81 Urinary symptoms and investigations

- Uraemia
- Urethra
- Urine-based tests

Bladder function assessment

Bladder function assessment

Flow rate and ultrasound scan residual urine Men with LUTS and women with recurrent UTIs or LUTS are frequently investigated with a flow rate and a USS residual urine at the first clinic appointment (Figures 81.30–81.32 A peak flow rate (Q) in excess of 15 /uni00A0 mL/s suggests that max significant BOO is not present, whereas a flow rate of <10 /uni00A0 mL/s suggests that BOO is present. A very low flow rate with a very protracted pattern of voiding is suggestive of a urethral stricture. Caution is required when interpreting the significance of a single high USS residual volume; repeated tests often give a more representative picture of the degree of bladder emptying. Urodynamics A urodynamic evaluation provides information about bladder pressure and urine flow and has been referred to as a pressure– flow study . The test is performed to investigate patients with unexplained or complicated LUTS or incontinence. It is also commonly used in patients with a suspected bladder neuropathy . A device for urodynamic assessment is shown in Figure 81.33 . During urodynamics, fine catheters (or a dual- lumen catheter) are inserted through the urethra into the bladder to allow bladder filling and to record the intravesical pressure. Involuntary rises in the intravesical (detrusor) pressure during). the filling phase, with or without a desire to void, are a classical sign of an overactive bladder. High intravesical pressure during voiding with a reduced flow rate is typically seen with BOO. An atonic bladder (no detrusor activity) is seen in diabetic neuropathy and in some patients following abdominoperineal excision of the rectum when damage to the pelvic nerve

(d) Vascular Excretion Concen- tration Half-time excretion (8–12 min) Activity

5 10 15 20 Minutes

(a) (c) Figure 81.29 Curves from a series of mercaptoacetyltriglycine renograms (red line for right kidney; blue line for left kidney). (b) The left kidney graph does not go downwards, suggesting accumulation of radiotracer in the kidney – a sign of out /f_l ow obstruction. (c) Both the graphs show prolonged plateau phases, suggesting slow drainage from the kidneys – suggestive of bilateral dilated non-obstructed systems. (d) The right kidney shows a plateau phase with a delayed decline in the curve, suggesting a partially obstructed right system. (a) (b) Figure 81.30 (a) A /f_l ow meter for use in males. (b) A /f_l ow meter for females (b) (d) (a) Normal excretion.

plexus has occurred. Detrusor–sphincter dyssynergia – when coordinated contraction of the detrusor muscle in conjunction with relaxation of the external sphincter, necessary to permit normal voiding, is lost – is often seen in neurological conditions such as multiple sclerosis. Summary box 81.10 Assessment of bladder function /uni25CF /uni25CF /uni25CF /uni25CF

Figure 81.31 A /f_l ow study from a young healthy male patient showing a high-volume rapid void with an excellent peak /f_l ow of 32 mL/s. The upper curve shows the /f_l ow rate of urine while the lower graph shows total urine voided. Figure 81.32 A /f_l ow study performed by a patient with bladder outlet obstruction showing a reduced peak /f_l ow of urine (8.1 mL/s). Simple tests are a /f_l ow rate and a USS residual urine estimation Urodynamics provides a pressure– /f_l ow pro /f_i le Urodynamics requires /f_i ne catheters to be inserted into the bladder and usually the rectum A non-invasive technique in males using a penile cuff has a limited clinical role Figure 81.33 A modern urodynamic machine.

Endoscopy

Endoscopy

Cystoscopy To further evaluate urinary symptoms, the entire lining of the urinary tract can be directly visualised from the urethra - -). and bladder (using a cystoscope) to the ureter and renal pelvis (using a semirigid ureteroscope), and finally the renal calyces (using a flexible ureteroscope). Cystoscopy can be under - taken either as flexible cystoscopy (Figure 81.4), using local anaesthesia, or as rigid cystoscopy (Figure 81.5), preferably under a general anaesthetic. Telescopes with di ff erent fields of le (0°, 12°, 30° and 70° lenses are commonly view are availab used). In the operating theatre, most endoscopic procedures, including cystoscopy , require a urology stack consisting of a camera, monitor, light source, electrocautery and insu ffl ator for laparoscopy procedures (Figure 81.6). The male urethra is longer than the female urethra and is angulated at the level of the symphysis pubis (Figures 81.7–81.12). Flexible cystoscopy is thus relatively poorly ted in young males, in whom it may be uncomfortable. It is tolera principally a diagnostic tool but a few minor procedures can be

Figure 81.2 White urine seen in chyluria (courtesy of Dr TC Goel, Emeritus Professor of Surgery, King George’s Medical University, Lucknow, India). (b) Figure 81.3 Haematochyluria with milky-red urine (a) ; the blood settles after some time, leaving chyluria above (b) (courtesy of Dr TC Goel).

accomplished using the flexible cystoscope, such as insertion/ removal of ureteric stents, small biopsies and diathermy/laser of small bladder lesions. More can be achieved with a rigid cystoscope under general anaesthesia, especially in relation to instrumentation of the ureters. Summary box 81.6 Cystoscopy /uni25CF /uni25CF /uni25CF Ureteroscopy Ureteroscopy can be performed as both a diagnostic and a therapeutic procedure. A rigid or semirigid ureteroscope can be used in the ureter as far as the renal pelvis, but to inspect or operate on the renal pelvis or renal calyces a flexible uret - eroscope is, generally , needed (Figure 81.13). The procedure is most often performed when pathology , commonly stones, strictures or tumours, of the ureter is suspected.

