URETERAL STONE:

WITH SPECIAL REFERENCE TO THOSE IN THE PELVIC URETER.

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CALCULI in the urinary tract nowadays present few difficulties in diagnosis and treatment for the expert; but for the unwary there are many pitfalls. All practitioners do not possess the facilities for detailed examinations which the specialist provides or has at his command. We have not yet come to the time in this country when the surgeon works in conjunction with a skilled pathologist and radiologist. Too much is left to the responsibility of one individual, and, unless some definite routine is followed, the chances are that mistakes in diagnosis and in treatment will occur.

Unfortunate sufferers from ureteral stone have far too frequently been submitted to operations with a diagnosis of appendicitis or inflamed ovary, or even mobile kidney, and have had the presumably offending organ removed or stitched in place. The patient, instead of being relieved, becomes morbidly depressed from the continued pain. Even now his real condition may be misunderstood, and he is classed as a neurotic or neurasthenic, or something equally unfair, until at last he seeks other advice or is lucky enough to pass the stone.

The ureter is about 30 cm. long, with a diameter of 5 mm. It may be divided into two parts: (1) abdominal, (2) pelvic.

The abdominal part runs almost vertically on the psoas muscle, from the lower level of the first lumbar vertebra to the sacro-iliac joint. In nearly the whole of its course it lies just beneath the peritoneum, to which it is united by connective tissue, so that when the peritoneum is stripped the ureter comes away with it. The abdominal ureter is crossed obliquely by the spermatic or ovarian vessels, while the genito-femoral nerve passes behind it.

The relations of the pelvic ureter differ according to the sex. This part may be subdivided into a parietal and visceral portion. The parietal part takes a curved course in both sexes to the ischial spine; it is covered on its medial aspect by the peritoneum, and laterally is in relation to the hypogastric vessels. This part is 10 to 12 cm. in length, and in the female it usually forms the posterior and lower boundary of the ovarian fossa.

The visceral portion in the male is crossed by the vas deferens, and is divisible into an extravescical and an intravesical portion. The extravescical part lies above the seminal vesicle, and is closely related to the vesical plexus of veins. After a course of one or two cubic centimetres it passes obliquely through the bladder wall, terminating at the orificium ureteris.

In the female the visceral part is longer than in the male, and lies in relation to the uterus and vagina, as well as to the bladder. As the ureter traverses the bladder

Fig. 1.—Diagram showing course of visceral ureter. (After Quain.)

wall it retains its independence and is separated from the muscular coat of the bladder by a layer of connective tissue. The ureteric sheath of Waldeyer is an extra covering of longitudinal muscular fibres enveloping the extramural ureter (Fig. 1).

The arterial supply is most generous, coming from the renal, spermatic, hypogastric, and vesical arteries. Sampson has shown that the ureter may be dissected

out in its whole course without suffering necrosis, by virtue of its intramural anastomosis. That it has an extremely good blood supply is shown by the fact that impaction of a stone never gives rise to necrosis.

Fig. 2.—Diagram showing common sites of impaction of ureteral calculi.

The calibre of the ureter is not uniform. There are three points at which it narrows:

1. Where it joins the pelvis of the kidney the diameter measures 2 mm.
2. Where it crosses the iliac artery it is 3.5 mm.
3. At the opening in the vesical wall 2.5 mm.

Nature's tightest barrier is therefore at the beginning of the ureter.

Bryan¹ quotes Schenk as recording 84 cases of ureteral stone which had been operated upon, the location being as follows:

- 50 per cent. at or about the vesical opening.
- 24 per cent. in the upper ureter.
- 10 per cent. at or near the pelvic brim.
- 16 per cent. other locations.

Between these constrictions the lumen is dilated, the abdominal part forming a long spindle obtaining a diameter of 8 mm. in its widest part. As is well known, the flow of urine is assisted by contractions of the ureter every few seconds. What part the nervous system plays in this is not definitely known. The contractions can and do occur when the ureter is cut off from its nervous connexions. The nerve supply is very elaborate, and is derived from neighbouring visceral plexuses. There are four points where a rich anastomosis of nerve fibrils occur:

1. Where the plexus ureteris and the renal plexus join in the upper ureter.
2. Where the plexus ureteris and the ovarian or spermatic plexus coalesce.
3. Where the plexus ureteris anastomoses with the plexus uterinae or vesicae.
4. Where the plexus ureteris comes in contact with the pelvic plexus.

