

Section of Urology

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Some Interesting Features Concerning 455 Personal Cases of Urinary Calculus

PRESIDENT'S ADDRESS

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WHEN we consider urinary calculus as it occurs amongst us to-day we are struck with the different form which this disease takes compared with the reports of the incidence of it up to half a century ago. For until that time this complaint was mostly found in the form of vesical calculus in children of the working classes. When we realize that this type of case is practically non-existent in Great Britain at the present time, we find ourselves with some interesting material upon which to reflect.

The revolution has been a slow one and has gone hand in hand with the improving standard of living in the lower strata of the people.

It has fallen to the lot of research workers in the past thirty years gradually to fit together the successive pieces of evidence which have made it abundantly clear that the fault was one of diet. One may say that diet has always been a matter for great consideration in connexion with attempts to reduce the recurrence of calculus. The old conception, however, that the presence of stone depended largely on the ingestion of the chemical substances of which the stone is composed, has now almost faded into insignificance.

When the incidence of stone has a relationship to diet, it is to do with deficiency, rather than excess, of food constituents. Deficiency of vitamin A of animal origin has been proved to be an important fault, while another factor has been shown to be some unidentified constituent of the whole meal of cereals when taken under certain conditions. It is from the work of McCarrison in India that so much proof on these matters has been forthcoming. Butter and milk, and wheat milled under modern conditions, have been the safeguard in our times against vesical calculus in children.

With regard to the incidence of stone my own cases accord roughly with those of many others. The principal features of such an analysis are as follows: Stone is twice as common in men as in women (males 294, females 161); about 78·4% occurs in the upper urinary tract. Renal calculus is somewhat more common in the male (male 128, females 108). In the ureter this preponderance is very definitely established, for here calculus is twice as common in the male as in the female. Another interesting fact is that the disease is more common in the left kidney than the right (left 109, right 86, bilateral 41), and that when we come to the ureter this discrimination is even more marked still, my figures being: Left 70, right 47, bilateral 4. The average age for stone in the upper urinary tract is 39·6 years.

Seeing that the maximum incidence of this disease is in the upper urinary tract is towards the end of the fourth decade of life, and that the cases due to proved dietary errors occur largely in the lower urinary tract in children, there must be an ætiological factor other than any of those already proved to explain our present-day cases. There are certainly a number of constitutional disturbances which encourage lithiasis; but it is difficult to explain the great bulk of the cases in this way.

The astonishing stone wave of central Europe which apparently started about 1924 and still continues, most likely expresses a widespread change in the conditions of life in those parts, but what those essential factors are has yet to be discovered. That the fault is dietetic is highly probable, and that it is different from those errors which have already been identified is equally likely because the form of the disease has altered in that it is renal instead of vesical, and it occurs in the middle-aged instead of in children.

I have been very much impressed with the fact that a high proportion of renal stones have been associated with identifiable chronic lesions indicating a past or present inflammatory change of the genital organs, the urethra, and the bladder-neck. Often these have not been very obvious, and in many cases would certainly have been missed if they had not been sought for carefully. In some cases, and I am speaking of those before middle age and of females as well as males, residual urine was found to be present in the bladder. This seems to be due to some bladder-neck change which in its turn may in some cases be the result of a past inflammation.

In 115 cases of stone in the upper urinary tract I have found either a focus of infection in one of the situations mentioned, or there has been residual urine in the bladder, in as many as 72%. It is surprising how often residual urine is found in the bladder, and the epididymes are thickened if not actually adherent to the testes, with some recognizable change of the internal genitals on palpation; although occasionally endoscopy will be necessary to establish the presence of inflammatory changes in these organs.

It might be thought from what I have said that gonorrhœa should be commonly associated with stone. This is not the case, but the mixed infection which lingers indefinitely after this infection, in time undoubtedly plays its part, as many of my cases have shown; others have emphasized these points. Cervical erosion is quite a common association, and so are chronic urethral and prostatic infections.

Now I would like to describe early pathological changes in a kidney, which is a stone-forming organ. Randall of Philadelphia has described how stones form on the renal papilla, first of all under the epithelium as a minute plate of calcium, on which other crystals are deposited; thus a tiny stone develops which breaks away, carrying a facet or depression representing its point of attachment to the papilla.

It is obvious that a stone bearing such characters must be extremely small, as, after resting in any part of the urinary passages for any length of time, it will soon become coated with further crystals, and thus the evidence of any papillary attachment is inevitably buried.

I have been fortunate in being able to collect five very small calculi which show these facets; each stone was passed by a different patient following an attack of renal colic. The physical characters of these stones invite the conclusion that there is an area on the surface of each which represents its former point of attachment to a papilla. The diameters of these stones vary between 2.5 and 4.5 mm. I have examined them all microscopically under a 50-mm. lens with direct light illumination, and their important characteristics are portrayed in this drawing (fig. 1). Dr. J. Fine, the pathologist at St. Paul's Hospital has analysed these stones for me, and he finds that they all consist of a mixture of calcium oxalate and calcium phosphate with a trace of carbonate and organic matter.

An additional stone larger than the others, actually 7 mm. in its longest diameter, is depicted separately. The appearance of this stone, two views of which are presented, suggests that following its detachment it has become completely covered with a further deposit of crystals, but that the zone of attachment (a depression) is still apparent (fig. 2).

There is no doubt that stones form in the kidney in localities other than the papillæ. Here, for example, is a drawing of a kidney where calculi are firmly adherent to ulcerated areas of the pelvic mucosa (fig. 3).

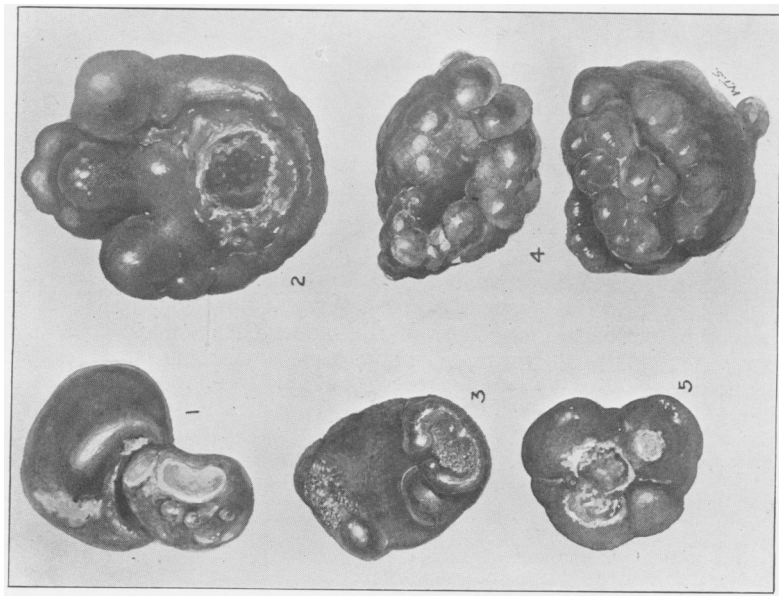


FIG. 1.—A collection of five small stones, each passed by a different patient after an attack of renal colic. Each calculus shows a facet or a depression which probably represents its point of attachment to a renal papilla. No. 4 represents two aspects of the same stone.