Figure 81.4 Flexible cystoscope with attachments for irrigating /f_l uid (black arrow), instruments (red arrow), and connection to video

equip ment (blue arrow). (a) (b) (c) (d) Figure 81.5 Parts of a rigid cystoscope. Telescope (a) , obturator (b) , sheath (c) and bridge (d) . The obturator is inserted into the outer sheath for blind insertion of the cystoscope sheath – usually in females. The light cable and camera are attached to the telescope, which replaces the obturator in blind insertions. In males, the bridge is attached to the sheath to provide additional length and the telescope is placed through the bridge for insertion of the

cystoscope under vision. Can be performed with either a rigid cystoscope under general anaesthesia or a /f_l exible cystoscope under local anaesthesia Flexible cystoscopy is principally a diagnostic procedure Rigid cystoscopy allows more procedures to be performed (a)

(b) (c) (d) (e) Figure 81.6 The urology stack. In this stack, from top down, are the monitor (a) , insuf /f_l ator for carbon dioxide for laparoscopy (b) , camera connector (c) , light source (d) and a video recording device (e) .

Epididymis

Epididymis

Epididymal pathology is rare in prepubertal males. In sexually active males, acute epididymitis (often due to Chlamydia) with significant pain and swelling needs to be distinguished from acute testicular torsion. A Doppler USS may help di ff eren - tiate between the two conditions: in epididymitis it shows an - increased blood flow into the inflamed epididymis, whereas in torsion it shows decreased or complete lack of blood flow to the testis. If ther e is any doubt, scrotal exploration is undertaken. Epididymal cysts can form similar scrotal swellings to hydroceles but can be distinguished by the fact that the testis can often be felt separately . They contain clear or white fluid. Both hydroceles and epidid ymal cysts transilluminate on clin - ical examination. Genitourinary TB can result in bilateral nodular induration of the epididymis and nodularity of the vas deferens. It may also result in scrotal abscesses that, unlike pyogenic abscesses, (Figure 81.1).

Figure 81.1 Cold abscess of the left scrotum. (Reproduced with permission from Kumar R. Reproductive tract tuberculosis and male infertility. Indian J Urol 2008; 24 : 392–5.)

FURTHER READING

FURTHER READING

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Glans penis

Glans penis

In the younger male, genitourinary warts due to human papillomavirus (HPV) infection may be observed. In the older male, red raised patches on the glans penis or the inner aspect of the prepuce due to Zoon’s balanitis or CIS (also known as erythroplasia of Queyrat or Bowen’s disease) are distinguished only on penile biopsy .

HAEMATURIA

HAEMATURIA

Haematuria occurs when there is blood in the urine. This is now classified as visible haematuria (VH) or non-visible haematuria (NVH). Enquiry should be made about the timing of the blood in relation to the urinary stream – initial (urethral pathology), throughout the stream (bladder or upper tracts) or terminal (bladder neck or prostatic pathology) – as well as the degree of haematuria and its frequency . A patient with haematuria should be investigated regardless of whether they are taking anticoagulant therapy . The concern is that the haematuria, especially if painless, may be due to an underlying neoplasm, usually a bladder or renal tumour. Causes of haematuria include trauma (T), infection (I) and neoplasm (N) anywhere in the urinary tract. Haematuria in association with loin pain and a palpable loin mass defines the classic triad of symptoms and signs of a renal tumour, although this triad is seen in less than - 10% of these patients. In countries with endemic tuberculosis (TB) or filarial disease, haematuria is also seen in patients with these genitourinary infections. In genitourinary TB, haema - turia is usually associated with dysuria and frequency due to bladder infection. In patients with filarial involvement of the retroperitoneal lymphatics, haematuria is intermittent, often lasting months or years , and is associated with ‘milky’ or cloudy urine, a condition called chyluria. Haematuria requires detailed investigation in almost all - cases except young women with a proven UTI. In vestigations include an ultrasound scan (USS) of the kidneys–ureters– bladder (KUB) and additional contrast imaging if needed. If no aetiology can be identified on laboratory and imaging studies, cystoscopy is mandatory . Although BPH can cause haematuria in older men, this diagnosis should be considered after exclusion of all other causes. The cancer detection rate depends on the degree of haematuria, being approximately 20% in those patients with VH but very much lower in those with NVH (<5%). - Summary box 81.3 Haematuria /uni25CF /uni25CF /uni25CF

Classi /f_i ed as VH or NVH A list of potential causes for haematuria can be rapidly generated by considering trauma (T), infection (I) and neoplasm (N) anywhere in the urinary tract Haematuria requires detailed investigation in nearly all cases

Many drugs and foodstu ff s have been reported to produce abnormal discoloration of the urine. Most colours have been reported but the most frequently encountered clinically are red/orange and brown. Apart from haematuria, the presence of haem in the urine also produces red discoloration and generates a positive dipstick test. Red urine discoloration due to haemoglobinuria may present in haemolytic disorders such as ‘march haematuria’, classically seen in dehydrated soldiers after prolonged marching. Likewise, myoglobinuria due to myocyte destruction, e.g. caused by rhabdomyolysis after crush injury or compartment syndrome, can also result in red discoloration of the urine. Disordered haem production, seen in porphyria, can result in red discoloration that may change to brown or purple with exposure to sunlight. Several medications can cause red/ orange discoloration of the urine, most commonly rifampicin, isoniazid or phenazopyridine. Others include chlorpromazine, thioridazine, senna and laxatives containing a phenolphthalein component.

Consumption of large quantities of beetroot can result in red discoloration of the urine. This discoloration is due to the excretion of betalain (betacyanin) pigments such as betanin. The commonly used antibiotics nitrofurantoin and metronidazole can lead to brown urine. Brown urine due to high levels of circulating bilirubin is a feature of obstructive jaundice.

