins lies in the fatty cellular tissue at the base of the broad ligament, and actually forms a venous ring around the ureter which drains into an anterior and a posterior trunk passing up in front of and behind the ureter to the iliac vein.

The ureter passes obliquely forwards and inwards in the base of the broad ligament half-way between the pelvic wall and the cervix, usually about 2 cm. from the latter. The uterine artery runs transversely inwards and is therefore posterior to the ureter opposite the cervix.

Step 3. Extirpation of the pelvic ureter.—The high Trendelenburg posture having been arranged the incision is deepened to expose the peritoneum, and this is at once peeled off the lateral pelvic wall commencing below, where it is more easily mobilized. When working up to the pelvic brim the vas or round ligament hinders its upward separation and a firm attachment of the sac near the anterior iliac spine may require

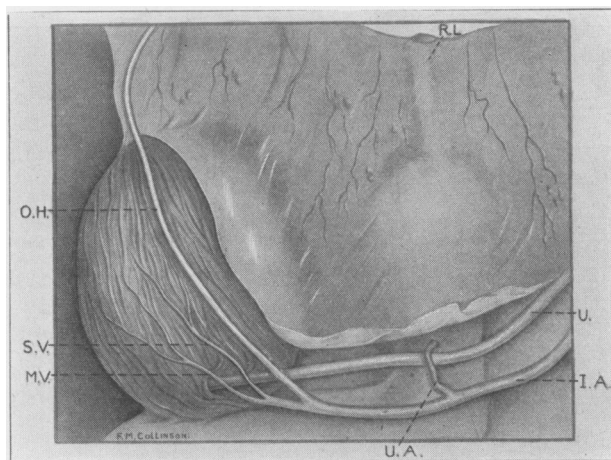


FIG. 12.—Relations of the pelvic ureter in the female. The crossing of the ureter (U.) by the uterine artery (U.A.) as it enters the base of the broad ligament is seen and, more anteriorly, are demonstrated the relations of the obliterated hypogastric and vesical arteries (O.H., S.V. and M.V.). The bladder is artificially displaced forward in this specimen. I.A., internal iliac artery.

[Drawn for the author from Spec. No. 296, Room No. 2, Hunterian Collection, R.C.S. Museum, with the permission of the Royal College of Surgeons.]

division with scissors, at the same time care being taken not to cut too deeply, or the peritoneum may be opened and adherent bowel damaged. The vas is separated from the sac, but it is usually necessary to divide the round ligament. Separation of adherent peritoneum will be simplified by passing the hand into the iliac fossa, tracing the sac downwards and lifting it off the pelvic brim and vessels. The peritoneal attachment in the lower and outer iliac region will then be reduced to a narrow process which may be divided with greater surety. Whilst proceeding in this way the ureter will soon be recognized, and more easily if its tension is altered by traction on the kidney. While separating the ureter the kidney should be lifted to relax it, and a gauze sling is passed under it and held in forceps. All strands of tissue passing to the ureter should be double clamped and ligated, as each may contain a vessel which if carelessly torn is prone to continue to bleed in the depth of the fatty bed, or the bleeding point may be a vessel of considerable size torn close to its parent iliac vessel. The ureter is usually separated without much difficulty to the point

where the vas arches over it in the male and to the base of the broad ligament in the female. In many cases the operation will have been regarded as fundamentally completed if the ureter is divided at this level. Papin regards it as impossible for the terminal section to be removed if only the lumbo-ilio-inguinal incision be used ; a vertical hypogastric incision is a necessity. Both Judd and Papin, advocating this incision, have described the next important step, namely elevation of the bladder by means of which the intramural region is raised and more completely exposed. Judd dissected the peritoneum from the superior and posterior walls. Papin went a stage further advising that the disc of peritoneum some 6 cm. in diameter, which is firmly welded to the bladder in the region of the urachus, should be detached from the peritoneal sac. To effect this the peritoneum is opened at the edge of the attached

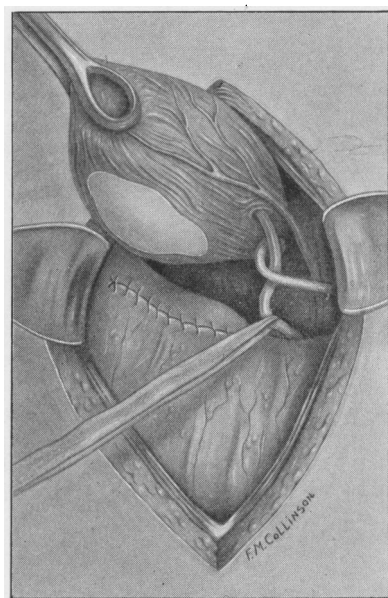


FIG. 13.—To gain better approach to the vesical end of the ureter the bladder has been mobilized by Papin's method of "extraperitonization". There are seen the elevated bladder with peritoneal disc attached, the relation of the vessels and vas to the ureter (supported on sling) and the sutured gap in the serous sac.

