MEDICAL PRACTICE

*Clinical Problems***Trauma to the Urinary Tract***

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Trauma to the urinary tract is so large a subject that trauma to each part, even the ureter alone, could present enough interest for a full lecture. To deal with the whole tract in one lecture inevitably means that only certain aspects can be considered, and this presentation today is therefore in no way a comprehensive survey.

Two Principles

The two principles I wish to discuss are, firstly, the more conservative approach that has developed towards injury of all parts of the urinary tract over the past 20 to 30 years, and, secondly, the progress towards a more logical mode of diagnosis and treatment.

As regards the more conservative approach to the kidney, for example, nephrectomy today is a rare operation for trauma. Similarly, in the case of bladder and urethral injuries the patient does not have to be rushed to the operating theatre within minutes of the diagnosis being made because of fear of extravasated urine. Even the ureter, which may occasionally be the victim of iatrogenic damage, can be successfully reanastomosed either to its lower end or to another part of the bladder, and no longer does the gynaecologist, having cut the ureter, satisfy himself with tying off this duct deliberately, assuming the patient's other kidney to be in satisfactory condition.

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The second principle I wish to emphasize is the progress towards a more logical approach in diagnosis and treatment. I cannot imagine any subject in surgery where so many instructions have been prepared for the young surgeon who has to deal with these injuries, and yet when faced with such a problem in the middle of the night he finds that trying to put the instructions into practice leaves him in utter confusion, and he feels guilty at the thought of telephoning his chief. Should he explore a kidney that seems on an intravenous pyelogram to be split into two parts or should he wait uneasily and watch? After repairing the damage to some intraperitoneal structure in a case of multiple injuries he finds a retroperitoneal haematoma in the region of one kidney: does he drain it or does he leave well alone? Orthodox teaching is to pass a catheter under full sterile precautions in a case of fractured pelvis in which lower urinary tract damage is suspected. The catheter slips in easily but nothing comes out. Is the tip of the catheter inside an empty bladder or has it coiled up in the pelvis, having emerged from a ruptured urethra? Has the bladder itself been ruptured, or is the patient anuric?

Textbooks explain concisely and systematically every possible urinary-tract injury, yet they do not answer any of these simple questions—whether to explore the split kidney; whether to operate to drain a loin haematoma; or how to interpret the dry-tap catheterization in a suspected lower urinary tract injury.

We all know how rare it is to be able to present a completely original idea in surgery. This paper is no exception, and is merely an attempt to clarify and simplify a subject about which there has been so much confused thought. One feature my junior colleagues tell me could possibly be claimed as original today is that the registrar or senior house officer faced with these problems in the middle of the night in Bristol has had the satisfaction of having a simple routine for all cases of urinary trauma and of knowing that there is no desperate urgency in any of the patients, except in the very occasional case of avulsion of the renal pedicle.

Injuries to Kidney

Renal injury in the past was most commonly caused in sport—such as in rugby when a player falls on the ball and is acutely flexed, with boots flaying around him trying to hook the ball out of the “ruck.” The gentler sex, with their affinity for riding, are not immune to renal injury from sport. A girl thrown from a horse across the triple bars lands on her side, and if the bar catches her in the loin a kidney injury is possible. Today, however, road traffic accidents are overtaking sport as the common cause of renal injury. There are few penetrating wounds that damage the kidney other than gunshot wounds, which we hope will still remain an extreme rarity in this country.

With the exception of penetrating wounds, injuries to the kidney are usually transmitted via the twelfth rib, which in a normal relationship lies exactly across the waist of the kidney (Fig. 1). The mode of injury of the kidney is acute flexion

FIG. 1—A blow in the loin is transmitted to the kidney via the 12th rib, which compresses the kidney against the vertebral column, particularly when the spine is laterally flexed.

augmented by a sudden blow over the twelfth rib which splits the kidney.