We may now plan out a routine examination utilizing the simpler methods first. The general detail is not very laborious, nor does it require an excessive amount of time. After all, the patient depends on his medical attendant for the primary diagnosis. It cannot be maintained too forcibly that the best interest of the patient is also that of the doctor. Every patient has a right to the proper working up of his case, and he will, as a rule, appreciate a systematic examination. The following plan is on the lines of one suggested by Lilienthal,² and begins with:

I. *History*.—Remote and immediate, especially as to pain and its distribution, colic, strangury, frequency of urination, time

of attack, fever or chills, changes in nutrition, remedies that appear to have given relief, painful emissions, pain in defaecation.

II. *General Examination*—that is, the examination of all easily reached parts of the patient's body by the usual methods: inspection, palpation, auscultation, percussion. The average patient appreciates such attention, and it gives useful and important assistance. The rectal and vaginal examinations should not be omitted. Stones have been detected by manual palpation of both these canals; not only this, but tender areas may be worked out after the manner of Mackenzie or Head. A tender area over the course of the ilio-inguinal nerve or in the loin is very suggestive of calculus.

III. *Examination of the Urine*.—This may reveal blood, pus, bacteria, phosphates, or there may be polyuria, or even anuria. This is no place to go into the detail of urine analysis, but any suspicious case should have an immediate examination of the urine for blood with the microscope, a centrifuged urine being taken. If this is not possible, it is far better to have the examination made at a clinical laboratory. The demonstration of blood, pus, or crystals of calculus-forming salts demands further inquiry, and may save a doubtful case of chronic appendicitis from an unnecessary operation.

IV. *Radiography*.—This is the most reliable means of diagnosing ureteral stone. It should be done by an expert, who should be capable of demonstrating his results, for his plate records the number, size, and location of the stone or stones. The assistance of such a skilled operator cannot be too highly estimated, on account of the confusion which is apt to arise from shadows cast by calcareous glands, phleboliths, or appendicular concretions, and these must be excluded. This is rendered possible, to some extent, by taking another skiagram with a leaded ureteral catheter in position; or, again, it has been suggested for cases in which the stone is suspected in the visceral ureter, that the patient be skiagraphed in the sitting posture, thus eliminating considerably the sacral shadows.

A point which Thelwall Thomas³ lays great stress upon is the need for repeating the x-ray examination on the day of the operation, for, he says, in the case of small stones they have a tendency to move downwards, and in those cases in which there is a dilated ureter the stone may even travel upwards into the pelvis of the kidney.

When radiography does fail, it may be traced to the composition of the stone; oxalate of lime stones giving the deepest shadow, whereas a uric acid calculus gives a very faint shadow or none at all.

Thomas makes the important statement from a large experience of cases of renal and ureteral stones, that he has yet to come across a pure uric acid stone, but that they invariably contain insoluble calcium salts.

According to Leonard,⁴ the Roentgen ray gives less than 3 per cent. of error.

V. *Cystoscopic Examination of the Ureter and Bladder*.—Cystoscopy should always follow radiography, and this should be strictly observed, because cystoscopy is apt to be attended with the greatest inconvenience.

A stone caught in the orificium ureteris can be plainly seen.

In those cases of stone in the pelvic ureter there is a distinct pathological appearance of the ureteral mouth caused by pressure of the stone on the venous and arterial radicles, the result being an oedema of the orifice which may appear more open and congested, with ecchymoses of the peripheral vessels, and which is decisively apparent on comparison with the fellow of the opposite side.

A pouting ureter discharging small quantities of blood-stained fluid may convince one of the presence of a calculus not discovered by the radiographer.

Ureteral catheterization with wax-tipped bougies is only available in women, and seems to the writer a questionable refinement.

The ureteral catheter will cause intense pain on impaction against a stone which may absolutely block its further passage, or, if small and lying like a ball valve, may allow the catheter to slip and pass on to the pelvis of the kidney, thus deceiving the operator.

