UKRAINIAN MEDICAL STOMATOLOGICAL ACADEMY

CHAIR OF UROLOGY WITH ANESTHESIOLOGY AND INTENSIVE CARE

«Confirmed»
First Prorector of Academy
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28.08.2019

U r o l o g y

GIUDE

Editor :
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2019

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Urology deals with diseases and disorders of the male genitourinary and female urinary tracts. Urologists have been responsible for the introduction of many new techniques. These include the development and widespread use of endoscopes, lithotripsy and prosthetic inserts for hollow organs (stents).

Symptoms arising from the kidney and ureter

Systemic

Fever

Acute pyelonephritis is usually associated with a high fever (40°C). In infants and children there may not be any associated urinary symptoms. Chronic pyelonephritis is not associated with fever. Swinging pyrexia is often a feature of renal carcinoma.

General malaise and weight loss

These are often seen —as in diseases of other systems — with cancer or chronic infection. They may also be features of chronic renal failure.

Pain

Pain may be perceived at the surface directly over the area of involvement: local renal pain is felt in the flank and costovertebral angle. It is typically a dull, constant ache and related to distension of the renal capsule. However, many renal diseases progress slowly and may not be associated with such pain until some secondary event occurs to cause acute capsular distension. Examples are cancer, tuberculosis, polycystic disease, staghorn calculi and hydronephrosis secondary to congenital pelviureteric junction obstruction (Fig. 1).

Pain may also be experienced at the surface further away from the site of origin. Such pain is often called 'referred', but it is being felt at the surface representation of the segment in which it originates. Thus the severe pain of ureteric colic which occurs in waves and is often associated with vomiting may be felt in the testicle (T11 to T12). A stone in the lower ureter may cause pain in the scrotal wall (LI) and in the bladder.

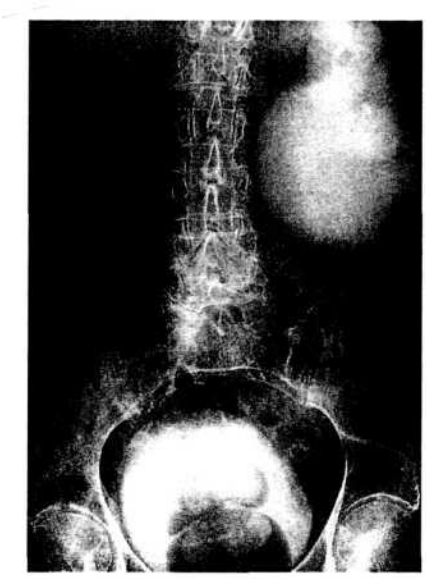

Fig. **1** An intravenous urogram of a congenital obstruction of the left pelviureteric junction.

Oliguria and anuria

A reduced or absent urine output may be caused by underperfusion of the kidney as a result of shock from blood, water and electrolyte loss or in sepsis. Bilateral ureteric obstruction or injury to a solitary kidney are other causes.

Anaemia and its symptoms

These are invariable in chronic renal failure but also occur as a result of renal tumours, chronic infection and blood loss.

Local

Haematuria

Haematuria always requires full investigation (Clinical Box 1). The additional presence of proteinuria and abnormal red-cell morphology on microscopy are more suggestive of a renal cause. Common causes «9 haematuria are shown in Box 1.

***Clinical* Box 1**

Haematuria diagnosis and investigation

- Haematuria may be painful or painless
- Painful haematuria is usually associated with an infection but may result from stones, carcinoma in situ of the bladder, self-induced foreign bodies or urethral trauma
- Painless haematuria is a sinister sign and most likely due to renal or bladder cancer. Other conditions are shown in Box 32.1
- A cystoscopy investigation and intravenous urogram or ultrasound scan are mandatory

Common causes of haematuria

Systemic

- Anticoagulants
- Sickle cell disease
- Bacterial endocarditis (emboli)
- Henoch-Schonlein purpura
- Cyclophosphamide
- Non-steroidal anti-inflammatory agents

Nephrological

- Mesangial IgA disease
- Glomerulonephritis
- Renal infarcts
- Urinary infection
- Tuberculosis
- Polycystic disease

Urological

- Carcinoma of kidney
- Urothelial tumours
- Stones
- Schistosomiasis
- Benign prostatic hypertrophy
- Trauma
- Infection

Clinical examination of the upper urinary tract

Tongue

Because water and electrolyte disturbance are common in urological disease, the tongue should be examined for dryness and at the same time the breath smelt for the characteristic fishy smefl of uraemia.

Abdominal inspection

In children, inspection is the most reliable method of identifying a renal mass, which may be seen in the upper abdomen or inferred from fullness or oedema in this area, the latter implying perinephric infection.

Palpation

The patient should lie supine on a firm surface. The kidney is lifted by one hand placed in the costovertebral angle. On deep inspiration, the kidney moves downwards. When it is at its lowest, the other (anterior) hand is pressed firmly backwards beneath the costal margin in an effort to trap the kidney below that point. The anterior hand can then palpate the size, shape and consistency of the kidney as it slips back into its normal position. The left kidney should be examined from the left side. The right kidney lies lower than the left and it

is sometimes possible to feel the lower pole even if it is normal. The left cannot usually be felt unless it is enlarged or displaced.

Enlargement of the kidney suggests polycystic disease, a renal cyst, tumour or hydronephrosis.

Percussion

Renal masses are frequently soft and difficult to feel. They can often be more easily outlined by percussion.

Auscultation

A bruit may be heard over the upper abdomen. Possible causes are renal artery stenosis, aneurysm of the renal artery and an arteriovenous fistula.

Investigation

A combination of haematological, biochemical, bacteriological, radiological, isotopic and endoscopic examination is needed to achieve an accurate, rapid, cost-effective determination of the probable diagnosis and requirements for treatment.

Examination of the urine

Technique

A tinned urine collection may be required for assessment of renal function (see 'Creatinine clearance', below), proteinuria or the excretion of substances associated with stone formation.

It is best to examine a freshly voided specimen taken midway through the act of micturition. Many of the details in the collection of this midstream (MSLJ) sample are shrouded in rituals which are mostly a waste of time and money. Specimens collected from women who have not undergone any special preparation and who void into disposable plastic cups show a 95% concordance with a catheter specimen. In addition, genital cleaning makes little difference to the bacterial count. The most important factor is rapid transport of specimens to the laboratory.

Urine is usually collected into a clean polystyrene cup and then transferred without spillage to a sterile universal container. In younger children, a plastic bag is attached around the urethral meatus. In girls, catheterisation with a fine catheter is appropriate, although, in cither sex, suprapubic needle aspiration is easy to perform, particularly if hydration is adequate and the bladder full. The suprapubic area is cleansed, local anaesthetic injected to raise an intradermal wheal 1-2 cm above the pubic symphysis. A 10 mL syringe with a 22 gauge needle is inserted perpendicularly through the abdominal wall into the bladder, maintaining gentle suction with the syringe so that the urine is aspirated as soon as the bladder is entered.

Colour and appearance

Overtly bloody urine is usually unmistakable. However, red urine can result from:

- betacyanin excretion after beetroot ingestion
- myoglobinuria, the result of muscle trauma
- haemoglobinuria after haemolysis.

Chemical tests

Chemically impregnated reagent strips permit the simultaneous rapid performance of a number of tests, including the presence of blood, protein, ketones, glucose, nitrites and leucocyte esterase. These tests can be useful for screening and show excellent correlation with more-extensive laboratory examination.

Microscopy

Examination of the centrifuged urinary sediment allows identification of red blood cells (which always requires further investigation), white blood cells, bacteria and casts. Cytological examination for malignant cells is also possible.

The presence of more than five white blood cells per high-powered field is abnormal (pyuria) and, if associated with bacteria, indicates a urinary infection. Sterile pyuria —white blood cells but without bacteria — occurs in:

- tuberculosis of the urinary tract
- urinary stones
- recovery from urinary infection.

Culture

Culture enables the organism present to be identified and a prediction made of which antibiotics may be effective in treatment.

Serum creatinine concentration and creatinine clearance

Creatinine in serum is the end-product of the metabolism of creatine in skeletal muscle, which takes place at a fairly steady rate. The molecule is filtered through the glomerulus and its clearance is approximately equal to the glomerular filtration rate (GFR). The serum creatinine concentration remains within the normal range until approximately 50% of renal function has been lost.

The determination of creatinine clearance is shown in Box 2.

Blood urea concentration

The amount of urea in the blood is also related to the GFR. However, it is more influenced by factors external to the kidney, e.g.:

- dietary protein intake
- endogenous sources of nitrogen in the gut such as a gastrointestinal haemorrhage
- rate of urine production, which is the outcome of a number of factors including the state of hydration.

Box.2

Creatinine clearance

Requirements

Timed urine sample (usually 24 hour)

Blood sample for creatinine concentration taken during the 24-hour urine collection period

Measurements

Urine volume throughput (mL/min or per 24 hours) = *V*

Urine creatinine concentration (mmol/L) = *U* Plasma creatinine concentration (mmol/L) = *P*

Calculation

$$\text{Clearance} = \frac{U \times V}{P} \text{ mL/min}$$

Interpretation

The creatinine clearance is the amount of blood completely cleared of the substance per minute; and, because creatinine is completely filtered through the glomerulus, clearance approximates glomerular filtration rate **(GFR)**

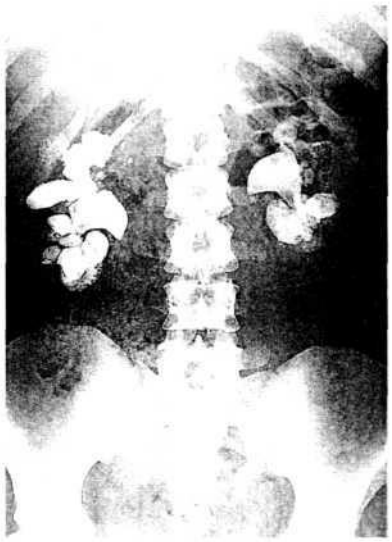

Fig. 2 Plain film of the abdomen. Bilateral renal calculi, which could be mistaken for an intravenous urogram, are shown.

Approximately two-thirds of renal function must be lost before a significant rise in the blood urea concentration takes place. The measurement is less specific as an index of renal function than is creatinine clearance.

Serum calcium concentration

The level of serum calcium should be routinely measured in patients with renal stones to identify hyperparathyroidism and alterations in vitamin D metabolism in those with renal failure. Calcium concentration may also be elevated in patients with renal-cell carcinoma either as part of **a** paraneoplastic syndrome caused by the secretion of parathyroid hormone-like substance or from bone destruction by secondary deposits.

Serum alkaline phosphatase

The concentration may be elevated as part of a paraneoplastic syndrome in renal-cell carcinoma or from bone deposits in patients with genitourinary or other cancer.

Imaging

Abdominal plain X-ray

A plain abdominal radiograph is frequently called a KUB (kidneys, ureters, bladder) and is the preliminary exposure taken in any radiological study of the urinary tract. It is always the first film to be examined before reporting on any contrast study and can avert pitfalls (Fig. 2) and yield a great deal of information (Fig. 3).

X-ray contrast studies

Some water-soluble preparations that contain iodine can be administered by several routes, including directly into blood vessels. All procedures which use intravascular contrast media carry a small but definite (-5%) risk of an adverse reaction. Most are minor and include nausea, vomiting, itching, rash or flushing. Cardiopulmonary adverse reactions can occur but are rare (1:40 000), although they may be life-threatening or fatal. The contraindications to the use of intravascular contrast to image the urinary tract are shown in Box 3.

Patients with relative allergic contraindications can be given corticosteroids. However, there is little evidence to indicate conclusively that their prophylactic use is efficacious.

Box *3*

Contraindications to intravenous urography

Absolute

- Pregnancy
- History of a previous severe reaction

Relative

- History of iodine sensitivity
- Asthma
- Hay fever
- General tendency to allergic reactions
- Patients taking metformin

Intravenous urogram (IVU)

IVU is the most frequently used contrast investigation. Many of the items shown in Figure 4 may also be

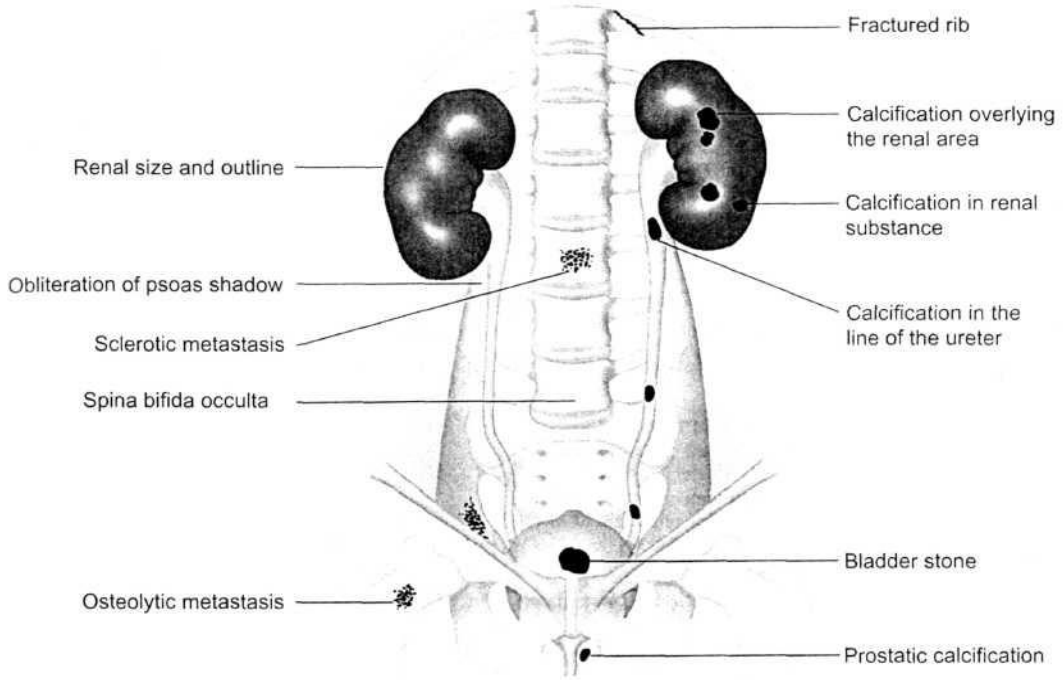

Fig. 3 A guide to the interpretation of a plain abdominal X-ray.

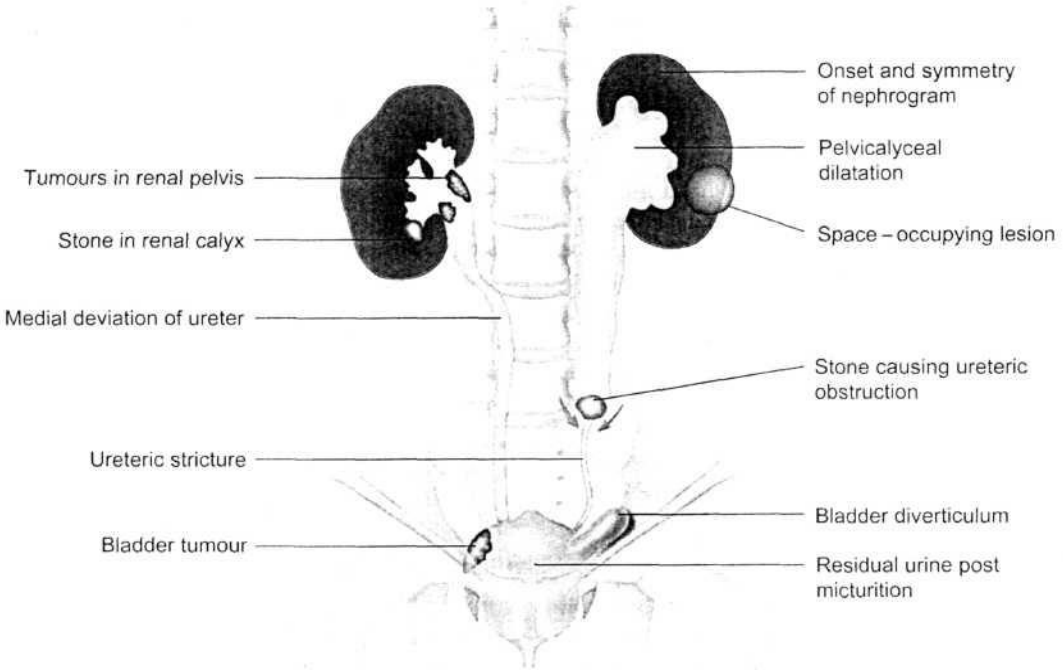

Fig. 4 A guide to the interpretation of an intravenous urogram (IVU).

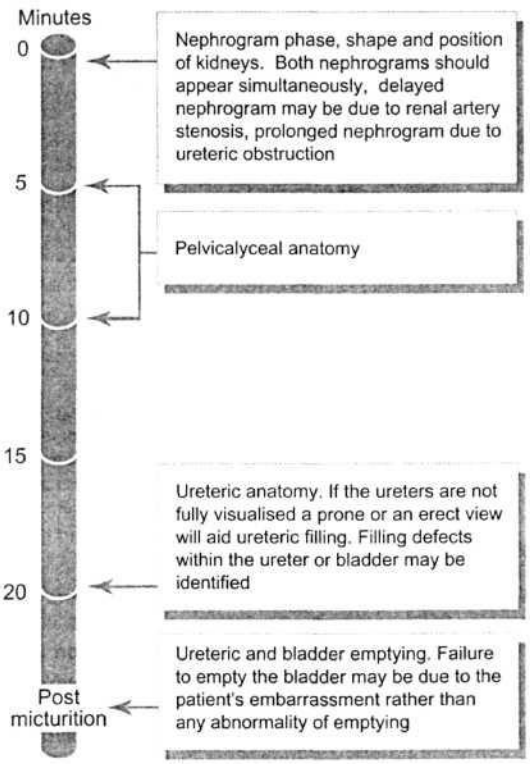

Fig. 5 Additional information from an IVU.

elicited or confirmed by urography and additional information also obtained (Fig. 5).

Those with moderate renal failure are unable to excrete the usual dose of contrast media at a concentration sufficient to provide an image, and a larger than usual dose is required. It is usual to restrict fluids before an IVU so as to concentrate the urine, but this should not be done in diabetics.

Retrograde ureterography

This may be necessary if the IVU is unsatisfactory. A cystoscopy and the placement of a catheter in the ureter are required. Radio-opaque contrast medium is then introduced directly into the renal pelvis or ureter.

Antegrade pyelography

Contrast medium is introduced either through a nephrostomy tube (nephrostogram) or by direct injection into the renal pelvis via a percutaneous needle puncture.

Arteriography

Arteriography (Fig. 6) is most frequently done to evaluate:

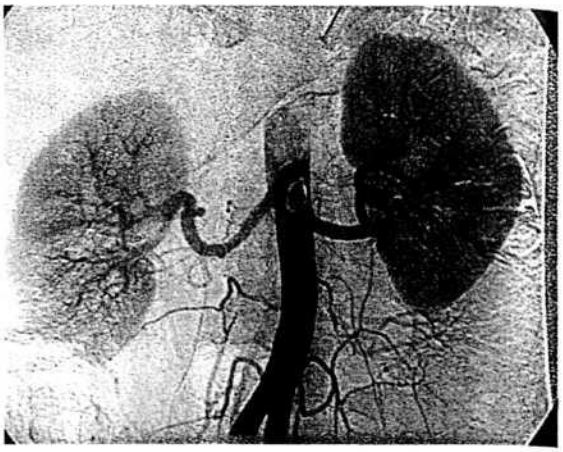

Fig.6 A normal renal arteriogram showing single arteries to both kidneys.

- possible causes of renovascular hypertension
- anatomical suitability of potential live related kidney donors
- vascular anatomy before surgery.

It is being superseded by magnetic resonance angiography.

Arteriographic techniques can also be used for therapy. Arteriovenous fistulae and bleeding vascular renal tumours can be embolised and renal artery stenoses dilated.

Micturating cystourethrography

This is done to determine the presence of vesicoureteric reflux. Contrast medium is introduced into the bladder via a urethral catheter which is then removed. **Dynamic** X-ray studies are made during voiding, and contrast may be seen to reflux up the ureter(s) (Fig. 7). The urethra is also delineated and an assessment of residual urine can be made.

Computed tomography

The principal uses of CT are:

- diagnosis and staging of tumours (Fig. 8)
- delineation and diagnosis of retroperitoneal masses
- identification and classification of renal trauma
- identification of urinary tract stones.

Ultrasonography

Ultrasound is used in the upper urinary tract to:

- determine the size of the kidneys and the presence of pelvicalyceal dilatation, which may be due to obstruction in patients with renal failure when IVU is unlikely to be effective
- distinguish between solid and cystic renal masses
- identify non-opaque renal stones.

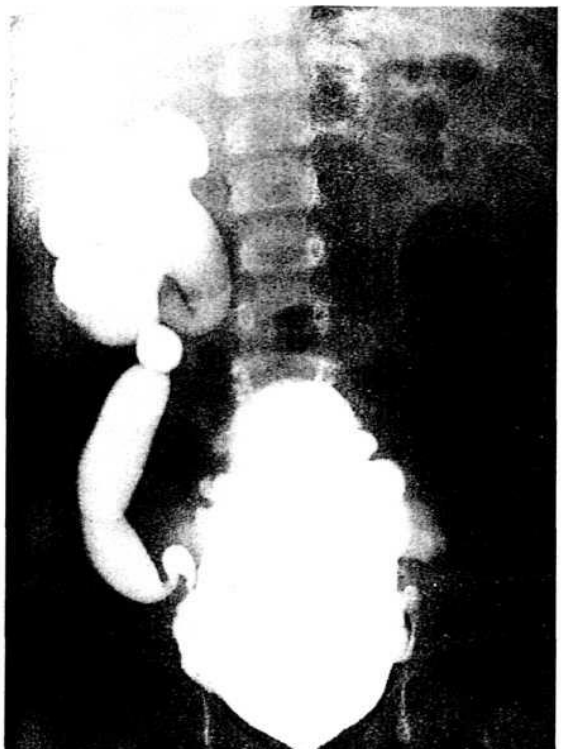

Fig.7 A micturation cystogram which shows reflux and renal scarring.

Ultrasonography cannot provide detailed visualisation of the calyces and pelvis, nor does it outline an undilated ureter or provide functional information about the upper urinary tract.

Magnetic resonance imaging

The main advantages of MRI, and contraindications to its use, are given in Box 4.

Radioisotope studies

I here are two types of radioisotope study:

- dynamic, in which the function of the kidney is examined over a period of time
- static, which involve imaging of a radiopharmaceutical taken up and retained by the renal tubules.