Classically the caliceal tear and small cortical tear are both regarded as minor injuries. The calico-cortical split and the polar amputation are both regarded as major injuries, while avulsion of the kidney pedicle has been said always to be lethal (Table). A caliceal tear (Fig. 2) produces haematuria but no haematoma. A small cortical tear produces a haematoma (Fig. 3), either subcapsular or even extracapsular, and no haematuria—or possibly delayed haematuria, since the blood may subsequently seep down the tubules to the papilla. The delay in appearance of haematuria can be quite long, and I have

Injuries to the Kidney

Injury	Category
Caliceal tear	Minor
Cortical tear	Minor
Calicocortical tear	Major
Amputation of lower pole	Major
Avulsion of renal vessels	Lethal

known it several days after a renal injury. Clot occluding a calix and separating some 48 to 72 hours after injury can also account for a delay in the appearance of blood in the urine, and strangely, this delayed haematuria can be quite heavy.

A complete calico-cortical tear (Fig. 4) may even extend to amputation of one pole of the kidney. Such a complete amputation is more likely to be of the lower pole, and these injuries will allow urine as well as blood to collect in the perirenal tissues.

One of the rare types of renal injury, rupture of the renal pelvis due to an impact injury, causes an explosive burst of urine from the pelvis (Fig. 5). If this continues as a slow leak the curious condition of a pseudo-hydronephrosis can develop at a later date. Though Fig. 5 shows the leak occurring from the renal pelvis, it would be more accurate to demonstrate it coming from the sinus of the kidney—in other words, leaking out of the hilum itself.

Finally, the condition of avulsion of the renal pedicle with a complete tear of both renal artery and vein (Fig. 6), is generally regarded as being incompatible with life, the pressure and blood flow in the renal vessels being so great that the patient would lose 60 to 70% of his blood volume within two to three minutes. However, some will have seen the curious situation of a kidney completely avulsed and yet remarkably little blood lost. This situation is comparable to the avulsion injuries of a limb when the vessels, having been grossly stretched, suddenly snap and the intima recoils back inside the vessel, occluding the lumen. Hypovolaemic shock and its consequent hypotension help to reduce the blood loss, so that this condition is possibly compatible with life.

MANAGEMENT

The classification of renal injuries into major and minor is little more than academic, because treatment should be exactly the same for all, irrespective of the severity of the haematuria or the size of the haematoma in the loin. The main advance that has occurred in the past few years has been to reduce the number of nephrectomies considered necessary for renal injury. This is due to two factors: firstly, that *all* renal injuries are treated with complete bed rest; secondly, the boggy of renal trauma—namely, infection of the surrounding haematoma with the consequent risk of secondary haemorrhage at 10 to 14 days—has been virtually eliminated by the routine administration of antibiotics.¹ In the past, as many as 25% of injured kidneys were removed, and in many of these the initial renal trauma appeared to be relatively minor. Exploration of a kidney, despite many reported attempts at reanastomosing torn vessels, is still tantamount to nephrectomy. It was only too common to see a patient making satisfactory progress after a kidney injury and either being allowed up too soon or developing infection in the haematoma, and in either event having to be rushed to the theatre.

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 2—A caliceal tear, which produced haematuria but no haematoma. FIG. 3—A small cortical tear producing a haematoma and no haematuria. FIG. 4—A calicocortical tear allowing urine, as well as blood, to collect in the perirenal tissues. FIG. 5—Rupture of the renal pelvis, causing extravasation or urine (a rare injury). FIG. 6—Avulsion of the renal pedicle, usually regarded as a lethal injury.

The management of all renal injuries is therefore bed rest and sedation, even when the damage to the kidney appears minor and the patient's general condition is satisfactory. Some young patients with renal injury do not take kindly to complete bed rest. Irrespective of the ward sister's instructions they may wander down the ward either to pass water or to talk to a friend. They must, therefore, be given some firm sedation, even in the so-called minor injuries. The need for quarter-hourly pulse reading and collection of every urine sample is self-evident, but, at the risk of seeming to make an elementary comment, I would mention that the change in colour of the urine occurs very much earlier than reduction of the intensity of the blood. So long as the colour is steadily changing from bright red to a deeper brown I am content to watch the patient for several days. I remember one lad who bled for 18 days, but as the staining of the urine was brown rather than red we felt safe to treat him conservatively, and this was fully justified by the outcome.