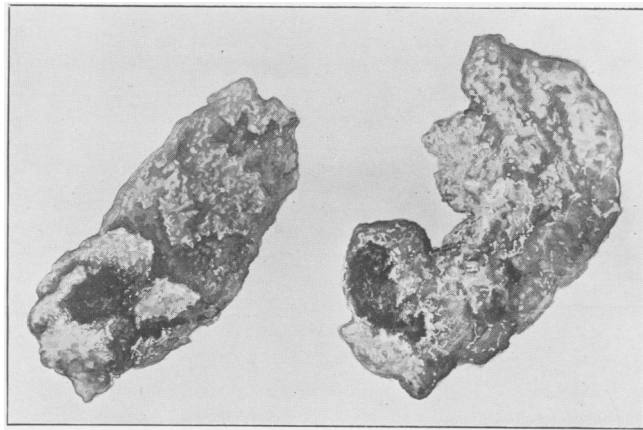


FIG. 2.—Larger calculus with a depression. Size and appearance probably due to further deposition of crystals since detachment from papilla.

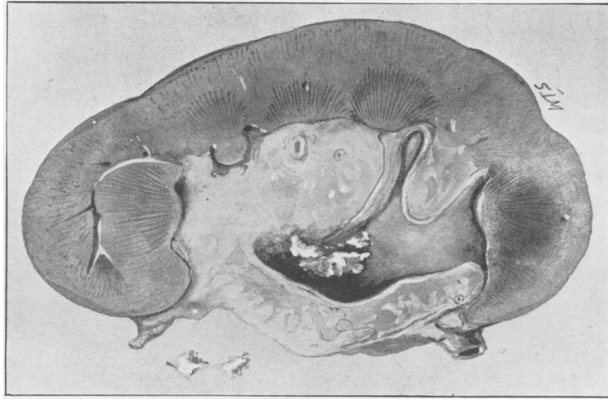


FIG. 3.—Calculi formed on patches of ulcerated pelvic mucosa.

The depth of fat surrounding the pelvis indicates the chronic nature of the pyelitis which was present. The patient had, over a course of many months, passed a number of stones.

Here are some drawings of a kidney showing that renal calculi can form under rare conditions (fig. 4).

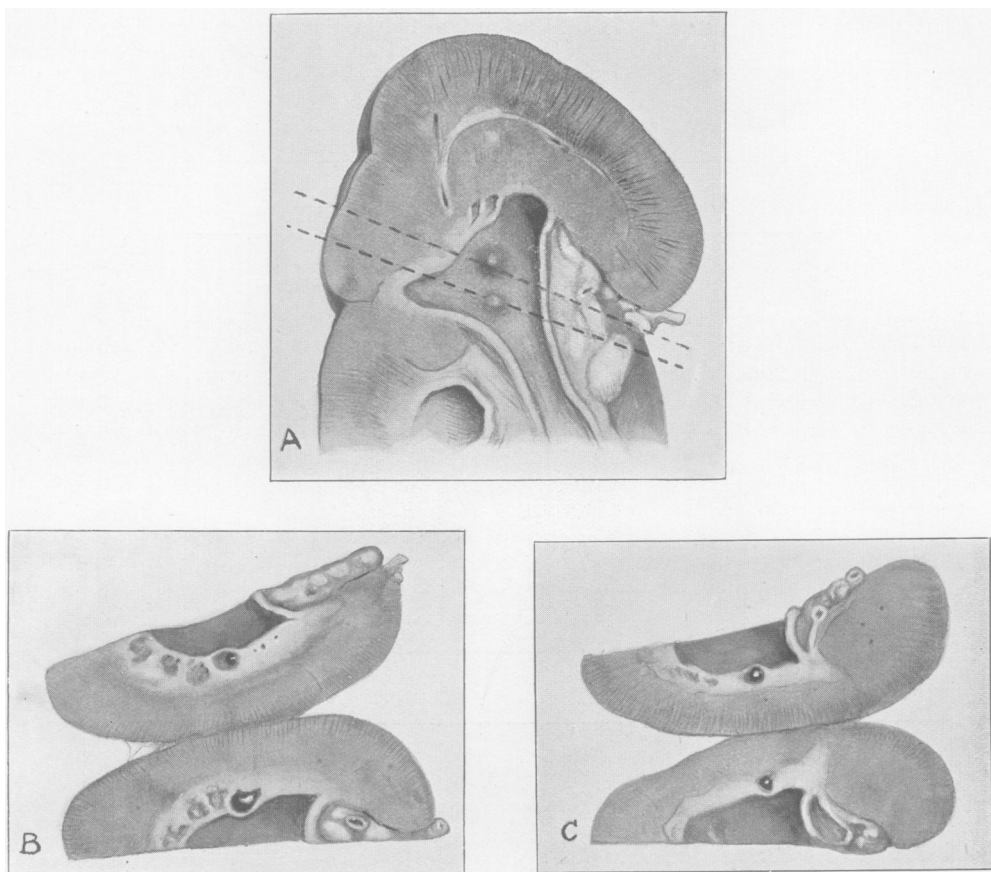


FIG. 4.—Calculi formed in closed cavities beneath the mucous membrane of a renal calyx.

They have developed beneath the mucous membrane in closed cavities which have apparently formed by the breaking down of renal substance.

Calculi may occur in more than one part of the urinary tract at a time. The following table shows the different situations of the calculi when these were multiple in 455 cases of urinary, and 29 cases of prostatic calculi :—

Situation							No. of cases
Bilateral, renal	..	..	..	..	..	..	41
Bilateral, ureter	..	..	..	..	..	..	4
Kidney and ureter	..	..	..	..	..	..	24
Bladder and upper urinary tract	..	..	..	..	..	..	2
Bladder and urethra	..	..	..	..	..	..	2
Urethra and elsewhere in urinary tract, or prostate	..	..	..	..	..	..	5
Prostate and some part of urinary tract	..	..	..	..	..	..	5

Changes in the kidney.—I have long since felt convinced that one of the important ætiological factors in the formation of renal calculus is an already existing dilatation of the pelvis, often only in a minor degree, but nevertheless capable of producing a certain amount of urinary stasis. Intravenous urography has given us the means of identifying many cases of this kind. The most convincing examples in relation to stone occur where the dilatation can be seen on both sides, while the calculus is present only on one side (fig. 5).

Single or multiple rounded calculi seen in the renal area of a radiogram are those which have formed secondarily to a hydronephrosis. I have discovered this association in about 10% of my cases. It is particularly marked in children; in fact in the majority of cases of stone in the upper urinary tract in children there was previous hydronephrosis (80% of my cases) (figs. 6 and 7).