Dynamic studies. Diethylene-triamine-penta-acetic acid (DTPA) is actively secreted by the renal tubules. It is labelled with technetium-99m and administered intravenously. There is a progressive accumulation of the isotope followed by excretion which is recorded over each kidney by a gamma camera (Fig. 9) to give

Box 4 Magnetic resonance imaging

Advantages

- It does not involve the use of ionising radiation
- It permits multiplanar imaging
- It is non-invasive
- It allows greater tissue contrast than do other modalities

Contraindications

Patients who should not undergo MRI include:

- those with cardiac pacemakers
- those with ferromagnetic metallic foreign bodies, including ones that have been placed surgically

quantitative data on excretory function. The information can be used to demonstrate the degree of obstruction in a kidney. Progressive uptake of isotope may also occur in a dilated but unobstructed system, but this can be distinguished from obstruction by the rapid clearance of the isotope after the intravenous injection of furosemide (frusemide; Fig. 10). Technetium-99m mercaptoacetyltriglycine (MAG3) is rapidly cleared by tubular secretion and is not retained in the parenchyma of normal kidneys. Due to a much smaller volume of distribution and faster clearance, MAG3 is replacing DTPA in diuretic renography.

Static studies. Dimercaptosuccinic acid (DMSA) is taken up by tubular cells in proportion to their function. The same technique is used as for DTPA scanning: labelling with ^{99m}Tc, intravenous injection and counting with a gamma camera. The relative function of each kidney can then be determined. The investigation is of value in identifying ectopic kidneys, renal scarring and pseudo-tumours in which normally functioning renal

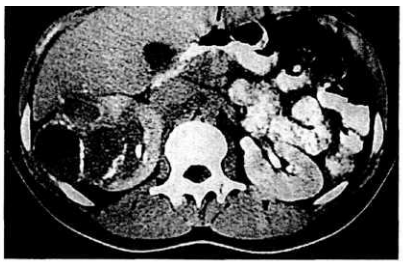

Fig.8 A CT image showing a right tumor with extension into the vena cava.

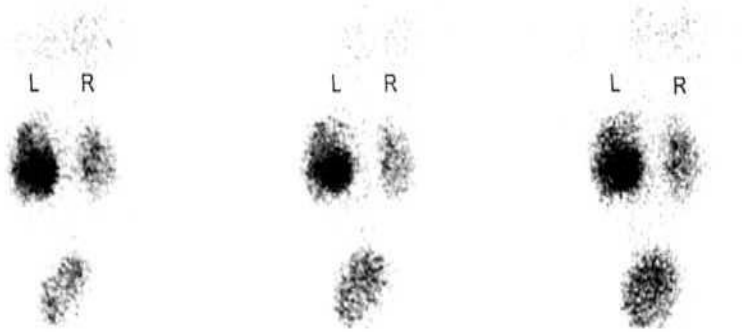

Fig. 9 A DTPA renogram which is suggestive of an obstructed left kidney.

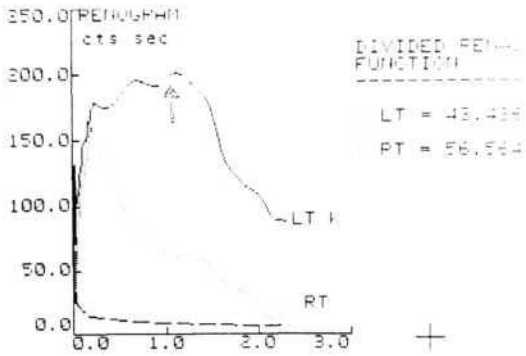

Fig.10 A DTPA renogram following furosemide.

tissue is abnormally placed within the substance of the kidney.

Disorders of the kidney

Congenital anatomical abnormalities

The developing kidney is lobulated and becomes kidney-shaped at around 34 weeks of intrauterine life. Persistence of such lobulation into adult life is not of significance. Renal agenesis (the absence of a kidney, ureter and half the trigone of the bladder) has an incidence of 1:450 and is important in the context of trauma. A solitary kidney undergoes compensatory hypertrophy. Renal aplasia is associated with a small number of nephrons and undeveloped pelvis and ureter. A hypoplastic kidney is a miniature adult organ commonly associated with the development of hypertension and infection for either of which nephrectomy may be indicated. An ectopic kidney may cause confusion by presenting as an abdominal or, more usually, a pelvic swelling.

Renal cysts

True cysts occur in three circumstances:

- a solitary cyst
- multicystic kidney
- polycystic kidney.

Solitary cysts

The aetiology is unknown. Symptoms are usually absent and the cyst is found during investigation of the urinary tract for other reasons. Very occasionally there may be pain or obstruction of urine drainage, and only then is treatment required by percutaneous aspiration under ultrasound guidance.

Multicystic kidney

Multiple cysts may be found in either dysplastic or otherwise normal organs. In a poorly functioning dysplastic kidney, a nephrectomy is indicated if pain, infection or hypertension is a feature. Multiple cysts in an adult kidney with normal function do not usually warrant treatment. However, if there is pain, aspiration under ultrasound guidance is done.

Polycystic kidney disease

There are two types: infantile and adult.

Autorecessive polycystic renal disease

Infantile disease is inherited as **an** autosomal recessive and presents within the first 9 months of life **with** gross abdominal distension because of renal masses. The child is pale, has easily palpable kidneys and renal failure. Most infantile polycystic disease has a hopeless prognosis and, without dialysis or transplantation, death takes place before the age of 18 months.

Autodominant polycystic renal disease

This is ten times more common than autorecessive disease. Its relatively common occurrence makes it important, especially as 10% of patients who require renal replacement therapy have this condition.

Aetiology and pathological features.
A single gene defect linked to the alpha-haemoglobin gene on the

short arm of chromosome 16 is inherited as an autosomal dominant. The precise mechanism of cyst formationtion is unknown. They are present in infancy and, witg advancing age, enlarge to cause progressive loss of intervening renal tissue and the development of renal failure. The following can be associated:

- berry aneurysms of the cerebral vessels
- polycythaemia
- cysts in other organs —liver, thyroid, breast and pancreas
- hypertension.

Clinical features. The common presenting age is between 25 and 50 years. Symptoms include:

- loin pain from increase in size of the kidneys
- acute loin pain with haematuria because of haemorrhage into the cysts
- hypertension and its associated sequelae.

General examination commonly reveals hypertension. There may be features of chronic renal failure. The kidneys are large and irregular (Fig. 11). Occasionally there is hepatomegaly from cystic involvement of that organ.

Diagnosis. A definitive diagnosis can be made by IVU, which shows the pelvis of each kidney elongated and attenuated by the smooth surface of adjacent cysts. However, ultrasonography is less invasive and more directly confirms the presence of multiple cysts in the kidneys and other organs. The investigation should be used to screen children who are the offspring of parents known to have the condition.

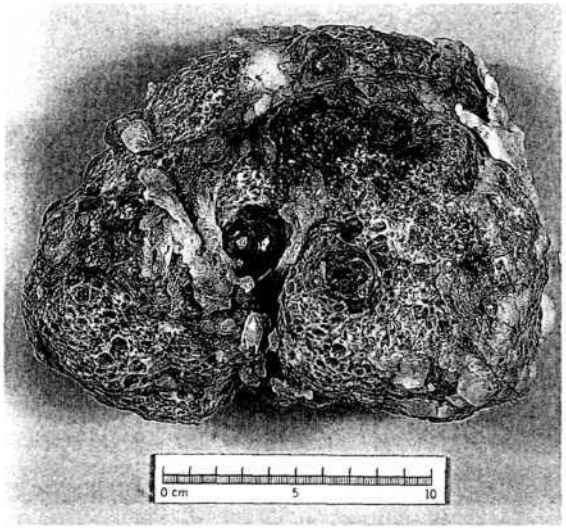

Fig.11 A polycystic kidney.

Management

In the majority, the disease is progressive and ultimately necessitates renal replacement by dialysis and/or transplantation. Failure to control hypertension accelerates the loss of kidney function.

Urinary infection

Urinary tract infection is the most common bacterial infection in humans of all ages. The incidence and sequelae of urinary infections, their diagnosis and treatment all vary with age. By the time adolescence is reached, 1-2% of boys and 5% of girls will have had a urinary infection.

Infection in children

Aetiology and pathological features

Organisms that ascend from the urethral meatus are usually Gram-negative faecal flora. E. coli and Proteus spp. are the commonest. Vesicoureteric reflux or other anatomical abnormalities may be associated. If infection ascends to the growing kidneys (up to the age of 5 years) and is repeated, renal damage occurs with progressive scarring (the outcome of healing of a cortical abscess) and the development of renal failure and hypertension. Infection is one of the few preventable forms of renal failure.

Clinical features

The younger the child, the less specific the symptoms (see Box 5). Older children may complain of:

- loin pain
- increased frequency
- burning on micturition
- haematuria
- enuresis.

Specific signs are absent, but there may be some tenderness in one or both renal angles.

Box .5

Non-specific symptoms associated with urinary tract infection in children

- Vomiting and diarrhoea
- Jaundice
- Weight loss
- High fever
- Unexplained screaming attacks

Investigation

Bacterial culture

Urine should be obtained for culture and antibiotic sensitivities before antibiotic therapy is begun.

Imaging

Any child with an infection must be thoroughly investigated to find out if there is an anatomical abnormality.

Ultrasound identifies congenital abnormalities, dilatation of the renal pelvis and ureter, urinary stones and renal scarring.

Micturating cystourethrography is done, after the urine has been made sterile, to identify and quantitate vesicoureteral reflux, scarring and the adequacy of bladder emptying (see Fig. 7).

DMSA renography is the best way of identifying renal scarring.

Management

Infants and children with a normal IVU and micturating cystogram

A single course of an appropriate broad-spectrum antibiotic (amoxicillin, trimethoprim, Augmentin and cephalosporins are among the most effective) should be given for 5-7 days. Thereafter, follow up for a year with monthly urine specimens for bacterial analysis. Because of the risk of renal scarring in infants, prophylactic low-dose antibiotics are given until the age of 2 years. In older children, prophylaxis is limited to 6 months. Clinical recurrence requires further antibiotic therapy and full investigation.

Children with vesicoureteric reflux and/or renal scarring

The treatment of the acute episode is as above. Thereafter, prophylaxis up to the age of 5 years is essential. Ultrasound examination of the kidneys is done at yearly intervals. A direct cystogram is done up to the age of 2 years if the reflux has not resolved. An indirect cystogram using MAG3 renography is performed annually up to the age of 5 years. The reflux resolves spontaneously in 80% and, in consequence, there has been a move away from its surgical correction. Indications for surgery are not clearly defined but include:

- recurrent infection in the presence of antibiotic prophylaxis
- persistent loin pain or fever
- poor compliance with prophylaxis
- progressive scarring.

Acute pyelonephritis

Aetiology

Aerobic Gram-negative bacteria which ascend from the urethra and genital tract are the principal cause; haematogenous infection is infrequent. Once infection is established in the bladder, its ascent to the kidney is the consequence of:

- microbial virulence
- presence of vesicoureteric reflux
- quality of ureteric peristalsis.

Clinical features

Symptoms are:

- high fever, sweating and often vomiting
- dull ache in the loin
- increased frequency
- dysuria
- haematuria.

The only specific sign is loin tenderness.

Investigation

Urine

This is turbid and contains protein and blood. Organisms, red cells, white blood cells and debris may be seen on direct microscopy. Culture is essential.

Blood

Apart from routine investigations, a blood culture may identify the pathogen responsible.

Imaging

Plain X-ray of the abdomen may show renal enlargement or obliteration of the renal outline by perirenal oedema or the presence of a radio-opaque stone. An IVU in the acute phase of the disease is of little value because renal excretion is reduced.

Ultrasonography may identify a radiolucent stone but, more importantly, may show dilatation of the renal pelvis which suggests an obstruction that needs urgent relief (Fig. 12).

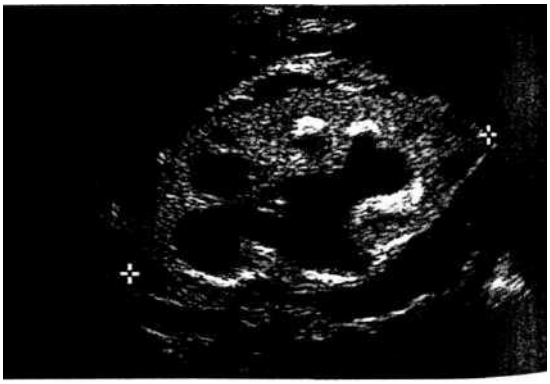

Fig. 12 Ultrasound examination showing dilatation of the renal pelvis, a result of ureteric obstruction.

Management

There is no need to wait for the results of bacterial culture and sensitivity tests. Antibiotic therapy should begin at once. The majority of infections are caused by organisms that are sensitive to trimethoprim, amoxi--cillin or cephalosporins. The urine is re-cultured a week after treatment is complete to ensure that the infection has been eradicated. In women, a high vaginal swab should also be taken to exclude the development of candidiasis which is a common sequel of treatment with broad-spectrum antibiotics and can cause recurrent infection of the lower urinary tract.

Once the acute episode has settled, any correctable precipitating cause is dealt with.

Chronic pyelonephritis

This is a confusing term. It is largely a radiological diagnosis based on the finding of shrunken kidneys with an irregular outline because of cortical scarring — the end result of cortical abscesses. The calyces are clubbed (Fig. 13).

Clinical features

The symptoms are those of:

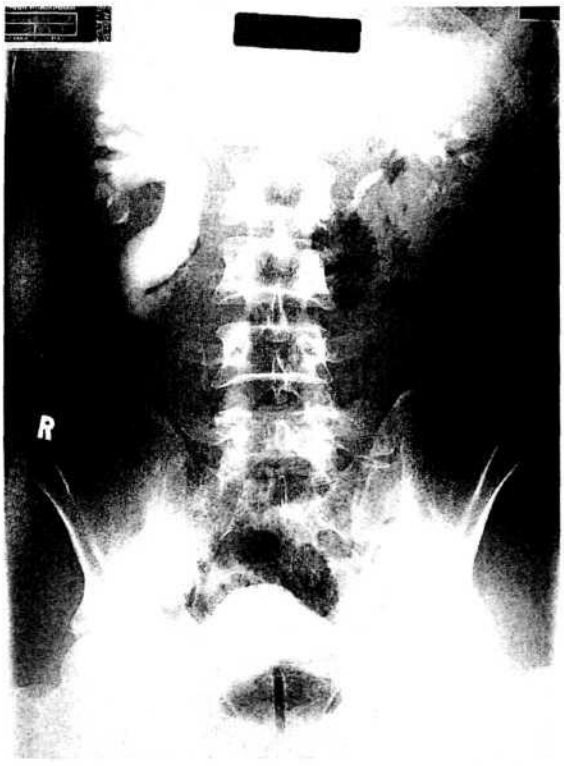

Fig. 13 An IVU showing chronic pyelonephritis. The right kidney is shrunken and scarred with calyceal clubbing.

- urinary tract infection
- renal failure
- hypertension.

There are no specific signs. Most patients are hypertensive, while some are normotensive due to the development of a salt (Na^+)-losing nephropathy.

Management

Existing infection must be eradicated and recurrence prevented by long-term continuous antimicrobial prophylaxis. If hypertension is associated with unilateral disease, a nephrectomy may be indicated.

Renal abscess

Aetiology and pathological features

There are two causes:

- Haematogenous spread —usually of *Stapln/lococcus aureus —from* a distant site. The condition is common in drug abusers and diabetics. Abscesses are usually multiple and in the cortex.
- Acute pyelonephritis, often with obstruction, causes medullary abscesses which are more common.

Clinical features

Symptoms

There may be a history of recurrent urinary tract infection or parenteral administration of therapeutic (insulin) or other non-therapeutic substances. The patient is often acutely ill with high fever and loin pain.

Signs

In *cortical abscess,* signs are of:

- flank tenderness
- palpable mass
- erythema of the skin of the loin
- clear urine.

In *medullary abscess,* signs are of:

- flank tenderness
- obvious pyuria.

Investigation

This is as for acute pyelonephritis. Ultrasonography can identify a renal abscess, but it is difficult to distinguish this from a cystic-necrotic renal carcinoma. However, percutaneous needle aspiration, under ultrasound guidance, confirms the presence of pus.

Management

Management is with systemic antibiotic therapy. Percutaneous drainage of any collections seen on ultrasound is carried out. In medullary abscess, there is subsequent correction of any precipitating factor.

Perinephric abscess

Aetiology and pathological features

The majority of perinephric abscesses result from rupture of a cortical abscess into the perinephric tissue. They therefore lie between the renal capsule and perirenal fascia. A large collection may point posterolaterally over the iliac crest (Fig. 14). The organisms are the same as those found in renal abscesses. There may be an underlying infected hydronephrosis (pyonephrosis).

Clinical features

The onset tends to be slower than in renal abscess. The patient has a fever and complains of loin pain. Signs are of:

- tenderness over the affected kidney
- large mass
- pleural effusion on chest examination.

Investigation

Blood

There will be a marked leucocytosis.

Imaging

Plain X-ray of the abdomen shows a soft-tissue mass in the flank with obliteration of the renal and psoas shadows. A stone in the renal pelvis may be seen.

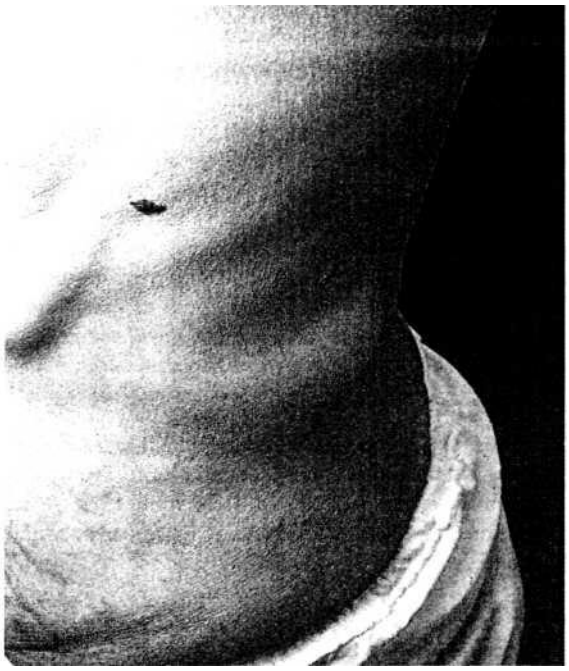

Fig. 14 A perinephric abscess pointing posteriorly over the iliac crest.

Because of spasm of the lumbar muscles, there is often a scoliosis with the concavity towards the affected kidney Gas —produced by coliform or other organisms — may be seen in the renal collecting system or around the kidney.

IVU may show delayed excretion or non-function.

Ultrasonography may demonstrate a hydronephrosis as well as delineating the extent of the abscess.

CT scan may also outline the mass (Fig. 15).

Management

Percutaneous drainage under ultrasound guidance may be adequate, but an open operation is sometimes required. Nephrectomy is often needed because of underlying kidney disease.

Complications

Ureteric stenosis because of periureteric fibrosis is a common sequel. If the kidney has not been removed, the patency of the ureter should be assessed after 1 month.

Renal tuberculosis

Epidemiology

The condition is on the increase. There are three known reasons:

- influx of migrants from developing countries where the disease is endemic
- tuberculosis in patients with the acquired immune deficiency syndrome (AIDS)
- tuberculosis in drug users.

However, in addition, renal tuberculosis is reappearing in those that do not meet the above criteria.

Aetiology and pathological features

The organism reaches the genitourinary tract by haematogenous spread from a focus in the lung, which

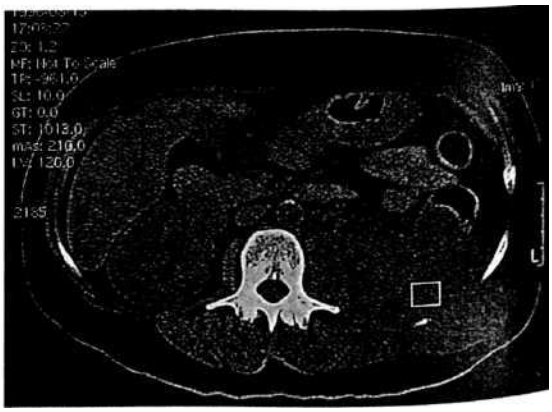

Fig. 15 A CT scan of a patient with a perinephric abscess and pyonephrosis.

is often asymptomatic. The kidney is usually the primary site, and other organs become involved by shedding of bacteria into the urine. The progress ofthe disease is slow; in a patient who is otherwise in good conditiontion, it may take many years to destroy the kidney. Involvement of the renal pelvis and ureter may lead to stricture and hydronephrosis. Infection of the bladder wall causes progressive fibrosis and ultimately a shrunken bladder.

Clinical features

The slow evolution of the disease means that, in a patient with an involved kidney, years may elapse before symptoms occur, although occasionally there may be a dull ache in the flank and haematuria. Spread to the bladder may cause increased frequency and pain on moderate bladder distension and at micturition. Rarely, the first presentation is when the patient discovers a painless epididymal swelling. There are no specific signs.

Investigation

Urine

The finding of persistent pyuria without pyogenic organisms on ordinary culture is an indication to collect a first morning specimen on at least three separate occasions for culture for tubercle bacilli. Although a negative result does not exclude the disease, a positive one —which is obtained in a high percentage of samples — is confirmatory. If there is strong presumptive evidence for the presence of tuberculosis, but a negative result, cultures should be repeated, because not only is it necessary to be certain that genitourinary tuberculosis is present, but also the antimicrobial sensitivity must be determined before treatment is begun.

Imaging

Chest X-ray may show evidence of tuberculosis.

IVU may demonstrate calcification in the kidney, an abscess cavity or dilated calyces (Fig. 16). Absence of function is a consequence of complete destruction- auto-nephrectomy.

Management

Management is by chemotherapy. Treatment does not usually need to exceed 9 months and consists of a combination of rifampicin, isoniazid and pyrazinamide. During this treatment, repeated examination by ultra-sound or IVU is required to make sure that a ureteric stricture does not develop as the tuberculous lesions heal (Fig. 17).

Renal trauma

Injury to the kidney is not uncommon, but it rarely results in an urgent life-threatening problem.

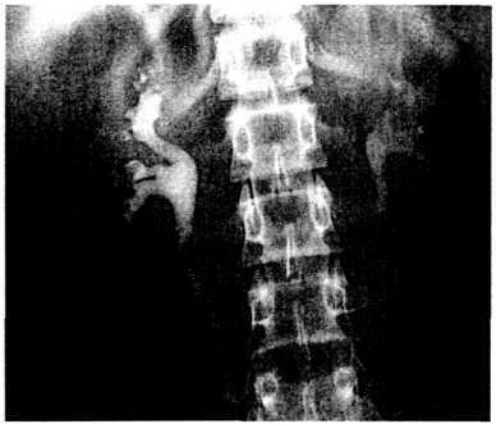

Fig. 16 A tuberculous abscess cavity in the upper pole of the right kidney in a patient who presented with an epididymal swelling.