INVESTIGATION OF URINARY SYMPTOMS Blood tests

INVESTIGATION OF URINARY SYMPTOMS Blood tests

Blood counts and chemistry Initial blood tests in suspected urological pathologies include a full blood count, urea, creatinine and electrolytes. Creatinine, a surrogate marker for renal function (glomerular filtration), is an end product of muscle catabolism and may be unchanged despite a wide variation in estimated glomerular filtration rate (eGFR). eGFR is recommended as the optimal method of reporting renal function in many countries. Patients with calculous disease routinely have serum calcium, uric acid and parathyroid hormone levels checked to rule out a metabolic predisposition to stone formation. Serum alkaline phosphatase may be elevated in patients with bone metastases due to a ur ological malignancy and is commonly seen in men with disseminated prostate cancer. Summary box 81.4 Biochemical assessment of renal function /uni25CF /uni25CF /uni25CF

eGFR is increasingly reported along with urea and creatinine as it is more informative of true renal function With both kidneys functioning normally, an individual has approximately six times the renal function needed to remain off dialysis Serum creatinine will remain normal with unilateral renal pathology but a normally functioning contralateral kidney

Serum tumour markers are utilised in patients with prostate and testicular cancer. Currently no serum tumour markers exist in routine clinical practice for renal or bladder cancer. Prostate-specific antigen PSA is a glycoprotein produced by prostatic epithelial cells. Altered architecture of the prostate in conditions such as BPH, prostatitis and prostate cancer allows PSA to enter the blood stream and be detected by a blood test. The commonly used PSA assays measure the total amount of PSA (tPSA). PSA levels can be influenced by certain drugs, most notably 5 α -reductase inhibitors used to treat men with LUTS, but also by aspirin, statins and thiazide diuretics. The PSA test can be significantly influenced by a recent UTI and the true PSA level only returns to baseline 6 weeks after eradication of an infection. Summary box 81.5 Prostate-specific antigen /uni25CF /uni25CF /uni25CF /uni25CF α PSA values in a population of men form a continuum with no clear abnormal threshold. The value of PSA that triggers a biopsy is variable and is influenced by age, ethnicity , family history and findings on DRE. The benefits of screening asymptomatic men for prostate cancer using PSA testing are controversial and a large UK-based clinical study (ProtecT trial) found that at a median of 10 years very few patients died of prostate cancer irrespective of treatment or surveillance. At present, PSA-based screening for prostate cancer is not routinely performed in the UK but men interested in having a PSA test can request this from their family practitioners. A similar practice is followed in many countries. Risk prediction models have been developed in recent years to assist clinicians and patients in predicting prostate cancer diagnosis, stage and prognosis. A number of these risk assessment tools are available online as a decision aid

for an individual man to ev aluate his own risk of prostate cancer. These include the Prostate Cancer Prevention Trial (PCPT) Risk Calculator and the European Randomized Study of Screening for Prostate Cancer (ERSPC) Risk Calculator. For men newly diagnosed with prostate cancer, PSA assists with risk (of disease progression) stratification. It is also a useful marker of response to treatment and of disease recurrence after treatment. Franz Ziehl , 1859–1926, German bacteriologist and a professor in Lübeck, Germany . Friedrich Carl Adolf Neelsen , 1854–1898, German pathologist and professor at the Institute of Pathology , University of Rostock, Germany . kinetics Since PSA may be elevated in non-malignant conditions, PSA derivatives/kinetics have been used to improve the specificity of testing. Some of the derivatives include free PSA (fPSA), complexed PSA (cPSA) and free/total PSA ratio (f/tPSA). Since BPH tissue within the prostate also contributes to tPSA, PSA density (PSAD) factors in the volume of the prostate by - dividing tPSA by prostate volume. A high PSAD increases the likelihood that the elevated PSA is due to malignancy and not due to the large gland alone. PSA kinetics involve measurement of the rate of change of various forms of PSA based on the premise that a rapid increase or change may be more predictive of cancer. PSA velocity is the annual absolute increase in tPSA /uni00A0 and a value >0.75 ng/mL per year compared with baseline has been considered suspicious. PSA doubling time is the number of months it takes for a baseline PSA to double. Testis tumour markers Serum tumour markers routinely used in the management of men with suspected testicular cancer are alpha-fetoprotein (α FP), beta-human chorionic gonadotropin (β HCG) and lactate dehydrogenase (LDH). These markers sometimes provide insight into the likely diagnosis, histological subtype of germ cell tumour present, success of treatment and recur - rence. They also contribute to the stratification of patients with testicular cancer into prognostic categories using a classification devised by the International Germ Cell Cancer Collaborative Group.

Is not signi /f_i cantly altered by DRE Can be signi /f_i cantly altered by a UTI After an infective episode, takes 6 weeks to return to baseline values Is arti /f_i cially lowered, up to two times, in men taking 5 -reductase inhibitors (/f_i nasteride, dutasteride)

Introduction

Introduction

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LESS COMMON URINARY SYMPTOMS Haematospermia

LESS COMMON URINARY SYMPTOMS Haematospermia

This refers to blood, which can be bright red or a brown colour, in semen. It is most commonly due to benign inflammatory change in the prostate or TB. A digital rectal examination (DRE) should be performed alongside a prostate-specific anti gen (PSA) test. A transrectal ultrasound (TRUS) or magnetic resonance imaging (MRI) of the prostate should be considered. In most cases, haematospermia is self-limiting.