section near the urachus and this edge is followed with scissors in a circular plan. The gap in the peritoneum so left is closed with a continuous suture. The disc of peritoneum is mainly situated on the superior wall, for separation of the serous coat from the posterior wall of the bladder is always easy. There is no doubt that this manœuvre is a considerable asset and I have found it actually an economy of time, for it facilitates hæmostasis and undoubtedly provides a means of a more satisfactory approach to the intramural region (fig. 13). So far I have only on one occasion had to remove the intramural ureter since adopting it. In either sex the bladder is held up in forceps or by a suspending suture and the ureter is traced down while supported on its gauze sling. The peritoneum with its contents is retracted upwards and laterally. All strands which may be vascular structures, notably the uterine, superior, and middle vesical arteries, are divided between clamps. This will allow rotation and elevation of the bladder and at the same time more complete exposure of the ureter, which is drawn upon and separated until a knuckle of bladder comes into view.

In the female, division of the uterine artery will allow retraction of the cervix and, indeed, of all the broad ligament structures, as though a pedicle were divided, so justifying Papin's reference to the uterine artery as the "uterine pedicle".

Alternatively to dividing the uterine artery the ureter may, after separation from the bladder, be dissected and freed below the artery or divided above the artery, and the residual stump is then removed separately from below (anterior to) the artery.

Step 4. Separation of the ureter.—(i) In the majority of cases it suffices to divide it between double clamps, to treat its ends with pure carbolic and to ligature either end. The lower clamp lies flush with the bladder. Some prefer to divide with the actual or diathermy cautery. The lower cut end may be buried by a Lembert or purse-string type of suture carried through the bladder wall, but such burying does not seem to be necessary and is rather difficult to carry out.

(ii) Where the intramural ureter is the seat of papillomata it must be removed by encircling it with a diathermy knife, thus removing a collar or disc of surrounding bladder wall. Some have advised a similar procedure in tuberculosis, but this could scarcely satisfy the ideal of a "closed" operation, for it would be difficult to avoid soiling of the wound with vesical contents either at operation or subsequently, an unhealthy state of the bladder predisposing to separation of the sutured edges of the bladder wound, as happened in one of my cases, resulting in the breaking down of the wound.

(iii) Fulguration of the intramural canal has been recommended by J. C. Colston, where papilloma transplants may exist (*see supra*). An electrode is introduced before the lower end is ligated. The cautery point is worked up and down so that all the mucous surface may be treated; the stump is then ligated or sewn. Colston advised that there be some fluid in the bladder so that the cautery can damage no part of the wall.

Step 5. Nephro-uretero-cystectomy.—All the preliminary stages completed, the bladder is opened anteriorly and its base illuminated with one of the modern retractors of the Morson or Bernard Ward type. A growth situated near the ureter orifice is surrounded by an encircling incision made with a diathermy knife. The excised section is removed in continuity with the ureter and the resultant opening closed with interrupted sutures. It is better to drain the bladder suprapubically than with an indwelling catheter.

Whichever of these methods has been employed all that remains is to draw upon the kidney and to separate any few remaining adhesions. The hypogastric incision is closed, allowing for ample drainage. The lower sutures of the upper wound are tied. No drainage to the loin is necessary.

II. Technique of Uretero-nephrectomy.

The Trendelenburg posture is adopted, the ureter is traced to the bladder and separated in the manner to be described, double-clamped, divided, cauterized, and ligated. The upper end is traced and freed as high into the iliac fossa as possible. The hypogastric wound is sutured and drained to the retrovesical space. The patient is then shifted to the lateral posture and the kidney is exposed from the loin. The lax ureter is at once sought and forms a ready guide to the vascular pedicle. The pedicle is separated, clamped, ligated and divided, allowing removal of the kidney and ureter in one piece. A loin drain is unnecessary.

POST-OPERATIVE COMPLICATIONS AND RESULTS

The complications have been few, and with the exception of the one case of "total" nephro-ureterectomy for tubercle, where the intramural ureter was removed, the average stay in hospital was 21.5 days, actually a day less than after nephrectomy alone! In the exception referred to, inefficient post-operative bladder catheter drainage was responsible for an over-distended bladder with consequent yielding of

the sutured site of the ureter. A loin fistula took two months to heal, and then only with the aid of suprapubic cystostomy. This was the only major complication in my series of 30 cases, 24 of which were performed for tubercle and the remainder for growths, stones, and developmental defects.