By carefully following out this sequence many complicated conditions may be cleared up which formerly were only suspected, so that by the time the patient arrives in the operating theatre the surgeon has every detail at his disposal whereby he can arrange his operation with every prospect of success.

There are, however, certain general facts which may be well worth recalling in these cases. In the first place stone in the ureter is certainly more prevalent than is supposed—according to some writers it is of greater frequency than renal calculus. They may arise in the ureter, but as a general rule they form in the renal pelvis and then pass into the ureter; the etiology is therefore practically that of renal calculi which is still a vexed problem.

Stone in the ureter is usually single, occasionally they are multiple, and rarely bilateral.

The general effects of ureteral calculi may be set down as:

I. Those due to mechanical obstruction—

- (a) Retention of urine behind the calculus.
- (b) Interference with the function of the kidney of the same side, for example, hydronephrosis, and pressure atrophy of the gland.
- (c) Reflex effect on the other kidney may give rise to anuria.

II. Those due to infection—pyelitis, pyelonephritis, pyonephrosis.

III. Secondary effects on the nervous system resulting from constant pain and irritation giving rise to that protean ailment *neurasthenia*.

IV. Local effects on the ureter:

- (1) Mechanical—dilatation with or without hypertrophy.
- (2) Inflammatory—leading to changes in the wall, for example, ulceration, fibrosis, and, rarely, abscess.

The clinical symptoms of ureteral stone are essentially those of long standing—discomfort, with acute exacerbations of intense pain lasting from a few minutes to several hours, referred to some definite somatic area corresponding to the ureteral nerve supply, coming without warning or any apparent cause, and accompanied by urinary and gastric disturbances.

I can now give details of 3 cases which have recently come under my care which expose avoidable errors in diagnosis and treatment, and which at the same time will give opportunity for discussing certain predominant symptoms, so that one may more clearly see the writing on the wall.

CASE I.

T. L., motor driver, aged 23, unmarried. Two years ago I was called to see this man, who had been taken suddenly ill with intense pain in his right side. The history I then obtained was that he had had two previous attacks, which another doctor had called appendicitis. This diagnosis I confirmed, although the lad had neither temperature nor increased pulse-rate, on the sole grounds, I believe, that he was tender over McBurney's spot, and also, on deep palpation, over the appendix, and that his attack began with vomiting. I advised him to have his appendix out, but this he declined.

In August last he called upon me, complaining of pain when he made water. This pain, he said, came on at the end of the act; moreover, he was troubled with greater frequency, accompanied by straining. He informed me that the pain had made him very miserable and depressed—which, by the way, he looked—and that he had now come to me to have his appendix out. On further questioning, he told me that he had had several attacks of pain in his right side since I last saw him, but the pain had shifted.

On examination I found that there was now no tenderness in his right iliac region. Rectal examination revealed nothing, so I passed a sound, and I distinctly heard and felt the click of a small stone. I suggested his going into hospital, and he complied.

Operation: August 18th. Suprapubic cystotomy was performed, and I was surprised to find on putting my finger into the bladder that the stone was very small and deeply placed, and moreover it was fixed. It at once dawned upon me that I was dealing with a stone in the process of extrusion from the ureter, and I thereupon located it at the base of the trigone and issuing from the right ureteric orifice. With a little difficulty I was able to dislocate it with my finger. The bladder was closed completely, but a small drain was left in the lower angle of the skin wound leading to the supravescical space to be removed in forty-eight hours.

Three days later he again began to have attacks of acute pain in his right iliac region and loin. These became intensely severe and almost unbearable, and were accompanied by retching and vomiting and a constant desire to micturate, with strangury. On August 25th he suddenly obtained relief whilst straining to make water, and felt the stone impacted in his urethra. This eventually gave rise to complete obstruction, and had to be removed by incising the penile urethra under local anaesthesia. His convalescence was marred by an acute infective nephritis setting in on the right side; but under treatment he got perfectly well, and he is at the present time actively engaged in the Army Service Corps.