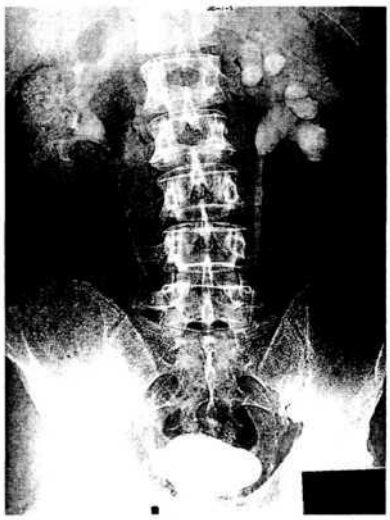

Fig. 17 An IVU which demonstrates a left ureteric stricture after treatment for renal tuberculosis.

Aetiology and pathological features

Closed trauma follows road traffic accidents and sporting injuries and may be accompanied by fracture of the 11th and 12th ribs and injuries to the liver and spleen.

Penetrating injuries by knives, bullets and a diagnostic biopsy may, in the first two instances, be associated with other abdominal and thoracic damage. A classification of renal injuries is given in Box 6.

Clinical features

No symptoms may be attributable to the kidney, especially in multiple trauma. An otherwise well patient may complain of loin pain and haematuria.

Box.6

Classification of renal injuries

- **Minor renal trauma** (85% of cases)—renal contusion, subcapsular haematoma, superficial cortical laceration. These injuries rarely require surgical exploration
- **Major renal trauma** (15% of cases)—deep corticomedullary lacerations which may extend into the collecting system. Extravasation of urine into the perirenal space may occur along with large retroperitoneal and perinephric haematomas
- **Vascular injury** (1% of blunt trauma)—there may be total avulsion of the artery or vein or partial avulsion of the segmental branches of these vessels

Signs of renal trauma are:

- haematuria
- bruising over the ribs posteriorly
- evidence of penetrating injury
- tenderness and guarding in the loin
- hypotension
- expanding mass
- localised bruit in arteriovenous fistula.

Investigation

Imaging

Plain X-ray may show fractures of the 10th, 11th or 12th ribs.

CT scan with contrast is now the investigation of choice. It will accurately assess:

- absence of function on the affected side but a normal contralateral kidney
- absence of function and no contralateral kidney
- the extent of injury
- lacerations
- extravasation
- surrounding haemorrhage
- vessel injury
- non-renal injuries.

Renal angiography is required in the following circumstances:

- non-function on CT
- persistent severe haematuria which might require embolisation
- presence or development of a bruit
- late development of hypertension in a patient who has recovered from an injury.

Management

Some factors influencing management are given in Clinical Box 2.

Clinical Box 2

Factors influencing management of renal trauma

- Only 2% of patients with blunt renal injuries, but up to 55% with penetrating injuries, will require exploration
- Nearly all patients with renal gunshot wounds have associated intra-abdominal injuries, compared with 12% with stab wounds posterior to the anterior axillary line
- Urine dipstick testing should be obtained early
- Radiographic imaging should not delay urgent surgery
- An IVU alone may not permit accurate assessment of injury, but may be more easily available than CT scanning or angiography and can be performed in the trauma unit
- CT scanning provides superior definition and is the primary investigation of choice if multiple abdominal injuries are suspected
- Ureteric and renal pelvic injuries are usually the result of a penetrating injury

Any patient with a renal injury should be at rest in bed and have the usual observations. All urine passed is examined for blood.

Penetrating injury

Because there is **a** high risk of injuries to other organs, surgical exploration is usual. Other injuries take priority and the kidney is explored only if there is evidence on preoperative evaluation or at operation of major damage. Nephrectomy may be inevitable.

Closed injury

Treatment is initially non-operative with careful continued assessment. Prophylactic antibiotics are administered. Unless one of the more severe injuries listed in Box 6 is present, most injuries resolve, although a relatively prolonged period of stay in hospital may be required. The incidence of later surgical intervention to manage complications is also increased but, in contrast to early exploration, nephrectomy is less commonly needed.

Persistent haematuria or arteriovenous fistula

Selective arterial embolisation of the site is the management of choice.

Renal tumours

Tumours of the kidney account for approximately 2% of all malignancies. Benign tumours are extremely rare.

There are four types of malignant tumour, apart from the very rare fibro- and liposarcomas:

- nephroblastoma (Wilms' tumour)
- Adenocarcinoma
- transitional cell carcinoma of the renal pelvis
- squamous carcinoma of the renal pelvis.

Nephroblastoma

This is also known as a Wilms' tumour. This is the commonest genitourinary neoplasm in infants and second only to brain tumours as a cause of death in this age group. Sex distribution is equal, there is a peak incidence at 2 years and the tumour is bilateral in 5%.

Pathological features

It is an undifferentiated embryonic tumour which contains primitive glomeruli and tubules as well as irregular areas of collagen, cartilage, bone and adipose tissue. Spread is by direct infiltration of the kidney and surrounding structures, by lymphatics and by the bloodstream to the liver, lungs, long bones and brain.

Clinical features

There is often failure to thrive, and a thin, ill infant or child presents with a visible abdominal mass. One-third have haematuria.

Investigation

Imaging

IVU. The preliminary film may show areas of speckled calcification. There is usually renal cortical and calyceal distortion. Evidence either of normality or of involvement of the other kidney is also obtained.

Ultrasonography demonstrates a solid renal mass.

Management

In all patients, a radical nephrectomy (a procedure in which, through an abdominal approach, the kidney, perirenal soft tissue and adjacent lymph nodes are removed as a block and the renal vessels divided as close to their origin as possible) is done. The renal vessels are ligated early in the operation to reduce the risk of escape of malignant cells during manipulation.

Additional treatment with radiotherapy and/or chemotherapy depends on the stage of the disease.

Prognosis

For localised tumours, there is a 5-year survival of 80%, but this falls to 30% in the presence of lymph node metastases and to zero for those with metastases to solid organs.

Adenocarcinoma

Epidemiology and pathological features

The peak incidence is in the fifth generation, and the condition is commoner in men. The tumour arises from the renal tubules, is usually well-encapsulated and contains areas of haemorrhage and necrosis. On histological examination, it consists of columnar or cuboidal cells with clear cytoplasm and dark nuclei. Spread is by local infiltration and chiefly by the blood to distant organs. Direct growth may take place into the renal vein and vena cava. Paraneoplastic syndromes may occur (Table 1).

Staging

TNM staging is used, based on the preoperative investigations, operative findings and the histological examination of the excised tissues. T stages are shown in Table 2 and N and M stages in Table 3.

Clinical features

Twenty percent of tumours are detected on ultrasound examination during the course of investigations for non-specific symptoms or for features that suggest a paraneoplastic syndrome.

Symptoms

Specific symptoms are not common, but there are some which are semi-specific:

- aching loin pain
- episodes of acute pain —caused by haemorrhage into the tumour and sometimes of sufficient severity for the patient to present as an emergency

Table 1
Paraneoplastic syndromes in renal cell carcinoma

Event	Cause
Raised ESR	Changes in plasma proteins
Anaemia	Depressed erythropoiesis and haemolysis
Polycythaemia	Erythropoietin secretion
Hypercalcaemia	Tumour secretion of parathormone-like substance
Raised alkaline phosphatase concentration	Secretion from the tumour
Pyrexia	Circulating pyrogens
Hypertension	Secretion of renin
Amyloid deposition	Unknown
Peripheral neuropathy and myopathy	Unknown

Table 2
T component of TNM staging of carcinoma of the kidney

Stage	Findings
T1	Tumour < 7 cm limited to kidney
T2	Tumour > 7 cm limited to kidney
T3	Tumour extends into major veins or invades adrenal or perinephric tissue but not beyond Gerota's fascia
T4	Tumour invades beyond Gerota's fascia

Table 3
N and M components of TNM staging of carcinoma of the kidney

Stage	Findings
NX	Regional lymph nodes cannot be assessed
NO	No regional lymph node metastases
N1	Metastases in a single lymph node < 2.0 cm in diameter
N2	Metastases in single lymph node 2-5 cm in greatest diameter or multiple lymph nodes, none > 5 cm in greatest diameter
N3	Metastases in lymph node > 5 cm in greatest diameter
MO	No distant metastases
M1	Distant metastases

- haematuria (60%)
- symptoms of parancoplastic syndromes (Table 1)
- pathological fracture.

Signs
A loin mass is the only finding unless there is clinical evidence of distant metastases. By the time that the triad of loin pain, loin mass and haematuria is present, the tumour is usually advanced.

Investigation

Urine
Haematuria should he sought. Significant proteinuria may indicate involvement of the renal vein.

Blood
Analysis should be done for any of the paraneoplastic syndromes. Hypercalcaemia or a raised alkaline phosphatase does not necessarily imply metastatic disease.

Imaging
Chest X-ray may show typical 'cannonball' metastases.

IVU demonstrates a space-occupying lesion best seen in the nephrogram phase and also calyceal distortion.

Ultrasonography can distinguish between a cyst and a solid tumour and is an effective way of identifying involvement of the renal vein and the vena cava.

CT scan is the most precise way of staging the tumour (Tables 2 and 3; Fig. 8).

Renal angiography is less commonly used but is essential in bilateral tumours or a tumour in a solitary kidney.

Management

Surgery
Radical nephrectomy is the primary treatment in the absence of metastatic disease. There is increasing utilisation of laparoscopy both for removal of the whole kidney and more limited resections of small periphearal tumours.

Non-operative treatment
In symptomatic patients who are unsuitable for surgical treatment, embolisation of the renal artery is effective in controlling pain and haematuria.

Radiotherapy to the primary tumour is ineffective but may help in reducing the pain of a bony metastasis. Endocrine therapy and chemotherapy are both ineffective. Other treatments that are used include alpha-interferon and interleukin-2 for patients with metastatic disease. Some partial responses have been recorded.

Prognosis
Seventy percent of those with Tl tumours survive for 5 years, and prolonged survival has been reported after removal of secondary deposits. However, there may be long intervals between the presentation of the primary and of metastases. Very rarely, secondary deposits may regress after removal of the primary. Nevertheless, very few patients who present with evidence of metastatic disease survive for more than 2 years.

Carcinoma of the renal pelvis

Carcinoma of the renal pelvis accounts for 10% of all renal tumours, and may be bilateral in up to 25% of cases.

Aetiology and pathological features
Ninety percent are derived from the transitional epithelium (urothelium) and are likely to be associated with similar tumours elsewhere in the urinary tract. However, urothelial tumours of the bladder are 60 times more common than those of the renal pelvis. The remaining 10% in the renal pelvis are squamous carcinomas — a consequence of metaplastic change — and are almost invariably associated with stones. The aetiological factors for transitional cell cancer are similar to those for the same lesion in the bladder.

Clinical features
These are loin pain and haematuria.

Investigation

Cytology
Malignant urothelial cells may be present in the urine.

Imaging
An IVU shows a filling defect in the calyces or renal pelvis (Fig. 18), which must be distinguished from a non-opaque renal calculus by ultrasound.

Management
Management is by removal of the kidney and ureter together with a cuff of bladder mucosa around the

Fig. 18 An IVU showing multiple transitional-cell carcinomas of the right renal pelvis.

ureteric orifice. The reason for such radical surgery is the possibility of the occurrence of a further tumour; in the bladder it is simple to diagnose by cystoscopy, but the ureteric stump cannot be so easily examined.

More conservative management has been attempted by endoscopic resection through a percutaneous nephrostomy tube, direct instrumentation of the ureter or instillation of chemotherapeutic agents directly into the renal pelvis.

Prognosis

In localised transitional-cell tumours of the renal pelvis the outlook is good, but squamous-cell carcinoma of the renal pelvis has a poor prognosis.

Stone disease

Epidemiology

The incidence and site of occurrence of urinary stones vary in different parts of the world and in different parts of the UK. Renal stones are more common in affluent communities whereas bladder stones remain the common site in developing countries. In the UK, the incidence of upper urinary tract stones varies from 15 per 100 000 in the north of England (Burnley) to 47 per 100 000 in the south-east (Canterbury). There are similar differences in the type of stone between countries: uric acid stones make up only 5% of the total in the UK, but this rises to 40% in Israel.

Box 7

Metabolic causes of urinary tract stones

Hypercalcaemia and hypercalciuria

- Hyperparathyroidism
- Idiopathic hypercalciuria
- Hypervitaminosis D
- Disseminated malignant disease
- Myeloma
- Prolonged immobilisation
- Sarcoidosis
- Milk alkali syndrome
- Cushing's disease
- Hyperthyroidism

Increase in other substances

- Cystinuria (tubular transport defect for cystine, lysine, ornithine and arginine)
- Xanthinuria
- Primary hyperoxaluria
- Secondary hyperoxaluria (ileostomy)
- Hyperuricuria (gout; chemotherapy for leukaemia)
- Indinavir therapy

Aetiology

In the majority of instances aetiology is unknown.

Metabolic disorders

Conditions that alter the composition of the urine, chiefly (but not exclusively) to increase its calcium content, are shown in Box 7.

Other causes

The commonest of these is infection with the urea-splitting organism *Proteus.* The result is the production of ammonia, an alkaline urine and triple phosphate stones (staghorn calculi) (see Fig. 2), which are a mixture of calcium, magnesium and ammonium phosphate. Other factors are dehydration and immobilisation.

Characteristics of stones

These are given in Table 4.

Clinical features

Symptoms

These depend on the size and position of the stone and the presence or absence of infection. The patient may be asymptomatic or give a history of occasional haematuria or dysuria. In cystine stone, there may be a family history, and in all stones there may have been previous episodes. A stone lodged at the neck of a calyx or at the pelviureteric junction causes renal colic, in which there are waves of increasing pain in the loin

Table 4 Characteristics of stones

Stone	Incidence	Colour	Appearance	Radio-opacity
Calcium oxalate (mulberry stone)	80%	Pale yellow-brown	Sharp projections	Opaque
Triple phosphate (staghorn calculus)	10%	Chalky white	Soft	Opaque
Uric acid	5%	Light brown	Facetted	Lucent
Cystine	2%	Yellow-brown	Smooth	Moderately opaque
Xanthine	Rare	Yellow-brown	Lucent	

often superimposed on a background of continuous nagging pain at the same site. Radiation downwards into the groin or scrotum is not common, in contrast to the symptoms of a stone in the ureter. The pain from a stone in the renal pelvis is continuous in the loin and often aggravated by movement.

Physical findings

Tenderness may be found in the loin and is increased in severity if there is infection or obstruction when pyrexia is common.

Differential diagnosis

Pain in stone disease is notorious for causing diagnostic confusion with other acute abdominal conditions, some of which require urgent surgical management (Box 8).

There are two reasons for making as precise a diagnosis as possible: first, to undertake relief of pain when one of the alternative conditions is present may mask the clinical features and compound the misdiagnosis; second, many substance abusers have learned the symptoms of renal colic in order to obtain analgesics or narcotics.

Investigation

Any patient who has formed a renal stone stands a greater than 20% chance of producing another. It is important to identify metabolic or structural abnormalities because appropriate management may reduce the risk of recurrence.

Box 8

Conditions which may mimic ureteric colic

- **Appendicitis**
- **Cholecystitis**
- **Diverticulitis**
- **Pyelonephritis**
- **Leaking aortic aneurysm**

Urine

- Culture and sensitivity, measurement of pH and screening for cystine.
- Two 24-hour collections with the patient on a normal diet for measurement of calcium, uric acid, oxalate and citrate concentrations.

Blood

Concentrations of the following are measured:

- urea
- creatinine
- electrolytes
- total protein
- calcium
- alkaline phosphatase
- uric acid
- phosphate.

In a patient with a stone causing complete obstruction, the bladder urine may be sterile. Urine should then be obtained by the insertion of a percutaneous nephrostomy, which is almost certainly required for relief of obstruction.

Imaging

A patient who presents with acute symptoms and signs and a suspected stone must have an urgent IVU. The diagnosis can be firmly established, the size of the stone determined, together with the degree of obstruction, the likelihood of the stone passing spontaneously, and the need for hospital admission. The use of spiral Cl with its ability to identify non-opaque stones is increasing.

Non-operative management

Asymptomatic stone

A small, asymptomatic, non-obstructing stone in an elderly, unfit patient can be left alone.

Acute episode

The pain of renal colic is severe and is treated with narcotic analgesics, antispasmodics such as Buscopan and non-steroidal anti-inflammatory agents such as Voltarol. Stones less than 0.5 cm in diameter will usually

pass spontaneously, and, if they are opaque, their progress can be assessed by repeated plain abdominal X-ray.

Oxalate stones

The commonest abnormality detected is idiopathic hypercalciuria. A low-calcium diet and a high fluid intake to dilute urine calcium concentration is often recommended. However, it is usually unsuccessful in that tap water in many areas contains significant amounts of calcium and a reduction in dietary calcium intake leads to an increased intestinal absorption of oxalate.

Attempts to reduce urine calcium excretion with bendrofluazide have only been shown to reduce calcium stone formation after prolonged periods of therapy. Sodium cellulose phosphate decreases calcium excretion but is often unacceptable because of the foul diarrhoea it may cause.

Cystine stones

Cystinuria is an inherited defect of ammo-acid transport involving cystine, ornithine, lysine and arginine. Cystine is relatively insoluble, particularly in acid urine, and this can lead to stone formation. Because its excretion is relatively constant, the stones can be both dissolved and prevented by maintaining a high fluid intake throughout the 24 hours and alkalinising the urine. The latter can be achieved with either sodium bicarbonate or potassium citrate, or a combination of both. If this fails, treatment with penicillamine, which produces a more soluble cystine-penicillamine complex, is sometimes successful. However, it may be associated with the development of skin rashes and the nephrotic syndrome.

Uric acid stones

Uric acid is less soluble in acid urine and, as a result, patients with chronic diarrhoea or an ileostomy are more likely to produce uric-acid stones. They can be dissolved or prevented by increasing the fluid intake and alkalinisation of the urine. In addition, allopurinol (100 ing three times a day) should be given to those with an elevated serum level.

Triple phosphate stones

The prevention of recurrent phosphate stones associated with infection is dependent on three factors:

- complete removal of the initial stone(s)
- correction of any anatomical abnormalities of urine drainage
- maintenance of sterile urine.

The last can be achieved with lone-term low-dose antibiotic therapy. If this proves difficult, treatment with a urease inhibitor (acetohydroxamic acid) should be considered.

Surgical management

Indications for intervention

Urgent percutaneous nephrostomy drainage is required when:

- fever does not resolve after 24 hours of appropriate antibiotic therapy in a patient with an obstructed kidney
- severe pain persists in spite of the medical management outlined above.

The nephrostomy track can be used at a later stage for endoscopic stone destruction or removal. An indwelling stent can be inserted to establish drainage down the ureter before treatment by lithotripsy (see below).

Intervention in persistent stone

Major advances have been made in the management of stones over the past decade by techniques other than open operation.

Destruction of the stone in situ can be done with:

- extracorporeal transcutaneous techniques (extracorporeal shock wave lithotripsy, ESVVL)
- direct application of shock waves or laser to the stone by a probe inserted endoscopically or percutaneously.

Removal can be achieved either endoscopically or percutaneously.

Disorders of the ureter

Congenital anatomical abnormalities

Ureteric duplication

Incomplete duplication is much more common than complete ureteric duplication and occurs in approximately 1% of individuals. Complete duplication is present in about 1 in every 500-600 individuals. The extent of incomplete ureteral duplication may vary from a bifid renal pelvis (which could be considered as a normal variant) to two separate ureters joining with each other at some point during their course. A complete duplication results in two separate ureters with two separate ureteric openings in the bladder. The orifice of the upper-segment ureter always enters the bladder more medial and caudal to the lower-segment orifice. The ureter from the lower part of the kidney is more likely to be associated with vesicoureteric reflux, as the orifice of this ureter is more lateral and cephalic. As the orifice of the ureter from the upper pole is more caudal, it can be located in an ectopic position which may open at the level of the bladder neck, urethra, vestibule or vagina and may result in either obstruction or incontinence.

Clinical features

Duplication of the ureters is commonly asymptomatic. Vesicoureteral reflux into the lower moiety can result in infection, haematuria or flank pain.

Management

Asymptomatic duplications do not require any treatment. If one of the moieties of the kidney is non-functioning, a heminephroureterectomy is the procedure of choice. In cases of complete duplication, vesicoureteral reflux is managed in the usual way. An ectopic ureter can either be re-implanted or a heminephroureterectomy can be performed, depending on the function of that portion of the kidney.

Congenital obstruction at the pelviureteric junction

The pelviureteric junction (PUJ) is the most common site of obstruction in the upper urinary tract.

Aetiology

In the congenital type, intrinsic abnormalities of the PUJ are the most common cause of obstruction. They result from an aperistaltic segment at the level of the PUJ, resulting in a functional obstruction to the passage of urine. In some cases, valve-like processes and polyps have been found.

Extrinsic abnormalities are seen in about one-third of patients with PUJ obstruction. Aberrant vessels may cause obstruction, especially when they cross in front of the PUJ or when the ureter appears to be trapped between two such vessels. PUJ obstruction occurs in approximately 1:1500 births. It is more common in males and is bilateral in 5% of cases. Obstruction is acquired as a result of stricture formation following surgery for stones, trauma or tuberculosis.

Clinical features

Symptoms

The typical clinical presentation has changed since the advent of widespread antenatal sonographic screening. A significant number of babies with antenatal hydronephrosis are subsequently found to have a PUJ obstruction.

Symptoms in infants and children are:

- abdominal mass
- urinary tract infection
- haematuria
- failure to thrive.

Symptoms in adults are:

- intermittent loin pain sometimes associated with alcohol consumption
- urinary infection
- haematuria following mild trauma
- symptoms of stones.

Signs

In infants and children, the sole sign is abdominal mass.

In adults, signs are:

- loin tenderness
- rarely, abdominal mass
- an incidental finding during the course of investigation for another condition.

Investigation

To diagnose PUJ obstruction, both anatomical and functional studies of the kidney are required. Anatomical information of the kidney can be obtained by ultrasound examination. Ultrasound examination reveals dilatation of the pelvicalyceal system and also demonstrates the state of the renal cortex.

Intravenous urography with diuretic enhancement of urine flow

IVU gives an indication of the anatomical as well as the functional state of the kidney (Fig. 5). IVU can also be combined with diuretic enhancement of urine flow by giving 40 mg furosemide (frusemide) intravenously. Following contrast and furosemide (frusemide) injection, if there is no increase of dilatation of the pelvicalyceal system and there is good washout of contrast, this indicates a non-obstructed system.

Nuclear isotope scan

A prolonged excretory third phase occurs w[T]hen there is pelvicalyceal dilatation. If furosemide (frusemide) is givea the counts may rise (obstructed) or fall (non-obstructed).

Management

Broad options of management include:

- observation
- surgical reconstruction
- percutaneous balloon dilatation
- retrograde balloon dilatation
- percutaneous incision (endopyelotomy)
- laparoscopic surgery.

Most PUJ obstructions are now discovered antenatally and hence are asymptomatic. Management is decided on the basis of anatomical and functional information provided by different scans. After birth, the kidneys are observed by repeated scanning with ultrasound and/[or] isotope renography.