LOWER URINARY TRACT SYMPTOMS

LOWER URINARY TRACT SYMPTOMS

A normal micturition cycle consists of two phases: storage and voiding. During the storage phase, the bladder holds urine at low pressures and the urethral sphincter is closed. During voiding, the bladder contracts to expel urine and the voluntary urethral sphincter relaxes to allow its passage. In addition, the urethral lumen must be patent to allow voiding to occur. Disruption of these processes results in lower urinary tract either storage LUTS (frequency , nocturia, urgency and urinary incontinence); voiding LUTS (hesitancy , a reduced stream, straining); or postmicturition LUTS (incomplete emptying and postmicturition dribble). Storage LUTS result from failure of the bladder to act as a functioning reservoir and are commonly seen in patients with an overactive bladder or a bladder neuropathy . Vo i d i n g a n d p o s t m i c t u r i t i o n LU T S a re c o m m o n l y s e e n i n men with bladder outlet obstruction (BOO) or an underactive bladder; however, a man with BOO may also have storage LUTS. BOO is also reported in women and may be caused by urethral stenosis, strictures or a hypocontractile bladder. The term ‘prostatism’ is obsolete. It was used to describe a combination of LUTS in men who were presumed to have an enlarged prostate or benign prostatic hyperplasia (BPH). Ho wever, the symptoms are not specific to BPH and may occur in several other conditions, including urinary tract infections (UTIs), urethral stricture, overactive bladder, CIS of the bladder, etc. Further, not all symptoms may be present in every patient and most patients have a variable degree of di ff erent symptoms. Thus, the term LUTS is now used to describe all such symptoms. It may not always be possible to identify the aetiology of LUTS and additional investigations with urodynamics (see Urodynamics) may occasionally be required. The International Continence Society provides the internationally accepted definitions for symptoms relating to lower urinary tract function. /uni25CF Frequency – the patient considers that they void too of ten during the day . /uni25CF Nocturia – the individual wakes at night at least once to void. /uni25CF Strangury – a sensation of constantly needing to void. Typically , the patient describes having to stand/sit for long periods with the sensation that micturition is imminent. /uni25CF Urgency – a sudden compelling desire to pass urine that is di ffi cult to defer. /uni25CF Urge incontinence – involuntary urinary leakage, of ten a large volume, immediately preceded by the sensation of urgency . /uni25CF Stress incontinence – involuntary urinary leakage that occurs when the intra-abdominal pressure rises during coughing, laughing, sneezing or exercising. /uni25CF Nocturnal enuresis – involuntary loss of urine during sleep. /uni25CF Hesitancy – when an individual has di ffi culty initiating micturition, resulting in a delay in the onset of voiding. /uni25CF Reduced urinary stream – usually reported com pared with previous performance or in comparison with the performance of others. /uni25CF Intermittency – when urine flow stops and starts, on one or more occasions. /uni25CF Straining – the muscular e ff ort used in order to initiate, maintain or improve the urinary stream. /uni25CF Incomplete emptying – the sensation that, at the end of micturition, bladder fullness persists. /uni25CF Postmicturition dribble – when involuntary loss of

urine occurs immediately after the individual has finished passing urine. Lower urinary tract symptoms (LUTS) /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

LUTS are classi /f_i ed as storage, voiding or post micturition Storage LUTS are typical of an overactive bladder Voiding LUTS are typical of BOO Some patients have storage and voiding LUTS in combination LUTS are sometimes investigated with urodynamics

Learning objectives

Learning objectives

To understand: The signi /f_i cance of pain relating to urinary tract pathology • The difference between renal pain and ureteric colic • The de /f_i nitions of common lower urinary tract symptoms •

PAIN

PAIN

Pain is a common urological symptom. Pain while passing urine is called dysuria and refers to discomfort experienced during voiding – typically described as a sensation akin to passing razor blades or glass. Most commonly , dysuria is due to an infection in the lower urinary tract but can rarely be due to carcinoma in situ (CIS) of the bladder, especially in an older male smoker with haematuria. Renal pain is usually caused by distension of the renal capsule and is felt as a constant, gnawing pain in the loin/renal angle. Ureteric colic (often incorrectly referred to as renal colic) is di ff erent from renal pain and is typified by the lateralised, colicky pain e xperienced by someone with a ureteric calculus. Ureteric colic can radiate to the groin or to the testicle/labium but does not radiate to the back of the leg. Ureteric colic can also, rarely , be caused by a blood clot or a sloughed renal papilla in the ureter. Some patients simultaneously experience both ureteric colic and renal pain. Summary box 81.1 Pain from the urinary tract /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF Infection or inflammation of the bladder can produce suprapubic pain. Suprapubic pain that is experienced when the bladder is full and is relieved by micturition is typical of interstitial cystitis, an idiopathic inflammatory disorder of the bladder typically seen in middle-aged women. Testicular pain is a common symptom in boys and young men. Sudden, severe testicular pain should be treated as a medical emergency to rule out a diagnosis of acute testicu - lar torsion. Hydroceles and epididymal cysts usually do not cause significant pain but can have an increasing pressure e ff ect as they enlarge. A dragging sensation in the scrotum that gets worse towar ds the end of the day is characteristic of a varicocele. Testicular tumours in young men are not usually associated with significant pain. Investigation of testicular pain in the young adult male/middle-aged male is frequently negative, resulting in a highly unsatisfactory diagnostic label of ‘idiopathic testicular pain’ or ‘chronic orchialgia’. Patients undergoing vasectomy are routinely counselled about the approximately 10% risk of testicular pain in the short term following surgery and, more importantly , the 1% chance of chronic testicular pain in the longer term. Perineal pain is often a feature of a complex of symptoms typically seen in middle-aged men who, by a process of exclusion, are diagnosed as having acute or chronic prostatitis. With prostatitis , perineal pain may be accompanied by suprapubic pain, low back pain that radiates to the legs and penile pain as well as frequency of micturition and dysuria. In the absence of the specific features that are required to diagnose prostatitis, these patients should be considered to have chronic pelvic pain syndrome (CPPS) and not prostatitis. Perineal pain is an ominous symptom after previous treatment for a pelvic malignancy , often signifying recurrent pelvic disease.

