Bilateral renal calculi

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Summary

Bilateral renal calculi were present in 114 (10.7%) of 1,070 cases of proved urinary calculus admitted to the Urological Department of the General Hospital, Kuala Lumpur, during the period November 1968–May 1973. The management of bilateral renal calculi is discussed with reference to the first 100 cases in this series. The introduction of renography has greatly facilitated the decision as to which kidney should be operated on first. The management of patients with and without uraemia is discussed and the use of the modified V and V–Y incisions for the removal of staghorn calculi is described. Complications and results are briefly reviewed.

Introduction

Among John Hunter’s varied interests was the study of renal calculi. In his collections was a large renal calculus. This specimen was destroyed during the Second World War, but there is an original engraving of the stone from a catalogue of 1842 which is hand-coloured (Fig. 1).

Of particular interest to my subject are the astute observations made by Mr (later Sir) Henry Morris in regard to a case of calculous disease of both kidneys that had been referred to him at the Middlesex Hospital in 1886. Mr Morris reported as follows:

‘The patient was very ill at the time, had passed several small calculi, and complained of severe pain in the right loin and frequency of micturition. Within a few days some pain had also been felt in the left loin. . . . The right kidney was explored through an incision in the loin. . . . The operation was followed by no relief. . . . Partial and then complete suppression of urine followed, and the patient died. . . . At the postmortem examination the left kidney was found very large and white and with a great increase of cortical substance. It contained two cysts with pus, in one of which there was about two hundred small calculi. . . . The right kidney was small, hard and contracted and one or two minute calculi were found scattered in its substance. . . .’

Mr Morris then stated: ‘It is argued from such a case as this that the surgeon may be easily misled by clinical symptoms, and also by abdominal exploration, to operate upon the wrong kidney. . . .’ He concluded that such cases are not favourable for operation.

The controversy on when to operate in such cases, or on which side to operate on first, has gone on. Several authors have laid down differing criteria. Cabot advised that in cases of large calculi in both kidneys the operation should be done on the younger and fitter patients alone. If there was a large calculus on one side and a small one on the other, he advocated the removal of the smaller calculus first to prevent further damage. Where the calculi were of moderate or small size in both kidneys he advised that because of the danger of calculus anuria the best kidney should be operated on first.

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Badenoch on the other hand considers other factors in deciding the side that should receive priority: 'If on one side a stone has caused complete obstruction, and this kidney has ceased to function, it should be tackled first. If a stone on one side is causing partial obstruction and on the other side there is none, then the side of obstruction should be operated upon first. If there is little between the size of the stones, the position of the stones or in the degree of obstruction, then that side which shows the poorer function should be given priority since it may subsequently be stimulated by having its better partner temporarily upset.' Michalowaki also advises operation first on the poorer kidney, whereas Winsbury-White advises that it is better to give priority to the better kidney. However, he adds that the published statistics showing the results when both sides have been operated upon 'make very depressing reading'.

No author, however, gives any definite rules or criteria whereby to decide which is the better or the poorer kidney. Cabot in his time stated that 'it is difficult to determine the amount of sound kidney tissue by any tests at our disposal'. Intravenous and retrograde pyelography display the anatomy of the kidney and the gross pathological changes but give very poor information about renal function and the degree of its impairment. I agree with Swinney that even infusion techniques in patients with poor renal function do not help to give an accurate picture of renal function. Hoffman and Grayhack stated the problem more succinctly when they said, 'The implicit faith that we have, at times, seen placed in the intravenous pyelogram as a reflection of renal functional status is frightening. Of all tests of renal function, intravenous pyelography performed as it now is, with many different contrast media, available in different concentrations and using the density of a roentgenographic film as an indicator of functional capacity, seems to be the least quantitative.' Several authors have shown that intravenous pyelograms cannot be relied upon to determine kidney function. My experience has been similar.
Since 1969 we have had the opportunity to use renographic studies of the kidney to help us, especially in cases of obstructive uropathies. The renogram is able to detect outflow system disorder and assess the function of the kidney more accurately. We have found renography to be safe, and it can be used in cases of uraemia even with a creatinine clearance as low as 5 ml/min. It can be used in an emergency and in patients who show sensitivity to iodine. The radiation that a patient receives during a renographic examination is $1/100$th that of intravenous pyelography. More recently Britton and Brown® have introduced the mobile system of CABBS (computer-assisted blood background subtraction) renography. We have found renography very useful in deciding the side to operate on, especially in cases of bilateral renal disease. By using background subtraction techniques the function of the kidneys can be more accurately assessed.