Indications for surgery

These are:

- deterioration of renal function
- worsening of renal dilatation

- thinning of renal cortex
- the presence of symptoms, pain, haematuria or infection.

por primary PUJ obstruction, if operative intervention is required, surgical reconstruction is the method of choice. The percutaneous or retrograde dilatation/ incision techniques are usually reserved for secondary PUJ obstruction. The most common surgical technique i_s the Anderson-Hynes pyeloplasty which disconnects the pelvis from the ureter, reduces the size of the pelvis bur requires re-anastomosis of the ureter to the pelvis. A Culp pyeloplasty is useful for those with a small extrarenal pelvis. Re-anastomosis of the ureter is not required (Fig. 19). Laparoscopic surgery is being increasingly utilised.

Disorders that may be either congenital or acquired

Megaureter

Aetiology

The underlying cause of the congenital variety is the same as that of PUJ obstruction, but the muscular imbalance in megaureter is at the ureterovesical junction. The ureter proximal to this becomes dilated and hypertrophied. The condition may be bilateral, and a secondary hydronephrosis may develop with the formation of stones.

Secondary megaureter may be caused by schistosomiasis or bladder outflow obstruction.

Pathophysiology

Classification on the basis of reflux and the presence of obstruction to flow is shown in Box 32.9 and is used to guide management. Very rarely, reflux and obstruction may coexist. A combination of IVU, micturating cystograms and renography permits appropriate categorisation.

Clinical features

Symptoms of megaureter are:

- incidental finding during investigation for another condition
- loin pain
- urinary infection.

Management

Non-obstructed, non-refluxing megaureters do not require treatment.

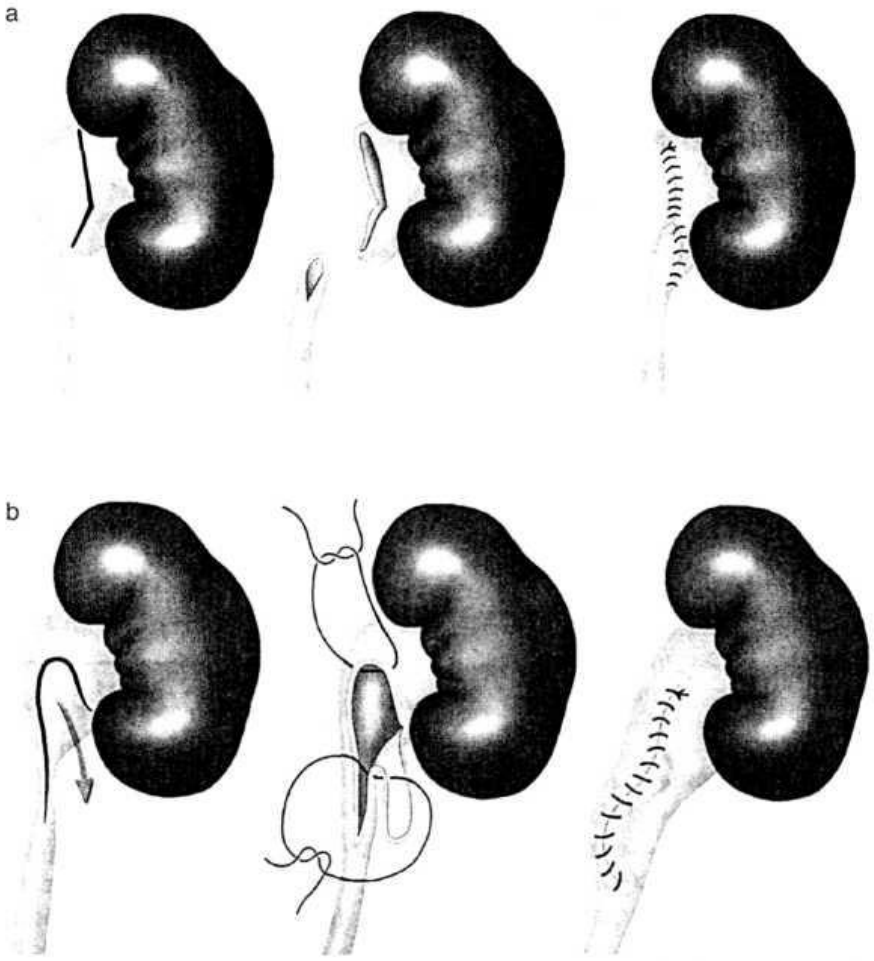

Fig. 19 Pyeloplasty operations: (a) Anderson-Hynes; (b) Culp.

Box 9

Pathophysiological classification of megaureter

Congenital
- Non-refluxing or refluxing
- Non-obstructed or obstructed

Secondary
- Non-refluxing or refluxing
- Non-obstructed or obstructed

Congenitally obstructed megaureters should be re-implanted after the narrowing at the distal end has been removed. Those with reflux are treated along the lines of management of vesicoureteric reflux. A secondarily obstructed megaureter requires treatment of its cause.

Vesicoureteric reflux

Aetiology and pathological features

Primary reflux is the result of a defective valvular mechanism at the ureterovesical junction; when compared with a normal ureter, the intramural course is short and more horizontally directed. The condition is bilateral in 50%, and 90% of affected patients are female. There is a familial incidence. As the ureterovesical junction matures, reflux may cease spontaneously.

Secondary reflux may occur because of bladder outlet or urethral obstruction or in neurogenic bladders.

Inflammatory conditions of the bladder wall (schistosomiasis, tuberculosis) can hold the ureteric orifice open.

Clinical features

In primary reflux, the onset is in the first decade. Symptoms may include fever, lethargy, anorexia, nausea and vomiting. There is often mild haematuria, but the main symptoms are those of recurrent urinary infections. Older children may complain of pain in the loin or on micturition. In secondary disease, the onset is later, and again symptoms of infection predominate. There are no specific signs.

Investigation

IVU. This is often normal but may show ureteric dilatation or renal scarring.

Micturating cystogram. Cystoureteric reflux is best demonstrated at the time of micturition (Fig. 7).

Isotope scanning. A DMSA scan can be used to identify current renal damage.

Management

The majority of patients can be satisfactorily managed by antibiotic therapy. Long-term therapy to suppress infection is necessary up to the age of 6 years. The incidence of renal scarring after this age is very low Surgical re-implantation of the ureter is indicated when medical management fails to suppress the development of new urinary infections or there is non-compliance with antibiotic treatment. The injection of inert, non-absorbable substances around the ureteric orifice to prevent reflux offers a non-surgical option to treat this condition.

Ureterocele

Ureterocele is a cystic dilatation of the terminal portion of the ureter and may occur in either a normally placed ureter or rarely in an ectopic one. This usually involves the upper-segment ureter of a duplex system. They may become very large and occupy most of the available space in the bladder. A stone impacted in the lower end of the ureter is one cause.

Clinical features

Some patients are asymptomatic. When symptoms do occur, they are usually secondary to complications, such as:

- obstruction of the bladder outlet
- infection
- loin pain.

Signs are minimal. An ectopic ureterocele in a female may present as a vaginal tumour at birth or in child-hood. Occasionally they may present at the urethral meatus.

Diagnosis

The diagnosis is made on an IVU which shows a rounded swelling in the bladder associated with a dilatation of the ureter — hydroureter.

Management

Asymptomatic ureteroceles do not need treatment. If the ureter is dilated or there is a stone, the ureterocele can be transected endoscopically. The cut is made on the inferior surface because this makes reflux less likely. Ectopic ureteroceles require a heminephroureterectomy.

Acquired conditions

Ureteric injuries

Aetiology

Open injuries occur from gunshot or stabbin. A closed avulsion of the ureter from the renal pelvis may follow rapid deceleration. However, surgical injuries during abdominal or pelvic operations are the commonest cause. The ureter is at particular risk if it is displaced from its usual anatomical position by.

Box 10

Operations most frequently associated with ureteric injuries

Gynaecological

- Hysterectomy
- Ovarian cystectomy
- Repair of vesicovaginal fistula
- Anterior colporrhaphy

General surgery

Sigmoid colectomy

- Abdominoperineal resection of the rectum
- Repair of aortic aneurysm

Urology

- Excision of bladder diverticula
- Ureterolithotomy
- Ureteroscopy

the condition under treatment. Operations most frequently associated with ureteric injuries are listed in Box 10.

Pathological features

One or both ureters may be ligated. The kidney stops secreting once the intraureteric pressure has risen to the filtration pressure. In consequence, dilatation of the renal pelvis is mild and, if the condition goes untreated, atrophy of the kidney takes place. Less commonly the lumen is incompletely obstructed by inclusion in a stitch, in which case the kidney continues to secrete and hydronephrosis develops often with accompanying infection. Alternatively, the ureter is divided or suffers a crushing injury. The latter may be ischaemic. Urine then leaks to the exterior or into the retroperitoneal tissues and, less commonly, the peritoneal cavity.

Clinical features

The injury may be recognised at the time of surgery. If not, bilateral ligation will be recognised very soon. Leak usually presents around the fifth postoperative day but may be delayed for 10-14 days if it results from ureteric ischaemia. The features are:

- bilateral ligation —immediate postoperative anuria
- unilateral ligation —either absence of clinical features or, if there is proximal infection, fever and persistent loin pain
- division —urine appears from the drain, the wound or the vagina
- retroperitoneal leakage of sterile urine leads to abdominal distension secondary to ileus and intraperitoneal leakage to signs of free fluid in the peritoneal cavity
- retro- or intraperitoneal leakage of infected urine is associated with the features of peritonitis and generalised sepsis.

Investigation

In the early stages of complete obstruction, an IVU shows a nephrographic effect — contrast medium outlines the whole kidney, but little change in radiodensity is seen in the renal pelvis or ureter. In incomplete obstruction or transsection, there is some delay in excretion, and ureteric dilatation on the side of the injury down to the site of damage is usually seen. If, however, this is not identified, retrograde ureterography may help.

Management

Prevention

An IVU should be done before any operation in which the ureters are at risk, particularly if there is the possibility of ureteric displacement.

Treatment

The insertion of a ureteric stent may allow a small fistula to close. In critically ill patients, a temporary percutaneous nephrostomy is the procedure of choice to allow drainage of the obstructed and usually infected kidney. In all other instances, surgical repair is necessary, and complicated procedures may be required.

If the injury is recognised at the time of surgery, ligatures should be removed, the crushed area resected, the cut ends should be spatulated and a primary anastomosis performed over a ureteric stent. Other techniques include (Fig. 20):

- re-implantation of the damaged ureter into the bladder
- anastomosis of one ureter to the other
- replacement of the ureter by small intestine
- use of the bladder flap (Boari) to replace the damaged segment.

Retroperitoneal fibrosis

Aetiology

There are two forms: idiopathic and secondary. In the first, as its name implies, the cause is not known. Secondary retroperitoneal fibrosis may follow:

- treatment with methysergide
- extravasation of urine
- retroperitoneal sepsis
- aortic or iliac aneurysms
- radiotherapy
- most commonly, retroperitoneal spread of malignant disease —cervix, ovary, testis, prostate and lymphomas.

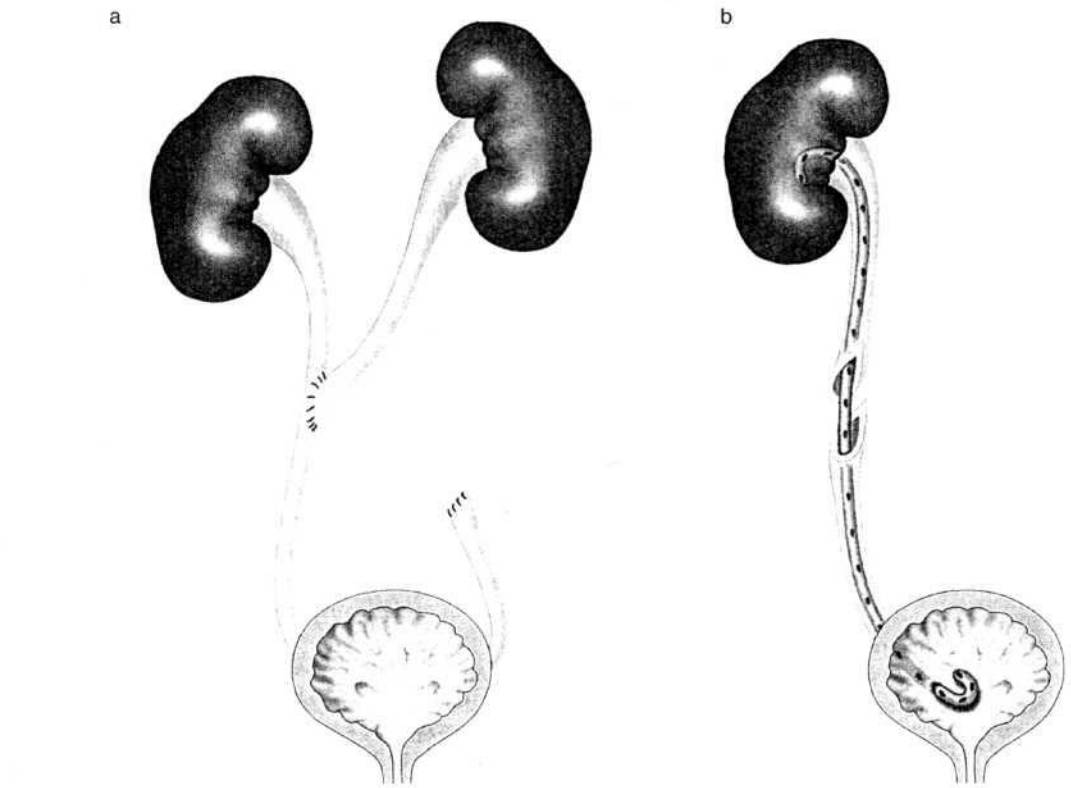

Fig.20 Techniques which may be used for repair of an injured ureter.

Pathological features

In the primary idiopathic form, one or both ureters become encased in and obstructed by a retroperitoneal plaque of fibrous tissue between the pelviureteric junction and the pelvic brim, although involvement may be more extensive.

Clinical features

Symptoms are non-specific but include backache, low-grade fever and malaise, as well as those of hypertension, renal failure or anuria.

The physical findings are also non-specific and related to the renal failure or hypertension.

Investigation

ESR is invariably raised.

Ultrasound may show upper urinary tract dilatation.

IVU shows upper urinary tract dilatation, with medial deviation of one or both ureters. However, if renal function is poor and the IVU inadequate to define the ureters, percutaneous nephrostomy tubes are inserted to improve renal function and allow subsequent identification of the site of obstruction.

Bilateral retrograde ureterography often results in complete anuria from ureteric oedema and should be avoided.

CT scan is useful to define the extent of the retroperitoneal mass.

Management

Treatment is surgical. A definitive diagnosis of possible underlying causes can only be made by histological examination of tissue from the retroperitoneum, and ureterolysis can be done at the same time. To prevent recurrence of obstruction, both ureters are either wrapped in omentum or brought laterally and intraperitoneally to distance them from the fibrotic mass. Idiopathic retroperitoneal fibrosis does respond to treatment with steroids, but long-term therapy is required. A histological diagnosis to exclude retroperitoneal malignancy is not made unless therapy is preceded by surgical exploration.

Ureteric stone

Aetiology and site of lodgement

These stones originate in the kidney and migrate downwards. Arrest is likely at the three sites of relative narrowing: the pelviureteric junction, the pelvic brim where the ureter crosses the iliac vessels, and the intravesical termination.

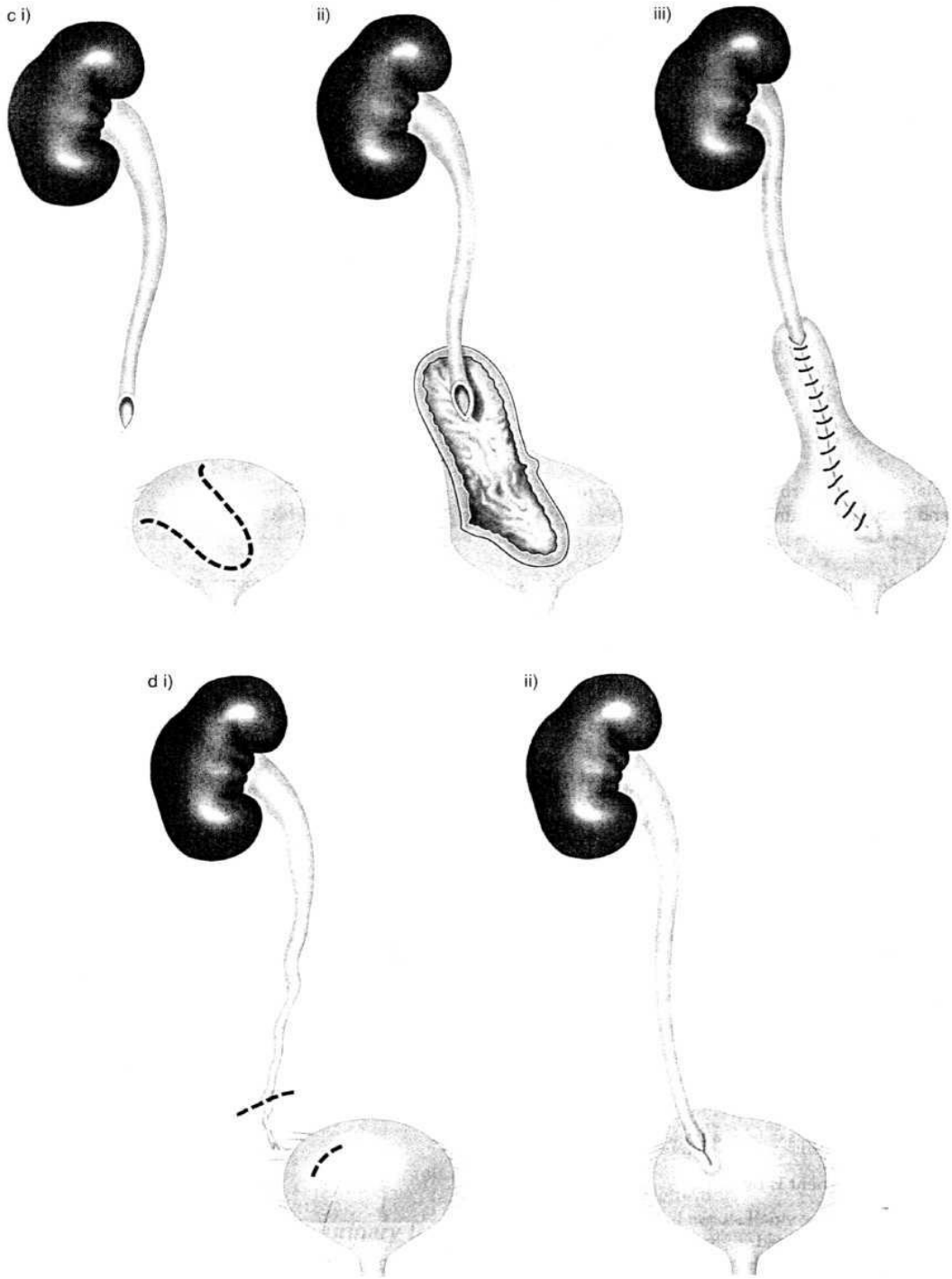

Fig.20, cont'd

Clinical features

Ureteric stones almost always cause renal colic, and they account for one of the most frequent urological presentations in the accident and emergency department.

Symptoms

The patient is in severe pain which is intermittent and radiates from the loin to the groin and sometimes into the testicle, scrotum or labia. Vomiting frequently occurs and the patient is unable to find any comfortable position or to lie still**.** The urine is often bloodstained.

Signs

Fever suggests the presence of a pyonephrosis. The abdomen is tender with slight guarding. An impacted stone may be complicated by paralytic ileus which produces a silent distended abdomen.

Investigation

Urine

Examination of the urine is carried out for red blood cells and bacterial culture.

Imaging

A plain abdominal X-ray may show a calcified opacity lying in the course of the ureter. An IVU should always be done urgently to confirm the diagnosis and to assess the degree of obstruction and the likelihood of the stone passing spontaneously; 90% of stones less than 0.5 cm in diameter will do so (Fig. 21).

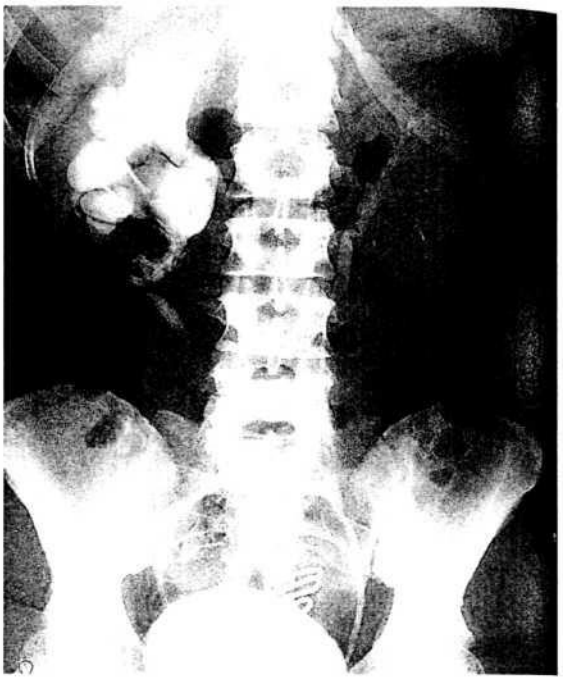

Fig. 21 An intravenous urogram showing clubbed calyces secondary to ureteric obstruction.

Management

Most patients are admitted to hospital for relief of pain, although the majority require only one parenteral injection of opiate. Antispasmodics and non-steroidal anti-inflammatory agents are effective thereafter.

Indications for intervention

These are:

- evidence of infection
- recurrent or persistent pain
- failure of the stone to progress downwards
- deterioration of renal function determined by isotope scanning.

Methods of intervention

In an emergency, intervention is by either percutaneous nephrostomy or the passage of a ureteric stent to bypass the obstruction (Fig. 22). Definitive treatment is by:

- extraction — snaring small stones in the lower 5 cm of ureter in a basket passed up the ureter; or very rarely by open ureterolithotomy
- extracorporeal destruction by shock wave lithotripsy
- in-situ destruction with lithotripsy or laser via a ureteroscope.

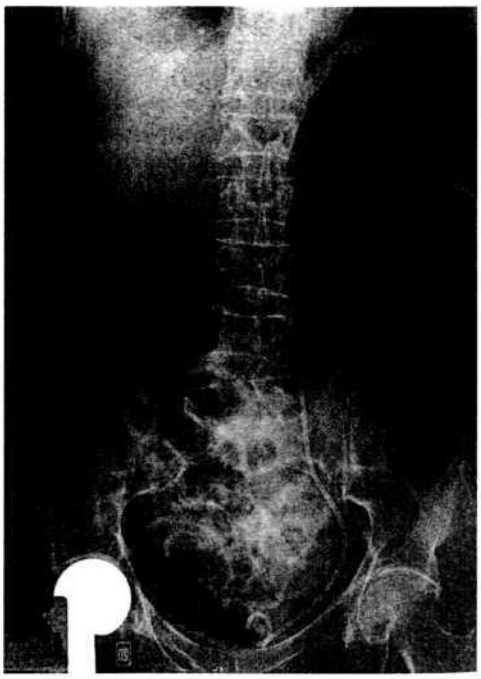

Fig.22 Double pigtail catheter providing drainage of the renal pelvis and stenting of the left ureter.