Renal colic is a misnomer and should be referred to as ureteric colic Renal pain can be distinguished from ureteric colic by careful history taking Renal pain and ureteric colic may be experienced simultaneously Ureteric colic may radiate to the groin/testicle/labium Ureteric colic does not radiate to the chest or the back of the leg To be able to: Select the appropriate diagnostic tests •

Penis

Penis

Peyronie’s disease is an idiopathic condition in which fibrosis develops in the corpora cavernosa of the penis. The ‘plaque’ of Peyronie’s fibrosis is usually palpable in the midline anywhere from the base of the penis to just behind the corona. It gives rise to painful angulation of the penis on erection. Penile fracture occurs when there is trauma to the erect penis. Classically , there is an audible crack during sexual intercourse François Gigot de la Peyronie , 1678–1747, French surgeon. Johannes Jacobus Zoon , 1902–1958, Professor of Dermatology , University of Utrecht, The Netherlands, described Zoon’s balanitis in 1952. Louis Auguste Queyrat , 1856–1933, French dermatologist, described erythroplasia of Queyrat in 1911. John Templeton Bowen , 1857–1940, American dermatologist, described Bowen’s disease. detumescence . The patient presents with gross bruising of the penile shaft skin.

Pneumaturia

Pneumaturia

This is gas in the urine. Patients typically describe frothy urine, bubbles in the urine or a stream that intermittently stops and starts. The commonest cause is an underlying colovesical fistula, usually due to primary pathology in the rectum or sigmoid colon. Giovanni Battista Morgagni , 1682–1771, Professor of Anatomy , University of Padua, Italy . Christian Johann Doppler , 1803–1853, Professor of Experimental Physics, Vienna, Austria, enunciated the ‘Doppler principle’ in 1842. Harry Fitch Klinefelter , 1912–1990, American rheumatologist and endocrinologist, first described Klinefelter’s syndrome in 1942. White urine is a complaint seen in two distinct conditions. One is in young men who may report the presence of a white substance in urine. This substance is usually semen and requires no treatment other than reassurance. The second condition is chyluria where lymphatic fluid, from channels obstructed by filarial inflammation, leaks into the renal pelvicalyceal system. This condition requires investigation for confirmation of the diagnosis.

Prepuce (foreskin)

Prepuce (foreskin)

Phimosis occurs when the distal foreskin is tight and will not retract. Paraphimosis occurs when a poorly retractile foreskin becomes trapped in the retracted state and cannot be replaced. Significant oedema of the foreskin results, making replacement of the foreskin increasingly di ffi cult. Depigmentation and scarring of the distal prepuce occurs in balanitis xerotica obliterans (BXO).

Radiology

Radiology

Urinary tract ultrasound scan USS (Figure 81.14) can characterise pathologies of the kidney , bladder, prostate and testis very well but is not very good for assessing the ureters unless they are significantly dilated or have sizeable pathology . The lack of radiation and contrast exposure coupled with portability and availability make USS the first imaging investigation in urological diseases. It is extremely useful in the detection of hydronephrosis (even at the bedside in an emergency), renal cysts, tumours, scarring and stones. Stones classically produce an acoustic shadow , but USS is not the most sensitive imaging modality for detecting renal stones. USS is extensively used for the insertion of a percutaneous nephrostomy (PCN) to drain an obstructed renal collecting system. It is sometimes used to further characterise renal lesions detected by other modalities such as computed

Figure 81.7 A normal urethra on urethroscopy. Figure 81.8 The appearance of normal bladder mucosa on cystos copy: a normal right ureteric ori /f_i ce (yellow arrow) at the end of the interureteric bar (red arrow). (b) Figure 81.9 (a, b) Bladder wall trabeculation (yellow arrows) and

saccules (red arrows) seen on cystoscopy. (Image (a) courtesy of The Center for Reconstructive Urology, CA, USA.)

Figure 81.10 An endoscopic view of the prostatic urethra with the verumontanum at 6 o’clock (red arrow) and the bulging right (black arrow) and left (blue arrow) lobes of the prostate.

tomography (CT) or MRI, particularly for haemorrhagic cysts versus solid lesions. USS can detect bladder tumours, calculi, a thickened, trabeculated bladder wall in patients with BOO and large bladder diverticula. It can also be used to determine the residual urine after micturition. In addition, USS is frequently employed to investigate men with scrotal swellings and has a role to play in the assessment of urethral stricture disease. Transrectal ultrasound scan TRUS is often performed in conjunction with biopsy of the prostate. It requires the use of a special probe (Figure 81.15 that provides transverse as well as sagittal views of the prostate Summary box 81.7 Ultrasound scan /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF (Figure 81.16). TRUS is most often used to guide a prostate biopsy in men suspected to have prostate cancer. The classic abnormality associated with prostate cancer is a hypoechoic area in the peripheral zone but this is rarely found in the absence of a palpable abnormality on DRE. Typically , 12 or more systematic biopsies are taken using a biopsy device such as that shown in Figure 81.17 . Additional biopsies may be) taken from areas that are suspected to be malignant.

(b) Figure 81.11 Bladder calculi seen on cystoscopy. Stones may be multiple (a) or single (b) . The stone in (b) has a characteristic shape and is referred to as a ‘jack’

stone. (Image (b) reprinted with permission from Medscape Drugs & Diseases (http://emedicine.medscape.com/) , 2017, available at: http://emedicine.medscape.com/article/2120102-overview) . Figure 81.12 Papillary bladder tumours seen at cystoscopy near the right ureteric ori /f_i ce (arrow) (courtesy of Tim Nathan). Figure 81.13 A /f_l exible ureteroscope (top) and a semirigid uretero

scope (bottom). Frequently used to screen patients with suspected urological pathology Frequently part of a haematuria clinic protocol An excellent method to detect hydronephrosis Can be performed at the bedside in critically ill patients Recently has been combined with contrast enhancement in certain settings, such as in the assessment of renal cysts

(c) (e) Figure 81.14 Ultrasound scan showing: (a) hydronephrosis (courtesy of Dr Bruno Di Muzio, Radiopaedia.org, rID: 21885); (b) renal cyst (courtesy of Dr Ian Bickle, Radiopaedia.org, rID: 21139); (c) tumour (courtesy of Wendy Boller); (d) medullary sponge kidney with renal calculi – note the stone gives rise to an acoustic window (courtesy of Dr Bruno Di Muzio, Radiopaedia.org, rID: 12141); (e) /uni00A0 angiomyolipoma (arrow). (d) renal Figure 81.15 Transrectal probe demonstrating the diagonal channel for the biopsy needle (arrow).

