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SUG 404

UROLOGY

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Course code: SUG 404

Course title: Urology

Course credit load: 2 Units

Series 1: Obstructive Uropathy and Complications

- **Part 1.1: Urethral Stricture Disease**
    - Sub Part 1.1.1: Anatomy of the urethra and aetiology of stricture
    - Sub Part 1.1.2: Clinical features and diagnosis of urethral stricture
    - Sub Part 1.1.3: Management of urethral stricture
- **Part 1.2: Benign Prostatic Enlargement**
    - Sub Part 1.2.1: Anatomy and pathophysiology of benign prostatic enlargement
    - Sub Part 1.2.2: Clinical features and assessment of BPE
    - Sub Part 1.2.3: Management of benign prostatic enlargement
- **Part 1.3: Prostate Cancer**
    - Sub Part 1.3.1: Epidemiology and risk factors of prostate cancer
    - Sub Part 1.3.2: Diagnosis and staging of prostate cancer
    - Sub Part 1.3.3: Management of prostate cancer
- **Part 1.4: Complications of Obstructive Uropathy**
    - Sub Part 1.4.1: Upper tract obstruction and hydronephrosis
    - Sub Part 1.4.2: Obstructive renal failure
    - Sub Part 1.4.3: Urinary fistulae

Introduction

Imagine a man in his sixties who has noticed, over many months, that his urinary stream has become weaker, that he strains to empty his bladder, and that he now wakes several times a night to pass urine. This gradual, easily overlooked pattern of symptoms is one of the most common reasons for surgical consultation in men, and it sits at the heart of this Series: obstructive

uropathy, the range of conditions that narrow or block the outflow of urine, and the serious complications that follow when obstruction is left unrecognised or untreated.

The aim of this Series is to equip you with the knowledge to recognise, investigate, and manage the common causes of obstructive uropathy and to anticipate and manage its complications.

We shall commence this Series by examining urethral stricture disease, from its anatomical basis and causes through to diagnosis and management. Next, we will consider benign prostatic enlargement, covering its pathophysiology, clinical assessment, and the medical and surgical options for treatment. Following that, our attention turns to prostate cancer, addressing its epidemiology, diagnosis, staging, and management. Finally, we will conclude by examining the complications of obstructive uropathy, including hydronephrosis, obstructive renal failure, and urinary fistulae.

Series Learning Outcomes

Upon completing this Series, you should be able to:

1. **SLO 1.1:** describe the aetiology, diagnosis, and management of urethral stricture,
2. **SLO 1.2:** describe the pathophysiology, assessment, and management of benign prostatic enlargement,
3. **SLO 1.3:** describe the diagnosis, staging, and management of prostate cancer, and
4. **SLO 1.4:** describe the complications of obstructive uropathy and their management.

1.1 Urethral Stricture Disease

1.1.1 Anatomy of the urethra and aetiology of stricture

The male urethra is divided into the anterior urethra (penile and bulbar segments, surrounded by the corpus spongiosum) and the posterior urethra (membranous and prostatic segments). A urethral stricture is a fibrotic narrowing of the urethral lumen from scar tissue replacing the normal elastic urothelium, most commonly affecting the bulbar urethra.

Common causes in Nigerian practice include trauma (pelvic fracture, straddle injury), iatrogenic injury (prolonged or traumatic catheterisation, instrumentation), infection (particularly untreated or recurrent gonococcal urethritis), and, less commonly, balanitis xerotica obliterans or congenital stricture. Many cases remain idiopathic.

Fill in the blank: A urethral stricture most commonly affects the _____ urethra. In Nigerian practice, a major infective cause of urethral stricture is untreated _____ urethritis.

1.1.2 Clinical features and diagnosis of urethral stricture

Clinical features include a progressively weak or split urinary stream, straining to void, incomplete bladder emptying, urinary frequency, and recurrent urinary tract infection. Longstanding strictures may progress to acute or chronic urinary retention, and complications include periurethral abscess and urethrocutaneous fistula if untreated.

Diagnosis is confirmed by retrograde urethrography, which outlines the stricture's site, length, and severity, or by flexible cystourethroscopy, which allows direct visualisation. Uroflowmetry supports the diagnosis by demonstrating a flattened, plateau-shaped flow curve characteristic of urethral obstruction.

Fill in the blank: Retrograde _____ is the standard imaging investigation for suspected urethral stricture. Uroflowmetry in urethral stricture classically shows a flattened, _____-shaped curve.

1.1.3 Management of urethral stricture

Management options include optical urethrotomy (endoscopic incision of the stricture, suitable for short, single strictures with a reasonable success rate but a significant recurrence risk), intermittent self-dilatation to maintain patency after urethrotomy, and urethroplasty (surgical reconstruction), the gold standard for long or recurrent strictures.

Urethroplasty techniques include excision and primary anastomosis for short bulbar strictures, and substitution urethroplasty using buccal mucosal grafts for longer strictures, offering the best long-term success rates. Suprapubic catheterisation may be required temporarily in acute retention until definitive treatment is arranged.

Fill in the blank: The gold standard surgical treatment for a long or recurrent urethral stricture is _____. Substitution urethroplasty commonly uses a graft harvested from the _____ mucosa.

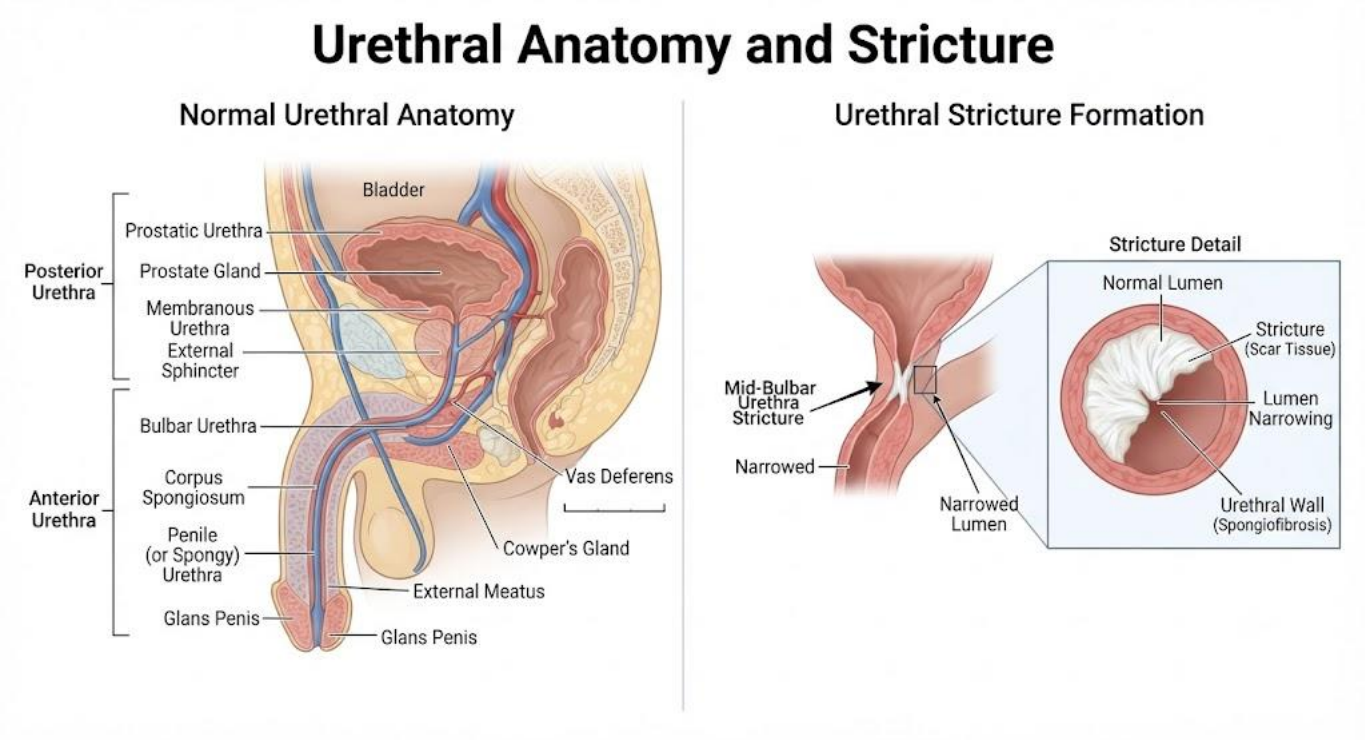

Figure 1.1: Urethral anatomy and the site and effect of urethral stricture.

Pilot questions 1.1

1. Describe the anatomical segments of the male urethra. (Linked to SLO 1.1)
2. List the common causes of urethral stricture in Nigerian practice. (Linked to SLO 1.1)
3. Describe the clinical features of urethral stricture. (Linked to SLO 1.1)
4. Describe the investigations used to diagnose urethral stricture. (Linked to SLO 1.1)
5. Compare optical urethrotomy and urethroplasty in the management of urethral stricture. (Linked to SLO 1.1)

1.2 Benign Prostatic Enlargement

1.2.1 Anatomy and pathophysiology of benign prostatic enlargement

The prostate surrounds the proximal urethra and is divided into zones, with benign prostatic enlargement (BPE) arising predominantly from the transition zone. Hyperplasia of glandular and stromal tissue, driven by dihydrotestosterone, causes progressive enlargement, which mechanically and functionally obstructs urinary outflow as men age.

Bladder outlet obstruction from BPE causes the detrusor muscle to hypertrophy and, over time, decompensate, leading to incomplete emptying, elevated post-void residual volume, and the risk of acute retention, upper tract dilatation, and secondary renal impairment if left untreated.

Fill in the blank: Benign prostatic enlargement arises predominantly from the _____ zone of the prostate. Prostatic growth in BPE is driven by the hormone _____.

1.2.2 Clinical features and assessment of BPE

Lower urinary tract symptoms (LUTS) from BPE are divided into voiding symptoms (hesitancy, weak stream, straining, incomplete emptying) and storage symptoms (frequency, urgency, nocturia), assessed using validated tools such as the International Prostate Symptom Score (IPSS), which also grades symptom severity and guides management decisions.

Assessment includes digital rectal examination (assessing size, consistency, and symmetry), urinalysis to exclude infection or haematuria, serum creatinine to assess renal function, and prostate-specific antigen (PSA) where prostate cancer is a concern, alongside uroflowmetry and post-void residual measurement.

Fill in the blank: Symptom severity in BPE is commonly assessed using the _____ score. Digital rectal examination in BPE typically reveals a smooth, _____ enlarged prostate.

1.2.3 Management of benign prostatic enlargement

Medical management includes alpha-blockers (such as tamsulosin, relaxing prostatic smooth muscle for rapid symptom relief) and 5-alpha reductase inhibitors (such as finasteride, reducing prostate volume over months by blocking dihydrotestosterone conversion), often combined in men with larger glands.

Surgical management is indicated for refractory symptoms, recurrent retention, renal impairment, or complications, with transurethral resection of the prostate (TURP) the gold standard, alongside newer techniques such as laser enucleation, and open prostatectomy reserved for very large glands where endoscopic access is unsuitable.

Fill in the blank: The gold standard surgical procedure for benign prostatic enlargement is _____. Finasteride works by blocking the conversion of testosterone to _____.