Urinary diversion

Decompression or drainage of the urinary tract is frequently employed in urological practice. It is now usually done under radiological control rather than at open operation.

Nephrostomy and pyelostomy

In nephrostomy, a drainage tube is passed through the kidney substance into its pelvis; in pyelostomy the pelvis is intubated directly. Either procedure is most frequently employed to decompress and drain a kidney obstructed at the pelviureteric outflow. Decompression may also be needed after operations such as reconstruction of the pelviureteric junction. An external drainage bag can be avoided if it is possible to intubate an obstruction or suture line by placing a ureteric stent across it so that one end lies in the renal pelvis and the other in the bladder (Fig. 22). The technique is frequently used before lithotripsy, to prevent fragments of stone causing ureteric obstruction.

Other forms of urinary diversion

Surgical diversion of urine to the exterior is required if the bladder is removed or is so congenitally deformed (exstrophy) or diseased that adequate function is impossible. Diversion is most frequently achieved by using an isolated segment of ileum into which the ureters are implanted. The segment acts as a conduit to bring the urine to the abdominal wall (Fig. 23). Intestine can also be used to make a new bladder with a continent external opening on the abdominal wall which the patient catheterises intermittently (cf. continent ileostomy). Rarely, the ureters may be implanted into the intact sigmoid colon. However, that technique often leads to ascending urinary infection and chronic pyelonephritis; and, because of reabsorption of urinary constituents from the intestine, hyperchloraemic acidosis develops. Yet a further complication is the development of adenocarcinoma at the site of ureteric implantation. This procedure has now been superseded by the creation of a pouch in the sigmoid colon (Mainz H). This has a much lower incidence of complications.

The lower urinary tract

Symptoms in the lower genitourinary tract

Bladder pain

This may be sharp or dull and is located in the midline of the lower abdomen. Rapid overdistension of a previously normal bladder causes severe pain, but if the distension is gradual over weeks or months, pain is absent.

Prostatic pain

This is a dull ache which may be felt in the lower abdomen, the rectum, perineum and anterior thighs.

Urethral pain

This is usually felt at the tip of the penis am) ranges from a mere tickling discomfort to severe and sharp pain exacerbated by passing urine.

Scrotal pain

Pain may be referred to the scrotum as in renal colic. Similarly, pain arising from the scrotal contents may bo referred to the groin or abdomen. Most scrotal pain is the result of stretching *o(* the tunica albuginea; if this happens acutely, pain is severe, but slow distension, as in a tumour, causes a dragging sensation or a dull ache.

Disorders of micturition

Increased frequency may occur during the day and the night (nocturia) and may be a response to an excess fluid intake or failure of the kidneys to concentrate the urine, as occurs in diabetes insipidus, hypercalcaemia, chronic renal failure and diseases which produce a high solute load such as diabetes mellitus.

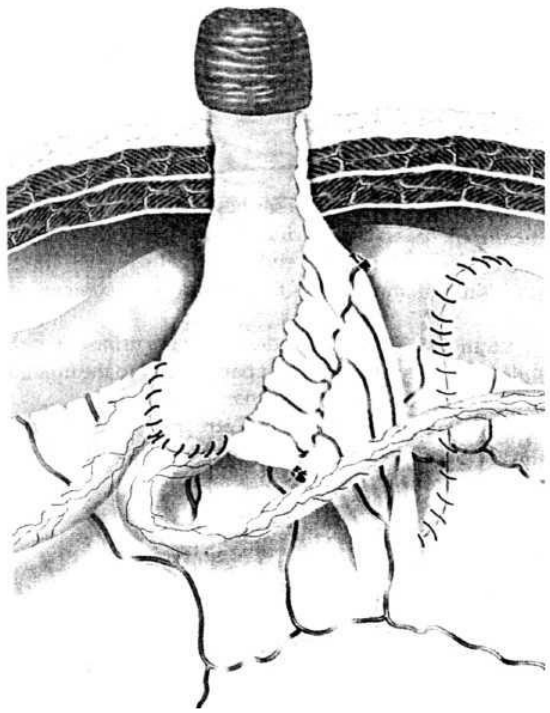

Fig. 23 An ileal conduit.

Urological causes of increased frequency are:

- urinary infection
- incomplete bladder emptying
- detrusor irritability
- small bladder volume
- bladder cancer.

Dysuria. The term describes a burning sensation during the passage of urine. It may occur throughout micturition or just at its end (terminal dysuria). Infection with inflammation of the urethra is the commonest cause.

Strangury is a repeated desire to pass urine but with little to show for it other than pain related to the urethra or the penile tip. Infection is likely.

Intermittency. The urine stream is interrupted during micturition. The symptom is associated with bladder stones, ureteroceles and benign prostatic obstruction.

Hesitancy is the need to wait before the urine stream begins. Prostatic obstruction to urine flow and stricture are causes.

Incomplete emptying is, as the phrase implies, a feeling that the bladder is not emptied at the end of micturition. Prostatic disease and detrusor dysfunction are possible causes.

Terminal dribbling is a progressive reduction in the rate of urine flow at the end of the urine stream and is associated with prostatic obstruction.

Postmicturition dribbling is leakage after the patient believes that micturition is complete and is associated with detrusor irritability, urethral diverticula or the failure to empty the urethra manually after micturition.

Incontinence is of five types (Box 11).

Abnormal urine stream. The stream may be:

- slow —prostatic obstruction or detrusor insufficiency
- forked —often associated with a urethral stricture.

Box 11

Types of incontinence

- True—a fistula between the urinary tract and the exterior
- Giggle—in young girls, provoked by bouts of unrestrained mirth
- Stress—leakage during a transient increase in abdominal pressure such as caused by coughing or laughing
- Urge—a desire to pass urine of such severity that the patient is unable to reach the toilet; it may be associated with urinary infection, bladder stones, detrusor instability or bladder cancer
- Dribbling or overflow—there is a continual loss of urine from a chronically distended bladder

Examination

A distended bladder is visible and palpable in most patients examined in the supine position. Dullness to percussion in the mid line of the abdomen above the pubic symphysis nearly always means bladder distension in a male.

The external genitalia are often not examined because of embarrassment. The foreskin, glans penis and urethral meatus must be examined for mental stenosis, phimosis, anatomical abnormalities such as hypospadias, penile tumours and warts. The scrotal contents are examined with the patient both supine and standing to aid identification of a varicocele.

Rectal examination

In the UK, it is traditional to examine the male in the left lateral position. The purpose is to identify abnormalities within the anal canal and rectum and to determine the size, contour and consistency of the prostate. A similar position is used in the female but is usually preceded by a vaginal examination with the patient supine and the knees flexed. In the latter, oestrogenisation of the perineum, urethral prolapse, urethral diverticula and gynaecological abnormalities of the vagina, cervix, uterus and its adnexa can be detected.

Investigation

General

Bacteriological and biochemical investigation for the upper urinary tract are also relevant to the lower tract.

Imaging

Urethrography

Water-soluble contrast medium is introduced into the urethra via a catheter to outline urethral strictures, urethral diverticula and urethral injuries.

Ultrasonography

Transabdominal, transurethral and transrectal routes are available (Fig. 24). The techniques provide precise information on:

- residual urine
- bladder tumours
- prostatic size
- nature of prostatic enlargement —benign or possibly malignant
- staging prostatic cancer.

Transrectal ultrasound (TRUS) guidance also improves the accuracy with which a prostatic biopsy is obtained when confirmation of malignant disease is required.

CT and MRI are the most accurate way of assessing the depth of invasion of bladder and prostate cancer.

Bladder function

Urinary flow rate

The patient voids into a device which records the rate of accumulation of the expelled urine (flow meter). The total voided, which should be greater than 150 mL, and the peak and mean flows are recorded (Fig. 25). A peak flow of less than 15 mL/s may indicate bladder outflow obstruction or detrusor failure.

Urodynamics

The investigations are more invasive to the extent that urethra] catheterisation with a filling catheter and a pressure transducer is required. A further pressure transducer is placed in the rectum to measure intra-abdominal pressure. Subtraction of pressures recorded by the two catheters is done automatically and gives a true intravesical pressure which is measured both during bladder filling and on micturition (Fig. 26). After micturition, residual volume is measured by emptying the bladder through the filling catheter.

Fig.24 Transrectal ultrasound scan showing benign enlargement of the prostate.

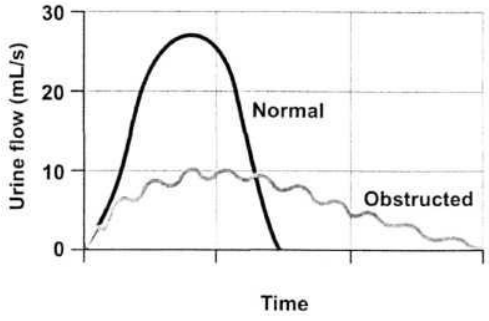

Fig.25 Measurement of urinary flow rate using a flow meter.

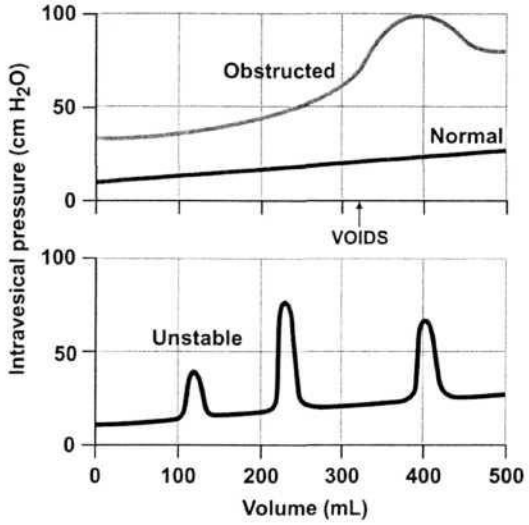

Fig.26 Urodynamic pressure studies showing obstructed and unstable responses.

Endoscopy

A flexible cystoscope passed under local anaesthetic, or a small rigid cystoscope using sedation or general anaesthesia, is used. The whole of the urethra and bladder can be examined and ureteric catheters passed.

Disorders and disease of the bladder

Congenital abnormalities

Urachus

Failure of the urachus to close results in a urachal fistula with leakage of urine from the umbilicus at birth. Persistence of the mid-part of the urachus produces an urachal cyst palpable in the midline below the umbilicus, which may undergo malignant change.

Exstrophy of the bladder (ectopia vesicae)

Epidemiology and aetiology

The incidence is approximately 1:50 000 live births, with 50% being male and 50% female. The cause is unknown. The bladder does not infold, so that its mucosa is exposed as a flat plate on the surface of the abdomen.

Pathological findings

There is failure of development of the anterior wall of the urogenital sinus and of the lower abdominal wall. The abnormality is associated with:

- wide separation of the symphysis pubis
- epispadias —failure of dorsal closure of the urethra
- inguinal hernia
- imperforate anus.

A secondary problem is the development of adenocarcinoma if the exposed bladder mucosa remains untreated.

Management

The bladder and penis are reconstructed in stages after a pelvic osteotomy to allow approximation of the symphysis pubis. The insertion of an artificial sphincter is usually necessary to maintain continence. Urinary diversion and excision of the deformed bladder may be required. Continence can be achieved in 80% of cases.

Infections of the lower urinary tract

Acute cystitis

In men, this is invariably bacterial and often associated with other bladder abnormalities such as outflow obstruction, foreign bodies, stones and tumours. In women, it is most commonly bacterial but may also be allergic or chemical. The agent responsible can easily ascend the short female urethra.

Clinical features

Frequency, dysuria, lower abdominal pain, strangury, haematuria and pyrexia all occur to a varying degree.

Mild suprapubic tenderness may be present, and the urethral meatus may be inflamed. Apart from these, specific signs are absent unless there is evidence of underlying disease.

Investigation

Urine

It is essential to send a urine specimen for culture and sensitivity before antibiotic therapy is begun. In females, a high vaginal swab should be sent for analysis to exclude *Candida*, ***Trichomonas*** and other vaginal pathogens, because such infections may precipitate an attack of cystitis.

Imaging

Patients who present with haematuria must have both an ultrasound and a cystoscopy, which are also indicated when the MSU shows no bacterial growth. Carcinoma in situ of the bladder may present with cystitis-like symptoms.

Management

An episode requires bed rest, a high fluid intake and antibiotic administration based on the results of urine culture. Seven days after the course of antibiotics, a further MSU and high vaginal swab should be obtained to ensure that bacteria have been eradicated. In women it is essential to identify those who have developed *Candida,* because this needs to be treated to stop the development of a vicious cycle of cystitis —> antibiotic administration —> persistent *Candida* infection —> further symptoms.

Chronic cystitis

The cause is usually inadequate treatment and investigation of an acute attack. Postmenopausal women are prone to recurrent episodes of cystitis and can benefit from topical or systemic oestrogen replacement therapy. Ten percent of patients who receive pelvic irradiation suffer from haemorrhagic cystitis without bacterial infection. Most cases subside spontaneously during the 12-18 months after completion of therapy, although it may lead to bladder fibrosis with a small contracted bladder.

Interstitial cystitis

This occurs most frequently in women who have irritative voiding symptoms and negative urine cultures. Many develop severe bladder pain, frequency, urgency and incontinence.

Tuberculosis of the bladder

In those who present with intractable symptoms that resemble cystitis and have a sterile pyuria, repeated examinations of early morning urine should be carried out to identify the tubercle bacillus.

Management

The treatment of contracted bladder is considered below.

Schistosomiasis (bilharzia)

Epidemiology and aetiology

The blood fluke *Schistosoma haematobium* is endemic in the Middle East and the Nile valley and other rivers and lakes of eastern and southern Africa. Human infestation is acquired by contact with infected water. Adult worms produce ova in the pelvic and vesical veins. The ova migrate through the bladder wall into the urine, which is passed into the irrigation ditches, where miracidia penetrate the water snail. These develop into cercarw which can pass through human skin and are carried to the pelvic venous plexuses where they develop into trie adult fluke (Fig. 27).

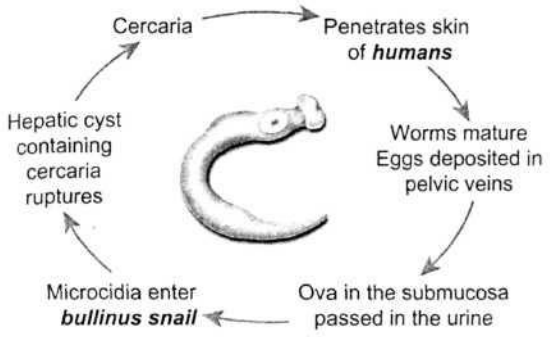

Fig.27 Life cycle of *Schistosoma haematobium*.

Pathological features

The eggs in the bladder wall cause an inflammatory reaction which goes on to fibrosis, calcification and secondary infection. Stone formation and squamous carcinoma are secondary consequences. The ureters may be involved directly or may become secondarily dilated because of the small, thick-walled and fibrotic bladder.

Clinical features

Symptoms

In acute presentations, pyrexia, itching, dysuria, frequency and haematuria are seen. In those who are in a chronic state, frequency, haematuria and episodes of infection resistant to treatment are usual.

Investigation

Urine examination and bladder biopsy

Eggs can be identified in either the urine or on bladder biopsy

Imaging

IVU may show dilated ureters, stone formation or a small contracted bladder.

Cystoscopy. There is a small bladder, and there may be small sandy patches around the ureteric orifices because of calcified granulomas. Areas of squamous malignancy may be obvious.

Management

Medical treatment is with praziquantel. Surgery may be required to reconstruct the ureters and the small contracted bladder.

Bladder trauma

Because of its anatomy, the bladder may rupture into either the peritoneal cavity or the extraperitoneal plane. The differences in cause between the two forms of rupture are summarised in Box 12.

Box 12

Causes of bladder rupture

Intraperitoneal

- Blunt abdominal trauma with a full bladder
- Penetrating injury (rare)
- Gross overdistension at endoscopy
- During endoscopic surgery on the bladder vault

Extraperitoneal

- Fracture of the pelvis
- Resection of prostate
- Difficult lower-abdominal surgery
- During repair of a direct hernia with bladder in the medial aspect of the sac

Intraperitoneal rupture

Clinical features

Symptoms

Usually there is a history of injury. Patients with a very full bladder have often consumed large quantities of alcohol, and a clear history may be difficult to obtain. There is usually also severe lower abdominal pain —modified by the patient's clinical state —and anuria.

Signs

These are as follows:

- If the urine is sterile, increasing abdominal distension and discomfort
- If the urine is infected, features of peritonitis
- Attempted micturition results in the passage of a few millilitres of bloodstained urine
- Urethral catheterisation is easy, but urine is not forthcoming, although there may be a little blood.

Management

The abdomen is explored, the bladder laceration repaired and the bladder drained.

Extraperitoneal rupture

Trauma is the only cause —a fracture of the pelvis, or during transurethral resection of the prostate or bladder tumours.

Clinical features

There is a history of injury, either accidental or surgical. Symptoms are:

- lower abdominal pain, although this may be masked by the effects of pelvic fracture
- inability to micturate or, at most, a few drops of bloodstained urine.

Urine and blood extravasated into the perivesical space cause the following:

- tender suprapubic thickening
- palpable mass (occasionally).

Management

Extravasation of urine after transurethral resection of the prostate or of a bladder tumour usually responds to a period of urethral catheterisation. For severe injuries which are a consequence of pelvic fracture, suprapubic drainage of the bladder and drainage of the retropubic space are required.

Bladder tumours

The bladder, like the rest of the urinary tract, is lined with transitional-cell epithelium and, because it acts as a store for urine and any carcinogens that may be present, it is the commonest site for the development of malignant urinary tract tumours. Benign tumours of the urothelium are exceedingly rare, as are benign tumours of the bladder muscle. Rhabdomyosarcomas of the latter occur in childhood. However, the great majority of bladder tumours arise from the urothelium, 95% of which are transitional-cell lesions. Carcinoma in situ (CIS) refers to flat areas of epithelium composed of cells with anaplastic features and disorderly pattern of growth without extension into the bladder lumen. They are multicentric and commonly occur in association with obvious transitional-cell tumours. Squamous-cell tumours occur in schistosomiasis, and adenocarcinomas are the consequence of untreated bladder exstrophy or an urachal remnant.

Epidemiology

For urothelial cancer there is a 5:1 male predominance, although the incidence in females is increasing and may be related to cigarette smoking. The highest incidence of bladder cancer is in the sixth and seventh decades.

Aetiology

Chronic irritation and carcinogenic chemicals are associated with the development of the disease.
Chronic irritation may be caused by:

- schistosomiasis
- exstrophy with persistent infection and physical trauma.

Carcinogens include:

- tobacco smoke
- products of the chemical industry —aniline dyes, printing, rubber processing, pesticides.

Because of the known association with the above industries, there arc now regular surveillance programmes which use cytological examination of the urine. If a worker in an industry that is known to have a high risk develops bladder cancer, both the victim and dependents may be entitled to compensation.

Clinical features

Symptoms

The great majority of patients present with painless haematuria. A small proportion have urinary infections A few tumours are found coincidentally in patients who undergo a cystoscopy for other reasons. Advanced coses have lower-abdominal pain, severe dysuria, strangury and incontinence of bloodstained urine. Similar irritative findings are found in patients with carcinoma in situ and must be distinguished from bacterial cystitis.

Signs

Unless the disease is advanced, abnormalities are usually absent. A careful bimanual examination may reveal a mass in the bladder wall, but if the diagnosis is established by other means (usually endoscopically), then bimanual examination is better done under anaesthesia to stage the lesion.

Investigation

Urothelial tumours are often multicentric. Any patient who presents with symptoms suggestive of a urothelial tumour requires full investigation of the urinary tract, which includes:

- urine microscopy and culture for evidence of haematuria and infection
- cytological examination of the urine —most likely to be positive in those with carcinoma in situ or well-differentiated tumours
- assessment of renal function
- IVU to search for other tumours in the renal pelvis, ureter or bladder (Fig. 28), although small tumours may be difficult to detect
- endoscopic examination of the urethra and bladder; endoscopy identifies the number, position and macroscopic type of urethral or bladder tumours and obtains a biopsy for histological examination of both the tumours and apparently normal mucosa
- bimanual examination (rectum and abdomen in the male; vagina and abdomen in the female) to assess spread of tumour beyond the bladder wall
- chest X-ray and bone scan to seek distant metastascs.

In tumours which show histological evidence of invasion into bladder muscle, a CT or MRI scan is essential to determine the stage of the disease (see below) and the need for more-radical treatment.

Histological grading

The grades used are:

- carcinoma in situ —this is a high-grade lesion
- well differentiated

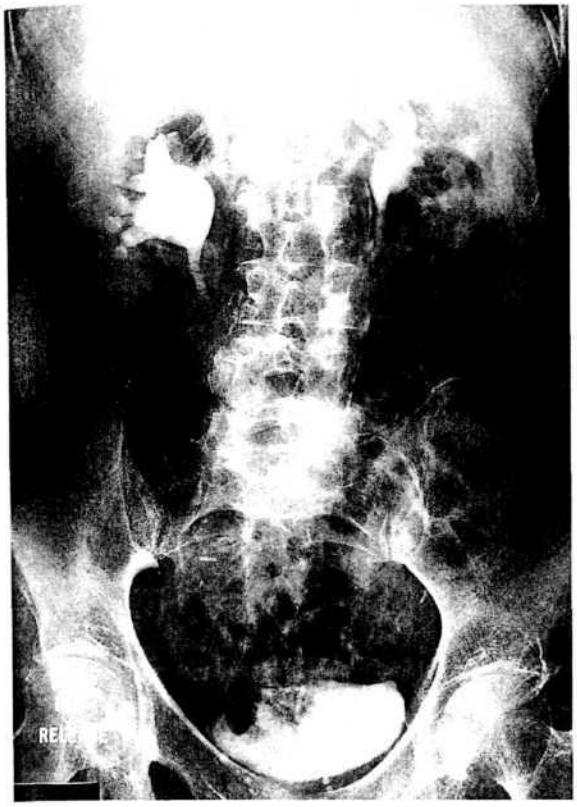

Fig. 28 Intravenous urogram showing a large filling defect in the right side of the bladder as a result of a tumour.

- moderately differentiated
- undifferentiated.

Most tumours contain a mixture of cell types. Grade is assigned on the worst pattern of differentiation.

Tumour staging

The TNM classification is used.

Tumour category is best assessed by histological examination of the resected specimen (pT category). The depth of penetration into or through the bladder wall is used as the criterion for the T component. A tumour is nominally regarded as superficial (pTIA) if it has penetrated no further than the basement membrane (Table 5). Tumours that have transgressed the bladder wall to a greater degree are pT2-pT4, and their classification is based on a combination of histological and bimanual examination (Table 6).

Node category. The lymphatic spread is to nodes on the surface of the bladder, the internal iliac and para-aortic nodes and then more distally. The classification is shown in Table 7.