This case illustrates a double error in diagnosis. In the first instance it was accepted as an ordinary case of recurrent appendicitis, and secondly it was labelled vesical calculus. Why? Because a routine examination was not made it was deemed so unmistakable that neither the Roentgen rays nor the cystoscope was employed. Without these aids to diagnosis, appendicitis may easily be confounded with impacted stone in the ureter. Although a diagnosis of renal stone may on clinical grounds be definitely and accurately made, its frequent

confusion with appendicitis leads me to contrast roughly and briefly certain symptoms:

	Symptoms.	Ureteral Stone.	Appendicitis.
1	Mode of onset	Sudden and intense	Gradual and less intense.
2	Referred pain	Urogenital area	Iliac region.
3	Temperature	Normal or subnormal	Elevated.
4	Pulse	Quickened temporarily	Increasing frequency.
5	Vomiting	Present	Present.
6	Bowels	Tenesmus may be present	Constipation.
7	Bladder	Frequency and tenesmus, if impacted in lower ureter	Frequency may be present.
8	Urine	Albumin, blood, pus	No change.
9	Blood count	Normal	Leucocytosis.

CASE II.

J. B., mechanic, aged 31, had always been a healthy man up to ten months ago, when he was taken with a sudden attack of pain in the right side which made him fall to the ground. He felt sick and vomited—the attack lasted four to five hours. A similar attack occurred about one month later. He got very depressed, lost all his energy, could not work, slept badly. Other less severe attacks came on, but he felt himself becoming gradually worse. A doctor saw him frequently, and found that he was tender over his appendix, and suggested his going to hospital for removal of that organ. He was admitted to the Victoria Hospital in August, but presented no symptoms of appendicitis in hospital, so he was discharged, but on returning home immediately had another attack. These attacks, though less severe, have recurred—one or two in the month, up to the present time. November 20th, 1914, after an attack he passed blood in his urine for about three days. He noticed now the character of the pain had changed, that after passing water he felt pain at the end of his penis for a variable time, sometimes as long as two or three hours, and although he had a more frequent desire to urinate, the pain after micturition only occurred during the attacks.

In his general appearance he is a well-built, healthy-looking man. He has no lesion of the heart or lungs, reflexes superficial and deep exaggerated, gait normal—that is, there was no bending forward to relax the psoas muscle which Bovee calls attention to. Hyperextension of the thigh caused no pain (Meltzer's sign); but he was tender on fist percussion in the right loin (Jordan Lloyd's and Murphy's sign). No tenderness on deep palpation over iliac fossa. Rectal examination revealed tenderness to the right. His urine showed the presence of a slight haze of albumin. The radiograph, taken by Dr. Crump, shows beautifully a stone impacted in the lower pelvic ureter.

Fig. 3.—Sketch of Radiogram 1, showing position of calculus in Case II. Largest diameter of stone, 1 cm.

I advised him to come to hospital to be cystoscoped. In the meanwhile he was told to drink large quantities of water, tea, coffee, and a diuretic was prescribed. Three days later, December 5th, he returned with a stone which he had passed that morning after most acute pain. I cystoscoped him two days later, and observed his right ureteric orifice still dilated, irregular, and congested. He has now returned to his work, and says he never felt better.

Both these cases strikingly demonstrate the similarity of the referred pain in stone in the ureter to the predominant symptom of stone in the bladder. To explain this

one must refer to the nerve supply of the ureter, which is chiefly composed of an anastomosis of sympathetic fibres in the outer and muscular coats of the ureter, which is derived from the various plexuses lying in relation to it—namely, in the abdominal portion the plexus ureteris is derived from the renal and spermatic plexuses, the pelvic portion deriving its nerve supply from the hypogastric and vesical plexuses.

For all practical purposes Mackenzie's⁵ theorem may be adopted as the best explanation of referred pain in ureteral colic. Put briefly, hollow muscular organs when violently

Fig. 4.—Diagram to illustrate the concept of a viscerosensory and visceromotor reflex, instigated by stone in ureter. Stimuli are conducted to the right half of the spinal cord (Sp. C.) by the splanchnic nerve (SY. AF.) from the area of the ureter in contact with the calculus, and there give rise to an irritable focus in the cord which is most intense in the right half segment indicated by the coarser stippling. The neighbouring cells and centres are then stimulated to activity—namely, (a) an efferent sympathetic fibre (SY. EF.), having its origin in this area, conducts impulses via the subsidiary ganglia (SUB. G.) to the musculature of the bladder; (b) motor impulses are conveyed to the voluntary muscles supplied by this same segment via the efferent somatic nerves (SOM. EF.) = visceromotor reflex; (c) sensory impressions are referred and intensified by the afferent somatic nerves (SOM. AF.), belonging to the segment to (1) the skin (D.), (2) the subperitoneal tissues (S. P.), (3) the muscles (VOL. M.), the general effect being a viscerosensory reflex.