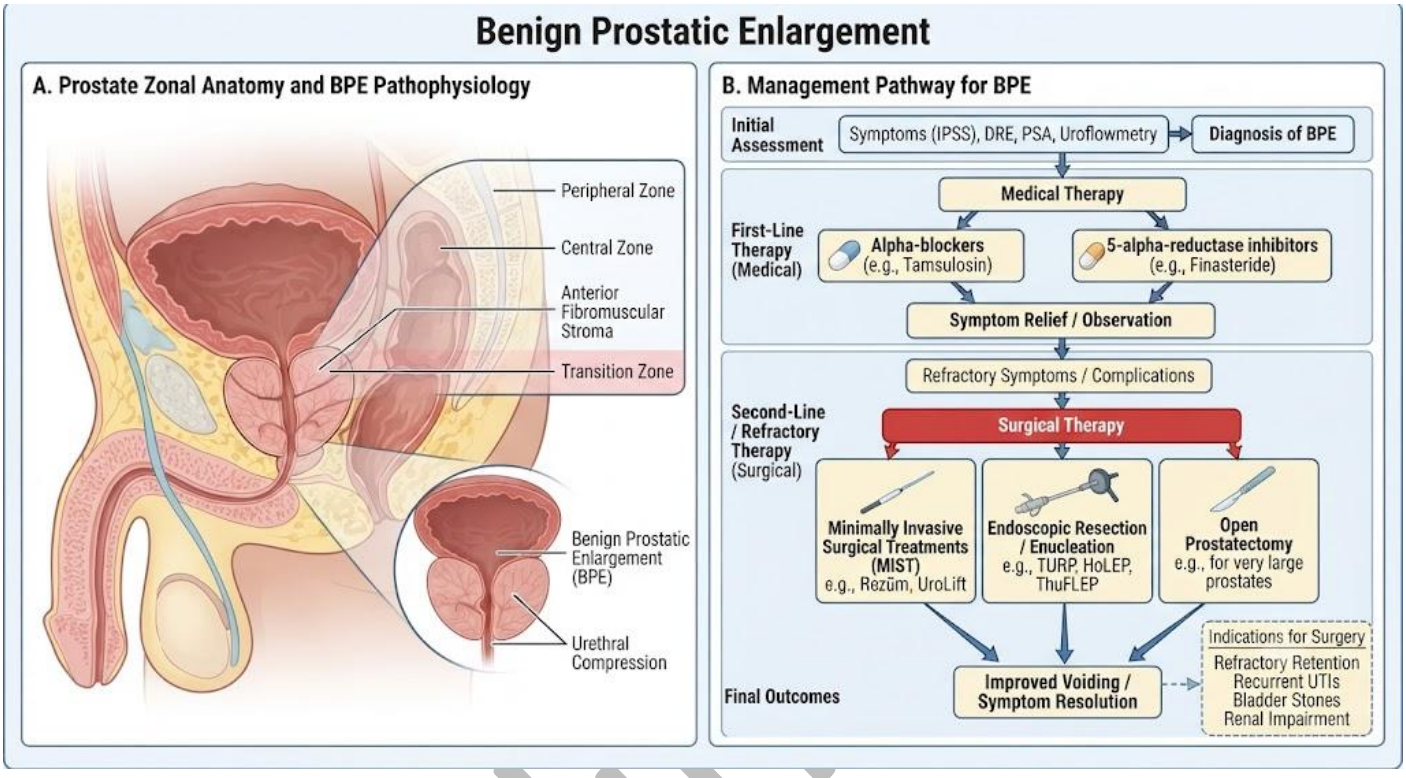

Figure 1.2: Prostate zonal anatomy and the management pathway for benign prostatic enlargement.

Pilot questions 1.2

11. Describe the zonal anatomy of the prostate and its relevance to BPE. (Linked to SLO 1.2)
12. Distinguish voiding from storage lower urinary tract symptoms. (Linked to SLO 1.2)
13. Describe the components of clinical assessment of a patient with suspected BPE. (Linked to SLO 1.2)
14. Compare the mechanisms of action of alpha-blockers and 5-alpha reductase inhibitors. (Linked to SLO 1.2)
15. List the indications for surgical management of BPE. (Linked to SLO 1.2)

1.3 Prostate Cancer

1.3.1 Epidemiology and risk factors of prostate cancer

Prostate cancer is one of the most common cancers in men and a leading cause of cancer death among Nigerian men, who tend to present at a later, more advanced stage than in high-income countries. Risk factors include increasing age, family history, and black African ancestry, which carries a notably higher incidence and more aggressive disease course.

Most prostate cancers arise in the peripheral zone, in contrast to BPE, which explains why early cancer often causes no urinary symptoms and why digital rectal examination (feeling the posterior peripheral zone) remains a valuable screening tool alongside PSA testing.

Fill in the blank: Most prostate cancers arise in the _____ zone of the prostate. Black African ancestry is associated with a higher incidence and more _____ course of prostate cancer.

1.3.2 Diagnosis and staging of prostate cancer

Diagnosis is suspected from an abnormal digital rectal examination (hard, irregular, asymmetrical prostate) or a raised age-specific PSA, confirmed by transrectal ultrasound-guided or, increasingly, MRI-targeted prostate biopsy, with multiparametric MRI now used before biopsy to localise suspicious lesions and improve diagnostic accuracy.

Staging and grading use the TNM system alongside the Gleason score (derived from the two most prevalent histological patterns on biopsy, summed to give a grade reflecting aggressiveness), and bone scan or CT to assess for metastatic spread in intermediate to high-risk disease.

Fill in the blank: Prostate cancer histological grade is described using the _____ score. Multiparametric MRI is increasingly used before prostate _____ to localise suspicious lesions.

1.3.3 Management of prostate cancer

Localised, low-risk disease may be managed with active surveillance, avoiding overtreatment of indolent tumours, while curative options for localised disease include radical prostatectomy and radiotherapy (external beam or brachytherapy), with the choice guided by patient age, comorbidity, and preference.

Advanced or metastatic disease is managed with androgen deprivation therapy (surgical or medical castration), as prostate cancer growth is androgen-dependent, often combined with chemotherapy or newer androgen receptor-targeted agents in appropriately selected patients, alongside palliative measures for bone metastases.

Fill in the blank: Low-risk localised prostate cancer may be managed with active _____. Advanced prostate cancer is managed with androgen _____ therapy.

Risk Group	PSA Level	Gleason Score	Clinical Stage
Low	≤ 10 ng/mL	≤ 6	T1–T2a

Risk Group	PSA Level	Gleason Score	Clinical Stage
Intermediate	10–20 ng/mL	= 7	T2b
High	> 20 ng/mL	8–10	≥ T2c

Table 1.3: D'Amico risk stratification for localised prostate cancer.

Pilot questions 1.3

1. Describe the epidemiology and risk factors for prostate cancer in Nigerian men. (Linked to SLO 1.3)
2. Explain why digital rectal examination remains useful in prostate cancer detection. (Linked to SLO 1.3)
3. Describe the diagnostic pathway for suspected prostate cancer. (Linked to SLO 1.3)
4. Describe the Gleason score and its clinical significance. (Linked to SLO 1.3)
5. Compare the management of localised and advanced prostate cancer. (Linked to SLO 1.3)

1.4 Complications of Obstructive Uropathy

1.4.1 Upper tract obstruction and hydronephrosis

Chronic bladder outlet obstruction can transmit back-pressure to the upper urinary tracts, causing bilateral hydroureter and hydronephrosis, the dilatation of the renal pelvis and calyces from obstructed urine flow. Ultrasound is the first-line investigation, showing dilatation and allowing assessment of cortical thickness as a marker of chronicity and renal reserve.

Management of significant hydronephrosis from lower tract obstruction is decompression, usually by urethral or suprapubic catheterisation to relieve the underlying obstruction, with nephrostomy reserved for cases of upper tract obstruction not relieved by bladder drainage or where the obstruction is at the ureteric level.

Fill in the blank: Dilatation of the renal pelvis and calyces from obstructed urine flow is termed _____. The first-line imaging investigation for suspected hydronephrosis is _____.

1.4.2 Obstructive renal failure

Obstructive (post-renal) renal failure occurs when bilateral upper tract obstruction, or obstruction of a solitary functioning kidney, impairs glomerular filtration, presenting with reduced urine output, rising serum creatinine and urea, and, if longstanding, features of chronic kidney disease such as anaemia and bone disease.

Post-obstructive diuresis is a brisk, high-volume diuresis that can follow relief of obstruction, particularly in longstanding cases, requiring careful monitoring of fluid balance and electrolytes to prevent dehydration and electrolyte derangement during the recovery phase after decompression.

Fill in the blank: Renal failure from urinary tract obstruction is termed _____ renal failure. A brisk, high-volume diuresis following relief of obstruction is called post-obstructive _____.

1.4.3 Urinary fistulae

Urinary fistulae are abnormal communications between the urinary tract and another epithelial surface, most commonly vesicovaginal fistula in Nigerian practice, frequently resulting from obstructed labour, though it may also follow pelvic surgery, malignancy, or radiotherapy, presenting with continuous, painless urinary leakage per vaginam.

Management depends on the cause and size: small, early fistulae may close with prolonged catheter drainage, while established fistulae usually require surgical repair (vaginal or abdominal approach) once local tissue inflammation has settled, typically after three months, to optimise surgical success.

Fill in the blank: The most common urinary fistula encountered in Nigerian practice is _____ fistula, often caused by obstructed _____.

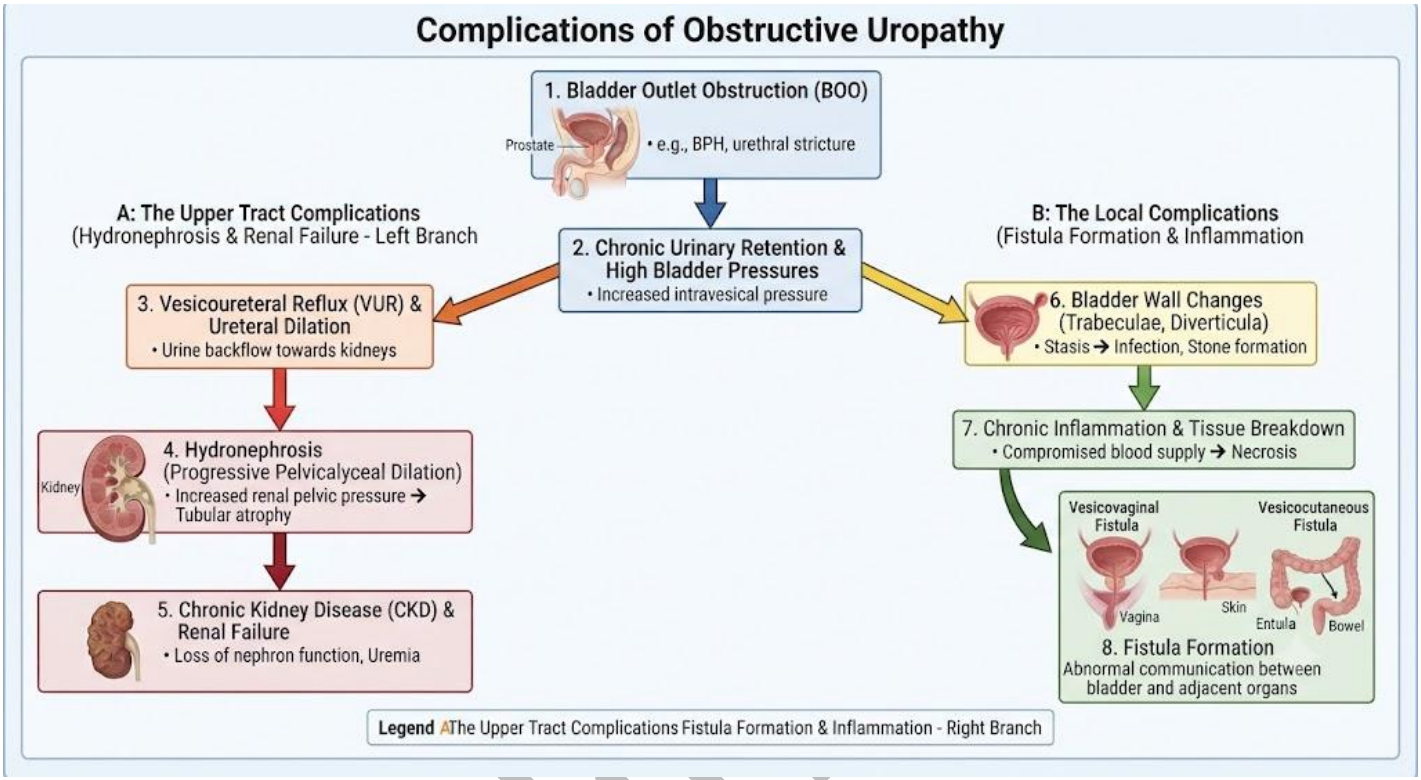

Figure 1.4: Progression of complications arising from chronic obstructive uropathy.