Antibiotics should be given for a full fortnight to avoid secondary infection of the haematoma. It may be asked why the haematoma should become infected in a closed injury, but the close proximity of the large bowel with its lymphatics, many of which must have been torn, gives access for an occasional coliform organism which, it is reasonable to suppose, may escape with the lymph from the bowel.

Lastly, an intravenous pyelogram should be arranged as soon as possible. The main object is not so much to see the damage to the kidney but to ensure that the opposite one is functioning normally. Intravenous pyelography of a recently injured kidney will show distortion of the caliceal pattern due either to a tear or to enclosed blood clot. There may be a leak of radio-opaque dye out to the periphery and into the perinephric tissues, and there may be delayed or absent function on the injured side. Usually the renal outline cannot be distinguished and there will be loss of the psoas shadow, owing to the collection of blood in the perirenal tissues. One other feature commonly seen in renal injury, as with any loin injury, is a lumbar scoliosis with its concavity towards the injured side, due to spasm of the quadratus lumborum and erector spinae muscle. Unfortunately, radiographs of renal injury are often of poor quality owing to rapid accumulation of gas in the gut.

SURGICAL ASSESSMENT

The renal injuries with which urologists are faced are usually either isolated injuries of kidney alone or the kidney injury is predominant among several lesser injuries. It is the general surgeon who has the misfortune to be faced with the difficult problem of severe multiple injuries, among which he incidentally finds damage to the urinary tract. The first intimation of the urinary tract damage may, in fact, be when the abdomen is opened for other intraperitoneal trauma and the surgeon finds a large haematoma in the loin, probably obscuring a ruptured kidney. He has to decide whether to open and drain the haematoma, with the almost inevitable nephrectomy to follow, or to leave well alone. From the few cases of this kind I have been called to see my answer is simply to try to assess whether the retroperitoneal haematoma is increasing in size, in which case exploration is imperative. If the haematoma, however large, does not appear to be increasing in size it is probably best left alone and treated expectantly. Disturbance of the clot will almost certainly restart the bleeding, which can be fierce and awkward to control.

The chances of survival of a kidney with expectant treatment can best be illustrated by the rare need today to remove a kidney for trauma. In 56 cases of renal injury in Bristol reviewed by Slade and his colleagues,² one nephrectomy was performed for secondary haemorrhage, but the patient had not been given prophylactic antibiotics nor had intravenous pyelography been adequate. The opposite kidney had been seen to function, but it was not recognized until some weeks later that it was pyelonephritic, and the patient died in uraemia 12 months

later. In one case of multiple injuries a nephrectomy was performed for an enormous haematoma in the loin. Follow-up of the remaining cases showed one staghorn calculus, one hydrocalycosis, and one non-functioning, shrunken kidney.

The justification of attempted vascular repair in renal damage is very dubious. To assess damage to renal vessels a severely ill patient must first be subjected to an intravenous pyelography. It has been suggested that if this shows a functionless kidney on the affected side the investigations should proceed to an angiogram, and the kidney must then be explored in the hope of restoring its vascular supply. To me this seems to be armchair surgery, because the general assessment of the extent of the injuries, resuscitative measures, arranging intravenous pyelography and investigation by renal angiography must consume a fair amount of time, and the accepted ischaemic time of a kidney at body temperature is, at the very most, an hour and a half. In intrarenal surgery it is accepted practice not to leave a clamp on the renal pedicle for longer than 20 minutes. The time factor therefore, would seem to me to rule out attempts to revascularize the kidney in cases of vascular injury. Furthermore, reports of vascular surgery in trauma to the kidney have shown an overall nephrectomy rate of over 10%, and yet in a conservative approach nephrectomy has been necessary in fewer than 4% of cases. I find it difficult to accept vascular surgery for trauma to the kidney until it produces better results than a conservative approach, though it is always harder to sit and wait than to have a look.