Clinical features.—Diagnosis by X-rays as a rule does not present any difficulty, but there are the odd cases where the appearances raise a doubt. Where any uncertainty exists it is generally a question of calcareous glands. On a lateral radiogram gland shadows are almost invariably seen well in front of the vertebral bodies, whereas the shadows of renal calculi are usually confluent with those of the vertebral bodies. Exceptions to the latter rule are found, however, from time to time (fig. 8).

I avoid instrumental pyelograms in renal stone cases because of the danger of stirring up infection in the kidney. The less dense shadow from the excretion pyelogram is so much more satisfactory as a means of showing the exact position of the stone in the kidney; and I never fail to make use of this method, for in addition, it gives so much information about both kidneys without any risk to the patient. And, as a rule, by this means one is able to make up one's mind before operation exactly what operative treatment should be carried out.

It is not often that calcified tuberculous masses in the kidney raise a doubt with regard to stone, but I had two cases which deceived me in this respect (fig. 9). Then there is also a condition which sometimes occurs in the kidney as a solitary circumscribed mass giving a shadow on X-rays. The substance is yellowish, semi-solid, and homogeneous. I had one case which was accompanied by a stone in the ureter (fig. 10).

Treatment.—The question of nephrectomy or lithotomy had to be considered in a large number of cases, and the decision was usually not difficult to make. I am more convinced than ever that to remove stones from a kidney which will subsequently contain residual urine, should be avoided if possible. I believe that such a result means inevitably further stone formation, not only on the same side, but with an added risk of it on the other. Unfortunately the state of the opposite kidney sometimes contra-indicates what would otherwise be the proper treatment, namely a nephrectomy. But nevertheless it is sometimes possible to excise the dilated portion of the kidney and thus to remove the opportunity for residual urine to collect.

There have been three different ways in which I have been able to carry this out successfully:—

- (1) By resecting a portion of the pelvis.
- (2) By resecting the dilated portion of the renal substance.
- (3) By resecting the hydronephrotic portion of a double kidney.

In resecting the pelvis I have carried out the Von Lichtenberg technique in three calculus cases as well as in a number of cases of non-calculus hydronephrosis, and the results in not one of these was to my satisfaction. On the other hand a simple resection was completely successful in all of a small number of cases in which it was attempted (figs. 11 and 12).

Resection of the dilated portion of the renal parenchyma in my cases has generally meant amputating the lower pole of the kidney. I regard this as highly necessary and very satisfactory in those cases where nephrectomy is inadvisable. When the portion corresponding to the middle group of calices had to be excised, I found it

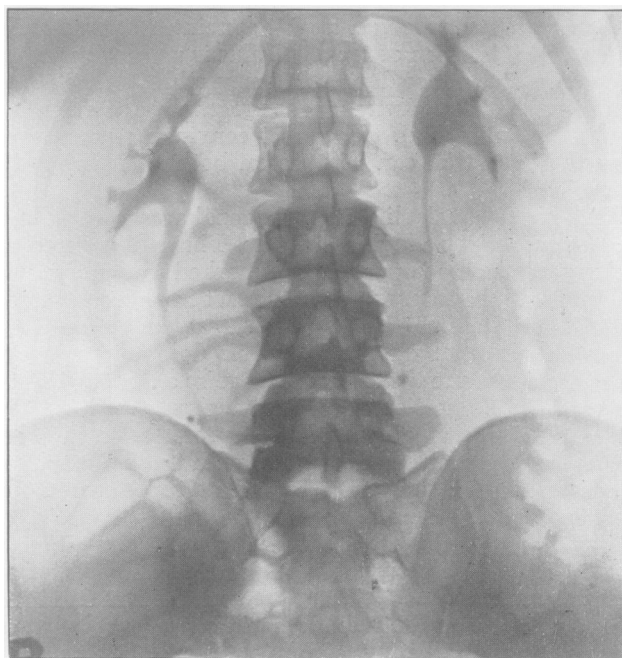


FIG. 5.—Intravenous urogram in a case of left-sided urinary lithiasis. It is to be noted that there is dilatation of both renal pelves.

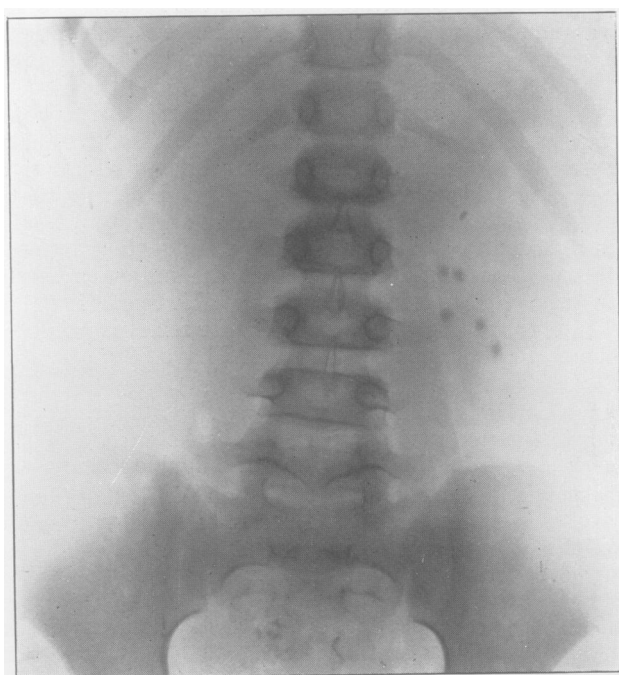


FIG. 6.—Multiple calculi in left renal pelvis in a case of bilateral hydronephrosis in a child aged 8.

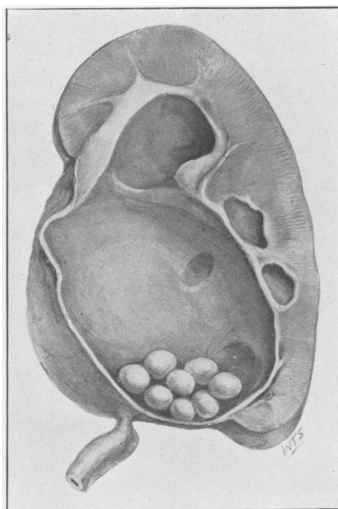


FIG. 7.—A collection of calculi in a left hydronephrosis in a child aged 5 years.



FIG. 8.—A lateral radiogram showing a series of calcified glands in front of the vertebral bodies, but the second shadow from the top is of a stone in the pelvis of a dilated kidney.



FIG. 9.—Shadows due to calcification in the walls of a renal pelvis and calices in a tuberculous kidney.