Pilot questions 1.4

11. Describe the pathophysiology of hydronephrosis secondary to bladder outlet obstruction. (Linked to SLO 1.4)
12. Describe the first-line investigation and management of hydronephrosis. (Linked to SLO 1.4)
13. Describe the clinical features of obstructive renal failure. (Linked to SLO 1.4)
14. Explain post-obstructive diuresis and its management. (Linked to SLO 1.4)
15. Describe the causes and management of vesicovaginal fistula in Nigerian practice. (Linked to SLO 1.4)

Series Summary

This Series has covered urethral stricture disease, from its anatomical basis and causes through to diagnosis and management, followed by benign prostatic enlargement, addressing its pathophysiology, clinical assessment, and treatment options. It went on to examine prostate cancer, covering epidemiology, diagnosis, staging, and management, before concluding with the

complications of obstructive uropathy, including hydronephrosis, obstructive renal failure, and urinary fistulae.

You should now be able to describe the aetiology, diagnosis, and management of urethral stricture, assess and manage benign prostatic enlargement, describe the diagnosis, staging, and management of prostate cancer, and recognise and manage the complications of obstructive uropathy (Linked to SLOs 1.1 to 1.4).

Glossary of Terms

- **Gleason score:** a grading system for prostate cancer derived from the two most prevalent histological patterns on biopsy.
- **Hydronephrosis:** dilatation of the renal pelvis and calyces resulting from obstructed urine flow.
- **IPSS:** the International Prostate Symptom Score, a validated tool for assessing the severity of lower urinary tract symptoms.
- **Lower urinary tract symptoms (LUTS):** voiding and storage symptoms arising from bladder outlet obstruction or bladder dysfunction.
- **Post-obstructive diuresis:** a brisk, high-volume diuresis that can follow relief of longstanding urinary tract obstruction.
- **TURP:** transurethral resection of the prostate, the gold standard surgical procedure for benign prostatic enlargement.
- **Urethral stricture:** a fibrotic narrowing of the urethral lumen from scar tissue replacing the normal urothelium.
- **Urethroplasty:** surgical reconstruction of the urethra, the gold standard treatment for long or recurrent urethral stricture.
- **Uroflowmetry:** a non-invasive test measuring the rate and pattern of urine flow, used to assess bladder outlet obstruction.
- **Vesicovaginal fistula:** an abnormal communication between the bladder and vagina, commonly caused by obstructed labour in Nigerian practice.
- **Active surveillance:** a management strategy for low-risk localised prostate cancer involving monitoring rather than immediate treatment.
- **Transition zone:** the region of the prostate surrounding the proximal urethra from which benign prostatic enlargement predominantly arises.

Concept Check Questions [Series 1]

Objective questions

6. A urethral stricture most commonly affects the _____ urethra.
7. The gold standard surgical procedure for benign prostatic enlargement is _____.
8. Most prostate cancers arise in the _____ zone of the prostate.
9. Renal failure from urinary tract obstruction is termed _____ renal failure.
10. The most common urinary fistula encountered in Nigerian practice is _____ fistula.

Short-answer questions

1. Describe the investigations used to diagnose urethral stricture. (Linked to SLO 1.1)
2. Distinguish voiding from storage lower urinary tract symptoms. (Linked to SLO 1.2)
3. Describe the Gleason score and its clinical significance. (Linked to SLO 1.3)
4. Describe the first-line investigation and management of hydronephrosis. (Linked to SLO 1.4)
5. Explain post-obstructive diuresis and its management. (Linked to SLO 1.4)

Long-answer questions

- Describe the causes, diagnosis, and management of urethral stricture. (Linked to SLO 1.1)
- Describe the pathophysiology, assessment, and management of benign prostatic enlargement. (Linked to SLO 1.2)
- Describe the diagnostic pathway and management of prostate cancer. (Linked to SLO 1.3)
- Describe the complications of chronic bladder outlet obstruction. (Linked to SLO 1.4)
- Describe the causes and management of vesicovaginal fistula. (Linked to SLO 1.4)

Answers to Concept Check Questions [Series 1]

Objective questions

- Bulbar.
- Transurethral resection of the prostate (TURP).

- Peripheral.
- Obstructive (post-renal).
- Vesicovaginal.

Short-answer questions

- Retrograde urethrography outlines the site, length, and severity of the stricture. Flexible cystourethroscopy allows direct visualisation, and uroflowmetry shows a flattened, plateau-shaped curve.
- Voiding symptoms include hesitancy, weak stream, straining, and incomplete emptying. Storage symptoms include frequency, urgency, and nocturia.
- The Gleason score is derived from the two most prevalent histological patterns on biopsy, summed to give a grade reflecting tumour aggressiveness and guiding management.
- Ultrasound is first-line, showing dilatation of the renal pelvis and calyces. Management is decompression by catheterisation or nephrostomy depending on the level of obstruction.
- A brisk, high-volume diuresis following relief of longstanding obstruction, managed with careful monitoring and replacement of fluid and electrolytes to prevent dehydration.

Long-answer questions

- **Basic response:** Urethral stricture is caused by trauma, iatrogenic injury, or infection, diagnosed by retrograde urethrography, and managed with urethrotomy or urethroplasty.

Value-added response: Urethroplasty is the gold standard for long or recurrent strictures, using excision and primary anastomosis or buccal mucosal graft substitution depending on stricture length.

- **Basic response:** BPE arises from transition zone hyperplasia, causing voiding and storage LUTS assessed by IPSS, managed with alpha-blockers, 5-alpha reductase inhibitors, or surgery.

Value-added response: TURP remains the surgical gold standard, though laser enucleation is increasingly used, and open prostatectomy is reserved for very large glands unsuitable for endoscopic access.

- **Basic response:** Prostate cancer is diagnosed by abnormal DRE or raised PSA, confirmed by biopsy, staged by TNM and Gleason score, and managed according to risk group.

Value-added response: Low-risk disease may be managed with active surveillance to avoid overtreatment, while advanced disease is managed with androgen deprivation therapy given its androgen-dependent growth.

- **Basic response:** Chronic bladder outlet obstruction can cause hydronephrosis, obstructive renal failure, and, in severe cases, fistula formation.

Value-added response: Post-obstructive diuresis after decompression requires careful monitoring of fluid and electrolyte balance to prevent dehydration during recovery.

- **Basic response:** Vesicovaginal fistula is most commonly caused by obstructed labour in Nigerian practice, presenting with continuous painless urinary leakage per vaginam.

Value-added response: Management depends on fistula size and chronicity: small early fistulae may close with catheter drainage, while established fistulae require surgical repair after inflammation settles.

Answers to Pilot Questions [Series 1]

Part 1.1

1. The urethra is divided into the anterior (penile and bulbar) and posterior (membranous and prostatic) segments.
2. Trauma, iatrogenic injury from catheterisation or instrumentation, infection (notably gonococcal urethritis), and balanitis xerotica obliterans.
3. A weak or split stream, straining to void, incomplete emptying, urinary frequency, and recurrent urinary tract infection.
4. Retrograde urethrography outlines the stricture, flexible cystourethroscopy allows direct visualisation, and uroflowmetry shows a plateau-shaped curve.
5. Optical urethrotomy is endoscopic and suitable for short strictures but has a significant recurrence risk. Urethroplasty is surgical reconstruction and the gold standard for long or recurrent strictures.

Part 1.2

1. BPE predominantly arises from the transition zone, which surrounds the proximal urethra, explaining its obstructive effect.
2. Voiding symptoms include hesitancy, weak stream, and incomplete emptying. Storage symptoms include frequency, urgency, and nocturia.

3. Digital rectal examination, urinalysis, serum creatinine, PSA where indicated, uroflowmetry, and post-void residual measurement.
4. Alpha-blockers relax prostatic smooth muscle for rapid symptom relief. 5-alpha reductase inhibitors reduce prostate volume over months by blocking dihydrotestosterone conversion.
5. Refractory symptoms, recurrent urinary retention, renal impairment, and other complications of BPE.

Part 1.3

1. Increasing age, family history, and black African ancestry, which carries a higher incidence and more aggressive disease course, with later presentation common in Nigeria.
2. Prostate cancer often arises in the posterior peripheral zone, which is palpable on digital rectal examination, unlike the transition zone affected by BPE.
3. Abnormal DRE or raised PSA prompts multiparametric MRI and transrectal or MRI-targeted prostate biopsy for histological confirmation.
4. The Gleason score is derived from the two most prevalent histological patterns on biopsy, summed to reflect tumour aggressiveness and guide treatment.
5. Localised disease is managed with active surveillance, radical prostatectomy, or radiotherapy. Advanced disease is managed with androgen deprivation therapy and other systemic treatment.

Part 1.4

1. Back-pressure from bladder outlet obstruction is transmitted to the upper tracts, causing dilatation of the renal pelvis and calyces.
2. Ultrasound is first-line, showing dilatation. Management is decompression by catheterisation for lower tract obstruction or nephrostomy for upper tract obstruction.
3. Reduced urine output, rising serum creatinine and urea, and, if longstanding, features of chronic kidney disease such as anaemia.
4. Post-obstructive diuresis is a brisk, high-volume diuresis after relief of obstruction, managed with careful monitoring and replacement of fluid and electrolytes.
5. Vesicovaginal fistula is commonly caused by obstructed labour, presenting with continuous urinary leakage, managed with catheter drainage or surgical repair depending on chronicity.

References and Attributions [Series 1]

Textual References

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- Wein, A. J., Kavoussi, L. R., Partin, A. W. and Peters, C. A. (2020). Campbell-Walsh-Wein Urology (12th ed.). Elsevier.
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- Mottet, N., van den Bergh, R. C. N., Briers, E. et al. (2021). EAU-EANM-ESTRO-ESUR-SIOG Guidelines on Prostate Cancer. European Urology, 79(2), 243 to 262.