Injuries to Ureter

Multiple trauma of the ureter is rare, though occasionally it has been reported in penetrating injuries such as gunshot wounds, particularly when there is extensive internal disruption. However, the associated injuries are then usually so severe that the patient rarely survives.

Most injuries to the ureter are iatrogenic and occur in gynaecological and rectal surgery—for example, in a Wertheim's hysterectomy, when the ureter may be caught not far below the brim of the pelvis. At the same site a neoplasm of the ovary will often lie right over the ureter, perhaps even encircling it. The lower end of the ureter may be caught at colporrhaphy or during vaginal hysterectomy. Here the damage to the ureter is usually within 2-3 cm of its intramural part.

Another instance of iatrogenic damage to the ureters is bilateral hydronephrosis and hydroureter caused by the pelvic fibrosis which sometimes results from radiotherapy. It is rare for this obstruction to progress to the stage of requiring urinary diversion. During surgery the ureter may be cut or tied or it may undergo avascular necrosis, particularly if it has been stripped of its blood supply for much of its lower third.

Another type of iatrogenic injury to the ureter I have seen is damage from diathermy reaction at the time of an appendectomy. Apparently the young surgeon while removing an appendix had trouble with bleeding in its mesentery, which had evidently slipped out of the clamp. He unwisely diathermized the area with some excess of enthusiasm, and five days later the ureter ruptured where the diathermy had been used. I should add that this rupture of the ureter was further aggravated by a ureteric calculus which had been missed, and it and not an inflamed appendix had been the cause of the pain in the right iliac fossa. Back pressure building up behind the stone had found the weak point in the ureteric wall where the diathermy had been used.

SEVERED URETER

One is always a little reticent in describing iatrogenic damage to ureters, since it inevitably seems to reflect on one's colleagues. It is comparable to a pathologist triumphantly reporting the

final answer at a necropsy when the clinicians have been completely misled over the diagnosis. Similarly, the urologist comes to repair the damaged duct after a colleague has made what appears to have been an unfortunate mistake, but whenever I have watched a difficult vaginal hysterectomy or an extensive colporrhaphy it has never ceased to be a source of admiration that the gynaecologists miss the ureter as often as they do. Similarly, when I have watched a Wertheim's hysterectomy for a fairly advanced growth the thought goes through my mind, "there, but for the grace of God, go I"—the grace of God having made me a urologist and not a gynaecologist.

These patients present either at operation with a cut end of ureter clearly exposed in the floor of the wound or postoperatively with anuria and pain in the loin, or at about 8 to 10 days with a fully established fistula.

The treatment of the severed ureter as it is seen at operation, is either to attempt immediate reanastomosis, making an adequate fishtail of both ureteric ends (Fig. 7), or to reimplant the ureter into the bladder. On one occasion I was telephoned

FIG. 7—Fishtailing the two ends of the cut ureter to provide an oblique anastomosis.

by a registrar in gynaecology who admitted that such an accident had just occurred and asked what should he do? He did not feel confident to reanastomose the ureter, because he thought the lower end was no longer viable, and he could not manage to reimplant the ureter at the level at which damage had occurred. My advice on that occasion was to intubate the upper end of the ureter in situ with a long polyethylene tube. When we re-explored some two to three weeks later it was remarkably simple procedure to find the ureter, and after mobilizing the opposite vesical pedicle the ureter could be anastomosed to the bladder.

It was not so long ago that some gynaecologists readily admitted that they tied a cut ureter if they were confident the opposite kidney was healthy. Under no circumstances could such surgical treatment be justified nowadays.

The patient may present with anuria 48 hours after the operation. Already the blood urea has risen, and the patient shows signs of acute renal failure due to obstruction of both ureters. Enthusiasts for dialysis have suggested that these patients should be dialyzed before surgical intervention. However, though their general condition may appear poor, they improve so dramatically with surgery that I have never thought dialysis to be of any benefit. Release of back-pressure by immediate surgery, reanastomosing both ureters to the bladder, will improve the patient's general condition even quicker than a six-hour haemodialysis.