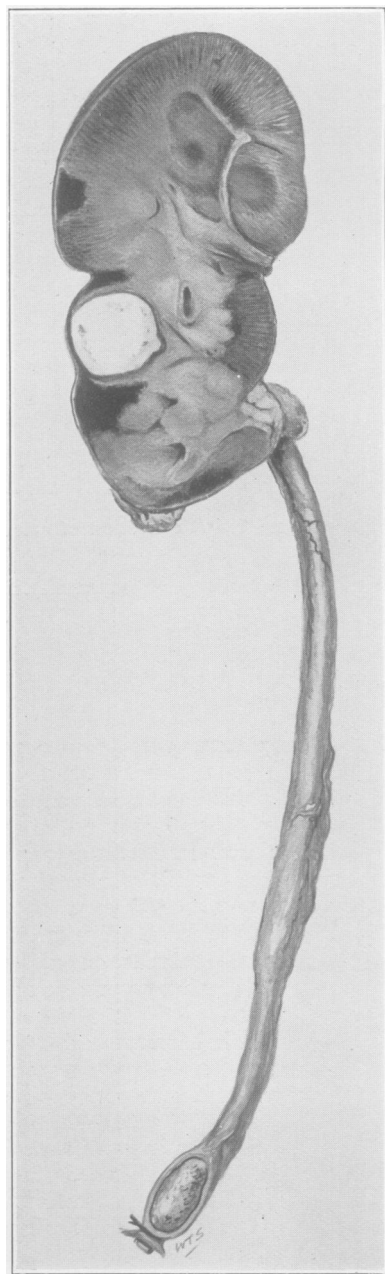


FIG. 10.—A nephro-ureterectomy specimen with a rounded non-tuberculous mass in the kidney and a stone in lower end of ureter.

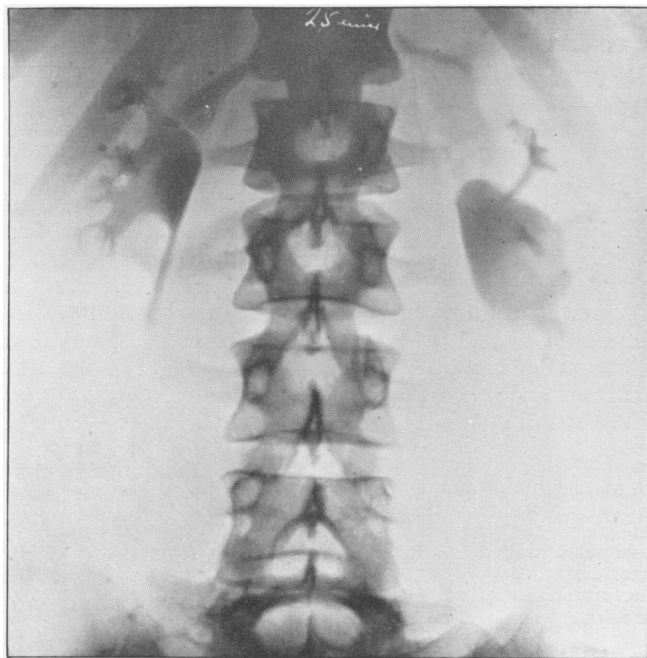


FIG. 11.—An excretion urogram of a left hydronephrosis. There was a small stone in the pelvis.

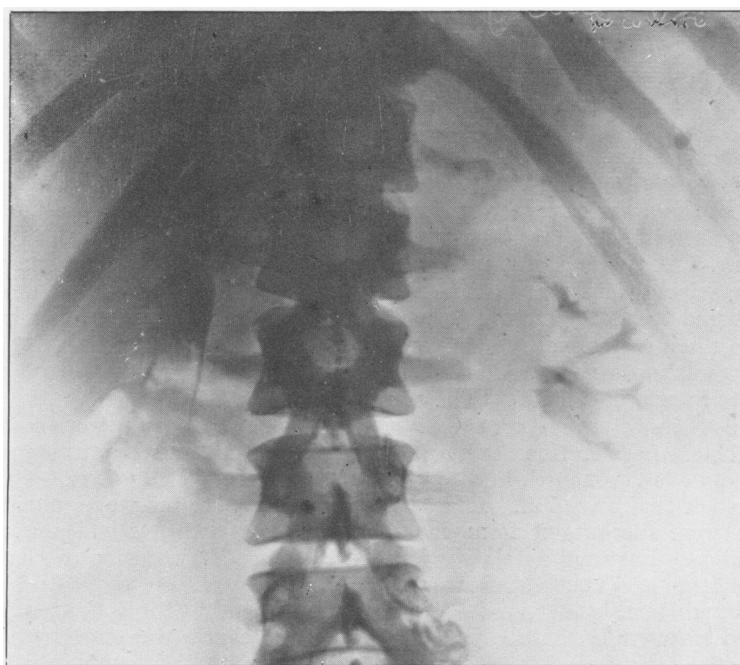


FIG. 12.—An excretion urogram of the same case several months after removal of the stone and resection of the pelvis.

quite adequate to cut away the dilated renal tissue and to drain the kidney through this region for several days. Excision of the hydronephrotic portion of a double kidney presents no difficulties after the blood supply of the healthy portion has been accurately identified and protected.

With regard to nephrectomy my experience makes me feel that in carefully selected cases this form of treatment is most satisfactory, not only because recurrence on the opposite side is uncommon, but because of the tremendous advantage to the patient of a complete riddance of a diseased organ. The subsequent improvement in health is a frequent cause for satisfaction amongst patients of this kind. Although I have no exact figures to give you I can recall a number of cases of recurrence of stone after lithotomy either in the same or the opposite organ, whereas I can recall only one case where stone recurred in the opposite kidney after nephrectomy. In this case fortunately the stone was passed *per urethram*. These conclusions are arrived at as a result of 81 operations of nephro- or pyelo-lithotomy, and 63 cases of nephrectomy which recovered from their operations.

Analysis of 154 operations on 144 cases of renal calculus :—

	No. of operations	Mortality
Pyelo- and nephro-lithotomy	77	2
Pyelo- and nephro-lithotomy and plastic operation on pelvis ..	6	0
Partial excision of kidney	2	0
Hemi-nephrectomy	1	0
Nephrectomy	61	2
Nephro-ureterectomy	4	0
Nephrostomy	3	0
Total number of operations	154	4

Percentage mortality, 2.5.

It may be a justifiable criticism of these figures that the proportion of nephrectomies is somewhat high. My reply is that results seem to justify such a policy.

Complications of nephrectomy.—There are two particular post-nephrectomy complications of which I have had experience. One is a failure of the ligature to control bleeding from the vascular pedicle, and the other is the development of a colic fistula in the loin wound. With regard to the first I had two cases. In one, after succeeding in getting clamps on the bleeding vessels, the patient was sent back to bed with these still in position; a week later these were removed without incident. In the other case Marion's method was successfully employed, of pressing gauze firmly into the depths of the wound and keeping up the pressure for five minutes by the clock. At the end of this time the bleeding had stopped, and there was no difficulty in seizing the stumps of the renal vessels.

With regard to post-operative fistula of the colon this occurred following a right nephrectomy in a case of calculous pyonephrosis in a woman aged 51. It was a case where there was known to have been stone in the right kidney for fifteen years and no operative interference had ever been undertaken for it.