Transperineal template biopsies of the prostate Transperineal template biopsies of the prostate (TPTBP) are increasingly used clinically and may replace TRUS-guided prostate biopsies as a first-line test. Currently , TPTBP are used to further evaluate men with a negative TRUS-guided prostate biopsy in whom the PSA trend remains suspicious, or younger men for whom a diagnosis of low-risk prostate cancer has been made and in whom it is important to exclude more significant disease in other parts of the prostate (most notably in the anterior aspects of the gland) not easily accessible via the transrectal route. TPTBP are usually performed under local anaesthetic and have a much lower risk of sepsis than TRUS-guided biopsies. Summary box 81.8 Prostate biopsies /uni25CF /uni25CF /uni25CF Kidneys–ureters–bladder radiograph A plain radiograph of the abdomen and pelvis that includes the regions of the body occupied by the KUB is frequently called an x-ray KUB (Figure 81.18). In the normal setting, soft-tissue outlines of the kidneys are commonly seen but normal ureters and bladder will not be seen. The commonest indication for a KUB radiograph is to screen patients for the presence of urinary tract calculi. Patients who have had a CT scan resulting in the diagnosis of a urinary tract calculus often have a supplementary KUB radiograph to determine if a plain radiograph can be used in the subsequent follow-up of the patient. Phleboliths (thrombosed, calcified veins in the pelvis) can easily be mistaken for distal ureteric stones. Finally , a KUB radiograph is often used to check for correct positioning of a ureteric stent. Intravenous urography Intravenous urography (IVU) continues to be frequently used in the evaluation and management of patients with urinary

Figure 81.16 Views of the prostate on a transrectal ultrasound scan. (a) On the transverse image, the normal prostate demonstrates an anterior transition zone (TZ) and a posterior (cow-horn-shaped) peripheral zone (PZ). Asterisk indicates the verumontanum. (b) sagittal image the bladder is seen above the prostate (arrowheads) as well as the seminal vesicles (arrow). (a) (b) Figure 81.17 (a) A biopsy device used for prostatic biopsy. (b) cores taken from the right and left prostatic lobes during transrectal ultrasound scanning. On the TRUS has been the traditional method of guiding prostate biopsies TPTBP are becoming increasingly popular TPTBP have a much lower sepsis risk than TRUS biopsies Biopsy

stones and urinary TB in many parts of the world, even though it provides less information than a CT scan. This is primarily due to its wider availability , lower cost and lower radiation exposure (Figure 81.19). Retrograde urethrogram and voiding cystourethrogram During a retrograde urethrogram (RGU), radiocontrast material is gently instilled into the urethra to delineate its anat omy . The investigation is primarily used to identify urethral strictures in men. Radiocontrast material is instilled into the bladder, through either a urethral catheter or a suprapubic Morton A Bosniak , 1929–2016, Professor of Radiology , New Y ork University (NYU) Langone School of Medicine, New Y ork, NY , USA. tube for a voiding cystourethrogram (VCUG). VCUGs are used to identify reflux into the ureter, usually in children, and for delineation of the proximal urethra in men with complete urethral strictures. They may also help in assessing bladder capacity in TB (Figure 81.20). Computed tomography scan A non-contrast CT scan is the imaging modality of choice in the investigation of a patient with suspected urinary tract calculi (Figure 81.21). This investigation is quick, often taking less than 2 minutes to perform, picks up most calculi and can be tailored to deliver low radiation doses. Other variations of the CT scan include a contrast CT , which can be tailored to acquire images in multiple phases (triple phase for renal tumours) and a urographic phase for urothelial tumours. A contrast CT scan of the chest, abdomen and pelvis is fre - quently used to stage patients with renal tumours (Figure 81.22), muscle-invasive bladder cancer and

young men with testicular cancer. CT is less fr equently used in men with prostate cancer but does have a role to play when lymph node disease is being assessed prior to treatment. Cysts are a frequent incidental finding on USS and CT - scans of the kidneys. In 1986, a classification of renal cysts based on CT criteria, known as the Bosniak classification, was devised. This classification can also be applied to MRI.

(c) Figure 81.18 (a) Left lower pole renal stone on a plain kidneys– ureters–bladder radiograph (courtesy of Professor Frank Gaillard, Radiopaedia.org, rID: 12555). (b) A staghorn calculus in the left kidney /uni00A0 (courtesy of Dr Natalie Yang, Radiopaedia.org, rID: 9733). (c) Right lower pole calculi and steinstrasse (multiple stone fragments from shock-wave lithotripsy to break the kidney stone), leading to the formation of a ‘stone street or steinstrasse’ in the distal right ureter (arrow) (courtesy of Dr Ali Abougazia, Radiopaedia.org).