If only one ureter is damaged the patient may complain three to four days after operation of pain in the loin. This will be relieved when a fistula develops and urine leaks per vaginam. An intravenous pyelogram will show a mild hydronephrosis and stasis in the length of the ureter. If the ureter has been tied and no fistula has developed the kidney will still show function, though this will usually be delayed and will be much poorer than on the normal side.

TECHNIQUES FOR REIMPLANTATION

In lower ureteric damage reimplantation into the bladder is comparatively easy, since there is enough ureter to reach the bladder and even to make an antireflux tunnel. When the damage is at a higher level—for example, just below the brim of the pelvis—it may be difficult to obtain enough ureter, even by mobilizing upwards, to join it satisfactorily to the bladder. Four possible techniques can be used. The first is to find the highest point of the bladder by "tenting it up" with an instrument passed per urethram (Fig. 8). Mr. Ashton Miller used to use a pair of Nelson Roberts forceps passed per urethram, which made it easy to pick up the bladder mucosa with two stay sutures. The second manoeuvre, as described by Turner-Warwick and Worth,³ is to mobilize the vesical pedicle on the opposite side (Fig. 9), so increasing the height to which the bladder can be tented on the side of the ureteric defect. Turner-Warwick also suggests that this highest point of the bladder should then be held in position by a stitch through the psoas muscle (the "psoas hitch" operation). The third and oldest method of increasing the height of the bladder is by constructing a tube of bladder wall by turning a flap upwards (Fig. 10). This Boari flap is a very satisfactory method provided the bladder wall is not thickened, but it much reduces the bladder capacity. I have made a very simple modification of this⁴ by tenting up the bladder to its highest point and then

FIG. 8—"Tenting up" the bladder with an instrument passed per urethram, to find the highest point for anastomosis.

FIG. 9—The "psoas hitch" operation of Turner-Warwick, in which the opposite vesical pedicle is divided and the highest point of the bladder is sutured to the psoas muscle.

making a transverse incision at right angles to the instrument tenting the bladder up. This incision is then sutured vertically (Fig. 11), giving quite a considerable extension to the highest point of the bladder. Smith⁵ advocates a simple and effective method of dealing with high ureteric damage by anastomosing the cut ureter across the abdomen to the side of the opposite healthy ureter (Fig. 12).

FIG. 10—The Boari flap, which is sutured into a tube to receive the cut end of ureter.

FIG. 11—The author's method of extending the highest point of the bladder by means of a transverse incision at right angles to the instrument in the bladder, and suturing this incision longitudinally.

FIG. 12—Ureteroureteric anastomosis, bringing the cut end of the ureter across the abdomen and making an end to side anastomosis with the healthy ureter.

Whichever method is used the ureter and bladder must lie comfortably in apposition with no suggestion of tension. If there is insufficient ureter to construct an anti-reflux procedure I would prefer to make a simple end-to-side anastomosis of ureter to bladder rather than the much more elaborate procedure of using a length of small intestine. In fact I have never yet had to use a length of bowel, and have succeeded by a combination of the various manoeuvres mentioned above to join ureter to bladder successfully in all cases. Despite constructing an anti-reflux tunnel in the majority of cases, six out of the last seven cases still show reflux. The patients, however, seem none the worse for it provided the urine is sterile.

Injuries to Bladder

Two factors in recent years have altered the management of injuries of the bladder and of the urethra. The first is the appreciation that extravasation of urine is not a serious complication of grave prognosis. The second is that injury of the posterior urethra causes more partial ruptures than was originally thought.⁶ To these factors may be added a third—that when damage to the lower urinary tract occurs in association with fracture of the pelvis there may be a rupture of both bladder and urethra in up to 20% of cases.⁶

Extravasated urine from an injured bladder or urethra is relatively harmless for 24 to 36 hours. The old fear of extravasated urine was owing to its association with stricture and periurethral abscess resulting in a spreading cellulitis. In those cases the urine was infected. In the cases of injury we deal with today 99% of the patients have sterile urine at the time of the injury. Chemical irritation can occur from extravasated urine but it is of little consequence until after 48 hours. Hence it need no longer be regarded as urgent to drain urine immediately injury of the lower urinary tract is suspected, and this provides the accident surgeon with time to give adequate resuscitation and to treat other major injuries in their true priority.