Material
The present report deals with the management of the first 100 out of a total of 114 cases of bilateral renal calculi treated from November 1968 to May 1973 in the Department of Urology and Nephrology at the General Hospital, Kuala Lumpur. The department has facilities for haemodialysis and peritoneal dialysis and this has afforded a good opportunity to gain experience in the treatment of these difficult cases.

The majority of our cases are from Kuala Lumpur and the surrounding areas. Cases from other States are also referred to this department, but their numbers are small. Table I shows distribution of admissions among the various communities in the years 1970 and 1972.

A survey has been made to study the incidence of urinary calculi in cases admitted to this hospital during the period 1968–May 1973. From November 1968 all urological cases were treated in our department. Only patients satisfying the following criteria were included in this study: (1) X-ray evidence of calculus; (2) operative removal of calculus; (3) definite history and production of stone passed. Patients with a history of renal colic alone or questionable passage of a stone were excluded, as were cases in which there were insufficient records. In this way 253 cases were excluded out of a total of 1,323 studied. The remaining 1,070 cases have been used to study the incidence in the 3 major communities. These are shown in Figure 2. Figure 3 shows the age incidence and it can be seen that in all 3 major com-

![Table 1](attachment:table1.png)

**TABLE 1 Admissions to General Hospital, Kuala Lumpur, 1970 and 1972**

<table>
<thead>
<tr>
<th>Community</th>
<th>1970</th>
<th>1972</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malays</td>
<td>14,697</td>
<td>20,833</td>
</tr>
<tr>
<td></td>
<td>30.2%</td>
<td>32.7%</td>
</tr>
<tr>
<td>Chinese</td>
<td>16,556</td>
<td>23,035</td>
</tr>
<tr>
<td></td>
<td>34.2%</td>
<td>36.2%</td>
</tr>
<tr>
<td>Indians</td>
<td>16,574</td>
<td>19,147</td>
</tr>
<tr>
<td></td>
<td>34.7%</td>
<td>30.1%</td>
</tr>
<tr>
<td>Others</td>
<td>435</td>
<td>645</td>
</tr>
<tr>
<td></td>
<td>0.9%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Total</td>
<td>48,352</td>
<td>63,660</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**FIG. 2 Racial incidence of urinary calculi.**
munities the highest incidence lies between the ages of 30 and 60 years.

Distribution of the urinary calculi in the different parts of the renal tract in the 1,070 cases studied is shown in Table II.

### Aetiological factors

Fifty male patients and 26 controls were studied to see whether, as suggested by Modlin\(^9\), the urinary sodium:calcium ratio played any part in the development of renal calculi in our patients. These studies have been reported elsewhere\(^10-12\). It seems unlikely that in our patients the liability to stone formation is governed solely by the sodium:calcium ratio. In our series we noticed that it was the calcium excretion and the calcium:osmolar ratio that was significantly elevated in the stone cases.

No case of hyperparathyroidism was found in our series.

### Incidence of bilateral renal calculi

Various authors have noted differing incidences of bilateral renal calculi. In Table III the findings of other authors are compared with ours.