Figures, Plates, Tables, and Boxes

1. Figure 1.1: Urethral anatomy and the site and effect of urethral stricture. AI-generated using the prompt: "Create a professional medical diagram titled Urethral Anatomy and Stricture, showing the anterior and posterior urethral segments and a stricture narrowing the lumen. Clean clinical surgical diagram style."
2. Figure 1.2: Prostate zonal anatomy and the management pathway for benign prostatic enlargement. AI-generated using the prompt: "Create a professional two-panel medical diagram titled Benign Prostatic Enlargement, showing prostate zonal anatomy and a management pathway from medical to surgical therapy. Clean clinical surgical diagram style."
3. Table 1.3: D'Amico risk stratification for localised prostate cancer. AI-generated using the prompt: "Create a clean reference table titled D'Amico Risk Stratification for Localised Prostate Cancer, listing low, intermediate, and high risk groups with PSA, Gleason score, and stage thresholds. Simple clinical reference table style with outside border."
4. Figure 1.4: Progression of complications arising from chronic obstructive uropathy. AI-generated using the prompt: "Create a professional medical flowchart titled Complications of Obstructive Uropathy, showing progression from bladder outlet obstruction to hydronephrosis, renal failure, and fistula formation. Clean clinical surgical diagram style."

Course code: SUG 404

Course title: Urology

Course credit load: 2 Units

Series 2: Urolithiasis, Trauma and Haematuria

- **Part 2.1: Urolithiasis I: Formation and Presentation**
  - Sub Part 2.1.1: Formation and types of urinary stones
  - Sub Part 2.1.2: Clinical features of urolithiasis
  - Sub Part 2.1.3: Investigation of urolithiasis
- **Part 2.2: Urolithiasis II: Management**
  - Sub Part 2.2.1: Medical management and expulsive therapy
  - Sub Part 2.2.2: Minimally invasive stone treatment (ESWL, ureteroscopy)
  - Sub Part 2.2.3: Percutaneous nephrolithotomy and open stone surgery
- **Part 2.3: Urological Trauma**
  - Sub Part 2.3.1: Renal trauma
  - Sub Part 2.3.2: Bladder and urethral trauma
  - Sub Part 2.3.3: Genital trauma
- **Part 2.4: Haematuria**
  - Sub Part 2.4.1: Classification and causes of haematuria
  - Sub Part 2.4.2: Clinical assessment of haematuria
  - Sub Part 2.4.3: Investigation and management of haematuria

Introduction

In the last Series, we explored obstructive uropathy, from urethral stricture through to benign prostatic enlargement, prostate cancer, and the complications that follow chronic obstruction. We

now turn to three closely related areas of urological practice that bring patients to the emergency department as often as to the outpatient clinic: urolithiasis, urological trauma, and haematuria. Each of these presents with dramatic, often frightening symptoms, and each demands a systematic approach to reach the correct diagnosis and offer timely, appropriate treatment.

The aim of this Series is to equip you with the knowledge to diagnose and manage urolithiasis, to recognise and manage urological trauma, and to systematically investigate haematuria.

We shall commence this Series by examining the formation and clinical presentation of urinary stones, followed by their investigation. Next, we will consider the management of urolithiasis, from conservative and medical therapy through to minimally invasive and open surgical options. Following that, our attention turns to urological trauma, covering injuries to the kidney, bladder, urethra, and genitalia. Finally, we will conclude by examining haematuria, its classification, causes, clinical assessment, and structured investigation.

Series Learning Outcomes

Upon completing this Series, you should be able to:

1. **SLO 2.1:** describe the formation, presentation, and investigation of urolithiasis,
2. **SLO 2.2:** describe the management options for urolithiasis according to stone size and location,
3. **SLO 2.3:** describe the classification and management of renal, bladder, urethral, and genital trauma, and
4. **SLO 2.4:** describe the classification, causes, and investigation of haematuria.

2.1 Urolithiasis I: Formation and Presentation

2.1.1 Formation and types of urinary stones

Urinary stones form when urine becomes supersaturated with stone-forming salts, allowing crystals to nucleate, aggregate, and grow into a solid mass within the urinary tract. Calcium oxalate stones are the most common type overall, followed by calcium phosphate, uric acid, struvite (infection) stones, and the rarer cystine stones seen in inherited cystinuria. Contributing factors include low fluid intake, hot climates that increase insensible fluid loss, dietary patterns high in animal protein and oxalate-rich foods, and metabolic conditions such as hyperparathyroidism and gout, all of which are relevant considerations in Nigerian clinical practice given the warm climate and dietary habits of many patients.

Struvite stones deserve particular attention as they form only in alkaline urine infected with urease-producing organisms such as Proteus species, and they can grow rapidly to fill the renal pelvis and calyces, forming a staghorn calculus. Because these stones are intrinsically linked to

ongoing infection, they carry a higher risk of recurrent urosepsis and progressive renal damage if not adequately treated, and their management requires both surgical clearance and eradication of the underlying infective organism to prevent recurrence.

Fill in the blank: Calcium _____ is the most common type of urinary stone. Struvite stones form in alkaline urine infected with _____-producing organisms.

2.1.2 Clinical features of urolithiasis

Renal colic is the classic presentation of an obstructing ureteric stone, characterised by sudden, severe, colicky loin pain that radiates from the flank towards the groin as the stone migrates distally, often accompanied by nausea, vomiting, and an inability to find a comfortable position, distinguishing it from the constant pain of peritonitis. The pain typically fluctuates in intensity as the ureter undergoes peristaltic contraction against the obstructing stone, and its precise location can offer a clue to the stone's position within the urinary tract, from the loin in upper ureteric stones to groin or scrotal or labial pain as the stone approaches the vesicoureteric junction.

Associated features include microscopic or visible haematuria in the majority of cases, and, when infection complicates an obstructing stone, fever, rigors, and systemic sepsis can develop rapidly, constituting a urological emergency requiring urgent decompression. Bladder stones, in contrast, more often present with suprapubic discomfort, interrupted urinary stream, and recurrent urinary tract infection, reflecting their different anatomical location and the mechanical effect of the stone within the bladder itself.

Fill in the blank: The classic presentation of an obstructing ureteric stone is _____ colic. An infected obstructing stone constitutes a urological _____ requiring urgent decompression.

2.1.3 Investigation of urolithiasis

Non-contrast computed tomography (CT KUB) is the gold standard investigation for suspected urolithiasis, offering high sensitivity and specificity for stones of all compositions except indinavir stones, and providing additional information on stone size, location, and the degree of any associated hydronephrosis, all of which guide treatment planning. Where CT is unavailable, as is common in many Nigerian centres, a combination of plain abdominal radiography (which detects radio-opaque calcium-containing stones) and renal ultrasound (which detects hydronephrosis and radiolucent stones such as uric acid calculi) offers a reasonable, more accessible alternative.

Baseline investigations also include urinalysis to assess for haematuria and infection, serum electrolytes and creatinine to evaluate renal function, and, in recurrent stone formers, a metabolic work-up including serum calcium, uric acid, and 24-hour urine collection to identify an underlying predisposing abnormality that might otherwise go unrecognised and lead to further stone recurrence if left uncorrected.

Fill in the blank: The gold standard imaging investigation for suspected urolithiasis is _____. Plain abdominal radiography detects _____-opaque stones.

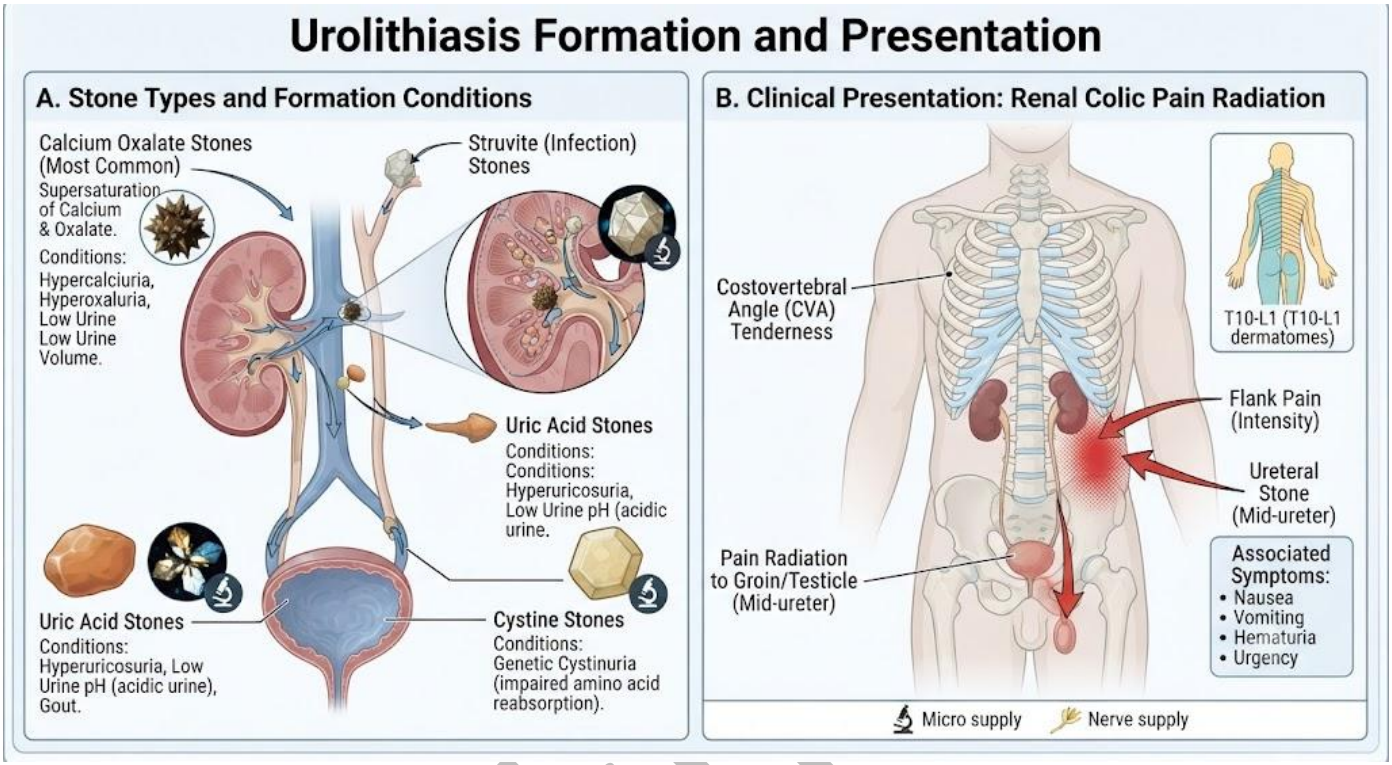

Figure 2.1: Types of urinary stones and the classic pain radiation pattern of renal colic.

Pilot questions 2.1

1. Describe the common types of urinary stones and their formation. (Linked to SLO 2.1)
2. Explain why struvite stones are particularly concerning. (Linked to SLO 2.1)
3. Describe the clinical features of renal colic. (Linked to SLO 2.1)
4. Describe the presentation of an infected obstructing ureteric stone. (Linked to SLO 2.1)
5. Describe the investigation of a patient with suspected urolithiasis. (Linked to SLO 2.1)

2.2 Urolithiasis II: Management

2.2.1 Medical management and expulsive therapy

Small ureteric stones (generally under 6 to 10 millimetres) have a reasonable chance of spontaneous passage, and initial management is conservative, with adequate analgesia (typically non-steroidal anti-inflammatory drugs, which are effective both for pain and by reducing ureteric spasm and oedema), hydration, and straining of urine to catch the passed stone for later analysis of its composition, which can guide future preventive strategies.

Medical expulsive therapy using alpha-blockers such as tamsulosin relaxes ureteric smooth muscle and can increase the likelihood and speed of spontaneous stone passage, particularly for distal ureteric stones, and is commonly used as an adjunct to conservative management in appropriately selected patients without signs of infection, significant renal impairment, or intractable pain, all of which would instead prompt more active intervention.

Fill in the blank: Small ureteric stones under approximately _____ millimetres have a reasonable chance of spontaneous passage. Medical expulsive therapy commonly uses the drug class of _____.