contracting produce severe pain; this pain is not felt in the organ itself, but is referred to the external body wall by sensory nerves derived from the same spinal segments to which the afferent automatic fibres of the viscus proceed. The diagram (Fig. 4) shows this in detail, and more vividly than any lengthy text.

The nerves reaching the ureter come from the last dorsal, upper lumbar, and sacral segments via the aforementioned plexuses. Strong afferent impulses to the cord will set in play, by over-stimulation, one or other nerves of the lumbar or sacral plexuses, according to the segment most involved, bringing about what Mackenzie calls a visceromotor and viscerosensory reflex, and resulting in increased muscular rigidity and painful sensibility in the referred area.

In order to explain the pain at the end of the penis one must recall the constitution of the vesical plexus which is responsible for the innervation of the lower ureter (Fig. 5). The vesical plexus is formed by nerve fibres from the upper lumbar segments via the hypogastric plexus and from the upper sacral segments via the pelvic plexus. Moreover the two plexuses intercommunicate; so to explain the referred penile pain in J. B.'s case we surmise the visceral nerves are so intensely stimulated by ureteric contractions that an irritable focus is produced in the cord involving especially the part from which the dorsal nerve of the penis originates—namely, the second and third sacral, causing a true viscerosensory reflex; but we must remember that the location of referred pain in low ureteral trouble may arise in other parts, for example, around the

anus with painful sphincteric contractions, or lumbo-sacral pain may be felt, also through communication between the

Fig. 5.—Diagram to show connexions of vesical plexus and path of referred pain from irritable focus in sacral cord.

second, third, and fourth sacral nerves with the vesical plexus (*vide* Fig. 5).

CASE III.

As an instance of sensation referred to other areas I relate briefly the case of E. C., married, aged 25, who had had attacks of pain in his right iliac region and back for about ten months and was eventually sent to the hospital. He also noticed occasionally that just before an attack was coming on he felt pain in his groin when walking. Latterly the pain altered in character. Besides penile pain he experienced a peculiar sensation at his seat associated with straining, and to obtain ease during the attacks he spent most of his time in the squatting posture. This unfortunate man got very despondent. Moreover he had not been married long, and he found that any marital act caused him further suffering, and he was now anxious to submit to any form of treatment to obtain relief. Without going into details of his physical examination, I will

simply state that the diagnosis made previously was renal calculus, but Dr. Crump demonstrated with the x-rays a ureteral stone (Fig. 6), and this was removed by operation.

This brings me to the subject of treatment. My own experience is too limited to be dogmatic. During the last four months I have had to deal with five cases of ureteral stone. Three have

Fig. 6.—Sketch of Radiogram 2, showing position of calculus in CASE III. Largest diameter of stone, .65 cm.

operative treatment; two were going to, but, under medical treatment, passed the stone. Previous to this I have had odd cases, but I am sure I have failed to recognize several others.

The first question to decide is, Should the treatment be

non-operative or operative? By non-operative treatment I mean the drinking of large quantities of fluids and the administration of diuretics. I have used potassium citrate 10 to 20 grains, with decoction triticum repens, three times a day with apparent success.

I regret that I have had no experience with the operating cystoscope; neither have I tried injections of oil or glycerine into the ureter by means of a catheter, or the various special ureteral dilating devices. These last in the hands of experts have undoubted advantages, but, failing these simpler methods, in reasonable time—say two to three months—one must resort to more radical steps unless the life is an absolutely unsafe risk for any major operation.

We decide to operate because we know the integrity of the kidney is being menaced, and because of the suffering incurred by the patient. The only good reasons I can ascribe for non-interference are: (1) When the stone is small and making reasonable progress down the ureter, as shown by the x ray; (2) so-called cases of chronic stones without severe symptoms, therefore not giving rise to acute obstruction, in people who are otherwise bad surgical risks.