#### TABLE III  Incidence of bilateral renal calculi

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1917</td>
<td>Kummel(^13)</td>
<td>16%</td>
</tr>
<tr>
<td>1918</td>
<td>Braasch(^14)</td>
<td>12.3%</td>
</tr>
<tr>
<td>1924</td>
<td>Chute(^15)</td>
<td>18%</td>
</tr>
<tr>
<td>1934</td>
<td>Winsbury-White(^16)</td>
<td>13%</td>
</tr>
<tr>
<td>1956</td>
<td>Baker and Connelly(^17)</td>
<td>8%</td>
</tr>
<tr>
<td>1960</td>
<td>Reddy(^18)</td>
<td>9%</td>
</tr>
<tr>
<td>1973</td>
<td>Sreenevasan (present series)</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

### Management of bilateral renal calculi

1. **Without renography**

   All our cases before 1969 were managed without the use of renograms, but by using plain X-rays, infusion intravenous pyelography, and bilateral ureteric catheterization. The criteria suggested by Farquharson\(^19\) and Aird\(^20\) were used to decide the side to operate on first. They suggested that if one of the kidneys is clinically enlarged it is probably disorganized by hydronephrosis. Hence it is the other kidney that is likely to be obstructed and is the one that should receive prior attention. The 2 cases reported below are examples of patients so treated.
showed tenderness on the right side. He vomited twice on the day of admission. Blood urea was 180 mg/100 ml. X-ray of the abdomen showed large bilateral ureteric calculi in the upper thirds. At an emergency operation the left ureter was explored first, but when the stone was removed there was no urine from this kidney. The renal cortex was very thinned out and there appeared to be little kidney tissue. As a result of this the right ureter and kidney were explored and the ureteric stones and several renal stones were removed. The kidney appeared to be in better shape than its fellow. A pyelostomy was also done. After a few days the pyelostomy tube was removed and the patient improved. Renography and intravenous pyelography were performed in the postoperative period. The pyelogram showed that both kidneys were excreting but there was gross hydronephrosis on both sides. The renogram, however, showed the right kidney only to be functioning; the left kidney showed very little activity. It is possible that if renography had been done preoperatively only the right kidney would have been explored.

2) With renography

The first case which showed us the value of emergency renography in deciding the correct side to operate on in cases of bilateral renal calculus is reported below:

Case 3 This patient, a 36-year-old Chinese woman, was admitted one night as an emergency into the surgical service with right lower abdominal pain and nausea. A diagnosis of appendicitis was made by the surgical service and the patient was operated on. At operation the right kidney was found to be enlarged and hydronephrotic. Appendicectomy was carried out. The patient's condition deteriorated. After the operation a plain X-ray of the abdomen showed a doubtful opacity in the region of the right renal pelvis and a staghorn calculus in the left kidney. The patient's blood urea was 165 mg/100 ml and she was oliguric. At this stage she was referred to the urology service.

Emergency renography was performed (Fig. 5). The renogram showed bilateral obstruction and a better functioning right kidney. On the strength of the renogram the right renal pelvis was explored and a large calculus removed. The patient's urine output increased and she showed gradual but steady improvement and was discharged from hospital 3 weeks after admission. At the time of discharge her blood urea was 45 mg/100 ml.
On the basis of our experience with this and similar cases we decided to adopt the following lines of management in cases of bilateral renal calculi:

a) *Calculus anuria without uraemia*  If a patient is admitted with a normal blood urea and his general condition is satisfactory renography is done as soon as possible and operation is performed on the more obstructed and better kidney as shown by the renogram. In addition to renography routine radiography of the abdomen and, if necessary, intravenous pyelography are done in order to locate the anatomical site of obstruction. The patient is hydrated and the operation is carried out as soon as possible.

Cystoscopy and retrograde pyelography are avoided because of the risk of infection, to which these patients appear to be particularly prone.

b) *Cases with uraemia*  If the blood urea is high, a more cautious procedure is adopted, depending on the severity of the uraemia. With a blood urea of 50–150 mg/100 ml and when the patient has a reasonable urinary output (between 800 and 1,000 ml/24 hr) his dehydration and anaemia are corrected with intravenous fluids and a carefully cross-matched blood transfusion. When the urine output is low the patient is put on frusemide (Lasix). A strict intake and output chart is always kept and regular estimations of serum electrolytes and blood urea are done. In the meantime an X-ray of the renal tract is taken and renography carried out. If the patient fails to improve and his blood urea keeps rising in spite of a high urine output dialysis is performed. In our series of 22 cases with a blood urea ranging from 50 to 150 mg/100 ml it was necessary to perform peritoneal dialysis in only 2 cases and haemodialysis in one. Once the condition of the patient has stabilized he is prepared for operation, and this is carried out