2.2.2 Minimally invasive stone treatment (ESWL, ureteroscopy)

Extracorporeal shock wave lithotripsy (ESWL) uses focused shock waves generated outside the body to fragment stones into smaller pieces that can then pass spontaneously, and is most effective for stones under 2 centimetres in the kidney or upper ureter, offering a non-invasive option, although success rates are lower for larger, harder, or lower ureteric stones, and repeat sessions may be required to achieve adequate fragmentation.

Ureteroscopy involves passing a rigid or flexible scope up the ureter to directly visualise and fragment the stone using laser lithotripsy, with fragments removed or left to pass, offering higher success rates than ESWL for mid and lower ureteric stones and for larger or harder stones resistant to shock wave fragmentation, though it requires anaesthesia and carries a small risk of ureteric injury or stricture formation.

Fill in the blank: Extracorporeal shock wave lithotripsy is most effective for stones under _____ centimetres. Ureteroscopy uses _____ lithotripsy to fragment stones under direct vision.

2.2.3 Percutaneous nephrolithotomy and open stone surgery

Percutaneous nephrolithotomy (PCNL) is the treatment of choice for large renal stones, generally over 2 centimetres, and for complex staghorn calculi, involving a percutaneous tract created directly into the renal collecting system through which the stone is fragmented and extracted under direct vision, offering high stone-free rates in a single procedure for stones that would otherwise require multiple sessions of less invasive treatment.

Open stone surgery has become uncommon with the advancement of minimally invasive techniques but remains relevant in resource-limited settings without access to PCNL or ureteroscopy equipment, or for very large or anatomically complex stones, and understanding its principles, including pyelolithotomy and nephrolithotomy, remains important for the Nigerian surgical trainee working across varied practice settings.

Fill in the blank: Percutaneous nephrolithotomy is the treatment of choice for renal stones generally over _____ centimetres. Open stone surgery remains relevant in _____-limited settings without minimally invasive equipment.

Modality	Typical Stone Size & Location	Advantages	Limitations
Observation + MET	Small distal ureteric stones (<5–6 mm)	Non-invasive, avoids surgery, cost-effective	Limited to small stones, risk of obstruction/infection, not always successful
ESWL	Stones ≤ 20 mm, renal or proximal ureter	Non-invasive, outpatient, minimal anesthesia	Less effective for hard stones, obesity reduces efficacy, may need repeat sessions
Ureteroscopy	Ureteric stones (any size), renal stones <20 mm	Direct visualization, high success rate, immediate clearance	Invasive, anesthesia required, risk of ureteral injury
PCNL	Large renal stones (>20 mm), staghorn calculi	Gold standard for large stones, high clearance rates	Invasive, bleeding risk, requires hospitalization
Open Surgery	Very large/complex stones, failed minimally invasive therapy	Definitive removal, useful in complex anatomy	Highly invasive, longer recovery, rarely used today

Table 2.2: Comparison of treatment modalities for urolithiasis by stone size, location, and approach.

Pilot questions 2.2

1. Describe the conservative management of a small ureteric stone. (Linked to SLO 2.1)
2. Explain the mechanism and role of medical expulsive therapy. (Linked to SLO 2.1)
3. Describe the indications and principles of extracorporeal shock wave lithotripsy. (Linked to SLO 2.1)
4. Compare ureteroscopy with ESWL in the management of ureteric stones. (Linked to SLO 2.1)
5. Describe the indications for percutaneous nephrolithotomy. (Linked to SLO 2.1)

2.3 Urological Trauma

2.3.1 Renal trauma

Renal trauma most commonly follows blunt injury (road traffic accidents and falls being the leading causes in Nigerian practice) and is graded from I to V using the American Association for the Surgery of Trauma scale, ranging from minor contusion to complete shattering of the kidney or avulsion of the renal pedicle, with grade guiding both prognosis and the likelihood of requiring surgical intervention rather than conservative management.

Haemodynamically stable patients with renal trauma, even with high-grade injury, are usually managed conservatively with bed rest, monitoring, and serial imaging, as the kidney has a remarkable capacity to heal without intervention, and unnecessary exploration risks nephrectomy that might otherwise have been avoided; surgery is reserved for haemodynamic instability, expanding or pulsatile perirenal haematoma, or associated injuries requiring laparotomy for other reasons.

Fill in the blank: Renal trauma is graded using the _____ scale, ranging from I to V. Haemodynamically stable patients with renal trauma are usually managed _____.

2.3.2 Bladder and urethral trauma

Bladder injury is classified as extraperitoneal (usually associated with pelvic fracture, managed conservatively with catheter drainage in most cases) or intraperitoneal (typically from a direct blow to a full bladder, requiring surgical repair as urine leaking into the peritoneal cavity causes chemical peritonitis), distinguished on cystography by the pattern of contrast extravasation, which is confined around the bladder in extraperitoneal rupture but outlines loops of bowel in intraperitoneal rupture.

Urethral injury is suspected when a pelvic fracture patient has blood at the meatus, an inability to void, or a high-riding or non-palpable prostate on rectal examination, all of which should prompt retrograde urethrography before any attempt at urethral catheterisation, as blind catheterisation risks converting a partial tear into a complete disruption and worsening the eventual outcome.

Fill in the blank: Blood at the urethral meatus after pelvic fracture should prompt _____ urethrography before catheterisation. Intraperitoneal bladder rupture causes chemical _____ from urine leakage.

2.3.3 Genital trauma

Testicular trauma from blunt injury (sporting injury, assault, or straddle injury) can cause testicular rupture, presenting with severe scrotal pain, swelling, and bruising, best assessed by scrotal ultrasound, which can identify disruption of the tunica albuginea; early surgical exploration and repair within 72 hours significantly improves testicular salvage rates compared with delayed intervention, making prompt recognition important.

Penile fracture is a rupture of the tunica albuginea of the corpus cavernosum, typically occurring during vigorous sexual intercourse and presenting with a sudden cracking sound, immediate detumescence, pain, swelling, and a characteristic eggplant deformity from

subcutaneous haematoma, and is managed with prompt surgical exploration and repair to preserve erectile function and prevent long-term complications such as painful curvature.

Fill in the blank: Testicular exploration and repair within _____ hours of blunt trauma significantly improves salvage rates. Penile fracture is a rupture of the tunica albuginea of the corpus _____.

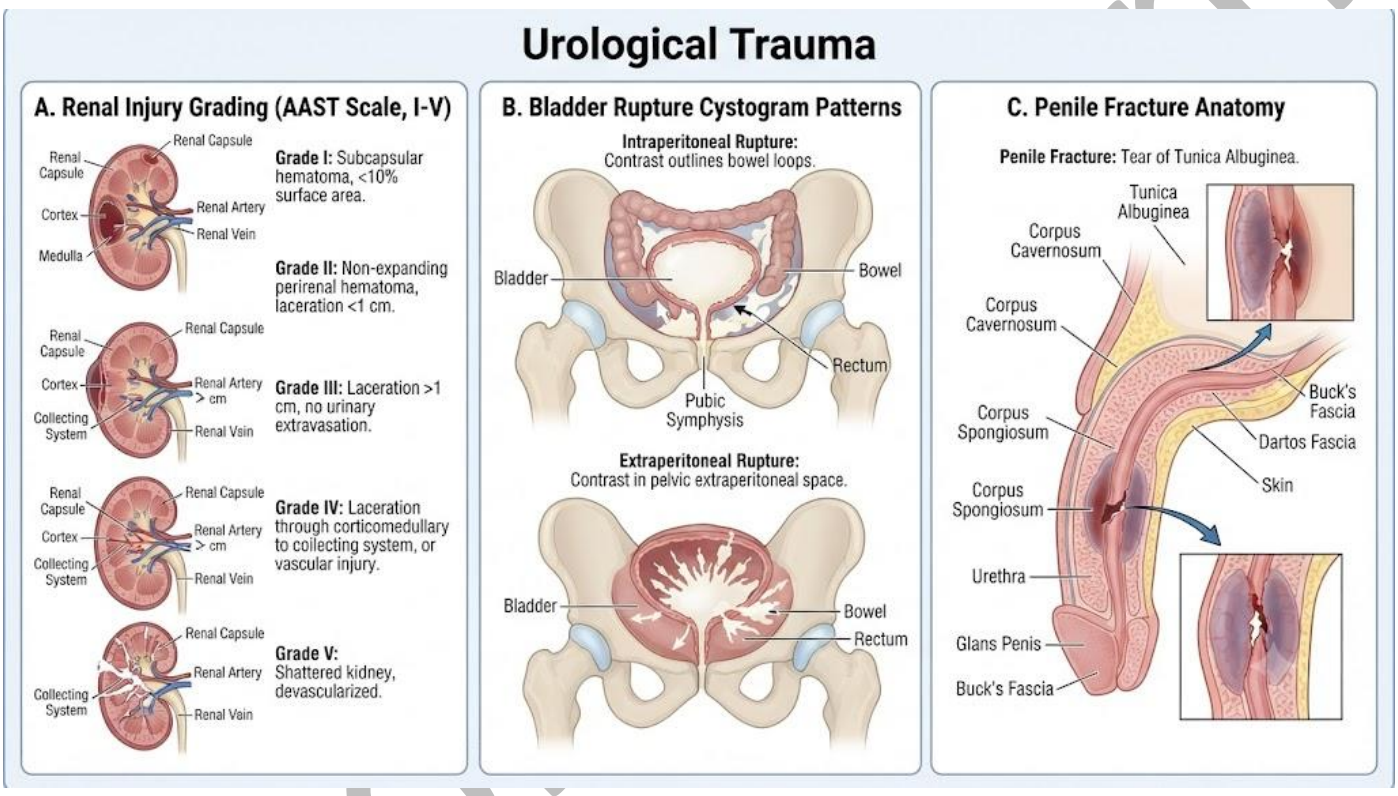

Figure 2.3: Grading of renal trauma, bladder rupture patterns, and penile fracture anatomy.

Pilot questions 2.3

1. Describe the AAST grading system for renal trauma. (Linked to SLO 2.2)
2. Describe the management of haemodynamically stable renal trauma. (Linked to SLO 2.2)
3. Distinguish extraperitoneal from intraperitoneal bladder rupture. (Linked to SLO 2.2)
4. Describe the clinical features and initial management of suspected urethral injury. (Linked to SLO 2.2)
5. Describe the presentation and management of penile fracture. (Linked to SLO 2.2)

2.4 Haematuria

2.4.1 Classification and causes of haematuria

Haematuria is classified as microscopic (detected only on urinalysis) or macroscopic (visible to the naked eye), and further described as initial, terminal, or total, depending on when blood appears during voiding, which can offer a useful clue to the likely site of bleeding along the urinary tract, from the urethra or prostate for initial haematuria to the bladder or upper tracts for total haematuria.

Causes span the entire urinary tract and include urinary tract infection, urolithiasis, benign prostatic enlargement, glomerular disease (particularly relevant in younger patients with associated proteinuria or red cell casts), and malignancy of the kidney, ureter, bladder, or prostate, which must always be actively excluded in any patient with unexplained visible haematuria, particularly those over 40 years of age, given the potentially serious underlying diagnosis it can represent.

Fill in the blank: Haematuria occurring only at the start of voiding is termed _____ haematuria. In any patient with unexplained visible haematuria, _____ must always be actively excluded.