The difficulties in separating the kidney from the peritoneum were considerable, but nevertheless neither this nor the bowel was opened, and I am not aware that the latter was even damaged, but its vitality must undoubtedly have been impaired in the course of the dissection. It was a great surprise to me when, about the fifth day, fæces were discharged from the loin. Ultimately intestinal mucosa made its appearance. Fortunately there was no important deterioration of the patient's general condition as a result of the fistula, and as time went on the prolapse of bowel into the wound steadily increased. It became obvious that the condition could only be remedied by opening the abdomen. This in due course was done by a colleague who was a general surgeon. He excluded and removed the affected portion of the bowel with an eminently satisfactory result.

Another most interesting consequence of nephrectomy for stone, which can hardly be called a complication, was the occurrence of a large fatty tumour in the renal fossa. It formed an easily palpable mass in the right loin and gave rise to pain, in a male patient who had had his right kidney removed some years before.

There are other operative complications of which I had experience; the more important of these are (1) secondary hæmorrhage after nephrolithotomy, and (2) the tearing away of the ureter from the renal pelvis as a result of traction on the kidney.

With regard to hæmorrhage I have only had two cases which caused me serious anxiety, in neither did I have to do a nephrectomy and both recovered; both cases were different with regard to the state of the kidney.

(1) The first was a woman aged 21 with extensive bilateral calculus and the bleeding occurred after the one and only operation I carried out, when I cleared out all the stones from the right kidney which I drained for about ten days after the operation. Everything was straightforward up to this point, but the removal of the drain from the kidney initiated an increase of sepsis which culminated in severe renal bleeding. It was finally controlled by blood transfusion and improving the loin drainage as much as possible, and the patient made a good recovery.

In looking back on this case I have no hesitation in saying that permanent nephrostomy would have been the better treatment. It is unlikely that any bleeding would have occurred had I continued my drainage instead of interrupting it.

The other case of secondary hæmorrhage was a man aged 45, who had his hæmorrhage on the seventh day after operation. I had removed a small stone from the lowest group of calices and, in so doing, had cut through a good depth of healthy-looking renal tissue. These are certainly the circumstances likely to lead to a hæmorrhage later on. I was careful to provide good drainage by rubber tissue down to the site of the renal incision, and the drain had not been shortened at the time when the bleeding occurred. I can think of no alternative technique which would have safeguarded against the hæmorrhage. Fortunately it was got completely under control simply by dropping a stitch in the skin, removing all clot from the depths of the wound, and providing more drainage down to the kidney.

(2) The first case in which rupture of the ureter occurred was one in which I had proposed nephrectomy, so no harm was done, but the rupture occurred without my knowledge, and it was certainly disconcerting to find that it could happen so easily. After removing the kidney I did not seek the upper end of the ureter to ligate it, and there followed a most interesting complication, namely, a leakage of urine from the loin wound for about a week. I was surprised to see this as the ureter had not appeared to me to be dilated, and its walls were certainly not rigid as is sometimes the case when such a fistula occurs following nephrectomy for tuberculosis.

What we have to remember, is that in some stone cases the pelvis and adjacent ureter are œdematous, inelastic, and densely embedded, and, in these circumstances, may easily rupture from traction on the kidney.

The second case of rupture was unfortunately one of bilateral renal calculus, and I was exposing the right kidney to remove stones from the pelvis and lower pole. Here I discovered, to my dismay, after delivering the kidney on to the loin, that the ureter had torn away from the pelvis. After removing the stones I re-implanted the ureter into the pelvis by the Von Lichtenberg method. There was a continued urinary fistula for many weeks after this, and I was ultimately forced to perform nephrectomy. On dissecting the kidney later, I found that the union between the ureter and the pelvis was so complete as to entirely obliterate the lumen of the ureter. Fortunately, six months after the removal of stones from the other side, there are still no stones in the remaining kidney, and the urine is free from pus.

This same case afforded one instance of anuria with stone in a single kidney.

After operation the patient was sent to a convalescent home to improve his general condition before removal of the small stone in the lower pole of his left kidney, but unfortunately he had only left hospital a week before he was hurried back again in a condition of anuria. I was out of town at the time, but a colleague passed a catheter up the left ureter and immediately established a flow of urine. It was instructive to observe the effect on the blood urea of the continued ureteric catheter drainage. On admission the blood urea was 245 mgm. per 100 c.c.; six hours after the

passage of the catheter it was 160, and it continued to drop steadily until it reached 20 after six days, when I removed the stone from the renal pelvis. Obviously the patient's ultimate prospects of recovery were immensely improved by the use of the indwelling ureteric catheter.

Operative mortality.—In cases of renal calculus the figures for operative mortality are on the whole satisfactory; my own are: 154 operations with four deaths—a mortality of 2.5%. In two the kidney was opened for the removal of stone, the remaining two were nephrectomies.

The first was a pyelolithotomy in a man aged 45 for a stone about 1½ in. in diameter in the pelvis of the left kidney. Before operation the urine revealed no pus and only a few staphylococci. Some days before the operation an instrument-pyelogram on the left side was carried out; at the operation I resected the 12th rib. The patient developed pneumonia at the right base on the third day, from which he died. On exposing the kidney at operation I found that the pelvis and the lowest calices were somewhat dilated, and turbid urine escaped from the pelvic incision as the stone was being removed.

This incident definitely made me feel that infection in the kidney had been stirred up as a result of the instrumental pyelogram. I doubt very much whether the rib resection had anything to do with his pneumonia as this began in the base of the right lung.

The other case was a man aged 45 who had a stone the size of a sparrow's egg in the pelvis of the right kidney. He was certainly not a good subject. He had had pre-existing urinary tract abnormalities which required surgical treatment; eighteen months previously I had removed a vesical diverticulum and a functionless left hydronephrotic kidney. There was no stone on either side at this time, nor was there at any time the question of dilatation in the right kidney, but a stone developed there in due course nevertheless; the blood urea before his last operation was 81 mgm. %. The left nephrectomy had resulted in a hypertrophied right kidney. At operation extensive adhesions between the upper pole and the diaphragm resulted in a very severe ordeal for the patient, in the delivery of the hypertrophied kidney on to the loin. The patient's blood urea steadily mounted after the operation and was 240 on the third day, and it continued to rise until his death.

The nephrectomy cases that I lost also had extensive perinephric adhesions. They were 38 and 39 years of age respectively, with old-standing and extensive calculi in each of which freeing of the kidney from the surrounding parts was very difficult. My hesitation in not doing a subcapsular nephrectomy in these cases was increased by the knowledge that the thin-walled and infected kidney was certain to be opened on attempting this. On looking back on other cases of subcapsular nephrectomy, one has the knowledge that this method is generally successful, but that there is a prolonged convalescence to look forward to as a result of the continued discharge from the thickened and infected renal capsule which remains.