It is used to predict the likelihood of malignancy in the lesion. Based on this classification (Figures 81.23 and 81.24 majority of cysts are category I and II and do not require treatment or follow-up imaging. Category IIF (‘F’ indicating the need for follow-up) cysts do require further imaging but the duration of this is uncertain. Category III cysts have a risk of malignancy of 30–100% and should undergo a biopsy to identify those patients requiring surgery . Category IV ‘cysts’ have an incidence of malignancy of 67–100% and surgical removal should be considered.), the Magnetic resonance imaging MRI scanning has a significant role to play , either on its own or as an adjunct to other cross-sectional imaging modalities, in the staging of a number of urological cancers, particularly prostate cancer. Modern MRI techniques utilise both anatomical and

(b) Figure 81.19 Intravenous urogram plain (a) and 5-minute (b) demonstrating a partial staghorn stone in the left kidney. The right kidney is normal. A 5-minute /f_i lm shows contrast entering the pelvica lyceal system and helps in

identifying the location of the stone. Figure 81.20 Cystogram in a patient with tuberculosis, demonstrating a small ‘thimble’ bladder and re /f_l ux into the right kidney. (a) (b) (c) (d) Figure 81.21 (a) A non-contrast computed tomography scan demon

strating bilateral renal calculi (courtesy of Dr Jeremy Jones, Radiopae

dia.org, rID: 6211); (b, c) left ureteric calculus in the axial and coronal reconstructions (courtesy of Dr Raju Sharma and Dr Ankur

Goyal); (d) bilateral lower ureteric calculi (courtesy of Dr Raju Sharma and Dr Ankur Goyal). /f_i lms,

functional imaging and are known as multiparametric MRI (mpMRI). Anatomical imaging is based on standard MRI techniques (T1- and T2-weighted images) and functional imaging is based on di ff usion-weighted imaging (DWI) (for enhanced (DCE) imaging (for tissue perfusion assessment after intravenous contrast administration) (Figure 81.25). The multiple parameters assessed in the scan are combined in a fiv e-point scoring system, called PI-RADS (Prostate Imaging – Reporting and Data System), to assign a likelihood (from 1, benign to 5, highly suspicious) that prostate cancer is present within the abnormality detected on mpMRI of the prostate. The lesions identified on mpMRI can be specifically targeted for biopsy using novel technologies. MRI images can be fused with real-time TRUS-USS images to guide the biopsies to these abnormal areas in a similar manner to TRUS biopsy . Such ‘fusion’ biopsies require specialised workstations. Similar scoring systems are being used to assess bladder cancer. Summary box 81.9 Magnetic resonance imaging /uni25CF /uni25CF /uni25CF /uni25CF

Figure 81.22 Computed tomography scan demonstrating a large left renal tumour with involvement of the left renal vein (arrow) (courtesy of Dr Laughlin Dawes, Radiopaedia.org, rID: 35937). I ~0% are malignant IIF ~5% are malignant III ~50% are

malignant Used to stage many urological cancers mpMRI has a signi /f_i cant role in the assessment of men with suspected prostate cancer mpMRI is increasingly used prior to prostate biopsy. Prebiopsy MRI permits selection of biopsy technique (TRUS versus TPTBP) Prebiopsy MRI assists with targeting of biopsies II ~0% are malignant Figure 81.23 Bosniak classi /f_i cation of renal cysts. The classi /f_i

cation depends on the characteristics of the cyst wall,

septae, solid component and enhancement on con

trast administration. IV ~100% are malignant

Figure 81.24 Computed tomography scans showing cysts of various categories: (d) Bosniak III cyst; (e) Bosniak IV cyst (courtesy of Dr Raju Sharma and Dr Ankur Goyal). (a) (c) Figure 81.25 Multiparametric magnetic resonance images of a patient with prostate cancer. (c) Apparent diffusion coef /f_i cient (ADC). (d) Dynamic contrast enhanced (DCE). The tumour appears dark on the axial T2-weighted image /uni00A0 (arrow); the corresponding area shows restricted diffusion on the DWI and ADC images as well as abnormal contrast enhancement on the DCE axial image (within the prostate, the red colour denotes abnormal areas that are possibly malignant) (courtesy of Janet Cochrane Miller, Radiology Rounds, Massachusetts General Hospital).

SPECT CT and PET CT

SPECT/CT and PET/CT

Single photon emission computed tomography (SPECT) and positron emission tomography (PET) are nuclear medicine imaging techniques that provide metabolic and functional information, unlike CT and MRI. They have both been combined with CT and MRI to provide detailed anatomical and metabolic information. PET/CT looks promising as a tool for the detection of distant metastases in bladder cancer. To date, the technique has not been used extensively in patients with renal cancer. In men with testicular cancer, it is recommended in the

(a) Bosniak I cyst; (b) Bosniak II cyst; (c) Bosniak IIF cyst; (b) (d) (a) T2 weighted. (b) Diffusion weighted (DWI).

follow-up of patients with seminoma with any residual mass. PET/CT may use a number of di ff erent radiotracers, including 11 18 18 C-choline, F-choline (Figure 81.26), F-fluciclovine and 68 the newer gallium-68 (GA)-labelled antibodies targeting prostate-specific membrane antigen (PSMA) for the detection and staging of prostate cancer and its recurrence after initial definitive therapy . Bone scan A bone scan is most frequently used when bone metastases are suspected based on symptoms or other investigations. It is also used in the routine staging of patients with high-risk prostate cancer, although there is a <5% chance of a bone scan being positive until the PSA is >40 /uni00A0 ng/mL. Dimercaptosuccinic acid renogram 99m Tc dimercaptosuccinic acid (DMSA) is a technetium radiopharmaceutical used in renal imaging to evaluate renal structure, especially in the paediatric population, where it is used to detect renal scarring (Figure 81.27). Diethylenetriaminepenta-acetate renogram 99m Tc diethylenetriaminepenta-acetate (DTPA) is another technetium radiopharmaceutical used in renal imaging. Previously it was used frequently in patients suspected of having ureteropelvic junction (UPJ) obstruction but it has largely been superseded by the mercaptoacetyltriglycine (MAG3) renogram in such cases. Mercaptoacetyltriglycine renogram 99m Tc Mercaptoacetyltriglycine (MAG3) is now the radio - pharmaceutical of choice used in the assessment of patients with suspected upper urinary tract obstruction such as UPJ obstruction. The shape of the renogram curve (following subtraction of background activity) is dependent, first, on MAG3 uptake from the circulation to the kidney and, second, on MAG3 elimina - tion from the kidney into the bladder. Classically , the nor mal MAG3 renogram curve has three phases (Figure 81.28): 1 The curve rises steeply upwards following intravenous tracer injection. This is indicative of the speed of tracer injection and its delivery to the kidneys (i.e. renal vascular supply). 2 A more gradual slope that represents renal handling of MAG3 (renal uptake by tubular secretion and glomerular filtration) and peaks between 2 and 5 minutes. The time taken for the curve to peak following tracer injection is referred to as T . This may be delayed in patients with max renovascular insu ffi ciency , renal failure and obstruction. 3 Commences after the peak. It is associated with the