2.4.2 Clinical assessment of haematuria

A thorough history should establish the timing and pattern of blood in the urine, associated symptoms such as pain (suggesting stone or infection) or painlessness (raising greater concern for malignancy), risk factors including smoking, occupational exposure to industrial dyes and chemicals, and a family or personal history of urological cancer, alongside medication history, particularly anticoagulant or antiplatelet use, which can unmask but rarely solely explain underlying pathology.

Examination should include abdominal palpation for a renal or bladder mass, and, in men, digital rectal examination to assess the prostate, though a normal clinical examination does not exclude significant underlying pathology and should never substitute for appropriate further investigation, particularly given how often early urological malignancy presents with no abnormal findings on examination alone.

Fill in the blank: Painless visible haematuria raises greater concern for underlying _____. A key modifiable risk factor for urothelial malignancy that should be asked about is _____ history.

2.4.3 Investigation and management of haematuria

Investigation of visible or unexplained haematuria follows a structured pathway including urine microscopy and cytology, renal function tests, upper tract imaging (ultrasound or CT urogram) to assess the kidneys and ureters, and flexible cystoscopy to directly visualise the

bladder and urethra, as no single test reliably excludes malignancy across the entire urinary tract, making a comprehensive combined approach essential in every case.

Management depends entirely on the underlying cause once identified: infection is treated with antibiotics, stones are managed as previously described, and malignancy is referred for appropriate oncological treatment, while a small proportion of patients will have no identifiable cause found despite thorough investigation and require surveillance given the small but persistent risk of an evolving diagnosis over time.

Fill in the blank: Direct visualisation of the bladder and urethra in haematuria investigation is achieved by flexible _____. Patients with no identifiable cause after thorough investigation require ongoing _____.

Features Warranting Urgent Referral
Age >40 with visible haematuria
Painless visible haematuria at any age
Microscopic haematuria with risk factors
Unexplained recurrent haematuria

Box 2.4: Red flag features in haematuria warranting urgent urological referral.

Pilot questions 2.4

- Classify haematuria by visibility and timing during voiding. (Linked to SLO 2.3, SLO 2.4)
- List the causes of haematuria across the urinary tract. (Linked to SLO 2.4)
- Describe the key elements of history taking in a patient with haematuria. (Linked to SLO 2.4)
- Describe the structured investigation pathway for unexplained haematuria. (Linked to SLO 2.4)
- Explain why a normal clinical examination does not exclude significant pathology in haematuria. (Linked to SLO 2.4)

Series Summary

This Series has covered the formation, presentation, and investigation of urolithiasis, followed by the full range of management options from conservative therapy through to minimally invasive and open surgical treatment. It went on to examine urological trauma affecting the kidney,

bladder, urethra, and genitalia, before concluding with haematuria, its classification, causes, clinical assessment, and the structured investigation pathway required to exclude serious underlying pathology.

You should now be able to describe the formation, presentation, and investigation of urolithiasis, select appropriate management according to stone size and location, describe the classification and management of urological trauma, and describe the causes and investigation of haematuria (Linked to SLOs 2.1 to 2.4).

Glossary of Terms

1. **AAST grading scale:** the American Association for the Surgery of Trauma system used to grade the severity of renal injury from I to V.
2. **Extracorporeal shock wave lithotripsy (ESWL):** a non-invasive treatment that uses focused shock waves to fragment urinary stones.
3. **Medical expulsive therapy:** the use of alpha-blockers to relax ureteric smooth muscle and promote spontaneous passage of a ureteric stone.
4. **Penile fracture:** a rupture of the tunica albuginea of the corpus cavernosum, typically occurring during sexual intercourse.
5. **Percutaneous nephrolithotomy (PCNL):** a surgical technique for removing large renal stones through a percutaneous tract into the kidney.
6. **Renal colic:** sudden, severe, colicky loin pain radiating towards the groin, the classic presentation of an obstructing ureteric stone.
7. **Staghorn calculus:** a large branching stone, usually of struvite composition, that fills the renal pelvis and calyces.
8. **Struvite stone:** a urinary stone that forms in alkaline urine infected with urease-producing organisms.
9. **Terminal haematuria:** blood appearing only at the end of voiding, suggesting a bladder neck or prostatic source.
10. **Ureteroscopy:** an endoscopic procedure passing a scope up the ureter to directly visualise and fragment a stone.
11. **Urethrography:** a contrast imaging study of the urethra, used to assess suspected urethral injury or stricture.

12. **Visible haematuria:** blood in the urine that is apparent to the naked eye, also termed macroscopic or gross haematuria.

Concept Check Questions [Series 2]

Objective questions

6. Calcium _____ is the most common type of urinary stone.
7. Extracorporeal shock wave lithotripsy is most effective for stones under _____ centimetres.
8. Renal trauma is graded using the _____ scale, ranging from I to V.
9. Blood at the urethral meatus after pelvic fracture should prompt _____ urethrography before catheterisation.
10. Haematuria occurring only at the start of voiding is termed _____ haematuria.

Short-answer questions

11. Explain why struvite stones are particularly concerning. (Linked to SLO 2.1)
12. Compare ureteroscopy with ESWL in the management of ureteric stones. (Linked to SLO 2.2)
13. Distinguish extraperitoneal from intraperitoneal bladder rupture. (Linked to SLO 2.3)
14. Describe the presentation and management of penile fracture. (Linked to SLO 2.3)
15. Describe the structured investigation pathway for unexplained haematuria. (Linked to SLO 2.4)

Long-answer questions

1. Describe the formation, clinical features, and investigation of urolithiasis. (Linked to SLO 2.1)
2. Describe the management options for urolithiasis according to stone size and location. (Linked to SLO 2.2)

3. Describe the classification and management of renal trauma. (Linked to SLO 2.3)
4. Describe the assessment and management of suspected urethral injury. (Linked to SLO 2.3)
5. Describe the causes and structured investigation of haematuria. (Linked to SLO 2.4)

Answers to Concept Check Questions [Series 2]

Objective questions

6. Oxalate.
7. 2.
8. AAST (American Association for the Surgery of Trauma).
9. Retrograde.
10. Initial.

Short-answer questions

11. Struvite stones form only in infected alkaline urine and can grow rapidly into staghorn calculi, carrying a high risk of recurrent urosepsis and progressive renal damage if not fully cleared and the infection eradicated.
12. ESWL is non-invasive but has lower success for larger or lower ureteric stones. Ureteroscopy offers higher success for mid and lower ureteric stones and harder stones but requires anaesthesia and carries a small injury risk.
13. Extraperitoneal rupture is usually associated with pelvic fracture and managed conservatively with catheter drainage. Intraperitoneal rupture follows a blow to a full bladder and requires surgical repair due to chemical peritonitis.
14. Penile fracture presents with a cracking sound, immediate detumescence, pain, and an eggplant deformity from haematoma, managed with prompt surgical exploration and repair to preserve erectile function.
15. Urine microscopy and cytology, renal function tests, upper tract imaging (ultrasound or CT urogram), and flexible cystoscopy, as no single test reliably excludes malignancy across the urinary tract.

Long-answer questions

16. **Basic response:** Urinary stones form from supersaturated urine, most commonly calcium oxalate, presenting with renal colic, and investigated with CT KUB or ultrasound and plain radiography.

Value-added response: Struvite stones warrant special attention as they form only with infection and can rapidly become staghorn calculi, requiring both surgical clearance and infection eradication to prevent recurrence.

17. **Basic response:** Small stones are managed conservatively with analgesia and medical expulsive therapy. Larger or resistant stones are managed with ESWL, ureteroscopy, or PCNL depending on size and location.

Value-added response: PCNL is preferred for large or staghorn stones, offering high stone-free rates in a single procedure compared with the multiple sessions often needed with less invasive techniques.

18. **Basic response:** Renal trauma is graded I to V using the AAST scale, with stable patients managed conservatively and surgery reserved for instability or expanding haematoma.

Value-added response: Preserving the kidney through conservative management where possible avoids unnecessary nephrectomy, reflecting the organ's considerable capacity for spontaneous healing after injury.

19. **Basic response:** Suspected urethral injury after pelvic fracture requires retrograde urethrography before catheterisation, as blind catheterisation risks converting a partial tear into complete disruption.

Value-added response: Recognising blood at the meatus, an inability to void, or a high-riding prostate as red flags prevents this avoidable complication and its long-term consequences for continence and sexual function.

20. **Basic response:** Haematuria has causes across the urinary tract, from infection and stones to glomerular disease and malignancy, investigated with urine cytology, imaging, and cystoscopy.

Value-added response: Malignancy must always be actively excluded in unexplained visible haematuria, particularly in patients over 40, given how often early urological cancer presents with no other abnormal findings.

Answers to Pilot Questions [Series 2]

Part 2.1

11. Calcium oxalate, calcium phosphate, uric acid, struvite, and cystine stones, forming from supersaturated urine with contributing metabolic and dietary factors.
12. Struvite stones form only with infection, can rapidly form staghorn calculi, and carry a high risk of recurrent urosepsis if not fully cleared with the infection eradicated.
13. Sudden, severe, colicky loin pain radiating to the groin, with nausea, vomiting, and inability to find a comfortable position.
14. Fever, rigors, and systemic sepsis can develop rapidly, constituting a urological emergency requiring urgent decompression.
15. CT KUB is the gold standard; where unavailable, plain radiography and renal ultrasound offer an accessible alternative, alongside urinalysis and renal function tests.

Part 2.2

1. Analgesia (typically NSAIDs), hydration, and straining of urine, with most stones under 6 to 10 millimetres passing spontaneously.
2. Alpha-blockers relax ureteric smooth muscle, increasing the likelihood and speed of spontaneous passage, particularly for distal ureteric stones.
3. ESWL fragments stones using external shock waves, most effective for stones under 2 centimetres in the kidney or upper ureter.
4. Ureteroscopy offers higher success for mid and lower ureteric stones and harder stones but requires anaesthesia, unlike the non-invasive ESWL.
5. Large renal stones over 2 centimetres and complex staghorn calculi are the main indications for PCNL.

Part 2.3

1. The AAST scale grades renal injury from I (minor contusion) to V (shattered kidney or pedicle avulsion), guiding prognosis and management.

2. Bed rest, monitoring, and serial imaging, as the kidney has considerable capacity to heal without intervention in stable patients.
3. Extraperitoneal rupture is usually from pelvic fracture and managed conservatively. Intraperitoneal rupture follows a blow to a full bladder and requires surgical repair.
4. Blood at the meatus, inability to void, or a high-riding prostate should prompt retrograde urethrography before any catheterisation attempt.
5. Sudden cracking sound, immediate detumescence, pain, and an eggplant deformity, managed with prompt surgical exploration and repair.

Part 2.4

1. Microscopic (detected only on urinalysis) or macroscopic (visible), further described as initial, terminal, or total depending on timing during voiding.
2. Infection, stones, benign prostatic enlargement, glomerular disease, and malignancy of the kidney, ureter, bladder, or prostate.
3. Timing and pattern of bleeding, associated pain, risk factors including smoking and occupational exposures, and medication history including anticoagulants.
4. Urine microscopy and cytology, renal function tests, upper tract imaging, and flexible cystoscopy, as no single test excludes malignancy alone.
5. Early urological malignancy often presents with entirely normal examination findings, so investigation should never be omitted on the basis of a normal examination alone.

References and Attributions [Series 2]

Textual References

1. Bailey, H. and Love, R. J. M. (2018). Bailey and Love's Short Practice of Surgery (27th ed.). CRC Press.
2. Wein, A. J., Kavoussi, L. R., Partin, A. W. and Peters, C. A. (2020). Campbell-Walsh-Wein Urology (12th ed.). Elsevier.