While recognizing the inevitable risk associated with operating on this type of case, my own experience indicates that if the kidney is especially difficult to free during the operation, changing to subcapsular nephrectomy should be seriously considered there and then in spite of the risk of additional sepsis and a tedious recovery.

There is one point in particular which contributes largely towards success or failure, and that is post-operative drainage in regard to both inside and outside of the kidney. It is important to pay attention to two points in connexion with this, (1) to stitch the drain to the vicinity of the opening in the kidney, and (2) not to remove it for a week.

Before I realized how important these points were, I often noted deep tenderness along the line of the ureter together with constitutional signs of some toxæmia, undoubtedly due to the passage of urine down the outside of the ureter; the clinical signs of this have been conspicuous by their absence with the improved technique mentioned.

The question as to when to drain the kidney itself after a lithotomy is indeed a vexed one. My most successful rules have been not to attempt to drain a kidney

unless there is one of the following conditions: Gross sepsis, considerable local or general dilatation, or anuria. One should take care to incise and drain only through a dilated portion of the organ and to keep the drainage going until the temperature is quite settled. Indeed where the kidney has been considerably dilated it is an advantage to fit the patient with an apparatus so that he can go about with the kidney drainage for months if necessary.

The point of view that a long-continued nephrostomy encourages staphylococcal infection, and therefore further stone formation, seems to be an objection which is more theoretical than practical. The many successful cases of permanent nephrostomy reported in recent years are the best answer to such a criticism.

Recurrence after operation.—The four most important causes of recurrence that I have had personal experience of are the following:—

(1) Leaving behind after operation a dilated and therefore badly draining portion of the kidney.

(2) Leaving behind pieces of stone at operation.

(3) When the stone removed is soft and phosphatic and is therefore accompanied by a high degree of sepsis.

(4) The rapid post-operative formation of soft phosphatic stones which may occur even after the removal of an oxalate stone.

As I have already mentioned, the way to avoid recurrence in the first state, if the kidney must be left behind, is to excise as much as possible of the dilated portion of the organ, or in the worst cases to establish permanent nephrostomy. The best way to avoid the second is to take X-rays on the table during the course of the operation when several small stones are present. This of course is not a complete safeguard, but I have found it a great help. With regard to the third, i.e. soft phosphatic stone, if the kidney must be preserved, the safest course is to establish permanent nephrostomy.

In looking back I can recall several cases of the latter type, and they all had some features in common. The principal of these was that they were all associated with stone in the other kidney.

I would like to make particular reference to the type of case where the recurrence is quick, i.e. within a few weeks of surgical removal. This is almost certainly the soft phosphatic type of calculus. My experience is that one should avoid as long as possible any temptation to reoperate on these cases, for two reasons, namely, that operation is more than likely to result in a nephrectomy, and that if the time can be spared and the stone is in the pelvis, it is very likely to pass. I have had both of these experiences. It is certainly very worrying to have a protracted urinary fistula from the loin, and to demonstrate by X-ray a post-operative obstructing calculus. But such a patient should be got on to his feet as soon as possible and encouraged to drink plentifully, as a result of which he will as likely as not pass his stone.

It is of interest at this stage to state that it is my experience that the majority of patients who have never had an operation for stone, but who pass a calculus following an attack of renal colic seem seldom to be bothered again in this way. The only explanation I can offer for this is that, in such cases, the cause of the stone formation is a transitory one. It also suggests that the retention for any length of time of the stone in the kidney encourages further stone formation.

Bilateral cases.—The incidence of bilateral urinary lithiasis varies according to the different ways in which the matter is studied.

DIFFERENT PERCENTAGES OF BILATERAL CASES ACCORDING TO THE MANNER OF INVESTIGATION

Total number of cases in upper urinary tract ..	12.6%
Renal calculus cases that came to operation ..	15.2%
Total number of renal calculus cases	17.3%

It seems to me that the important objective in going into this question is to obtain a clear idea as to what extent there is a tendency for the disease to be bilateral. There is no doubt that the figures of the last group are nearer the truth than those of the first two groups. However, to obtain the final word on this subject, it would be necessary to know the post-mortem findings on a large series of renal calculus cases.

The following table gives some details with regard to operations on my cases :—

ANALYSIS OF 32 OPERATIONS ON 22 CASES OF BILATERAL RENAL CALCULUS

	Operations	Mortality
Lithotomy	24	0
Lithotomy and plastic operation on pelvis ..	1	0
Lithotomy and amputation of lower pole of kidney ..	1	0
Nephrectomy	4	0
Nephrostomy	2	0
	—	—
	32	0
	—	—

The treatment of cases with both kidneys occupied by stones at the same time cannot be stated in a few words. Six cases may quite likely require treatment in six different ways according to the particular circumstances in each case.

For instance extensive bilateral calculus in a young person as a rule would require bilateral nephrostomy, whereas the same condition in an elderly person might quite easily require no surgical interference at all.

In one case, a female aged 51, seven years ago I found it justifiable to remove a well-marked pyonephrosis, and two small stones from the calices of the opposite kidney some months later. That patient is in excellent health now and her single kidney is free from stone.

In another bilateral case I removed a stone from each renal pelvis six years ago. There were then stones in both pelves with considerable renal dilatation. The kidneys were tackled separately, and both were drained during the convalescence. Recent radiograms show no recurrence of stone and considerably reduced dilatation.

The type of case already referred to in which there is a stone on one side and a branched calculus forms quickly on the other side in association with a good deal of sepsis, requires permanent nephrostomy at least of the kidney which formed a stone last.

Permanent nephrostomy seems to have been practised very little on this side of the Atlantic. I am personally very favourably impressed with the results of it from my own limited experience. Let me show you a photograph of the apparatus fitted to a patient upon whom I carried out this operation on each side. The patient, a man aged 21 who has had stones removed from both kidneys, still has bilateral calculi. He goes about in complete comfort now and in excellent health (fig. 13).

STONE IN THE URETER

Although the great majority of ureteric calculi undoubtedly come from the kidney, I have had several cases where there was some justification for the conclusion that the stones formed in situ. In each case the appearances suggested a dilatation of the ureter previous to the stone formation. Ureterocele is of course an extreme in this respect. My figures give a definite preponderance in incidence on the left side. In 121 cases, 70 left, 47 right, and 4 bilateral, it is of interest to note that ureteral calculus has occurred in my series twice as often in the male as in the female (male 33, female 38). Indeed in a descending sense it is not till we get to the ureter that it becomes evident how much more common urinary calculus is in the male than the female.

Clinical features.—It has been noticeable how much more frequently colic occurred when the stone was in the upper two-thirds of the ureter than in the lowest third. By the time the stone has arrived in the position outside the bladder, the symptoms were generally nothing more than an aching in the loin. Another point of interest is that it is exceptional not to be able to detect on a plain X-ray any stone in the ureter which gives rise to symptoms. I have had only occasional instances where intravenous urography was necessary to demonstrate the calculus. Phleboliths do not as a rule cause any difficulty with regard to diagnosis, but every now and again the single shadow of a phlebolith calls for careful discrimination.