FIG. 5  *Direct-tracing renogram (Case 3).*
on the better-functioning kidney. In this group there were no deaths. It must be stated that it is not necessary to put all patients in this group on frusemide, since with correction of the dehydration and anaemia alone their condition improves considerably. It is essential to carry out this treatment in the early stages of the illness to keep the mortality and morbidity to a minimum. Of late we have preferred, where dialysis has been necessary, to put in a Scribner shunt and have these patients put on haemodialysis rather than on peritoneal dialysis. This seems to keep the patient more comfortable and the presence of the shunt enables postoperative dialysis to be done more easily when necessary. Also patients on haemodialysis in this group are less prone to infection.

When the blood urea ranges between 150 and 300 mg/100 ml the patient is fairly ill on admission and is usually in an acidotic state with a high serum potassium level. When these patients come in in the middle of the night peritoneal dialysis is performed as an emergency if their general condition warrants it. As soon as the blood urea comes down they are put on the haemodialysis programme and investigations such as renography and intravenous pyelography are carried out. In these cases too, unless there is an obviously obstructing stone and a reasonably functioning kidney on the poorer side, the better kidney as shown by the renogram is operated on first. When the condition of the patient has improved and he has recovered from the first operation the other kidney is operated on during the next few months. In this group there were 19 patients, of whom 4 had peritoneal dialysis and 9 had haemodialysis. There were 3 deaths.

It should be emphasized that in the successful management of these patients a careful watch has to be kept, especially during the postoperative period, on the fluid and electrolyte losses. The obstructed kidneys have a tendency to go into a massive diuretic phase and lose considerable amounts of water and salt. This may last for several days or weeks but can be controlled with careful management. The other problem is that of infection, which has to be treated vigorously from the start, if possible with non-nephrotoxic antibiotics.

In female patients who recover after the two operations tubal ligation is advisable in order to avoid further pregnancies. One of our patients went home after her second operation and later returned with a 7-month pregnancy and died after delivery of a stillborn fetus. Since our experience with this case we have had two other female patients, for whom we have recommended tubal ligation. The renal function in these patients is unable to stand the strain of pregnancy.

**Removal of staghorn calculi** In this series of 100 cases of bilateral renal calculi there were 26 calculi of the staghorn variety. A calculus was defined as 'staghorn' if it occupied the pelvis and at least two calyces on X-ray or at operation. Sixteen of the staghorn calculi were bilateral, 6 were in the right kidney, and 4 in the left. Some of these calculi were quite large and occupied the whole kidney. These cases presented special problems, and the standard operative procedure advised by Gil-Vernet had to be modified.

Pyrah in his Hunterian Oration in 1969 quoted the description of a kidney as found in John Hunter's case book in November 1757. I quote a relevant part of it:

'A man was dissected and on examining the Kidneys, we found that that on the left side was diseased. Its sise was rather less than the other. The Fat Surrounding that was hard, and adhered very firmly to it. . . .'

I have found this description by John Hunter very apt for many of our cases with staghorn calculi. In most of our cases there is a
marked amount of peripelvic fat adherent to the renal sinus and renal pelvis. This is probably because our patients generally do not seek early medical or surgical treatment. Therefore as a result of long-standing inflammation there is marked peripelvic fat and the renal pelvis is very friable. The extracapsular approach to the renal sinus described by Gil-Vernet in 1965 is a major advance in the operative management of cases with staghorn calculi. However, we have found that because of the adherent peripelvic fat the transverse pyelotomy incision that he recommends is unsuitable in many of our cases. We prefer a V-shaped incision, which can be modified into a Y for correction of pelviureteric narrowing, to the transverse pyelotomy incision. The apex of the V is placed near the pelviureteric junction and the limb of the V near the lower pole is extended into the lower calyx and that near the upper pole is extended into the upper calyx. Where necessary (and this has been the case on only 2 occasions) the incision of the lower limb of the V is extended into the lower pole of the kidney (Fig. 6).