3. Turk, C., Neisius, A., Petrik, A. et al. (2022). EAU Guidelines on Urolithiasis. European Association of Urology.
4. Morey, A. F., Broghammer, J. A., Hollowell, C. M. P. et al. (2014). Urotrauma: AUA Guideline. Journal of Urology, 192(2), 327 to 335.

Figures, Plates, Tables, and Boxes

- Figure 2.1: Types of urinary stones and the classic pain radiation pattern of renal colic. AI-generated using the prompt: "Create a professional two-panel medical diagram titled Urolithiasis Formation and Presentation, showing stone types and formation conditions, and the pain radiation pattern of renal colic. Clean clinical surgical diagram style."
- Table 2.2: Comparison of treatment modalities for urolithiasis by stone size, location, and approach. AI-generated using the prompt: "Create a clean reference table titled Treatment Modalities for Urolithiasis, comparing observation, ESWL, ureteroscopy, PCNL, and open surgery by stone size, location, advantages, and limitations. Simple clinical reference table style with outside border."
- Figure 2.3: Grading of renal trauma, bladder rupture patterns, and penile fracture anatomy. AI-generated using the prompt: "Create a professional three-panel medical diagram titled Urological Trauma, showing renal injury grading, bladder rupture cystogram patterns, and penile fracture anatomy. Clean clinical surgical diagram style."
- Box 2.4: Red flag features in haematuria warranting urgent urological referral. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Red Flag Features in Haematuria, listing key features warranting urgent referral in a clean bulleted list. Clinical reference box style."

Course code: SUG 404

Course title: Urology

Course credit load: 2 Units

Series 3: Urological Tumours and Infections

1. **Part 3.1: Renal Tumours**
    1. Sub Part 3.1.1: Renal cell carcinoma
    2. Sub Part 3.1.2: Other renal tumours
    3. Sub Part 3.1.3: Investigation and management of renal masses
2. **Part 3.2: Bladder Tumours**
    1. Sub Part 3.2.1: Epidemiology and risk factors of bladder cancer
    2. Sub Part 3.2.2: Clinical features and diagnosis of bladder cancer
    3. Sub Part 3.2.3: Staging and management of bladder cancer
3. **Part 3.3: Testicular Tumours and Scrotal Swellings**
    1. Sub Part 3.3.1: Testicular tumours
    2. Sub Part 3.3.2: Hydrocoele and other scrotal swellings
    3. Sub Part 3.3.3: Management of testicular tumours and scrotal swellings
4. **Part 3.4: Urological Infections**
    1. Sub Part 3.4.1: Urinary tract infection
    2. Sub Part 3.4.2: Acute and chronic prostatitis
    3. Sub Part 3.4.3: Epididymo-orchitis and Fournier's gangrene

Introduction

In the last Series, we explored urolithiasis, urological trauma, and haematuria, conditions that frequently present acutely and demand a swift, structured response. We now turn to two further pillars of urological practice: tumours arising anywhere from the kidney to the testis, and the infections that affect the urinary and genital tract, ranging from the everyday urinary tract infection to the rare but life-threatening Fournier's gangrene. Recognising the difference between

a benign scrotal swelling and a testicular tumour, or between simple cystitis and a surgical emergency, is a skill every general surgeon must carry into practice.

The aim of this Series is to equip you with the knowledge to recognise and manage urological tumours of the kidney, bladder, and testis, and to diagnose and manage the common and serious urological infections.

We shall commence this Series by examining renal tumours, from renal cell carcinoma through to the less common benign and urothelial tumours of the kidney. Next, we will consider bladder tumours, covering their epidemiology, presentation, staging, and management. Following that, our attention turns to testicular tumours and the scrotal swellings that must be distinguished from them in clinical practice. Finally, we will conclude by examining urological infections, from urinary tract infection and prostatitis through to epididymo-orchitis and Fournier's gangrene.

Series Learning Outcomes

Upon completing this Series, you should be able to:

1. **SLO 3.1:** describe the classification, presentation, and management of renal tumours,
2. **SLO 3.2:** describe the epidemiology, presentation, and management of bladder cancer,
3. **SLO 3.3:** describe the classification and management of testicular tumours and common scrotal swellings, and
4. **SLO 3.4:** describe the presentation and management of the common urological infections.

3.1 Renal Tumours

3.1.1 Renal cell carcinoma

Renal cell carcinoma (RCC) is the most common malignant renal tumour, arising from the renal tubular epithelium, with clear cell carcinoma the most frequent histological subtype. Risk factors include smoking, obesity, hypertension, and acquired cystic kidney disease in patients on long-term dialysis, and the classic triad of loin pain, haematuria, and a palpable mass is now uncommon at presentation, as most tumours are detected incidentally on imaging performed for unrelated reasons, reflecting the widespread modern use of abdominal ultrasound and CT.

Paraneoplastic syndromes occur in a significant minority of patients and can be the presenting feature, including hypercalcaemia (from parathyroid hormone-related peptide secretion), polycythaemia (from ectopic erythropoietin production), and Stauffer's syndrome (reversible hepatic dysfunction without liver metastasis), all of which typically resolve following successful

tumour removal and should prompt consideration of an underlying renal tumour when identified without an obvious alternative cause.

Fill in the blank: The most common histological subtype of renal cell carcinoma is _____ cell carcinoma. Reversible hepatic dysfunction associated with RCC without liver metastasis is called _____ syndrome.

3.1.2 Other renal tumours

Angiomyolipoma is the most common benign renal tumour, composed of blood vessels, smooth muscle, and fat, often identifiable on CT by its characteristic fat density, and associated with tuberous sclerosis when multiple and bilateral; larger lesions, generally over 4 centimetres, carry a significant risk of spontaneous haemorrhage and may warrant prophylactic embolisation or partial nephrectomy even in the absence of symptoms.

Transitional cell carcinoma of the renal pelvis arises from the urothelium lining the collecting system, sharing risk factors and field-change biology with bladder urothelial carcinoma, and often requires nephroureterectomy with excision of a bladder cuff, as the entire urothelial lining from the renal pelvis to the bladder is at risk of synchronous or metachronous tumour development, a principle central to appropriate surgical planning in this condition.

Fill in the blank: The most common benign renal tumour is _____. Transitional cell carcinoma of the renal pelvis is typically treated with nephroureterectomy including excision of a _____ cuff.

3.1.3 Investigation and management of renal masses

Contrast-enhanced CT is the mainstay of investigation for a suspected renal mass, characterising its size, enhancement pattern, local invasion, and involvement of the renal vein or inferior vena cava, while chest imaging and, where indicated, bone or brain imaging complete staging for metastatic disease; renal biopsy is reserved for cases where the diagnosis remains uncertain or where histology would change management, as most solid enhancing renal masses are managed as presumed malignancy without biopsy.

Management of localised RCC is surgical: partial nephrectomy is preferred where technically feasible to preserve renal function, particularly in smaller tumours or patients with a solitary kidney, while radical nephrectomy remains appropriate for larger or centrally located tumours; active surveillance is an option for small, incidentally detected masses in elderly or comorbid patients, and systemic therapy with targeted agents or immunotherapy is reserved for metastatic disease.

Fill in the blank: The mainstay imaging investigation for a suspected renal mass is _____ CT. Where technically feasible, _____ nephrectomy is preferred over radical nephrectomy to preserve renal function.

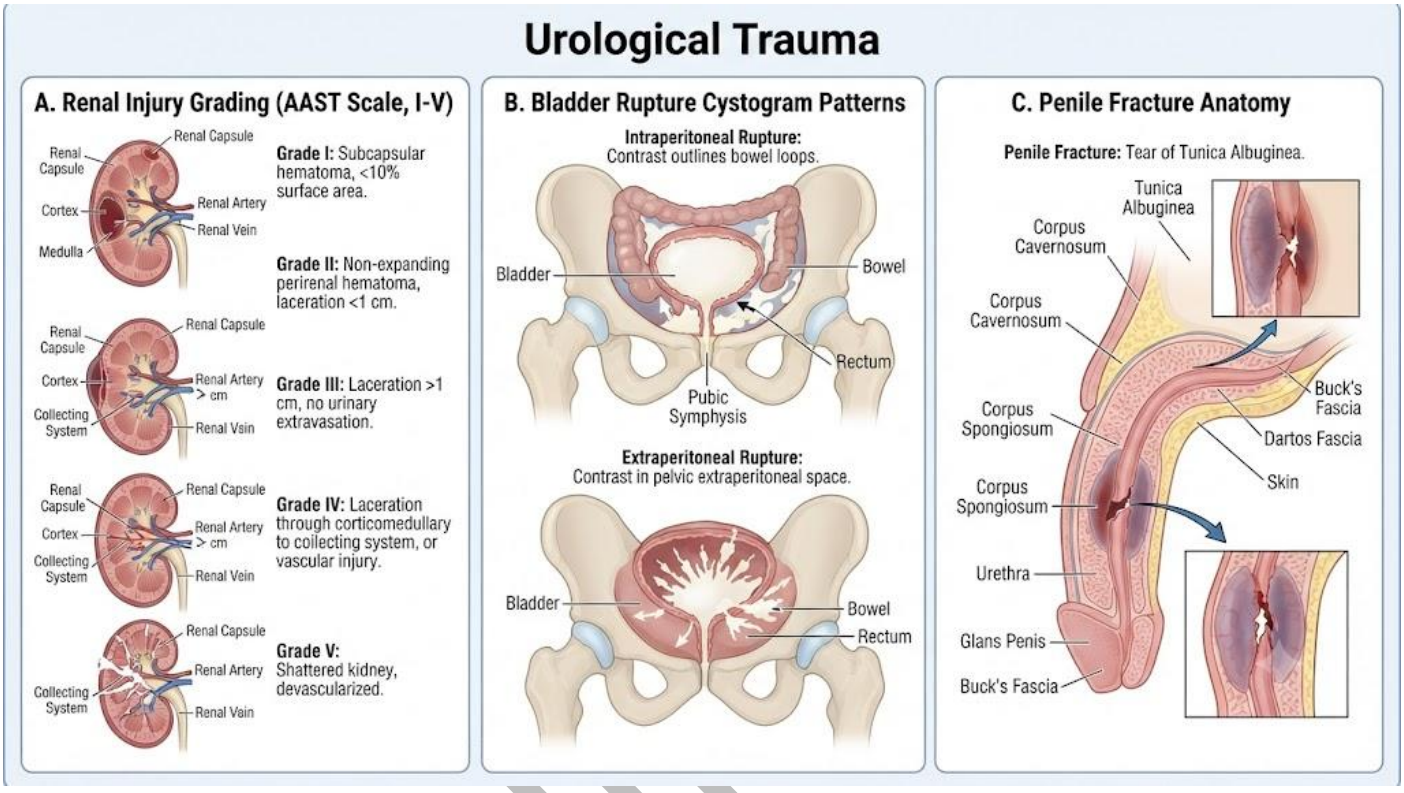

Figure 3.1: Comparison of renal tumour types and the surgical management pathway for renal cell carcinoma.

Pilot questions 3.1

1. Describe the risk factors and typical presentation of renal cell carcinoma. (Linked to SLO 3.1)
2. Describe the paraneoplastic syndromes associated with renal cell carcinoma. (Linked to SLO 3.1)
3. Describe the features and management of angiomyolipoma. (Linked to SLO 3.1)
4. Explain the surgical principle behind nephroureterectomy for renal pelvis transitional cell carcinoma. (Linked to SLO 3.1)
5. Compare partial and radical nephrectomy in the management of localised renal cell carcinoma. (Linked to SLO 3.1)

3.2 Bladder Tumours

3.2.1 Epidemiology and risk factors of bladder cancer

Bladder cancer is predominantly a disease of urothelial (transitional cell) origin in most parts of the world, though in regions with endemic schistosomiasis, including many parts of Nigeria, squamous cell carcinoma is proportionally far more common, reflecting the chronic inflammatory field-change effect of long-standing bladder schistosomal infection on the urothelium, an important epidemiological distinction from the urothelial-predominant pattern seen elsewhere.