(b) Figure 81.26 A 55-year-old patient with an increasing prostate-speci /f_i c antigen level 27 months after radical prostatectomy. Coronal (left), axial (middle) and sagittal (right) fused image projections of choline positron emission tomography/computed tomography (PET/CT) scans. 11 C-choline uptake in the right (large arrow) and left (thin arrow) iliac regions revealed lymph node involvement. 18F- /f_l uorodeoxyglucose PET (courtesy of Hussein Farghaly). (a) Focal (b) This was not observed with

emergence of tracer in the bladder and represents elimination (but also delivery) of tracer from the kidney . After 3 minutes, both elimination and uptake are in competition, but the former subsequently dominates. It is this elimination curve that is dependent on the upper tract urodynamics. Renogram curves of a number of nor mal and pathological conditions are shown in Figure 81.29 .

(b) Figure 81.27 Dimercaptosuc

cinic acid scans. (a) Normal kidneys; (b) horseshoe kidney; (c) focal renal scarring (arrow); (d) renal tumour (arrow). Figure 81.28 Diagrammatic representation of the three principal phases (vascular, concentration and excretion) of a mercaptoacetyl triglycine renogram curve. The time taken for the activity to become half of the peak level is called the half-time excretion and is used to determine the presence or absence of obstruction to urine out /f_l ow. Increased half-time suggests obstruction.

SYMPTOMS RELATED TO THE EXTERNAL GENITALIA Testis

SYMPTOMS RELATED TO THE EXTERNAL GENITALIA Testis

A testis may be absent from the scrotum in patients with unde - scended or ectopic testes. In boys <5 years, a common cause of testicular pain and swelling is torsion of a hydatid of Morgagni (appendix testis). In a young male suspected of having a testicular torsion, exam - ination of the normal, i.e. contralateral, testis may reveal a horizontal lie or ‘clapper bell testis’, raising the level of clinical suspicion. If torsion is suspected, immediate testicular explo - ration is mandatory and, if confirmed, bilateral testicular fix - a tion is performed. A Doppler USS may aid in the diagnosis. Patients with Klinefelter’s syndrome have bilateral small, firm testes in addition to the other signs typical of this con - dition. A hydrocele is an accumulation of fluid between the testis - and the tunica vaginalis; in the younger male it can be associ - ated with a patent pr ocessus vaginalis. The hydrocele fluid is typically a yellow colour. A testis that cannot be felt in a tense h ydrocele, in the age groups at risk of testicular cancer, needs to be assessed by USS.

Spermatic cord

Spermatic cord

Ten per cent of males have a left-sided varicocele and a smaller left testis. Masses are occasionally found associated with the spermatic cord, which on removal are found to be lipomas, mesotheliomas or sarcomas.

Uraemia

Uraemia

Rarely , the initial symptoms of urological disease may be those of severe renal dysfunction or uraemia. In infants and children, this may manifest as failure to thrive as well as anorexia, vomit ing and altered sensorium due to encephalopathy .

Urethra

Urethra

Hypospadias occurs when there is failure of the urethra to completely close on the ventral aspect and epispadias occurs when there is failure of closure on the dorsal surface. A urethral diverticulum in a female can be a cause for recurrent UTIs and is notable for its capacity to fill and empty at cystoscopy . A urethral caruncle is a minor prolapse of the urethral mucosa in a female and usually requires no treatment.

Urine-based tests

Urine-based tests

Urinalysis In a urine dipstick test, used to screen for significant disease, urine is dipped with a stick on which there is a series of small chemical-containing pads designed to detect, typically , glucose, bilirubin, ketones, the specific gravity , blood, pH, protein, urobilinogen, nitrites and leukocyte esterase through colour changes. A similar test may be performed using reagents in a laboratory . Midstream specimen of urine or urine culture A midstream specimen of urine (MSU) or urine culture is used to establish the diagnosis of a UTI and allows identification of the urinary pathogen and selection of the most appropriate antibiotic. Most MSUs will be processed in two stages, with initial urine microscopy followed by urine culture only if appropriate. Normal urine contains small numbers of white blood cells, red blood cells and epithelial cells as indicated in Table 81.1 . Early-morning urine Early-morning urine (EMU) samples are sent on three consec - utive days for Ziehl–Neelsen staining and culture for acid-fast bacilli if genitourinary TB is suspected. Staining results are available within a day but culture results take 6 weeks. Nucleic acid amplification tests based on polymerase chain reaction ® ® (PCR), such as GeneXpert and TruNAAT , are frequently used for rapid detection of a small amount of bacterial DNA. An early-morning sample is preferred since it is expected that overnight shedding of bacilli will increase detection rates. Voided urine cytology V oided urine cytology is performed when a urothelial carci noma is suspected. The test has the disadvantage of a high false-negative rate. Approximately 15% of low-grade transi tional cell carcinomas produce positiv e voided urine cytology compared with approximately 50% of high-grade transitional cell tumours. Urine for chyle Testing urine for chyle is performed in specific situations where the suspicion for chyluria is high. This is restricted to certain endemic regions of the world. A high-fat diet is administered the night prior to collection of a morning sample of urine. The urine may visibly appear milky white (Figures 81.2 and 81.3

White blood cells 3–5 per high-power /f_i eld Epithelial cells <10–15 per high-power /f_i eld Red blood cells 0–2 per high-power /f_i eld