Certain general principles should be remembered. In the first place, the incision should give an exposure that will enable the operator to deal with the ureter freely and without constraint. The ureter must be well

freed in order that it may be brought into the wound. This is, of course, not possible in the lowest portion.

It is a good precaution to place a weak clamp above the point at which it is to be opened to prevent contamination of the wound with septic urine, or at least take care to prevent soiling the wound with gauze packs, before incising the ureter.

Some authorities advise opening the ureter over the stone; this may not be possible, and it may be taken for granted that the stone will already have damaged the ureter at this point. I have opened the ureter about an inch above the stone with no evil results. The stone may be then extracted with forceps—for example, Desjardin's, or a scoop. If this is not possible an attempt may be made to push the stone forward with a flexible sound into the bladder.

Before incising the ureter a couple of guy sutures for traction purposes may be inserted with advantage and the incision made between.

The closure of the ureter seems to be an important detail, although I am aware that even without suture leakage may be quite trivial. I have employed the finest catgut and obtained excellent closure, for although I have used a fine drain I have had no evidence whatever of leakage. It is advisable to retain the drain three or four days, as leakage has been known to occur at this time.

Other essential aids to the operation are a good head light and the Trendelenburg posture.

The operative plan must necessarily vary with the position of the stone in the ureter, and consequently that method should be adopted which will give the best exposure with the minimum risk to the patient and the least disturbance of the anatomical structures. The ureter is usually exposed either by what are known as the retroperitoneal or the transperitoneal routes, the latter being reserved for operations chiefly on the pelvic ureter, and is upheld, more especially by Sinclair White,⁶ in this country. Other routes—such as those devised for exposure of the lower ureter through the vagina, rectum, perineum, or even by a parasacral incision—have been for the most part abandoned on account of the difficulties of technique or the risk of infection.

My own personal experience has been limited to retroperitoneal operations, and to carry these out successfully an exact knowledge of the location of the stone is necessary. Hence it is advisable to operate as soon as possible after the position has been verified by the radiographer, and for practical purposes we must adopt a

regional incision according a good exposure to one or other of the following sections of the ureter:

1. Abdominal section.
2. Parietal section of the pelvic ureter.
3. Visceral section of the pelvic ureter.

Under these numbers I will briefly allude to the operations I have myself used.

1. *For Stone in the Abdominal Ureter.*—An oblique lumbo-iliac incision extending from just below the twelfth rib in the angle which it forms with the erector spinae, passing obliquely downwards about one inch internal to the anterior superior iliac spine, then inclining forwards parallel to Poupart's ligament as far as the rectus is required. The muscles are then divided in this line to the peritoneum. The peritoneum is retracted inwards, pulling the ureter with it, but the latter can be comparatively easily isolated.

2. *For Stone in the Parietal Portion of the Pelvic Ureter.*—A McBurney incision lengthened some inches as suggested by Thelwall Thomas; the muscles are split to the required extent and forcibly retracted. The peritoneum is then exposed and stripped upwards until the ureter is seen crossing the iliac vessels.

3. *For Stone in the Visceral Portion of the Pelvic Ureter.*—A median abdominal incision, as described by Judd⁷ will be found satisfactory. Starting from just below the umbilicus and extending to the pubis, the recti are retracted, and the peritoneum well exposed and pushed upwards by gauze dissection. The bladder is then pulled out of the wound as far as possible, and towards the side opposite to that in which the stone is located. By this means the ureter can be seen in its lowest part. An equally good exposure can be obtained by Kelly's modification of the Pfannenstiel incision.

And now a few words of warning. The search for ureteral stones is by no means always successful. The surgeon may fail to find the stone, or perhaps, what is more disappointing still, he may find the stone and be unable to extract it. This has happened to me on two occasions after prolonged operations. In one instance where I had used Thomas's incision a stone was found impacted just outside the bladder wall. The ureter was opened above and the fine forceps (Desjardin's) passed down to it, but every endeavour to grasp it failed. A small flexible scoop was then used to try and dislodge it, without success. Finally, I was able to push it forward with the Desjardin's searcher and a long probe. The ureteral incision was closed with catgut, a small rubber drain inserted, and the wound rapidly closed.