INTRAPERITONEAL RUPTURE

The first essential for a bladder to rupture is that it must be full at the time of injury. Intraperitoneal rupture results from a blow in the lower abdomen causing a sudden rise of intravesical pressure, and the bladder virtually bursts. The rent in the bladder wall is therefore large. The case presents as a suspected rupture of something in the abdomen, and peritoneal inflammation slowly develops over the next 24 to 36 hours. The degree of peritoneal irritation will not be so severe from urine as it is from the leakage of the contents of other hollow viscera.

The diagnosis of intraperitoneal rupture of the bladder is rarely obvious when the patient is first admitted to hospital, and may not be made until the abdomen is opened. One patient seen recently with a fractured pelvis had only moderate guarding, compatible with a bony injury. However, after 18 hours he had failed to pass urine and his abdomen had increased in size by circumferential measurement. The initial peritoneal aspiration was dry, but 18 hours later fluid was obtained. He was found to have a 6-cm tear in the mid-posterior wall of his bladder and 1,500 ml of urine inside the peritoneal cavity, yet the pulse rate had increased from 80 to only 90 a minute.

A tear is often large, sometimes even bivalving the bladder with a long rent down its posterior wall. I have often wondered why the bladder should burst on its peritoneal aspect when additional support for this surface might be expected from the peritoneal covering, but probably the pelvic bones round the extraperitoneal surface of the bladder give the required support while the peritoneal aspect is the only one that can expand. Intraperitoneal rupture of the bladder is rarely, if ever, associated with a ruptured urethra, and immediate closure via the peritoneal cavity, leaving an indwelling urethral catheter, is all

that is necessary, having assured oneself that there is no other intra-abdominal injury.

EXTRAPERITONEAL RUPTURE

Extraperitoneal rupture of the bladder usually occurs in association with a fractured pelvis, and it is due to penetration of the anterior wall of the bladder by a small spicule of bone from the superior ramus. In contrast to intraperitoneal ruptures, the tear is small and the bladder may retain as much as 170 ml of urine. It may be slightly bloodstained, but I have known it to be clear. The patient may even pass urine. In fact, one man, referred some three weeks after injury, was found to be leaking a trickle of urine into his prevesical space each time he micturated.

The diagnosis can be made on the patient's general condition. If he fails to pass urine after 24 hours and there is no sign of a distended bladder a rupture should be suspected. He will become increasingly tender over the suprapubic area, and his pulse will begin to rise—more rapidly than in intraperitoneal rupture. Urethrography and intravenous pyelography is usually useless in confirming the diagnosis, and the bladder should be explored. In view of the frequency with which the injury is associated with a ruptured urethra, suprapubic catheter drainage is advisable for two to three weeks until either urine is passed spontaneously or panendoscopy can be performed to confirm that the urethra is normal.

The tear in the bladder is usually so small that there is no need to suture it.

RUPTURE OF POSTERIOR URETHRA

I have already said that extravasated urine is not a serious complication of grave prognosis. The second factor that in recent years has altered our approach to rupture of the urethra is the high incidence of partial ruptures (over 90%).⁶ This may be due to the different type of accident causing the trauma. In the past most of the urethral and bladder injuries associated with a fractured pelvis occurred from crushing, either by falling masonry or in a mining accident, but today a great majority of pelvic injuries result from road traffic accidents, and in most cases the patient sustains an impact injury rather than a crushing injury. The pelvis may be grossly distorted at the time of the accident—sufficient to rupture the urethra—but the bones and pelvic contents spring back nearly to their original position. A relatively satisfactory position of the bones in a fracture of the pelvis is therefore no indication of the disruption of the pelvic contents that may have occurred.