Management

treatment depends on the site, size and histological grading of the tumour. At the initial endoscopic examination, the tumour is resected as far as possible, with deeper areas of resection being sent separately for histological examination to assess spread into the bladder muscle. Random biopsies of apparently normal bladder mucosa should also be obtained, as these may show changes of dysplasia or carcinoma in situ and provide useful prognostic information on the likelihood of recurrence. The treatment of superficial cancer (pTiS-pTIB) is summarised in Table 8. pT2 to pT4 tumours, unless they have advanced nodal involvement (N3-N4) or distant metastases, are managed by radical resection, radical radiotherapy or systemic chemo-therapy, or a combination of these.

Table 5
Local staging of superficial bladder cancer from histological examination of the resected specimen

Stage	Histological findings
pTiS	Carcinoma in situ
pT1A	Papillary carcinoma with basement membrane intact
pT1 B	Tumour has penetrated the basement membrane

Table 6
Local staging of bladder cancer that is no longer superficial

Stage	Findings
T2	Superficial muscle is involved
T3A	Deep bladder muscle is involved
T3B	Extending beyond muscle but bladder still mobile
T4A	Adjacent structures involved
T4B	Fixed to pelvic wall

Table 7
Nodal staging in bladder cancer

Stage	Findings
NO	No nodes involved
N1	Single regional node
N2	Multiple regional nodes
N3	Fixed regional nodes
N4	Distant lymph nodes

Table 8
Management of superficial bladder cancer

Stage	Treatment
pTiS	Endoscopic removal of local areasand intravesical BCG
pT1A	Transurethral resection (TUR)
pT1B	TUR For recurrence — repeated resection and intravesical BCG, or mitomycin
pT1B with poorly differentiated tumour	Radiotherapy or radical cystectomy.

Surveillance

Once a diagnosis of urothelial carcinoma has been made, regular lifelong follow-up is required; 50% of patients will develop further tumours.

Prognosis

Five-year survivals are summarised in Table 32.9; 95% of those with pTl A tumours survive 5 years.

Table 9
Survival in bladder cancer

Stage	Grade	5-year survival (%)
pTiS		75
pT1A	1	95
pT1B	1	72
pT1	3	39
pT2		45
pT3		39
pT4		5

Bladder diverticula

A diverticulum is a protrusion of mucosa through the bladder muscle (Fig. 29).

Aetiology and pathological features

The majority are acquired and associated with bladder outflow obstruction.

Diverticula are often multiple, not surrounded by muscle fibres and therefore unable to empty when the detrusor contracts. Stagnation of urine in a diverticulum or the urinary tract leads to infection, stone formation and squamous metaplasia with the possibility of tumour. A tumour in a diverticulum has a worse prognosis than one in the intact bladder because invasion into surrounding tissues occurs earlier.

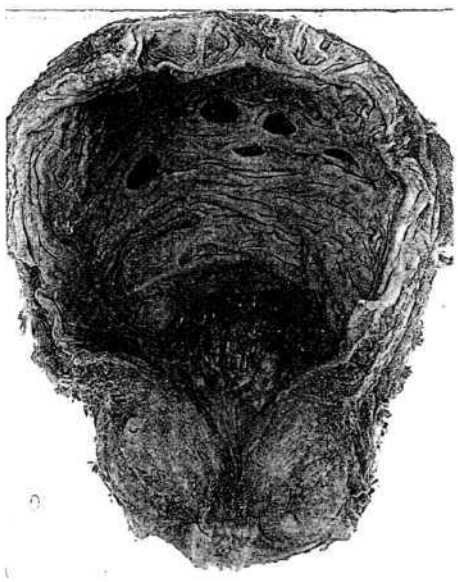

Fig.29 Bladder showing the openings of multiple diverticula.

Clinical features

Uncomplicated single or multiple diverticula are usually asymptomatic and found coincidentally during the course of investigation of a patient with bladder outflow obstruction. Complications lead to haematuria, dysuria and frequency.

There are no signs which are specific to the condition but infection may cause local tenderness.

Investigation and management

Diverticula are frequently seen on ultrasound, intravenous urography and at cystoscopy.

Bladder outflow obstruction should be relieved. If diverticula do not cause problems thereafter, treatment is not required. Persistent infection is an indication for removal.

Bladder fistulae

A fistula is an epithelium-lined track between one hollow viscus and another or between a viscus and the exterior. Bladder fistulae are classified in Table 10.

Vesicovaginal fistula

Aetiology and pathological features

The commonest cause of vesicovaginal fistula in developing countries is prolonged obstructed labour and ischaemic necrosis, by the descending fetal head, of the anterior vaginal wall and bladder. In developed countries, they occur as a result of gynaecological surgery, pelvic malignancy and irradiation damage to the vagina and bladder following treatment for cervical cancer.

Clinical features

There is a constant leak of urine through the vagina.

There may be features of the underlying cause apparent. Examination of the vagina shows urine trickling down from the vault, and the fistula may M thickened and palpable.

Investigation I

IVU

An intravenous urogram is mandatory to exclude a ureterovaginal fistula.

Dye test

If there is doubt about the source of leakage, a swab is placed into the vagina and methylene blue inserted into the bladder via a urethral catheter. Blue staining of the swab in the vagina confirms the presence of vesicovaginal fistula.

Table 10

Classification of bladder fistulae

Type	Origin	Condition
Bladder to exterior	Congenital	Extrophy of bladder Urachal fistula
Bladder to vagina	Acquired	Injury (prolonged obstructed labour) Hysterectomy Cancer Radiotherapy
Bladder to colon	Acquired	Diverticular disease Cancer Radiotherapy
Bladder to small intestine	Acquired	Crohn's disease Radiotherapy
Bladder to rectum	Acquired	Post-prostatectomy Carcinoma of rectum Radiotherapy for prostatic cancer Laser therapy to the prostate
Bladder to uterus	Acquired	Malignancy of either organ Caesarean section Radiotherapy

A swab soaked in clear urine suggests a ureterovaginal fistula. Patients with a vesicovaginal fistula often have multiple fistulae. The dye test should be repeated without the swab and the vagina examined directly using a Sim's speculum.

Management

Very few fistulae close spontaneously, however prolonged is bladder drainage.

Fistulae caused by irradiation or malignancy

Urinary diversion via an ileal or sigmoid conduit is most appropriate because the tissues are unsuitable for repair and life expectancy is short. In women with a long life expectancy, a continent urine diversion or Mainz II pouch may be appropriate.

Obstetric and post-traumatic fistulae

Repair should not be attempted within 3 months of confinement, to allow control of infection and revascularisation of the ischaemic tissues. For postoperative fistulae, an immediate repair is done.

Fistulae from bladder to gut (enteric fistulae)

These are usually between the large bowel and the bladder.

Clinical features

Hie patient complains of:

- recurrent urinary infections
- bubbles in the urine (pneumaturia)
- faecal material in the urine (uncommon).

Signs are non-specific but include those of cystitis.

Investigation and management

The diagnosis is not usually in much doubt, but a barium enema often identifies the site and extent of underlying disease. This is usually diverticular disease or, more rarely, carcinoma of the large bowel.

Management is by resection of the abnormal bowel and closure of the bladder.

Neuropathic bladder

This term is used to describe bladder dysfunction of neural origin. The neurophysiology of bladder function is incompletely understood, and clinical classifications are therefore the most useful in therapy and widely used. Three types are recognised:

- acute atonic bladder
- chronic atonic bladder
- hyperreflexic bladder.

Aetiology

The causes may be divided into congenital and acquired. The latter are further divisible into trauma, cord compression, primary central nervous system disease, and spinal cord disease secondary to that elsewhere.

Pathological features

Whatever the type of neuropathy, the secondary effects are:

- urinary stasis with dilatation of the upper urinary tract
- recurrent ascending infection
- progressive loss of renal function
- secondary stone formation.

Clinical features

Symptoms

These range from painless retention of urine to uncontrolled incontinence, frequency, urgency and poor urine stream. In long-standing neuropathy, there may be systemic symptoms of renal failure.

Signs

There is commonly evidence of other neurological involvement from the underlying cause. A full neurological examination is essential. Depending on the clinical nature of the neuropathy, the bladder may be distended with a trickle of overflow or empty with urine constantly emerging from the urethral meatus.

Investigation

Urine

Because of the likelihood of infection, bacterial culture is carried out repeatedly.

Renal function

Standard techniques are used.

Ultrasonography

Upper urinary tract dilatation and bladder emptying can be assessed.

Urinary flow studies

These are an essential part of the diagnosis and management of the neuropathic bladder. The patient with a full bladder voids into a machine which measures both the volume voided and the maximum flow (Q_{max} in mL/s). The pattern of voiding can also be observed. Voided volumes of < 150 mL may lead to erroneous results. A patient who has a normal bladder outlet and normally functioning detrusor will void with a flow rate of > 15 mL/s.

Pressure flow studies. Bladder and intra-abdominal pressure (usually rectal) are measured simultaneously. The abdominal pressure is automatically subtracted from the bladder pressure to give detrusor pressure. The bladder is filled at a standard rate and the detrusor pressure measured. Rises in pressure during filling are recorded, as is the detrusor pressure at maximal urine flow. After completion of voiding, the residual urine can be measured. Bladder emptying can be recorded using a video system.

Management of clinical types of neuropathy

The general aims of treatment are to restore continence and preserve renal function.

Acute atony

This condition typically occurs after spinal cord injury in the stage of spinal shock and may last up to 3 months. The internal involuntary sphincter remains closed and the detrusor inactive so that the bladder is distended and empties by overflow. However, this situation should not be allowed to occur, because it results in delay of return of function to the bladder spinal reflex centres (sacral 2, 3 and 4). Intermittent urethral catheterisation performed by either the patient or the carer four to five times a day, best carried out in a specialised centre, prevents distension. The eventual result is an automatic bladder which empties involuntarily every 2 or 3 hours or a bladder from which the urine can be expelled by manual compression.

Chronic atony

The cause is either a peripheral neuropathy or long-standing outflow obstruction. The former is usually irreversible, and either intermittent self-catheterisation or urinary diversion should be considered. It may be possible to correct the latter without producing incontinence (see 'Prostatic hyperplasia'). Urodynamic studies are essential in assessing residual detrusor function and the likelihood of the bladder being able to empty once the obstruction is relieved.

Hyperreflexia

Uninhibited high-pressure detrusor contractions are found on urodynamic studies but are not diagnostic of systemic neuropathy. Other features which may be found are:

- detrusor sphincter incoordination
- high voiding pressure
- significant residual volume
- poor and intermittent flow rate.

The bladder assumes a fir tree appearance on IVU or cystography (Fig. 30).

Management includes:

- *bladder conditioning* — the patient is asked to delay voiding for longer and longer periods
- ***anticholinergics***—these are usually used in combination with bladder conditioning and are effective in mild to moderate cases
- ***clam cystoplasty***—an opened segment of small bowel is sutured into the opened bladder. This decreases the bladder pressure and increases the bladder volume. The reduction in bladder pressure results in poor bladder emptying, and intermittent self-catheterisation is usually necessary
- *urine diversion* if indicated.

Incontinence

Incontinence is the involuntary passage of urine from the urethra and occurs as a result of either sphincter weakness or bladder instability.

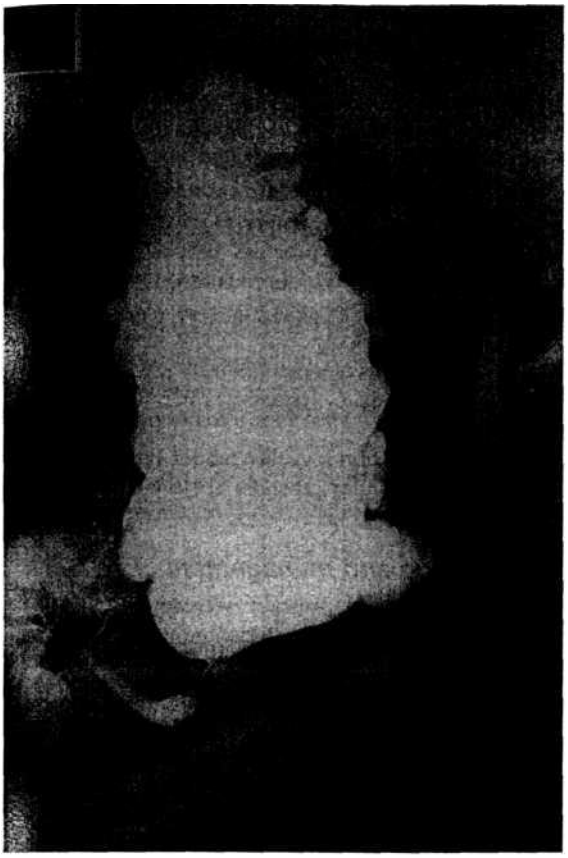

Fig. 30 Fir tree appearance of a neuropathic bladder.

The most common cause of stress incontinence in women is descent of the bladder neck so that any sudden increase in abdominal pressure acts only on the bladder and not the sphincter mechanism. In men it results from a prostatectomy.

Clinical features

Symptoms

Stress incontinence results in involuntary loss of urine whenever intra-abdominal pressure is raised —by coughing, sneezing or exercise. Symptoms of detrusor instability include frequency, urgency, urge incontinence, nocturia and bed-wetting. Not all of these symptoms may be present.

Signs

Patients with detrusor instability may have evidence of a neuropathy. Stress incontinence may be demonstrable when the patient coughs or strains.

Investigation

Urine examination

Bacterial culture is essential. Cytology should be obtained because the clinical features of detrusor instability can be mimicked by carcinoma in situ of the bladder. The two conditions can coexist.

Urodynamic studies

Patients with symptoms of detrusor instability may have normal urodynamic findings.

Management

Stress incontinence

Conservative treatment includes:

- weight loss
- pelvic floor exercises
- pelvic floor stimulation
- local or systemic oestrogen therapy
- ephedrine 15-30 mg t.d.s. (at least 3 months' treatment is usually required).

In men pelvic floor exercises and ephedrine are worth a trial. Failure to respond requires surgical therapy with the insertion of an artificial sphincter or injection of inert substances into the sphincter area.

In women who have failed to respond to a conservative regimen, surgical treatment aims to elevate the bladder neck by a retropubic approach (colposuspension) or a transvaginal approach inserting an inert sling to support the urethra.

Detrusor instability

Whether or not detrusor instability has been identified by urodynamic studies, the majority of patients respond to bladder training. After a full explanation of the condition, the patient is asked not to pass urine for increasingly lengthy periods. An accurate fluid chart of input and output and of the timing of micturition is also kept. In the few patients who fail to respond, anticholinergic agents are of value (e.g. oxybutynin hydrochloride or tolterodine), but they must not be used in patients with a history of glaucoma.

The prostate

The gland is subject to hormonal influences throughout life. In utero, it is stimulated by maternal oestrogen, and an alteration in the androgen-oestrogen balance may be responsible for the enlargement of the prostate which occurs in later life. During the active sexual period, androgenic stimulation predominates. Testosterone produced by the testes, adrenals and the peripheral conversion of other steroids is converted in the prostate by the enzyme 5-aIpha-reductase to dihydrotestosterone, the most active androgen within the prostate.

Clinical assessment

Rectal examination allows direct assessment of the size, shape, consistency and other features of the gland

by digital palpation through the anterior wall of the rectum.

The normal gland has the following characteristics:

- It is soft to firm
- It has a well-defined median sulcus
- It is not tender.

Abnormalities are as follows:

- Increased size causes the prostate to bulge backwards into the rectum so that the finger inserted through the anus passes a posterior overhang. The median sulcus becomes less obvious.
- Changes in consistency are either diffuse or localised. A very hard and irregular gland is characteristic of prostatic cancer but can occur in other conditions.
- Tenderness is present in inflammation.

It is notoriously difficult to judge accurately absolute prostatic size.

Diseases of the prostate

The prostate is subject to three major disorders:

- infection
- benign hyperplasia (BPH)
- carcinoma.

Infections

There are three clinical entities:

- acute bacterial prostatitis
- chronic bacterial prostatitis
- chronic pelvic pain syndrome.

Acute bacterial prostatitis

Aetiology

This condition is more common in patients with diabetes mellitus. *E. coli, Staphylococcus aureus* and *Neisseria gonorrhoeae* are the common organisms. ***Chlamydia*** may also be found. The route by which these organisms reach the prostate is unknown, but some instances may be by retrograde spread from the urethra.

Clinical features

There is general malaise with fever, rigors, dysuria and frequency. Pain is felt in the perineum, the rectum, and the suprapubic and sacral areas. Rectal examination reveals an acutely tender but soft prostate.

Investigation and management

Bacterial culture of urine should be performed and, if possible, fluid obtained from the urethra after gentle prostatic massage.

Management is with bed rest and appropriate antibiotic therapy. If *Clilmiiydin* is identified, tetracycline or erythromycin are the agents of choice. The patient's partner will also need to be treated.

Chronic bacterial prostatitis

Aetiology

This condition may arise as a result of a blood-borne infection or failure adequately to treat an episode of acute prostatitis. The prostate becomes the site of chronic inflammation with fibrous tissue formation.

Clinical features

There are symptoms of generalised ill health, frequency, dysuria, haematuria, haemospermia and perineal discomfort.

Rectal examination reveals a tender, hard and sometimes slightly irregular prostate. The prostate may also be normal.

Investigation and management

Culture of expressed prostatic secretion usually does not result in a growth of bacteria, but white blood cells are present.

The condition is difficult to eradicate. Long-term antibiotic therapy with **a** quinolone antibiotic, trimethoprim or tetracycline may be of value with alpha-adrenergic blocking agents to relax the smooth muscle of the prostate.

Chronic pelvic pain syndrome

These patients do not have prostatic infection but suffer from chronic pelvic pain and require symptomatic relief.

Benign prostatic hyperplasia

This condition is present in all men over the age of 40. The only method of prevention —unlikely to receive much support from the male population —is castration before puberty. Benign prostatic hypertrophy occurs in 75% of men in the eighth decade, and 20% of men over the age of 40 will require treatment during their lifetime for bladder outflow obstruction.

Aetiology and pathological features

The cause of BPH is unknown, but the condition is generally regarded as a consequence of fluctuating levels of both androgen and oestrogen (and consequently the ratio between them) at different times of life The effect is to produce hyperplasia of the glandular cells of the central zone with associated myoepithelial and fibrous tissue development. The cells involved vary in their proportionate contribution in any one patient. Perhaps because of this, the condition is variably referred to as benign prostatic hyperplasia and benigin prostatic hypertrophy/ but both are subsumed under the

shorthand BPH. The hyperplastic central zone cells displace the peripheral zone so that a pseudo-capsule is formed. Hyperplasia also variably compresses the urethral lumen, but this has little relationship to the overall size —glands of less than 40 g can cause as much trouble as those in excess of 100 g. The only relevance of the size of the prostate is that it may affect the type of treatment given.

Clinical features

The patient may present in one of three ways:

- benign prostatic obstruction
- acute retention of urine
- chronic retention of urine.

Prostatic obstruction

Symptoms are:

- hesitancy
- poor stream
- intermittency
- terminal dribbling
- increased frequency, particularly at night
- urinary infection.

The last two, in part, are due to incomplete bladder emptying. In addition, patients with prostatic outflow obstruction frequently have detrusor instability and may therefore also complain of urgency, urge incontinence and postmicturition dribbling.

Signs are usually absent. Rectal examination shows that the prostate is enlarged with a regular contour.

Acute urinary retention

Forty percent of patients who present in this way do not have a preceding history of prostatic outflow obstruction. The episode may be precipitated by anticholinergic drugs, diuretics (including alcohol), prolonged voluntary suppression of micturition, and surgery for conditions outvvith the urinary tract.

Symptoms are a sudden inability to pass urine and, after a very short period, acute severe suprapubic pain because of distension of what is usually a previously normal bladder.

Signs. The patient is in severe pain and frequently unable to stay still. The bladder is palpable and tender in the midline above the pubis and below the umbilicus. Rectal examination shows an enlarged prostate, but the gland is pushed down by the overfull bladder so that the size may be exaggerated.

Chronic retention

Symptoms. Chronic retention is painless. The patient may be ill from the metabolic effects of back pressure on the kidneys. There is characteristically the passage at frequent intervals of small quantities of urine and of rising on a number of occasions at night.

Signs. The patient's clothes and underwear may be wet and smell of urine. Apart from the systemic features of renal failure, there is a visible suprapubic swelling, dull to percussion. A search is made for any neurological abnormality because a painless bladder enlargement from such a cause may be confused with BPH and chronic retention.

Rectal examination shows the same general features as those of acute retention.

Investigation

Bladder outflow obstruction

Urine is taken for culture.

Renal function is assessed as described previously.

Plain X-ray is done to exclude stones. There is no role **for** an IVU in the assessment of a patient with prostatic outflow obstruction because of BPH.

Ultrasonography is done to assess dilatation of the upper urinary tract and to estimate residual urine and prostatic size.

Micturition flow rate is measured. Ninety percent of men with a flow rate of less than 12 mL/s **have** bladder outflow obstruction.

Management

Prostatic obstruction

Not all men require treatment, and a period of watchful waiting to see whether they become more symptomatic is justifiable.

Conservative treatment includes:

- alpha-adrenergic blocking agents
- 5-alpha-reductase inhibitors (finasteride) for men with glands greater than 40 g
- thermotherapy
- temporary prostatic stents.

Surgical treatment. The treatment of choice for a prostate estimated to weigh less than 100 g is a transurethral resection (TUR). If the gland is estimated to be larger than this, an open operation may be indicated. The use of lasers and prostatic vaporisation is still being assessed.

Acute retention of urine

The patient is in severe pain, and catheterisation is required (Emergency Box 1). It is best achieved by the suprapubic route, though the majority of patients still receive a urethral catheter. The advantages of a suprapubic catheter include:

- lack of damage to the urethra
- urethral stricture from an indwelling catheter does not occur
- false passages are avoided
- ease of introduction in a patient with a large prostate
- trial of voiding is simple
- the operative field is left clear for a subsequent TUR.

Emergency Box 1

Acute retention of urine

- This is a urological emergency. The aim of treatment is to relieve pain. If a urethral catheter is to be used, it should be the smallest, softest self-retaining catheter, e.g. 12 Fr Foley
- If retention is due to blood clot then a large (22 Fr) three-way catheter, to allow irrigation, should be used. The volume of urine drained (< 700 mL) is a good predictor of the likelihood of spontaneous voiding when the catheter is removed
- A short course of an alpha-adrenergic blocker, e.g. alfuzosin, may aid initiation of voiding
- Insertion of a catheter by the suprapubic route has significant advantages (see main text)
- If it is not possible to insert a catheter, do not persevere. Call for more senior help
- Only those trained in their use should utilise a catheter introducer
- A rectal examination with the bladder distended will give misleading information as to the prostate size
- Acute urinary retention will significantly increase the level of serum prostate-specific antigen, misleadingly suggesting a diagnosis of carcinoma of the prostate

Because 40% of patients with acute retention have no previous history of outflow obstruction, it is reasonable to allow them to attempt to void after clamping the suprapubic catheter. Those who are able to void usually had a residual urine of less than 700 mL when initially catheterised and avoid a prostatectomy in the short term. Patients who revert back into retention require a prostatectomy.