FIG. 13.—A double nephrostomy for bilateral renal calculi.

It may also be said that it is seldom that shadows of calcified glands give any difficulty, but in one case it was wise to continue the investigation beyond the first X-rays.

On the few occasions when I have thought it necessary to pass a wax-tipped bougie up the ureter I have always been satisfied as a result of this procedure that there was no stone present, showing how reliable a good radiogram is in this respect. Cystoscopic appearances of the ureteric orifice when a stone is in the vicinity are sometimes of interest. Here is a contrast in appearances (figs. 14, 15 and 16).

Treatment.—With regard to getting rid of the stone, I have found that the majority of stones in the ureter which have been associated with colic, have passed either

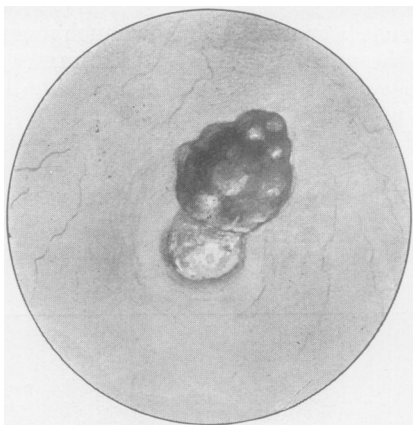


FIG. 14.—Drawing made at the time a calculus was entering the bladder from the left ureteric orifice.

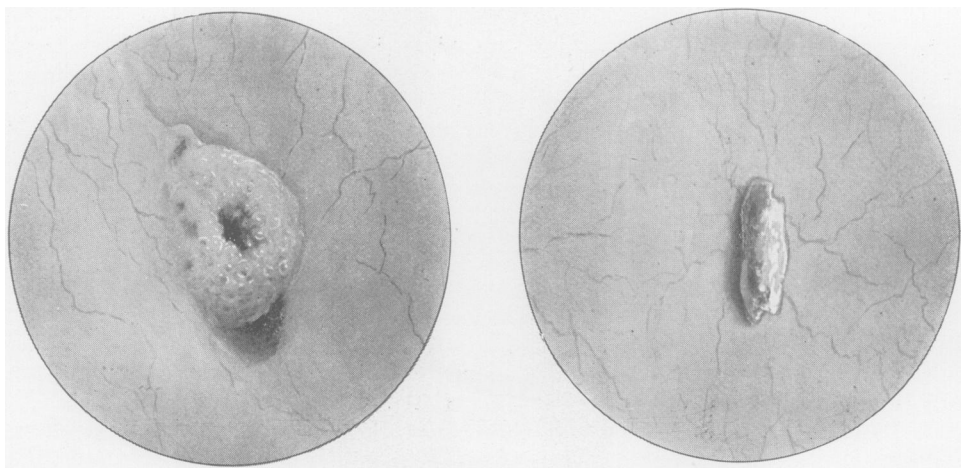


FIG. 15.—Drawings showing the œdematous condition of the left ureteric orifice and the stone which had been recently extruded from it.

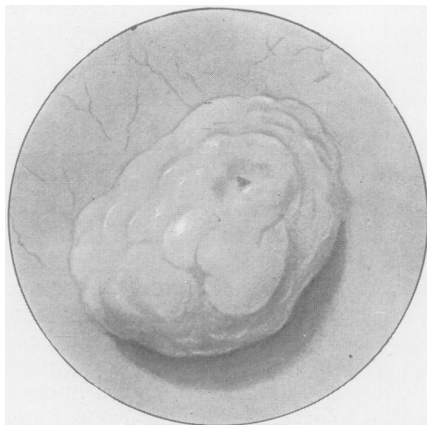


FIG. 16.—Edematous ureteric orifice with stone impacted behind it. The stone was liberated by incising the orifice with a high-frequency current through a cystoscope.

without any surgical interference, or with the assistance of some procedure which can be carried out through a cystoscope, such as the passage of ureteric catheters and the slitting of the ureteric orifice. A high-frequency and not a coagulating current should be used for this (fig. 16). Only 23% of my 121 cases of ureteric calculi required open operation.

I feel it incumbent at this point to call attention to a special danger in passing instruments up the ureter in the hope of assisting the passage of a stone which is situated in the uppermost third of the ureter. There is, unfortunately, a probability that the calculus will be pushed back into the kidney. If this happens and the stone enters the lowest group of calices, then the whole outlook of the case is altered at once, the probability being that a nephrolithotomy may be necessary where previously there had been no worse prospect than a ureterolithotomy.

It may seem to some that the operative differences are unimportant, but let me remind you that a nephrolithotomy at once introduces the danger of secondary hæmorrhage, and there is, moreover, the difficulty and uncertainty of finding a small stone in the kidney.

Once a stone has reached the pelvic floor, months can be allowed to elapse without the likelihood of serious renal damage and with good prospects that the stone will ultimately pass. This opinion is based on the observations I have made from time to time by intravenous urography, that with the stone in this situation both interference with renal function and the amount of renal dilatation, are relatively slight and diminish as the stone descends.

On the other hand there can be sudden and severe interference with function when a small stone becomes impacted in the upper part of the ureter. In one case when the stone was in the pelvic ureter I waited as long as nine months, with ultimate success. I remember two cases in which the stone had passed into the bladder where I thought this quite impossible from the size of the calculus. I had advised operation in both cases, and in each without any kind of instrumental interference the stone passed into the bladder, where I crushed it. The larger of these was 1 in. \times $\frac{3}{4}$ in. and situated in the sacral portion of the right ureter.

It seems that sometimes a simple cystoscopy will cause an activity of the ureter which results in the evacuation of the stone, and to this I attributed the results in both these cases.

Open operation.—The following is a table giving a brief analysis of the 28 open operations which I carried out for stone in the ureter :—

Ureterolithotomy	19
Nephro-ureterectomy	7
Excision of ureterocele	1
Reimplantation of ureter	1
Total	28
Mortality	0

As is usual in open operations on the ureter for the removal of stone, the majority were for stone in the lowest third of this passage and in the extramural portion. I have found the approach through an incision above the inguinal region easier than that through the mid-line ; I therefore always employ the former, but were it necessary to remove stones from the lower ends of both ureters at once, I certainly would make use of the latter. In the only case in which this question arose, one stone was coaxed into the bladder by various trans cystoscopic manipulations. I had one interesting experience in setting out to remove two stones by open operation from the lower end of a dilated ureter : I had tilted the patient into the Trendelenburg position before the lower end of the ureter was completely exposed, and when I reached the pelvic floor the stones were no longer in the ureter in this situation ; they had undoubtedly

been tipped back into the kidney, but the case was one where there had been a ureterocele and in addition a constriction of the ureter at its junction with the bladder, and this latter condition necessitated a division of the ureter with a reimplantation into the bladder. Fortunately, with the dilated ureter there was no difficulty in leaving the newly constructed orifice of such a width that the stones would be able to pass easily into the bladder; in due course the patient produced the stones, having passed them *per urethram*.