We have always imagined that the membranous urethra was only 0.5 cm long, as shown in textbooks of anatomy, but in the living body it is much longer, as can easily be demonstrated on urethrography and panendoscopic examination of the urethra. The membranous urethra is an elastic structure which can be elongated considerably before it will tear. Hence it is more likely to split than to transect.

The importance of partial as opposed to total rupture of the urethra is in the prognosis and the subsequent risk of stricture formation. After complete transection the urethra is bound to develop a stricture. We have heard the surgeon who reports a complete rupture of the urethra treated with an indwelling catheter—sometimes even claiming that part of the length of the urethra has been lost—yet subsequently no stricture forms. The simple answer to this is that either the case has not been followed-up long enough or, that intact urethra was not recognized owing to gross bloodstaining of all the tissues at the time of the injury. The extent to which these tissues are suffused with blood can make it extremely difficult to recognize an intact bridge of mucosa between two torn ends. Sometimes formation of a stricture can be delayed for so long as three or even four years, but there is no doubt that it will occur. These strictures are always severe and I have seen four in which claims of com-

plete cure had been made on an inadequate follow-up of only one to two years.

The objective in treatment should therefore be to preserve the strand of tissue constituting the partial rupture. We should not inflict further injury on the urethra by testing it with a catheter or by introducing infection into the area of blood clot, broken bones, and some dead tissue—the whole forming a perfect nidus in which any organism can thrive.

The diagnosis of a ruptured urethra can be made more accurately on clinical grounds than by any other means. If the patient has blood at the external meatus, fails to pass urine, and subsequently has retention the diagnosis of ruptured urethra is certain. The passage of a catheter to test the urethra can be misleading in that it can pass across the bridge of partially ruptured urethra into the bladder, leaving the surgeon assuming that the urethra is intact. On the other hand, the catheter can do further serious damage to the vital strand of partially ruptured urethra and can also introduce infection.

OPERATIVE TREATMENT

When it is urgent to know whether the urethra is ruptured—because the patient is about to be operated on for other major injuries—it is my practice if there is blood at the external meatus to do a suprapubic cystostomy. But if the diagnosis is still uncertain and there is no blood at the external meatus then, and then only, would I advise injecting some radio-opaque medium into the urethra to demonstrate the rupture radiologically.

If on suprapubic cystostomy the surgeon finds the whole bladder floating high and nothing between the prostate and triangular ligament—in other words, there is no hope of the urethral injury being partial—then the two ends should be approximated across a splint catheter in the orthodox manner. The patient is bound to develop a stricture, and nothing is lost by the indwelling catheter.

Assuming that the bladder is not floating high in the abdomen and a suprapubic cystostomy has been performed a urethrogram can be carried out after 10 days to confirm the diagnosis and to demonstrate radiologically the site of the injury. The disorganized tissues of the pelvis will be sufficiently sealed off for the investigation to be safe, and the risk of infecting the healed area is minimal. If the urethrogram is left until 14 days or later the urethra will be completely occluded by organizing blood clot. At three weeks the urethra is inspected by panendoscopy, and it is here that the skilled help of the urologist is required to inspect the ruptured wall of the urethra without allowing the tip of the instrument to do further damage. It is extremely easy to direct the panendoscope into the hole in the urethral wall and create a false passage, because the instrument has a fore-oblique view, and the beak is therefore directed 30° away from the line of viewing. For this manoeuvre the direct viewing instrument (180°) is much more useful than the fore-oblique telescope, but at present few urological centres are equipped with this instrument. In most cases of partial rupture it is possible to pass a panendoscope.

Approximately 35% of patients require open surgery at the second stage procedure three weeks after injury.⁶

In our series of cases at Bristol we were dubious about only one at the time of panendoscopy, but in all others the site of rupture was clearly visible. This one case is probably the only patient who might be considered to have had an unnecessary suprapubic cystostomy. He was in fact the only one done without the accepted triad of signs—no blood had been seen at the external meatus. However, I think this error of only one suprapubic cystostomy in over 50 cases is a small price to pay when compared with the inaccuracy of diagnostic catheterization and even radiology, both of which have an error greater than 2%.