Of the *tuberculous* cases, the operations were :—

Total nephro-ureterectomy ..	1
Juxta-vesical ureterectomy ..	17
Uretero-nephrectomy ..	3
Secondary ureterectomy ..	3
	—
	24

There was no operative mortality in the total series and I am aware of only two late deaths amongst the 30 cases, one, tuberculous, who died three years after in uræmia probably from tuberculosis of the second kidney, a kidney always suspected but never proven tuberculous. The other death was the case of primary papillomatosis of the ureter who died three years later apparently from a growth in the liver ; there was no recurrence of papillomata.

During the period of these operations, approximately twelve years, I also carried out 50 nephrectomies with partial ureterectomy for tubercle. The low number of my late ureterectomies must at once raise the question : “ Why perform the major operation when, after the minor, ureterectomy is so rarely needed ? ” The answer is, partly, that by primary removal of 30% of ureters in the cases presented for operation, i.e. 21 ureterectomies in 71 cases, the need was anticipated and therefore excluded. But I cannot say that the remaining 70% were satisfactory for, of the 50 cases, 23 could not be traced, and of the rest, three had unhealed sinuses in the loin for many months, others tubercle bacilluria and persistent cystitis, and several extra-urinary foci which denied further urological investigations.

It is clear that the final answer to the question of the relative merits of the major and the minor operation in tuberculosis can only be on the evidence of many hundreds of both operations, and not until the subjects have been followed through a period of, at least, a decade. Bad as the ureter may often seem at the primary exploration of the kidney, it is phenomenal to what extent and with what rapidity recovery may take place, as proved symptomatically, bacteriologically and, in a few cases, where opportunity has arisen for direct examination of the ureter at autopsy or when some other operation has been required. On the other hand, where the outcome has not been so good and the reduced constitutional state, involvement of other structures, or the refusal to submit to further operation now deny it him, the surgeon may have cause to regret a lost opportunity.

It is no longer an axiom in the surgical treatment of tuberculosis to remove all possible foci, but where an operation, agreed by all to be necessary (nephrectomy) can be extended without severe risk, it should include a useless anatomical structure which, in all probability, is a potent source of infection. On that point, however, no surgeon at the time of his operation can be quite certain ; there is no bell that rings to tell us definitely that here is a ureter which will or will not recover. Is it not wiser then to remove it ?

Whilst, therefore, the verdict in the case for primary nephro-ureterectomy in the presence of renal tuberculosis must be regarded as open, a submission in favour of this operation is reasonable if it appears to be within the capacity of the patient's endurance, especially if he is young. As age advances greater technical difficulties are met. Stoutness presents a considerable hazard, scar tissue from other operations, and the greater complexity of the pelvic vascular system, especially in the multipara of advancing years, introduce obstacles which will limit the freedom of choice of operation. Fortunately renal tuberculosis of the middle-aged, and aged, is prone to run a milder course, and conservatism in its surgery is the more permissible. In

adolescence and young adult life, and up to the age of 35, preference should be given to juxta-vesical nephro-ureterectomy.

My object has not been to urge primary nephro-ureterectomy in tubercle or, indeed, in any other cases than neoplasm. It has been rather to call attention to some noteworthy developments, especially in operative technique. In a patient offering a fair operative risk the danger of the major operation is little if any greater, convalescence is not prolonged, and the prospects of recovery are materially improved. To have performed total ureterectomy will insure the surgeon against one of the more unpalatable problems to be faced in urology: "Shall I go for that ureter stump?"

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Discussion.—Mr. HUGH LETT proposed a vote of thanks to the President for his valuable address.

Mr. JOCELYN SWAN, in seconding the vote of thanks to the President, congratulated him upon his lecture, the value of which was so much enhanced by the fact that he was able to include such an amount of material from his own personal observation. With regard to the removal of the ureter, Mr. Swan was strongly in agreement with the President that this should be carried out, unless special circumstances prevented, in all cases in which nephrectomy was performed for tuberculous disease. Preferably the operation should be carried out by first separating the kidney and ligating the renal vessels, leaving the renal pelvis and upper ureter intact, through a small lumbar incision. The kidney is then tucked into a space made in the retroperitoneal tissues by separating the peritoneum downwards towards the iliac fossa and the lumbar incision is sutured. A second incision is then made in the iliac area and the peritoneum separated inwards, when the kidney and intact ureter are easily delivered from the incision. The ureter is then separated from the peritoneum downwards to the retrovesical space and clamped and ligated close to the bladder. The only difficulty likely to be met with is in the final separation of the ureter from under the broad ligament in the female, when bleeding may arise from the uterine veins. Mr. Swan had seen several cases in which a tuberculous fistula had resulted in cases in which the infected ureter had not been removed with the kidney and he could see no reason why a length of infected ureter should be left to remain a potential source of infection.

When operating for a papilliferous tumour of the renal pelvis, Mr. Swan expressed the opinion that not only should the kidney and ureter be removed, but that the terminal intramural portion of the ureter, together with the immediate vesical wall, should be resected, though he did not go to this length in the removal of tuberculous disease.