There is no doubt that renal destruction can be very advanced as a result of the prolonged residence of a stone in the ureter. Eight out of 28 (28.5%) of the open operations which I carried out for stone in the ureter required a nephro-ureterectomy.

Vesical calculus.—To-day the majority of cases of vesical calculus occur late in life; the average age in my cases was 54.6 years.

Vesical calculus to-day becomes most obvious at the period in life when the various types of bladder-neck obstructions begin to assert themselves, the incidence being overwhelmingly more common in the male. My figures in 87 cases are 84% in this sex. These figures are in striking contrast with those which were published up to the first decade of this century. From these it is obvious that a change in the incidence of vesical calculus is taking place. Freyer, in 1908, in considering the sex incidence in 1,623 patients, found that more than 98% occurred in the male. Hugh Lett, in considering 608 cases of vesical calculus admitted to the London Hospital in the thirty-year period, 1905–34, found that the incidence in the male was reduced to 91%.

My own cases with 84% of males represent a later period still, 1922–38. So that there seems to be good reason for believing that vesical calculus is less frequent in men than it used to be. The most likely cause of this change is that obstructive conditions at the bladder neck are dealt with surgically more frequently than formerly. On the other hand we must not overlook the fact that from the beginning of the century onwards, the more frequent performance of pelvic operations on women may have some bearing on this sex incidence.

Lett is strongly of the opinion, from an analysis of his personal cases, that injury to the bladder during the course of a pelvic operation is the cause of the increase which his figures showed had occurred in women.

On three occasions I have found unabsorbable ligature material inside the female bladder—twice in connexion with vesical calculus. In all cases there had been pelvic operations several years before. In the male simple prostatic enlargement provided the commonest ætiological factor.

Fragmentation of the stone is an interesting condition which I am able to record as a personal experience. I found it in a man aged 82 where there was an associated condition of prostatic hypertrophy. Fig. 17 is a drawing showing the state the calculi were in when I retrieved them from the bladder.

With regard to ætiology the more unusual cases that I have had have been from the debris following electro-coagulation of bladder growth and in association with vesicocolic fistula.

Clinical features and diagnosis.—I need hardly mention that when the stone is in association with prostatic enlargement, symptoms from the stone may be insignificant, and that the less obvious the obstructive condition is, the more pronounced are the symptoms from the stone.

The patient with vesicocolic fistula and vesical calculi had most distressing symptoms by the time I saw him; there was intense pain on micturition. In this case there were several large stones in the bladder.

The only point I wish to emphasize with regard to diagnosis is that it is dangerous

to rely upon a negative X-ray that no vesical calculus exists. In contrast with the upper urinary tract there is a fairly high proportion of cases of vesical calculi in which a good X-ray film gives no indication that a stone is present. I make the rule of never giving a final opinion on this point without a cystoscopy.

Treatment.—I have already called attention to the high proportion of cases of vesical calculus which are associated with an obstructive condition at the bladder neck. When simple enlargement of the prostate was present, the stone was removed in the course of the procedures carried out for the removal of the prostate. In certain other cases, however, where the obstruction was fibrous, litholapaxy and transurethral resection were employed. After doing these two operations at the same sitting in

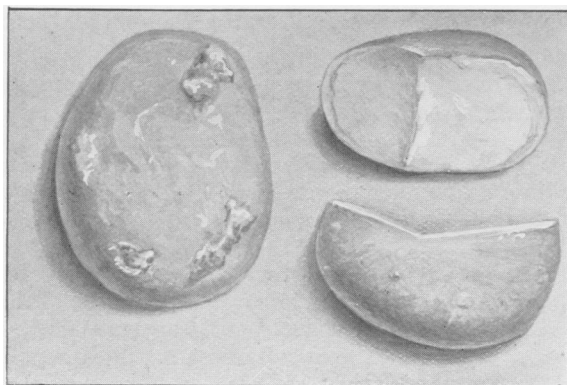


FIG. 17.—Two vesical calculi removed by suprapubic lithotomy. The stone on the right—in two portions—had apparently undergone spontaneous fragmentation.

several cases I gave up this routine and found it more satisfactory to do the litholapaxy first, and not to do the resection until the congestion at the bladder-neck from the manipulation of the lithotrite had settled.

The figures relating to my operations were as follows :—

				Suprapubic lithotomy	Litholapaxy	Removal with Rongeur forceps	Total
No. of cases	..	..	..	40	44	2	86
Percentage	..	..	..	46.5	51.1	2.3	
Mortality	..	..	..	5%	4.5%	0%	

The presence of even a small degree of urethral stricture will wisely be considered as a contra-indication for the use of the lithotrite, the reason being that the continued urethral instrumentation can so easily be the means of stirring into activity the latent infection which is inevitably present in the tissues in the vicinity of a urethral stricture. I had the experience in one case where although the stricture was only mild in character and offered no obstruction to the passage of the lithotrite, the consequent infection resulted in a peri-urethral abscess and fistula, which later required repair.

In looking back on the cases that died after litholapaxy, I cannot help feeling that the best safeguard against fatalities is to make ample use of indwelling catheter drainage, both before and after operation. Pre-operatively this is particularly advisable if renal function is bad, or bladder sepsis marked. After operation this

form of drainage should be continued in the presence of the same complications until these have gone.

Urethral calculi.—I dealt with 11 of these cases and the outstanding features have been as follows :—

Most commonly in the prostatic urethra, 55%.

Associated with urinary calculus elsewhere, 62%.

The absence of acute symptoms.

The toleration of the stone in the urethra for long periods.

The slow increase of local symptoms with the passage of time.

The treatment varied widely according to circumstances, as follows :—

External urethrotomy.

Suprapubic lithotomy.

Stone pushed from prostatic urethra to bladder and there crushed.

There was no mortality from these procedures.

Prostatic calculi.—I feel that there are good reasons for considering prostatic and urinary calculi together, for the two conditions are not only often associated, but the chemical composition of the stones in the two situations is often the same. Treatment is just as successful by complete removal of the gland as prostatectomy is for adenomatous prostate, the outstanding requirement in both cases is the same, namely adequate pre-operative bladder drainage, either entirely by indwelling catheter or by suprapubic cystostomy.

When I say that treatment is satisfactory, I mean with regard to mortality and recurrence of stone. I have carried out prostatectomy in 12 of these cases, 5 in one stage and 7 in two stages. I am not aware of recurrence of the lithiasis in any of them. In three other cases where the calculi were insignificant I relieved the obstruction by transurethral resection with the electrotome. There were no deaths from any of these operations; one should keep in mind in the prostatectomy cases the tendency to post-prostatectomy obstruction. I have noted this in several of mine. The best safeguard that I have found is to stitch the margin of the prostatic cavity to its floor. Alternatively contraction of the bladder neck can be prevented by intermittent dilatation, or transurethral resection at a later date, but I have never had to carry out this last procedure in any of my cases.