Time does not allow a full discussion of the urethral injuries in children. They are a separate problem. Though those of us

who deal with both adult and children's surgery like to regard children as smaller adults, this is unacceptable in cases of ruptured urethra. In small boys it is a different injury, since the prostate has not developed and commonly rupture occurs just below the bladder neck. Again, if the transection is complete the orthodox splint catheter should be used, but if there is anything remaining intact to tether the bladder down to the pelvis surgery should at first be limited to suprapubic cystostomy. These children possibly face a lifelong disability and the second stage of their treatment should be supervised by a surgeon experienced in paediatric urology. One fascinating problem peculiar to children is the postoperative hesitancy to micturate—though once started the stream is free and full.

The message therefore in the management of posterior urethral injuries is that extravasation of sterile urine is not a matter of urgency for 24 hours, and attention to the patient's general condition and other major injuries can take priority. Secondly, blood at the external meatus should be watched for on first examining any patient with suspected fracture of the pelvis. Thirdly, partial rupture as opposed to complete transection of the posterior urethra is much more common than has been appreciated in the past. Fourthly, every effort should be made to preserve the remaining strand of urethra in partial rupture, thus reducing the risk of a severe disabling stricture.

Rupture of Anterior Urethra

Anterior urethral injuries are caused by the patient falling astride an object. A more awkward injury surgically is the disruption of the urethra exactly at the triangular ligament from a blow in the perineum. An inmate of one of our mental hospitals in Bristol had a long-standing vendetta with another inmate and one day he spied his enemy bending down weeding a rosebed. He crept up behind and kicked him with his ammunition boot straight in the perineum, severing his victim's urethra so

that the two ends retracted above and below the triangular ligament, leaving me with an extremely difficult repair.

Early surgical interference with anterior urethral injuries may be precipitated by distension of the tissues by the haematoma. The skin can be so tense over the extravasating blood that there is a risk of necrosis, but unfortunately drainage of the haematoma immediately converts a closed into an open wound with the inevitable risk of infection aggravating the subsequent stricture.

All these patients will develop some degree of stricturing of the urethra, depending on the extent of local infection and actual tissue necrosis, but a stricture of the anterior urethra offers relatively easy access for subsequent successful urethroplasty.

Conclusion

The management of all urinary tract injuries has moved towards a more conservative approach, and there has been a return to diagnosis by clinical acumen. Surgery can be carried out as a formal, planned operation and not as a midnight emergency, and this has relieved young accident surgeons of much anxiety both in diagnosis and treatment. I hope that I have presented a more logical approach to the diagnosis and simplified some of the confused advice on the surgical treatment.

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Gynaecology in General Practice

Physiology of Abnormal Bleeding

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Bleeding from the female genital tract is a physiological function with a wide range of normal. It is also the most important symptom of gynaecological disease. The terminology of this symptom during the reproductive phase is based on the pattern and the amount of bleeding. Menorrhagia signifies heavy but regular monthly losses. Epimenorrhoea and polymenorrhoea indicate a short cycle, whereas epimenorrhagia and polymenorrhagia denote a short cycle with heavy bleeding. Metrorrhagia indicates irregular bleeding and this is by far the most sinister. Though these labels are useful they sometimes give rise to confusion and descriptive phrases are usually more informative. There is no perfect classification of abnormal

bleeding but the time scale before, during, and after the reproductive period serves as a useful basis.

Bleeding Before Reproductive Period

The two most common causes of bleeding before the reproductive period are vaginal trauma and a foreign body. Neonatal bleeding due to maternal hormones worries the mother but she can be reassured that no treatment is required. General conditions must be excluded. They include acute leukaemia, rare local lesions such as cervical sarcoma which tend to occur in the very young and the very old, and oestrogen-producing tumours of the ovary—such as a granulosa cell tumour, theca cell tumour, and malignant teratoma, which may occur at any age.

Precocious puberty is an unusual phenomenon defined as the onset of menstruation accompanied by the development of secondary sexual characteristics before the age of 10 years.

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