We have found the V and the Y incision useful and now use it routinely for larger stones. We do not hesitate to use multiple nephrolithotomy incisions to remove the 'mushroom extensions' as suggested by Blandy. In cases where the incision is confined to the pelvis the triangular flap is easily sutured back into place with 3 sutures, one for the apex and one for either side of the flap. In cases where the incision has been extended into the lower pole and lower calyx the latter is sutured separately and a few sutures are applied to approximate the lower pole of the kidney. Where the incision is a Y for correction of pelviureteric narrowing we suture the V flap to the lower end of the vertical limb of the Y, converting it into a Y-V-plasty. A Penrose drain is always left to drain the region of the pelvis and ureter. This is usually removed on the second or third postoperative day. The V incision has been used in 60 of our 1,070 cases. The postoperative results appear satisfactory (Fig. 7). However, it is our impression at present that the incidence of recurrent renal calculi is higher in these cases than in our cases of partial nephrectomy. We have used the V operation in 18 and the Y-V in one of the 100 cases of bilateral calculi.

Complications
Recurrences In the 100 cases of bilateral renal calculi 89 operations were performed, and 15 of these patients had recurrent renal calculi. It would appear from the various types of operation analysed in this

FIG. 6 Y-V incision for staghorn calculi.
TABLE IV  Operations and recurrences in 100 cases of bilateral renal calculi

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No. of operations</th>
<th>No. of recurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyelolithotomy</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Modified V-Y Gil-Vernet</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Partial nephrectomy</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Nephrolithotomy</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Nephrectomy</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Ureterolithotomy</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>89</td>
<td>15</td>
</tr>
</tbody>
</table>

series that partial nephrectomy carries the lowest recurrence rate (Table IV).

While all attempts are made to remove all the calculi wherever possible at operation, we agree with Blandy that "this should not be pushed to such absurd lengths that the kidney, cleared of all fragments of stone, but traumatised beyond belief, will never function again".

**Carcinoma**  In our 1,070 cases of renal calculi 3 patients had carcinoma of the renal pelvis. All 3 also had bilateral renal calculi. The carcinomas were of the epidermoid type.

**Results**  There were 3 deaths in our series of 100 cases of bilateral renal calculi. One of the patients died from carcinoma of the liver 3 years after the operation on his first kidney and 1 1/2 years after the operation on his second kidney. The second patient, a woman, had returned home after operations on both the kidneys and unfortunately became pregnant and succumbed during the birth of a premature child as a result of renal insufficiency. The third death was in our first case, in which renography had not been used to determine the better kidney for operation.

**Conclusions**  It was customary to believe, and unfortunately this view is held in some circles even today, that surgery is unnecessary in cases of bilateral staghorn calculi and bilateral renal calculi unless there are severe symptoms. I do not advocate that even the smallest calculi in both the kidneys should be removed, but I feel that while renal failure, especially with uraemia, can be a difficult problem, it is possible with the judicious use of haemodialysis, medical treatment, and renography to bring many of these patients to surgery safely. In our experience it is important to operate first on the better kidney as shown by renography. We did not
have any operative deaths.

One cannot fail to be impressed by the enormous capacity for recovery of a kidney that is operated on. It is the duty of the surgeon and the nephrologist combined to save as much of a kidney as possible in order to save the patient from the chronic dialysis and transplantation programmes. The best artificial kidney or the best transplanted kidney cannot equal the long-term functioning of even half a normal kidney.

I wish to thank the Director-General of Medical Services, Malaysia, and the Director of the General Hospital, Kuala Lumpur, for permission to use the records of the hospital to prepare this lecture. I wish to express my thanks to all the staff of the Department of Urology and Nephrology and to the various other departments in the General Hospital, Kuala Lumpur, for all their help and co-operation. I would like to acknowledge my thanks to Miss Elizabeth Allen for permission to reproduce Fig. 1 from the Hunterian collections.

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