Chronic retention

The treatment is by prostatectomy. The only indication for preoperative catheter drainage is in patients with impaired renal function secondary to back pressure on the kidneys. Catheterisation eventually leads to the development of a urinary infection, which increases the morbidity and mortality of a subsequent operation and is difficult to eradicate in a large floppy bladder. If a catheter is required, attempts should be made to decompress the bladder slowly, as this reduces but does not completely do away with the development of severe bleeding from distended submucosal veins. The renal concentrating mechanism is usually impaired, and bladder catheterisation may result in diuresis leading to dehydration, hypotension and further impairment of renal function. Close monitoring of the patient's weight, blood pressure, pulse, fluid input and urine output is required. Once renal function has improved and stabilised, definitive surgery can be undertaken.

Prostatectomy

The operation of choice for glands less than 100 g is a transurethral resection in which the greater part of the adenomatous hyperplasia inside the pseudo-capsule of compressed peripheral zone is removed piecemeal by diathermy. For larger glands, a retropubic prostatectomy which incises the pseudo-capsule and enucleates the adenoma is preferred.

The advantages of transurethral prostatectomy are:

- absence of wound infection
- significant reduction in pain
- less frequent urinary infection
- postoperative incontinence reduced
- lower incidence of general complications such as chest infection, deep-vein thrombosis and pulmonary embolus
- hospital stay and early mortality are reduced.

Disadvantages include:

- a long period of training is required to learn the technique
- a high incidence of reoperation for recurrent disease
- possible increased incidence of later postoperative mortality.

Complications are:

- bleeding —primary, reactionary or secondary haemorrhage
- absorption of irrigation fluid into the systemic circulation which can cause hyponatraemia with epileptiform fits and cardiovascular collapse (the TUR syndrome)
- failure to void
- urinary infection
- epididymo-orchitis
- incontinence
- erectile dysfunction.

Retrograde ejaculation is an invariable sequel of prostatectomy about which patients must be warned.

Prognosis. Only 70% of patients are completely satisfied with the result of a prostatectomy. The main reasons for this are that either the operation was performed for detrusor instability rather than bladder outflow obstruction or, where both conditions existed, detrusor instability did not resolve after prostatectomy.

Carcinoma of the prostate

Epidemiology

This tumour is rapidly becoming the most common malignancy to affect men. The disease is one of ageing rarely discovered under the age of 50 and with a peak incidence in the 70s. Examination of serial sections of the prostate of men who have died from other causes

has demonstrated that 29% of those aged between 50 and 60, 49% of men in the age group 70-79 and 67% of those aged 80-89 had unsuspected prostate cancer. Not all are clinically apparent and, even when identified, they do not express the same malignant potential. At one extreme are those tumours which are found only at death, while at the other there are rapidly progressive tumours with invasive and metastatic potential. In between there are tumours with intermediate degrees of aggression and long periods of local growth only. However, current techniques are unable to identify ".hich are which. In consequence, there is much confusion and controversy about whether or not to screen for the condition. To do so would lead to a significant over-treatment of the many men discovered. The same dilemma exists about treatment: diagnosis does not necessarily imply progression or a need to treat.

Aetiology

Apart from the relationship to ageing, the cause is unknown, although there is probably some relationship with the hormonal environment. Some men have a strong family history.

Pathological features

The tumour is an adenocarcinoma usually arising in the periphery of the prostate and confined within the prostatic capsule. Its spread is:

- local in the periprostatic and perirectal soft tissues and upwards into the pelvis
- lymphatic to the iliac and para-aortic nodes
- blood-borne, principally to bone.

Clinical features

Symptoms

These include:

- bladder outflow obstruction (see above)
- metastatic disease —bone pain, leg swelling from lymphatic obstruction
- renal failure from bilateral ureteric obstruction.

Signs

Signs are:

- a nodule in a palpably benign gland
- hard irregular prostate on rectal examination, sometimes with perirectal and periprostatic thickening
- ankle and leg oedema
- other signs of metastases.

(he disease may only be discovered at an incidental rectal examination or on histological examination of prostatic tissue removed during a prostatectomy for clinically benign disease.

Investigation

A histological or cytological diagnosis must be made and can be achieved by:

- transrectal or transperineal biopsy, preferably guided by ultrasound
- aspiration cytology
- transurethral resection. '

Other investigations include:

- routine evaluation of renal function
- serum alkaline phosphatase concentration —elevated in patients with bone metastases.

Serum prostate-specific antigen (PSA) concentration

Prostate-specific antigen is secreted into the serum by both benign and malignant prostatic tissue. Its level relates to the volume of prostatic tissue, and there is considerable overlap in the serum levels of patients with benign and malignant prostatic disease, particularly in the range associated with confined and hence potentially curable prostate cancer. Many men with mildly elevated PSA levels will not have prostate cancer, and 20% of those with cancer will have a 'normal' PSA. In consequence, its use as a screening test for prostatic cancer is severely limited. However, it has value in monitoring the progression of the disease and response to treatment.

Ultrasonography

Abdominal ultrasound may identify unilateral or bilateral hydronephrosis because of ureteric involvement. Transrectal ultrasound is used both as an aid to diagnosis and for staging prostate cancer, but unfortunately it is not particularly accurate in either. It is unable to detect microscopic spread beyond the prostate.

Bone scanning

Radioisotope bone scan can detect areas of increased bone activity irrespective of their cause (Fig. 31). Confirmatory X-rays need to be taken of areas of increased isotope uptake. Bone metastases from carcinoma of the prostate are sclerotic (osteoblastic).

Staging

Prostate cancer is staged by the TNM classification.

The T stage is most accurately assessed with the patient anaesthetised; a description is given in Table 11.

Management

As yet there have been no useful randomised clinical trials in the treatment of prostate cancer. As a result, no hard and fast rules can be given on optimal treatment. Decisions should be based on the patient's age and general state. Options include:

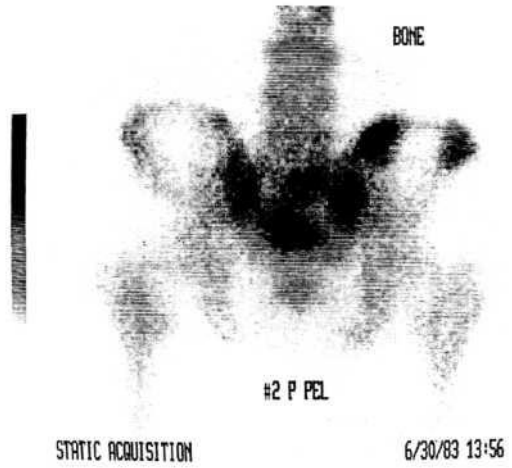

Fig. 31 A bone scan showing multiple hot spots caused by metastatic carcinoma of the prostate.

- no treatment, with assessment of progress
- endocrine therapy
- radiotherapy
- surgery.

No treatment

Men with asymptomatic low-stage, low-grade disease and those with significant comorbidity can be offered follow-up with regular observation. Those who show signs of disease progression can then be treated with one of the therapies outlined below.

Early treatment by hormone therapy provides a slight survival advantage and reduction in morbidity from disease progression in men who have asymptomatic advanced localised or metastatic prostate cancer.

Endocrine therapy

Most of the cells of the prostate are dependent for their multiplication on the male hormone testosterone.

Table 11
Staging of prostate cancer

Stage	Findings
T1a	An incidental finding of tumour with low biological potential for aggressive behaviour in a prostate removed for clinically benign disease
T1b	An incidental finding of a tumour with potentially biological aggressive behaviour found in a prostate removed for clinically benign disease (high-grade or diffuse)
T1c	Tumour identified because of an elevated serum prostate-specific antigen
T2a	Tumour involving half a lobe or less
T2b	More than half a lobe but not both
T2c	Both lobes
T3	Tumour extends through capsule and may involve seminal vesicle
T4	Tumour fixed invasive of adjacent structures other than seminal vesicle

Ninety percent of circulating testosterone is produced by the testes under the influence of luteinising hormone (LH), which is in turn controlled by the hypothalamic secretion of luteinising hormone-releasing hormone (LHRH, Fig. 32). The remaining 10% of testosterone is produced by the adrenals and by peripheral conversion of other steroids. Eighty percent of patients with symptomatic prostate cancer respond subjectively and 60% respond objectively to androgen suppression or ablation. The mean duration of response is 2 years. Once the tumour is no longer hormone-responsive, the mean survival is 6 months.

Androgen suppression. This is only used in men with locally advanced or metastatic disease. LHRH analogues initially stimulate the pituitary, but after approximately 7 days the pituitary receptors become blocked and down regulation occurs. Serum testosterone falls to castrate levels. These substances are long-acting and are administered subcutaneously every

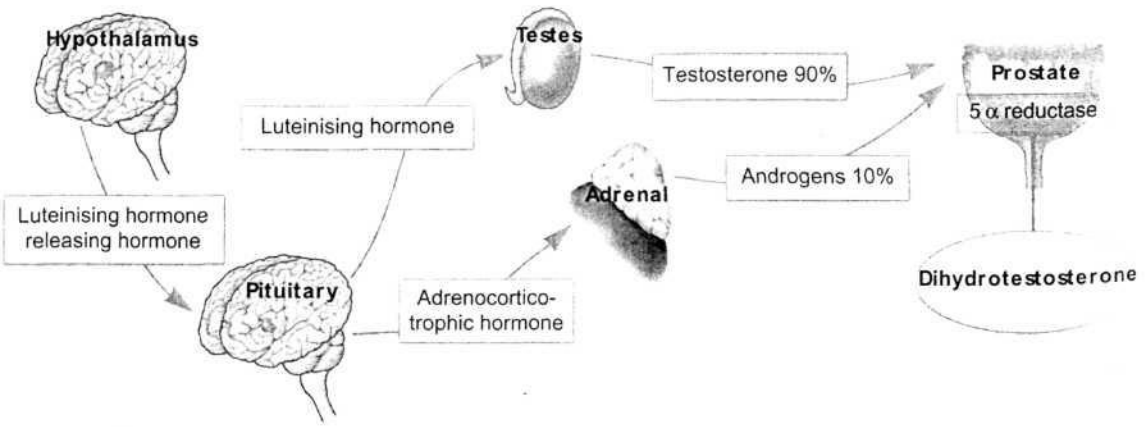

Fig. 32 Hormonal control of the prostate.

1 or 3 months. Because of the initial stimulation of the pituitary, an anti-androgen should be given for 10-14 days before the analogue is given to prevent disease progression.

Androgen ablation is by bilateral subcapsular orchidectomy, which can be done under local anaesthesia on an out-patient and removes the testosterone-producing part of the testicle. There is no difference in response between orchidectomy and LHRH analogue therapy, and the choice of treatment should lie with the patient.

Radiotherapy

Radiotherapy is effective in controlling the pain of bony metastases. It is also used for the treatment of the primary if it is thought that the tumour is confined to the prostate. There have been no useful randomised controlled trials to assess its benefit compared with radical surgery. More recently, brachytherapy, in which radioactive seeds are placed throughout the prostate with the aid of a template and ultrasound guidance, has been used. Long-term results are awaited.

Surgical treatment

Transurethral resection is used in patients who present with symptoms of outflow obstruction or acute retention.

Radical prostatectomy is one of the most controversial aspects of the treatment of carcinoma of the prostate. Its use for disease that is believed to be localised to the prostate is widespread in the USA and Europe and is increasing in the Ukraina. The reasons why its use in the Ukraina has been slow to increase are:

- The purpose of the operation is to remove the whole of the prostate with its confined cancer, but current staging techniques cannot accurately identify patients in this class.
- Radical prostatectomy fails in its objective of removing the whole of the cancer in 50% of those submitted to it.
- Bilateral lymphadenectomy is required.
- A high proportion of prostatic cancers have low malignant potential, and radical prostatectomy is over-treatment.
- There is a mortality of 1%.
- Morbidity is considerable and includes incontinence, erectile dysfunction and anastomotic strictures.

Against this, it is probably indicated in men with poorly differentiated tumours which are thought to be localised to the prostate and who would otherwise have a 10-year life expectancy. A radical prostatectomy correctly performed will eradicate the disease if it is confined to the prostate. Until it is possible to accurately identify confined disease preoperatively, a substantial proportion of men 'suitable' for radical prostatectomy will not be cured.

Prognosis

In men with prostate cancer confined within the capsule who undergo radical prostatectomy, approximately 55% survive 10 years, whereas only 25% of those who have metastatic disease at presentation can be expected to survive 5 years with current therapy.

The male urethra

Congenital abnormalities

These are:

- urethral valves
- hypospadias
- epispadias.

Urethral valves

Pathological features

Folds of urothelium develop in the posterior urethra in utero to form a valve-like obstruction to the passage of urine. Gross dilatation of the prostatic urethra (Fig. 33), distension of the bladder and ureters and hydronephrosis result. Severe renal impairment follows. With increasing use of antenatal ultrasound, many boys with urethral valves are diagnosed in utero by antenatal screening.

Clinical features

The bladder may be palpable, and the infant constantly dribbles urine. The development of a urinary infection

Fig.33 Urethral valves causing bladder distension and dilatation of the prostatic urethra.

may draw attention to the problem before end-stage renal failure develops.

Management

When diagnosed in utero, a stent can be inserted to drain the baby's bladder into the amniotic cavity, so preserving renal function. Endoscopic division of the valves is required, sometimes with urinary diversion to improve renal function.

Hypospadias

Aetiology

The two genital folds on the ventral aspect of the phallus fail to fuse and form the anterior urethra of the male. The meatus is therefore displaced posteriorly for a variable distance. Hypospadias is classified according to where the opening lies (Fig. 34). Other genital abnormalities, such as failure of testicular descent, are often present, and there may be a family history.

Clinical features

Apart from the abnormal opening of the urethra, the foreskin is hooded and the penis is bent (chordee) ventrally because of secondary fibrosis in the area of the absent urethra.

Management

Surgical repair, usually utilising the foreskin, is carried out at around the age of 3 years before the child goes to school and has to face his 'normal' contemporaries.

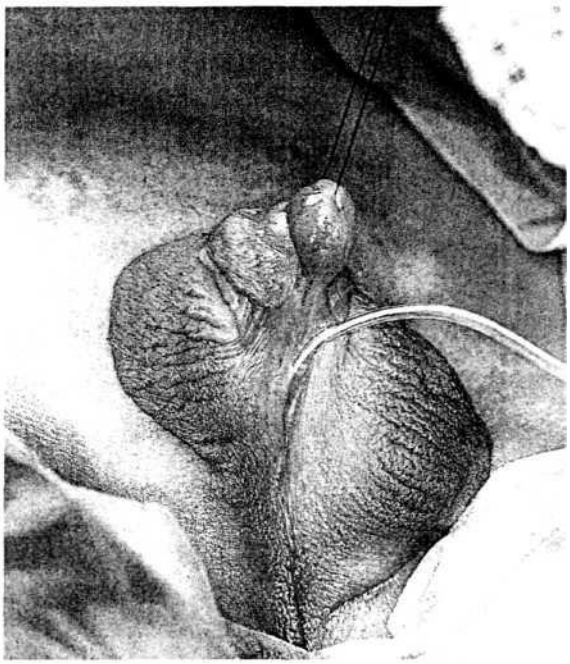

Fig.34 An example of a penile hypospadias.

Epispadias

This is extremely rare. The urethra opens on the dorsum of the penis, and there may be exstrophy of the bladder. No clear embryological mechanism has been formulated. Complex repair is required.

Urethral injury

Aetiology

The male urethra is more frequently injured than that of the female. The most common cause is instrumentation of the urethra by a catheter or cystoscope. Up to 30% of pelvic fractures are associated with urethral damage, and 10% of urethral trauma, beyond the pelvic floor, is caused by a fall-astride injury.

Clinical features

History

A urethral injury should always be suspected in a patient who has been injured and who presents with any of the following:

- blood at the urethral meatus
- haematuria
- anuria.

Signs

Physical examination may reveal a palpable bladder. Lower abdominal tenderness is always present in a patient with a pelvic fracture and does not necessarily imply bladder or urethral damage. In fall-astride injuries there may be bruising and swelling in the perineum. In rupture of the membranous urethra, the prostatic area is said to be boggy and the prostate high-riding. However, anyone who has attempted to perform a rectal examination in a man with a fractured pelvis realises how difficult this physical sign is to elicit.

Investigation

It is unwise to make repeated attempts to pass a urethral catheter. If the diagnosis is in doubt, urethrography using water-soluble contrast media is done.

Management

The urethral injury takes low priority in the overall management of patients subjected to severe multiple trauma.

Anterior urethral injuries

If the rupture is complete, the perineal haematoimi is evacuated and a primary repair done. If incomplete either a well-lubricated soft, small urethral catheter should be passed by an experienced urologist and left in situ for 10 days or a suprapubic catheter inserted.

Posterior urethral injuries

Either a suprapubic catheter should be inserted or a urethral catheter should be railroaded into the bladder (Fig 35). This allows aligment of the divided ends, and if a stricture develops, subsequent management may be easier.

Complications

These are as follows:

- urethral stricture
- incontinence

. erectile dysfunction (neurogenic and vascular).

Urethral stricture

Aetiology

Strictures may be congenital, traumatic or inflammatory (Box 13).

Clinical features

There may be a history related to the underlying cause The patient complains of difficult and incomplete micturition with a poor stream.

There is a thin, divergent urine stream with terminal dbbling. The bladder may be palpable.

Investigation and management

Urine flow rate is reduced and prolonged with intermittent peaks signifying temporarily improved flow due to abdominal strain. Urethrography demonstrates the site, length and number of strictures

Urethral dilatation used to be the only treatment but invariably had to be continued indefinitely to prevent recurrence. Today the treatment of choice is direct endoscopic incision or an urethroplasty.

Box 13

Causes of urethral stricture Congenital

- Meatal stenosis

Traumatic

- Urethral catheterisation
- Cystoscopy
- Transurethral resection
- After rupture of urethra

Inflammatory

- Gonorrhoea
- Non-specific urethritis
- Long-term urethral catheter

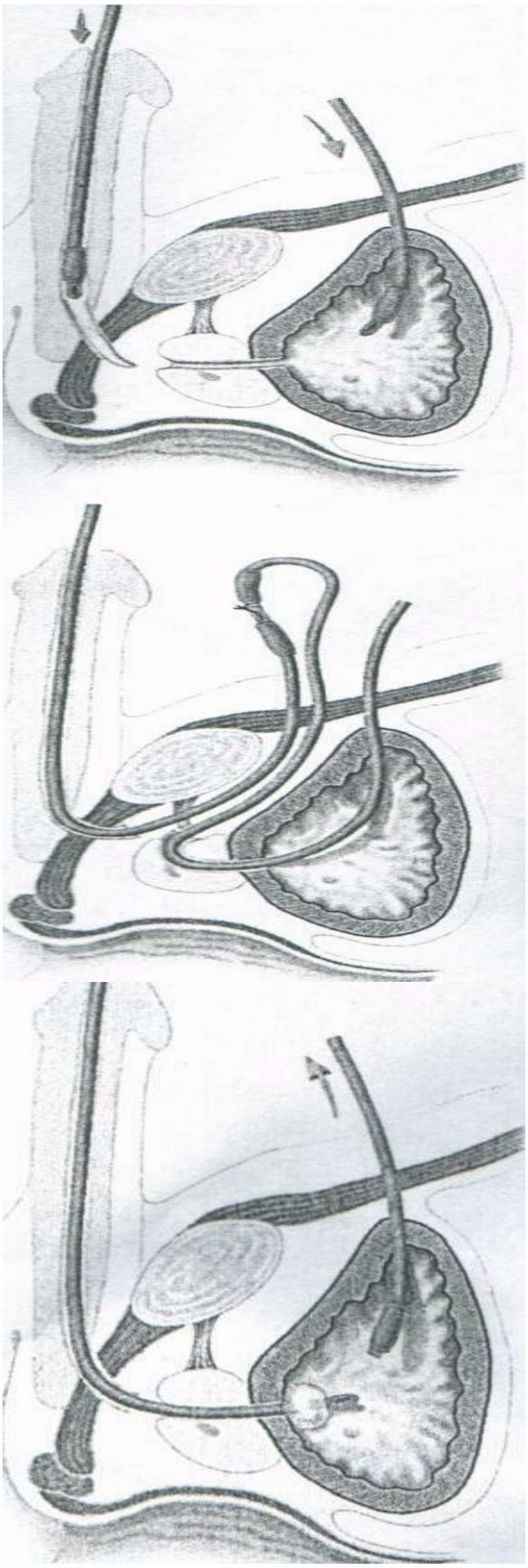

Fig. 35 A technique for railroading a urethral catheter in a patient with a ruptured urethra.

Penis

Phimosis

Definition and aetiology

This is inability to retract the foreskin.

Congenital

It is not usually possible to retract the foreskin without the application of undue force until the age of 2-3 years, because the inner surface of the foreskin adheres to the glans. No active measures are required for uncomplicated, unretractile foreskin even when the foreskin is reported as ballooning when the child passes urine.

Acquired

This is the result of:

- recurrent infections (balanitis) of which diabetes mellitus is an associate
- underlying tumour of the glans penis.

Clinical features

The preputial orifice is white and scarred and indurated, presenting symptoms including secondary intractability of the foreskin, irritation at or bleeding from the preputial orifice, dysuria and occasionally acute urinary retention.

Management

Treatment is by circumcision. The operation should not be carried out until infection is under control.

Paraphimosis

Aetiology and pathological features

The foreskin contains fibrous tissue because of previous attacks of inflammation usually as a result of forceful retraction of the prepuce. It normally cannot be retracted, but if this occurs either by manipulation or during sexual intercourse, the fibrous band encircles the penis in the subcoronal area to cause congestion of the glans.

Clinical features

There may be a suggestive history. Pain in the glans is usually moderate to severe, and there may be difficulty on micturition.

It is not possible to reduce the retracted foreskin. The glans is oedematous. A tight band may be palpable in the subcoronal area.

Management

An injection of hyaluronidase with lidocaine (lignocaine) into the constricted area, followed by gentle pressure and traction, will usually result in reduction. Failure necessitates incision of the constricting band.

Patients should subsequently be circumcised if it is a recurrent problem.

Circumcision

Indications

Indications are:

- religious ritual circumcision — Muslims, Arabs and Jews
- phimosis
- paraphimosis
- recurrent balanitis
- preputial injuries.

Complications

The operation should not be undertaken lightly. There is an anaesthetic mortality. In addition there may be:

- primary or secondary haemorrhage
- secondary infection
- meatal ulceration and stenosis because of the absence of protection by the foreskin
- injury to the glans
- over-radical excision with scarring.

Peyronie's disease

Aetiology and pathological features

The cause of this condition is unknown. There is fibrous thickening in the corpora cavernosae which results in bending or angulation of the penis when erect. Circumferential fibrosis may result in distal flaccidity during an erection.