The other case was even more trying. I had used Judd's incision. The position of the stone was found after great difficulty, and could just be felt outside the bladder wall. I could not get a good exposure to see what I was doing, partly on account of general oozing and partly owing to the depth of the wound. Moreover, the ureter was so small that it would not have taken my extracting forceps. As a last resort I opened the peritoneum and inserting a finger hooked the base of the bladder and ureter forward, and, working with another finger in the wound, I was able to milk the stone onwards to the bladder.

These two cases were extremely tedious and trying, but despite the disappointment to both the patients and myself at not being able to see the stone after the operation, they had the satisfaction of voiding it without much difficulty a few days later, and made a speedy and complete recovery. I myself was equally pleased that these simpler measures were more than justified. I hesitate now to think what might have happened had I persisted in making more heroic efforts. The mortality is said to vary from 15 to 20 per cent. with such open operations, not so much from the operation itself as from the after-effects, such as persistent suppuration, fistula formation, thrombosis of the iliac vessels, embolism and even gangrene of the lower extremity, which have been recorded. My own personal experience is that the open operation for stone in the lower ureter may be one of extreme difficulty, not to say danger, more especially should the surgeon, in his intense desire to demonstrate a stone, proceed to slit up a ureter recklessly or combine an intravesical operation after an extensive extraperitoneal dissection, and these dangers are again multiplied with the presence of an infected urine. To corroborate this I

will simply quote Deaver,⁸ who says that the operation for the removal of a calculus situated low down in the ureter may be one of the most difficult undertaken.

I have here purposely insisted on the difficulties of the surgery of the lower ureter, because I believe less hazardous operations are being undertaken with more than encouraging success. I refer to the use of the operating cystoscope, such as the later models of the American type of Buerger and Bransford Lewis.⁹ The procedure with this plan and equipment undoubtedly requires a careful technique and no mean skill, but this should be acquired by the surgeon attempting these cases, and from its comparative harmlessness, it is to be commended in the future as a first step before resorting to the more serious open operation.

My best thanks are due to Dr. Crump for his excellent radiographs; to my house-surgeon, Mr. G. Stevenson, for getting together notes of the cases and assistance with the diagrams; and finally, to Mr. Noel H. Leaver, A.R.C.A., for the trouble he has taken in converting crude drawings into finished diagrams.

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THE MORTALITY OF APPENDICITIS.

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In the opening sentences of his interesting article on "Acute Appendicular Obstruction," which appeared in your issue of April 3rd, Mr. S. T. Irwin says that the mortality of this disease "under modern scientific treatment still runs to from 5 to 25 per cent., according to its type." This, if true, ought not to be, and even in these busy times must not be allowed to pass without comment.

I quite admit in some of the worst cases the mortality may be even higher than 25 per cent., but I am satisfied, as the result of the experience of the last fifteen years, that the over all mortality should not reach more than 5 per cent., and that if the disease is treated by operation sufficiently early the mortality of acute cases need not be more than 1 or 2 per cent. There is nothing inherently dangerous about appendicitis—it is for the most part a question of the extent of peritoneal involvement and of the stage at which interference is carried out.

If, in the practice of any large general hospital or individual surgeon, the over all mortality is higher than 5 per cent., there is some fault either with the surgeon, the contributing doctors, or the public. I must at once say that the better results which we have obtained in this district during the last ten years are largely due to the promptness with which practitioners in our contributing area send their patients for operation. At the present time over 60 per cent. of the cases reach us while the inflammation is still limited to the neighbourhood of the appendix (Groups 1, 2 and 3), while ten years ago it was exactly the reverse. This is well brought out in Table 1, showing the grouping of my cases for last year:

TABLE I.

		Cases.	Deaths.
Group 1	Acute appendicitis without peritonitis	10	0
Group 2	Acute appendicitis with localized peritonitis	47	0
Group 3	Acute appendicitis with flank or pelvic peritonitis or both	19	1
Group 4	Acute appendicitis with diffuse peritonitis	13	1
Group 5	Appendicitis with residual abscess	7	
Group 6	Appendicitis with primary localized abscess	27	2
Group 7	Appendicitis—interval removal	58	0
		181	5 (2.76%)