Clinical features

The penis is angulated during erection, which may make intercourse impossible or painful (Fig. 36). The degree of angulation can be assessed by inducing an artificial erection with an injection of intracavernosal prostaglandin El.

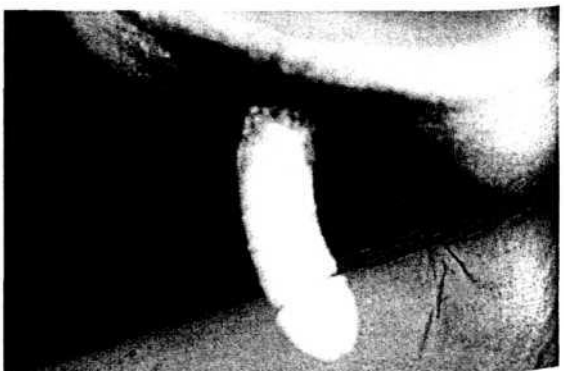

Fig.36 Peyronie’s disease with penile bending.

Management

The penis can be straightened but made shorter by excising a wedge from the corpora opposite to the maximum angulation. Resuturing the excised edges straightens the penis.

Priapism

This is a persistent and painful erection of the penis.

Aetiology and pathological features

The great majority (80%) have no underlying cause. Those known are summarised in Box 14, and some relate to episodes of blood sludging. If detumescence does not take place within 8 hours, venous and arterial thrombosis ensues with fibrosis in the corpora and permanent erectile failure.

Management

Because of the risk of irreversible damage to the erectile apparatus, this is a urological emergency. Aspiration of the thick viscid blood from the corpora may be sufficient. If that fails, a shunt is created between the corpora cavernosa and the glans penis, the corpora cavernosa and the corpora spongiosa, or the corpora cavernosa and the saphenous vein.

Carcinoma of the penis

Aetiology

The occurrence of the disease mainly in the uncircumcised and elderly suggests that poor standards of subpreputial hygiene allow the accumulation of carcinogens, but there is no direct evidence for this. The tumour is a squamous carcinoma. It is now rare in developed countries.

Clinical features

There is an offensive bloody discharge issuing from beneath a non-retractile foreskin. Inguinal lymphadenopathy is invariably present as a result of either infection or secondary spread. An early carcinoma is shown in Figure 37.

Box 14

Causes of priapism

- Idiopathic (80%)
- Intracavernosal injections of vasoactive drugs for the treatment of erectile dysfunction
- Sickle cell anaemia
- Leukaemia
- Malignancy

Management

This depends on the extent of the disease. Treatment options include:

- partial amputation
- radical amputation with block dissection of inguinal lymph nodes
- radiotherapy
- chemotherapy.

Testis, epididymis and cord

Undescended testis

Epidemiology

Both testes are undescended in 30% of premature infants: at term this has fallen to 3%; and at one year 1%. Spontaneous descent after 1 year is exceedingly rare.

Aetiology

The cause is failure of migration along the normal line of descent. In an ectopic testis the testicle deviates away

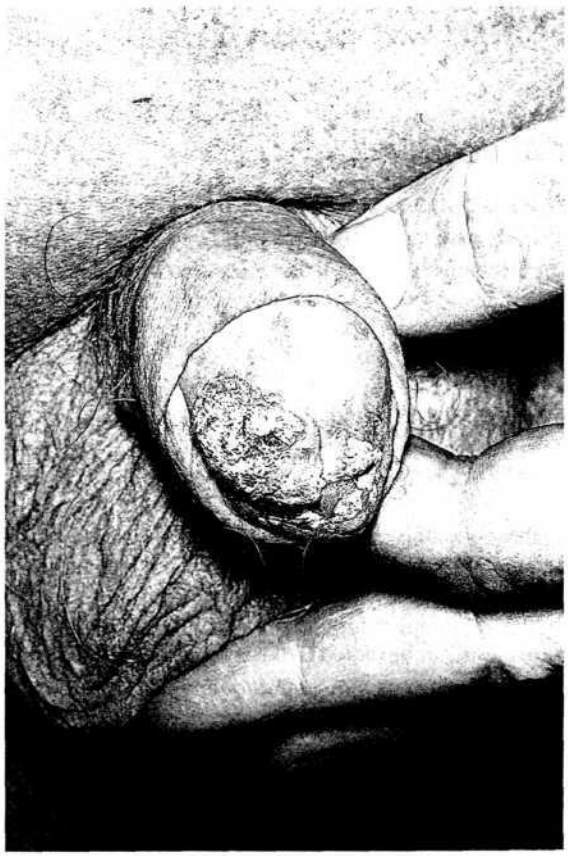

Fig. 37 An early carcinoma of the penis.

from the line and may lie in front of the penis in the superficial inguinal pouch, in the perineum or in the thigh. The cause is not known.

Clinical features

An empty scrotal sac or hemiscrotum at 1 year indicates that the testicle is:

- proximal to the external inguinal ring (undescended)
- truly absent
- retractile — the cremaster muscle reflexly pulls the organ up towards the inguinal canal
- ectopic.

A retractile testis can usually be coaxed into the scrotal sac, or will enter spontaneously if the child is asked to crouch. An ectopic testicle may be palpable in the areas described above but cannot be brought into the scrotum. An incompletely descended testis may be palpable at the external ring or in the neck of the scrotum. A testicle in the inguinal canal is impalpable.

Complications

Complications are:

- infertility —inevitable in bilateral and common in unilateral undescent, and frequent in those who have had undescent treated
- torsion
- trauma
- inguinal hernia
- malignant disease.

Investigation

If the testicle is not palpable, ultrasonography, CT and laparoscopy are useful investigations to determine whether the testicle is truly absent and, if not, where it is situated.

Management

The aim is to bring the testicle with its blood supply into the scrotum as early as possible, usually between 1 and 2 years. Boys who present with a well-developed undescended testis before puberty should undergo an orchidopexy, an operation to bring the testicle and its blood supply into the scrotum. However, if the testis is poorly developed, an orchidectomy is advised. Beyond puberty, orchidectomy should be done. A testicular prosthesis can be placed in the scrotum.

Torsion

Aetiology and pathological features

Torsion is a recognised complication of testicular maldescent. The episode occurs any time between birth and early adolescence but is uncommon thereafter. A horizontally lying testicle with a long mesorchium and cord within the vaginal sac, so that the testis hangs like the clapper of a bell, is most prone to torsion. This anatomical arrangement is usually bilateral, so that both testes are at risk. The twist deprives the organ of its blood supply; if untwisting does not take place within 6 hours, ischaemia is irreversible, gangrene develops and the testis either suppurates or atrophies.

Clinical features

There may be a history of previous episodes of testicular pain. The pain may be initially felt in the iliac fossa or over the cord and is often associated with vomiting.

The testicle is extremely tender, swollen and drawn up in the scrotum. The unaffected testicle may have a horizontal lie.

Other conditions which must be considered are:

- torsion of an appendix of the testis
- acute epididymo-orchitis
- idiopathic scrotal oedema.

Investigation

Urinalysis will reveal a sterile, acellular urine. Ultrasonography will demonstrate the absence of blood supply to the affected testicle.

Management

Treatment of testicular torsion is, for the reasons given above, a surgical emergency.

Non-operative

It may be possible to de-rotate the testis. Standing at the foot of the bed, the testis is rotated towards the thigh and may have to be rotated through two or three turns. If this manoeuvre is successful, the testicle and that on the other side should be surgically fixed on the next operating list.

Surgical

Failure of non-operative reduction requires immediate operation. The testis is de-rotated and fixed. The unaffected testis is dealt with at the same operation. A gangrenous testis is removed.

Orchitis and epididymo-orchitis

Aetiology and pathological features

Primary orchitis is rare except in association with mumps. The testis is often secondarily infected from epididymitis which originates by retrograde spread from the prostate and seminal vesicle; a blood-borne infection is the alternative source. A surgical procedur on the lower urinary tract, such as a TUR, may also be precipitating factor. The organisms are Neisseria gonorrhoeae, Escherichia coli and Chlamydia. Chronic infection or a discharging sinus may be the consequence of tuberculosis.

Clinical features

There may be a preceding history of an operation or of dysuria, frequency and haematuria. Pain in the scrotum is acute, and the patient is conscious of swelling. Fever and rigors are not uncommon.

The epididymis is acutely tender and enlarged, although it may be difficult to distinguish it from the equally tender testis. Overlying redness and oedema may be present.

Investigation

Blood count. Leucocytosis is present.

Blood culture. A positive culture is useful to direct antibiotic treatment, although this should be started on an empirical basis before the result is available.

Urinalysis. This will reveal a pyuria, and the organism may be revealed by culture.

Aspiration of the epididymis. ***Chlamydia*** is best grown from this source.

Ultrasonography. Increased blood flow may be demonstrated.

Management

In a young man the commonest infecting organism is *Chlamydia.* Bed rest, scrotal elevation and tetracycline or erythromycin are appropriate. Other antibiotics may be needed according to the bacteriological analysis. The partner should also be investigated and treated.

Scrotal swellings

A non-inflammatory swelling of the scrotal contents may be a:

- testicular tumour
- epididymal cyst (spermatocele)
- varicocele
- hydrocele
- hernia.

Clinical examination

The following points enable distinctions to be made:

- If it is possible to get above the swelling and palpate a normal cord, the swelling is not a hernia.
- If there is a cough impulse in the groin or, with the patient lying flat, the scrotal mass disappears or is reducible, the swelling is a hernia.
- The testicle lies anteriorly and the epididymis posteriorly, gentle palpation establishes where the swelling lies and therefore its origin.
- Hydroceles transilluminate.
- Varicoceles are more apparent with the patient standing and feel like a bag of worms.

Hydrocele

Aetiology

These may be congenital or acquired. Congenital hydroceles follow failure of obliteration of the processus vaginalis. Peritoneal fluid can then enter the scrotum. The great majority of acquired hydroceles are of unknown origin, but 10% are associated with tumour or infection of the testicle.

Clinical features

An infant presents with a large scrotal sac, and the hydrocele is easily demonstrated by transillumination.

In adult life, there is a firm painless transilluminable swelling which it is possible to get above.

Management

The majority of congenital hydroceles resolve spontaneously by the age of 3, but persistence beyond this time requires operative treatment by division and ligation of the processus. In acquired hydrocele, an ultrasound scan will identify any underlying cause. If the hydrocele is symptomatic, surgical excision of the outer wall of the hydrocele is required.

Epididymal cysts and spermatoceles

These may be single or multiple and are usually related to the head of the epididymis. They lie posterior or superior to the testicle and may transilluminate.

Management

Asymptomatic cysts do not require treatment. If they cause discomfort, simple aspiration is often satisfactory: spermatoceles yield a turbid milky fluid and epididymal cysts a fluid the colour of lemon barley water. Should recurrence occur after aspiration, surgical excision is required.

Varicocele

Aetiology and pathological features

The venous valve at the junction of the left spermatic vein with the renal vein is incompetent or becomes so. It is most uncommon for the same to take place on the right. Very occasionally, a tumour in the kidney with extension along the renal vein may be present. Varicocele is a common finding in men presenting with subfertility but is equally common in men requesting vasectomy for contraception. The veins of the pampiniform plexus become enlarged and tortuous.

Clinical features

There is a dragging sensation in the scrotum which is worse in hot weather and on prolonged standing. Subfertility may be mentioned.

Physical examination reveals the 'bag of worms', which becomes more obvious if the patient stands. A cough impulse is present in the same position. The left testicle may be smaller than the right.

Management

Treatment is required for those with symptoms and for those with subfertility. The procedure of choice is embolisation of the testicular vein under radiological control.

Testicular tumours

Benign, interstitial cell and Leydig cell tumours of the testis are exceedingly rare. Malignant tumours are uncommon (1-2% of all neoplasms in males) but do occur in young adults with an otherwise long expectation of life. In the age range 20-35 years, testes tumours are the most common malignancy excluding leukaemia. The psychological effects of a diagnosis of malignancy are, in consequence, considerable.

Aetiology and epidemiology

Maldescended testes —particularly those retained within the abdomen —have a 40% greater chance of malignant change than does a normal testis. Otherwise the cause is unknown. The overall incidence is 2-3 per 100 000 of the population per year. They are rare before puberty. Teratomas (see below), which account for 60% of germ cell tumours, have a peak incidence at 20-30 years. Seminomas (see below), which account for the remaining 35%, have a peak incidence at 30-40 years. Lymphomas, which are often bilateral, occur in the 60-70 year age range.

Pathological features

Classification of germ cell tumours is as follows:

- seminoma
- teratoma (Fig. 38)

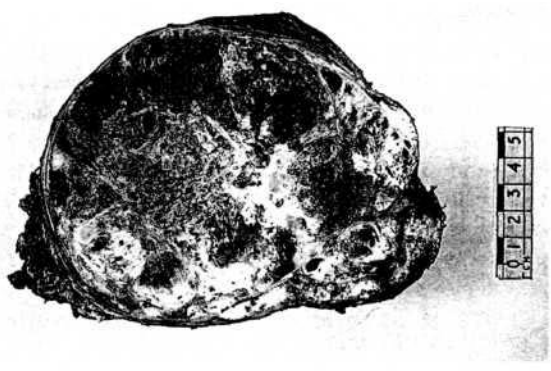

Fig.38 A malignant teratoma showing cystic degeneration and haemorrhage.

- mixed — these consist of both seminomatous and teratomatous elements but should be treated as teratomas.

The further subdivision of teratomas is shown in Box 15.

Clinical features

Symptoms

Ten percent of patients give a history of previous orchidopexy, and in 5% the tumour is bilateral. There is often a recent history of trauma, although this is not a cause but merely draws the patient's attention to the presence of a lump. The most frequent complaint is of a painless swelling which causes a dragging sensation in the scrotum. In one-third, the swelling is painful. Patients with a choriocarcinoma may develop gynaecomastia. Others present with symptoms from secondary deposits such as backache, haemoptysis or neurological complaints.

Signs

These include:

- a hard lump in the body of the testis
- diffuse testicular enlargement
- absence of tenderness on gently squeezing the testicle
- hydrocele.

Investigation

Tumour markers

Testicular teratomas secrete alpha-fetoprotein (AFP) and beta-human chorionic gonadotrophin ((β-hCG). Both teratomas and seminomas may secrete lactic dehydrogenase, and seminomas may secrete placental alkaline phosphatase. These should be measured preoperatively and at regular intervals postoperatively. They are good indicators of the likelihood of complete excision of the tumour or, alternatively, the presence of residual disease which requires further treatment.

Imaging

Ultrasound. If it is not possible to determine the nature of the mass in the testicle clinically, ultrasound is

Box 15

Teratomatous tumours of the testis

- Differentiated (TD)—teratoma differentiated
- Intermediate (MTI)—malignant teratoma intermediate
- Undifferentiated (embryonal) carcinoma (MTU)—malignant teratoma undifferentiated
- Trophoblastic (chorionic) carcinoma (MTT)—malignant teratoma trophoblastic

particularly helpful. The normal testis has a homogeneous appearance. Malignant tumours are inhomogeneous, may be cystic and are often associated with speckled calcification.

CT scan of the chest and abdomen is done to identify pulmonary deposits and lymphadenopathy. Regular repeated examination is required postoperatively.

Staging

The stage of an individual tumour and its pathological type have considerable influence on management (see below). The Royal Marsden Hospital Staging System is summarised in Table 12.

Management

Patients with testicular tumours should be dealt with in specialist centres. There is no doubt that the earlier the diagnosis, the better the results. Improvements in therapy mean that the majority of testicular tumours should be regarded as curable.

Surgery

Orchidectomy is done through a groin incision — operations through the scrotum have a high incidence of tumour implantation. In order to reduce the risk of disseminating malignant cells by manipulation of the testis, the cord is mobilised and occluded before the testis is delivered from the scrotum. In men with a small or atrophic contralateral testis, or a history of subfertility, a biopsy from the contralateral testis should be taken. Up to 5% of men will have carcinoma in situ involving the other testis.

Table

Royal Marsden Hospital Staging System

Stage	Details
I	Tumour confined to testis
IM	Rising concentrations of serum other evidence of metastasis
II	Abdominal node metastasis
A	< 2 cm in diameter
3	2-5 cm in diameter
C	> 5 cm in diameter
III	Supradiaphragmatic nodal
ABC	Node stage as defined in stage II
M	Mediastinal
N	Supraclavicular, cervical or axillary
0	No abdominal node metastasis
IV	Extralymphatic metastasis
Lung	
L1	< 3 metastases
12	> 3 metastases, all < 2 cm in
L3	> 3 metastases, one or more of < 2 cm in diameter
H+, B+	Liver, brain or bone metastases

Supplementary management

The management options of seminoma and teratoma are given in Table 13. If chemotherapy is to be used, the patient should be advised to store semen prior to the chemotherapy. Patients with testicular tumours are often subfertile, and chemotherapy may result in irreversible germ cell damage.

Prognosis

Seminoma. For a tumour localised to the testis, over 95% of patients should survive 5 years. For those who present with metastatic disease, the 5-year survival is approximately 75%.

Non-seminomatous germ cell tumours. For those with a tumour confined to the testis and low tumour markers, 90% survive 5 years. If the tumour markers are grossly elevated and metastases are confined only to the lungs, 80% survive 5 years, but if there are visceral metastases and grossly elevated tumour markers, the 5-year survival falls to 45%.

Andrology

Infertility

Ten percent of couples have difficulty in conception. In approximately one-third, the problem lies with the male and in a further one-third there are contributory factors from both. Unless the male is found to be azoospermic (a complete absence of sperm), investigations of both partners should proceed simultaneously. The purpose of investigation is to give the couple a prognosis on the likelihood of conception. Couples who have been trying for more than 5 years with regular unprotected intercourse are unlikely to conceive without assisted conception.

Clinical features

History

Relevant questions include:

- age of both partners
- length of time trying to conceive
- previous children of both
- frequency of intercourse
- whether intercourse is taking place in the vagina.

A previous medical history of orchitis, venereal disease, inguinal or scrotal surgery, testicular injury or fallopian tube injury or disease should be sought. The occupation of both may be of significance, as may their general health and social habits (drug and alcohol intake).

Physical examination

In the male, testicular and epididymal size should be assessed, the presence of a vas on both sides confirmed and gynaecomastia excluded.

Table 13
Supplementary management of seminoma and teratoma after orchidectomy

Stage	Seminoma	Teratoma
I	Pelvic and para-aortic irradiation for	Surveillance Platinum-based chemotherapy for relapse
IIa &b	relapse Irradiation	Platinum-based chemotherapy Radical retroperitoneal lymphadenectomy for residual disease Platinum-based chemotherapy
II c	Platinum-based combination	Radical retroperitoneal lymphadenectomy for residual disease
	chemotherapy	

In the female, further examination is the province of a gynaecologist and is not further considered here.

Investigation

Semen analysis

This is the most useful investigation. The patient should abstain from intercourse for at least 4 days, and the specimen should be produced by masturbation into a sterile container and examined within 1 hour of production. The measurements provided by the laboratory and their normal values are shown in Table 14.

If white blood cells are found, a further semen specimen should be cultured for bacteria. The mixed agglutination reaction (MAR) test screens for antisperm antibodies and should be negative.

Endocrine analysis

Measurements of testosterone and prolactin are only required if a patient complains of lack of libido. In those with small testes, the FSH concentration in the blood should be measured. If it is elevated and the patient has azoospermia, no further action is required as no treatment is available.

Management

In patients with oligospermia, it may be possible to separate out the most actively motile sperm and use these for artificial insemination. Azoospermia and a normal FSH suggest a diagnosis of testicular obstruction, which may be amenable to surgical correction.

Table 14
Semen analysis

Measurement	Normal value
Volume	2-6 mL
Sperm concentration	More than 50
Sperm motility	More than 60%
Abnormal sperms	Not more than 30%
White blood cells	None
Mixed agglutination reaction	Negative

Treatment of varicocele may improve both the sperm count and motility but not necessarily conception. Infected semen is an indication for treatment with antibiotics as for prostatitis. In the presence of antisperm antibodies, there is some evidence that treatment with prednisolone improves pregnancy rates, but using high-dose steroids has significant risks and side effects. It is now possible to directly aspirate sperm from the epididymis or extract viable sperm from a testicular biopsy. These sperm can be directly implanted into an ovum. These techniques are used in cases of severe oligospermia and azoospermia.

Impotence

A better term is erectile dysfunction. The definition is the inability to achieve and maintain an erection for completion of satisfactory intercourse. Approximately 80% of men have a predominantly organic cause, but the fact that they cannot make love introduces an additional psychological element.

Aetiology

Organic

Organic factors are:

- generalised atherosclerosis
- diabetes mellitus
- multiple sclerosis
- pelvic fracture with urethral injury
- arterial disease at the aortic bifurcation
- endocrine dysfunction
- anti-hypertensive therapy
- corporeal venous dysfunction
- other drugs.

Psychogenic

The psychodynamics are poorly understood and probably multifactorial.

Clinical features

Organic

The findings are those of the underlying cause.

Psychogenic

In this form, the following are more likely to be present:

- age less than 50
- non-smoker
- absence of neurological or endocrine disorder
- no anti-hypertensive therapy
- nocturnal and early morning erections
- erections with different partners
- erection is present up to the time of attempted penetration.

Investigation

These are required only in the following situations:

- The patient presents with lack of libido, when measurements of serum testosterone and prolactin concentrations are required.
- Young patients with impotence as a result of pelvic trauma, to ensure that there is not a correctable arterial problem.
- Failure to respond to an artificial erection test with vasoactive drugs —corporeal venous incompetence may be present and requires specialist investigation.

Management

Those with obvious psychogenic causes may benefit from psychosexual counselling. Correctable organic disease should be treated.

Therapies are as outlined below:

- Sildenafil, vardenafil and tadalafil are type 5 phosphodiesterase inhibitors which prevent the breakdown of cyclic GMP, a second messenger for smooth muscle relaxation. They improve erectile ability sufficiently to allow intercourse to take place in approximately 60% of men with organic disease.
- Intraurethral prostaglandin El. A small pellet of prostaglandin is inserted into the anterior urethra in men with organic erectile dysfunction —66% achieve an erection satisfactory for intercourse.
- Intracavernosal prostaglandin El. The patient administers an injection of prostaglandin El directly into the corpora cavernosa —80% of men with organic erectile dysfunction achieve an erection.
- Vacuum erection devices. These consist of a plastic cylinder placed around the penis. By creating a vacuum within the cylinder, the penis becomes erect. The erection is maintained by placing a rubber constriction device around the base of the penis prior to removal of the cylinder.
- Penile prostheses. These are of two types: a semi-malleable and an inflatable. They are inserted at operation into both corpora cavernosa. They should only be used when other treatments have failed.

Complications

Complications are:

- phosphodiesterase inhibitors — facial flushing, headache, visual disturbances
- intraurethral prostaglandins —penile pain and discomfort
- intracavernosal prostaglandin —penile discomfort, penile fibrosis, prolonged erection
- penile prostheses —pain, infection, extrusion
- vacuum devices —penile oedema and bruising.

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