Established risk factors for urothelial bladder cancer include cigarette smoking (the single largest risk factor), occupational exposure to aromatic amines used in the dye, rubber, and textile industries, and prior pelvic radiotherapy, while schistosomiasis remains the dominant risk factor for squamous cell carcinoma in endemic areas, making a travel and residence history in schistosomiasis-endemic regions a relevant part of the clinical assessment of any patient presenting with haematuria in Nigerian practice.

Fill in the blank: In regions with endemic schistosomiasis, _____ cell carcinoma of the bladder is proportionally more common. The single largest risk factor for urothelial bladder cancer is _____.

3.2.2 Clinical features and diagnosis of bladder cancer

Painless visible haematuria is the most common presenting feature of bladder cancer and should always prompt urgent investigation regardless of whether it recurs or settles spontaneously, as intermittent bleeding does not indicate resolution of the underlying tumour; irritative storage symptoms such as frequency and urgency may also occur, particularly with carcinoma in situ or muscle-invasive disease, and can sometimes mimic a simple urinary tract infection, delaying diagnosis if not appropriately investigated.

Diagnosis is confirmed by flexible cystoscopy, which directly visualises the tumour, followed by transurethral resection of bladder tumour (TURBT), which is both diagnostic, providing histology and depth of invasion, and therapeutic for non-muscle-invasive disease, making it the pivotal initial step in both establishing the diagnosis and beginning definitive treatment for most patients with newly detected bladder tumours.

Fill in the blank: The most common presenting feature of bladder cancer is painless _____ haematuria. TURBT is both diagnostic and _____ for non-muscle-invasive bladder cancer.

3.2.3 Staging and management of bladder cancer

Bladder cancer is fundamentally divided by TURBT histology into non-muscle-invasive disease (confined to the mucosa or lamina propria) and muscle-invasive disease (invading the detrusor muscle), a distinction with profound implications for management, as the two categories are treated with entirely different strategies and carry substantially different prognoses even at the point of initial diagnosis.

Non-muscle-invasive disease is managed with TURBT followed by intravesical therapy (chemotherapy or Bacillus Calmette-Guerin immunotherapy) to reduce recurrence and

progression, with regular cystoscopic surveillance thereafter, while muscle-invasive disease requires radical treatment, typically radical cystectomy with urinary diversion or, in selected patients, bladder-preserving combined radiotherapy and chemotherapy, reflecting the more aggressive biological behaviour and metastatic potential of muscle-invasive tumours.

Fill in the blank: The critical distinction in bladder cancer staging is between non-muscle-invasive and _____-invasive disease. Non-muscle-invasive bladder cancer is managed with TURBT followed by intravesical _____.

Category	Non-Muscle-Invasive (NMIBC)	Muscle-Invasive (MIBC)
Depth of invasion	Confined to mucosa or lamina propria (Ta, T1, CIS)	Invades detrusor muscle (≥ T2)
Management	TURBT ± intravesical therapy (e.g., BCG, chemotherapy)	Radical cystectomy ± neoadjuvant chemotherapy, or bladder-preserving chemoradiation
Surveillance	Regular cystoscopy and urine cytology (high recurrence risk)	Imaging for metastasis, follow-up after cystectomy or chemoradiation

Table 3.2: Comparison of non-muscle-invasive and muscle-invasive bladder cancer.

Pilot questions 3.2

1. Explain why squamous cell carcinoma of the bladder is proportionally more common in schistosomiasis-endemic regions. (Linked to SLO 3.1)
2. List the risk factors for urothelial bladder cancer. (Linked to SLO 3.1)
3. Describe the clinical presentation of bladder cancer. (Linked to SLO 3.1)
4. Describe the role of TURBT in the diagnosis and management of bladder cancer. (Linked to SLO 3.1)
5. Compare the management of non-muscle-invasive and muscle-invasive bladder cancer. (Linked to SLO 3.1)

3.3 Testicular Tumours and Scrotal Swellings

3.3.1 Testicular tumours

Testicular cancer is the most common solid malignancy in young men aged 15 to 35, typically presenting as a painless testicular lump or diffuse enlargement, occasionally with a dull ache or heaviness, and classified broadly into seminomas (generally slower growing and highly

radiosensitive) and non-seminomatous germ cell tumours (which include teratoma, yolk sac tumour, and choriocarcinoma, tending to behave more aggressively and spread earlier).

Risk factors include cryptorchidism (undescended testis, even after orchidopexy), a personal or family history of testicular cancer, and infertility, and any solid intratesticular mass should be considered malignant until proven otherwise, distinguishing it clinically from the far more common benign extratesticular scrotal swellings, a distinction that relies heavily on careful scrotal examination and ultrasound rather than clinical impression alone.

Fill in the blank: Testicular tumours are broadly classified into seminomas and _____ germ cell tumours. A key risk factor for testicular cancer is a history of _____ (undescended testis).

3.3.2 Hydrocoele and other scrotal swellings

Hydrocoele is an abnormal collection of serous fluid within the tunica vaginalis surrounding the testis, presenting as a soft, non-tender, fluctuant scrotal swelling that characteristically transilluminates and in which the testis cannot be palpated separately from the fluid, distinguishing it from solid or complex scrotal masses; it may be primary (idiopathic) or secondary to underlying testicular pathology including tumour, infection, or trauma, making careful examination for an underlying cause essential in every case.

Other scrotal swellings include epididymal cysts (arising from the epididymis, typically separate from the testis and often multiple), varicocele (dilated pampiniform plexus veins, classically described as feeling like a bag of worms and more common on the left due to the anatomy of left testicular vein drainage into the renal vein), and inguinoscrotal hernia, distinguished by the ability to get above the swelling on examination, which is possible with a hydrocoele but not with a hernia extending from the inguinal canal.

Fill in the blank: A hydrocoele characteristically _____ when a light source is applied. A varicocele is classically described as feeling like a bag of _____.

3.3.3 Management of testicular tumours and scrotal swellings

Any suspected testicular tumour is managed by radical inguinal orchidectomy, approaching via the groin rather than the scrotum to avoid disrupting lymphatic drainage and altering the pattern of subsequent metastatic spread, with tumour markers (alpha-fetoprotein, beta-human chorionic gonadotropin, and lactate dehydrogenase) sent preoperatively both to aid diagnosis and to provide a baseline for monitoring treatment response and detecting recurrence.

Simple hydrocoeles and epididymal cysts are managed conservatively if asymptomatic, with surgical excision reserved for large, symptomatic, or cosmetically bothersome cases, while varicocele is generally managed conservatively unless associated with pain, testicular atrophy, or male infertility, in which case surgical or radiological varicocelectomy may be offered, always with underlying testicular pathology excluded first when any scrotal swelling is being assessed for management.

Fill in the blank: A suspected testicular tumour is managed by radical _____ orchidectomy rather than a scrotal approach. Tumour markers sent for testicular cancer include AFP, beta-hCG, and _____.

Condition	Key Clinical Features
Hydrocoele	Transilluminates; can get above swelling; smooth, cystic consistency
Varicocele	"Bag of worms" consistency; does not transilluminate; disappears when lying down
Epididymal cyst	Transilluminates; separate from testis; smooth, cystic consistency
Inguinoscrotal hernia	Cannot get above swelling; does not transilluminate; cough impulse present; firm consistency

Box 3.3: Distinguishing features of common scrotal swellings.

Pilot questions 3.3

- Describe the classification of testicular tumours. (Linked to SLO 3.2)
- List the risk factors for testicular cancer. (Linked to SLO 3.2)
- Describe the clinical features that distinguish a hydrocoele from other scrotal swellings. (Linked to SLO 3.2)
- Compare the clinical features of varicocele, epididymal cyst, and inguinoscrotal hernia. (Linked to SLO 3.2)
- Explain why radical inguinal orchidectomy, rather than a scrotal approach, is used for suspected testicular tumour. (Linked to SLO 3.2)

3.4 Urological Infections

3.4.1 Urinary tract infection

Urinary tract infection (UTI) is classified as uncomplicated (occurring in an otherwise healthy urinary tract, predominantly in women) or complicated (occurring in the presence of a structural or functional abnormality, indwelling catheter, stones, or immunosuppression, and disproportionately affecting men), with Escherichia coli the most common causative organism in both categories, though complicated infections show a broader range of resistant and less typical organisms.

Clinical features range from lower tract symptoms (dysuria, frequency, urgency, and suprapubic discomfort in cystitis) to upper tract involvement (fever, rigors, and loin pain in pyelonephritis, which represents a more serious infection with a real risk of progression to sepsis if inadequately treated), and recurrent UTI in men or any UTI in a child should always prompt investigation for an underlying structural or functional predisposing abnormality.

Fill in the blank: The most common causative organism of urinary tract infection is _____. Upper tract urinary infection with fever and loin pain is termed _____.

3.4.2 Acute and chronic prostatitis

Acute bacterial prostatitis presents with fever, perineal or suprapubic pain, and marked lower urinary tract symptoms, with a tender, boggy prostate on digital rectal examination (which should be performed gently, as vigorous examination risks precipitating bacteraemia), managed with prolonged antibiotic therapy, as inadequate treatment risks progression to prostatic abscess or chronic prostatitis, making a sufficiently extended treatment course essential from the outset.

Chronic prostatitis or chronic pelvic pain syndrome presents with persistent pelvic, perineal, or genital pain lasting more than three months, often without demonstrable infection on standard culture, making it a diagnosis of exclusion after urological and, where relevant, gastrointestinal causes have been considered, with management centred on symptomatic control (alpha-blockers, anti-inflammatories, pelvic floor physiotherapy) rather than repeated antibiotic courses, which offer little benefit in the absence of confirmed infection.

Fill in the blank: Digital rectal examination in acute bacterial prostatitis classically reveals a tender, _____ prostate. Chronic prostatitis or chronic pelvic pain syndrome is diagnosed after at least _____ months of symptoms.

3.4.3 Epididymo-orchitis and Fournier's gangrene

Epididymo-orchitis is inflammation of the epididymis and testis, most commonly from ascending bacterial infection (sexually transmitted organisms in younger men, urinary pathogens in older men with bladder outlet obstruction), presenting with gradual-onset scrotal pain and swelling, relieved by elevation of the testis (a positive Prehn's sign), a feature that helps distinguish it clinically from testicular torsion, though ultrasound with Doppler flow assessment remains essential whenever the diagnosis is uncertain given the time-critical nature of torsion.

Fournier's gangrene is a rapidly progressive necrotising fasciitis of the perineal, genital, and perianal region, a true surgical emergency most often arising in patients with diabetes, immunosuppression, or a perianal or urethral source of infection, presenting with disproportionate pain, systemic toxicity, and crepitus or skin necrosis, requiring immediate broad-spectrum antibiotics and urgent, often repeated, aggressive surgical debridement, as mortality rises sharply with any delay in definitive surgical source control.

Fill in the blank: Relief of pain on elevation of the testis in epididymo-orchitis is called a positive _____ sign. Fournier's gangrene is a rapidly progressive necrotising _____ requiring urgent surgical debridement.

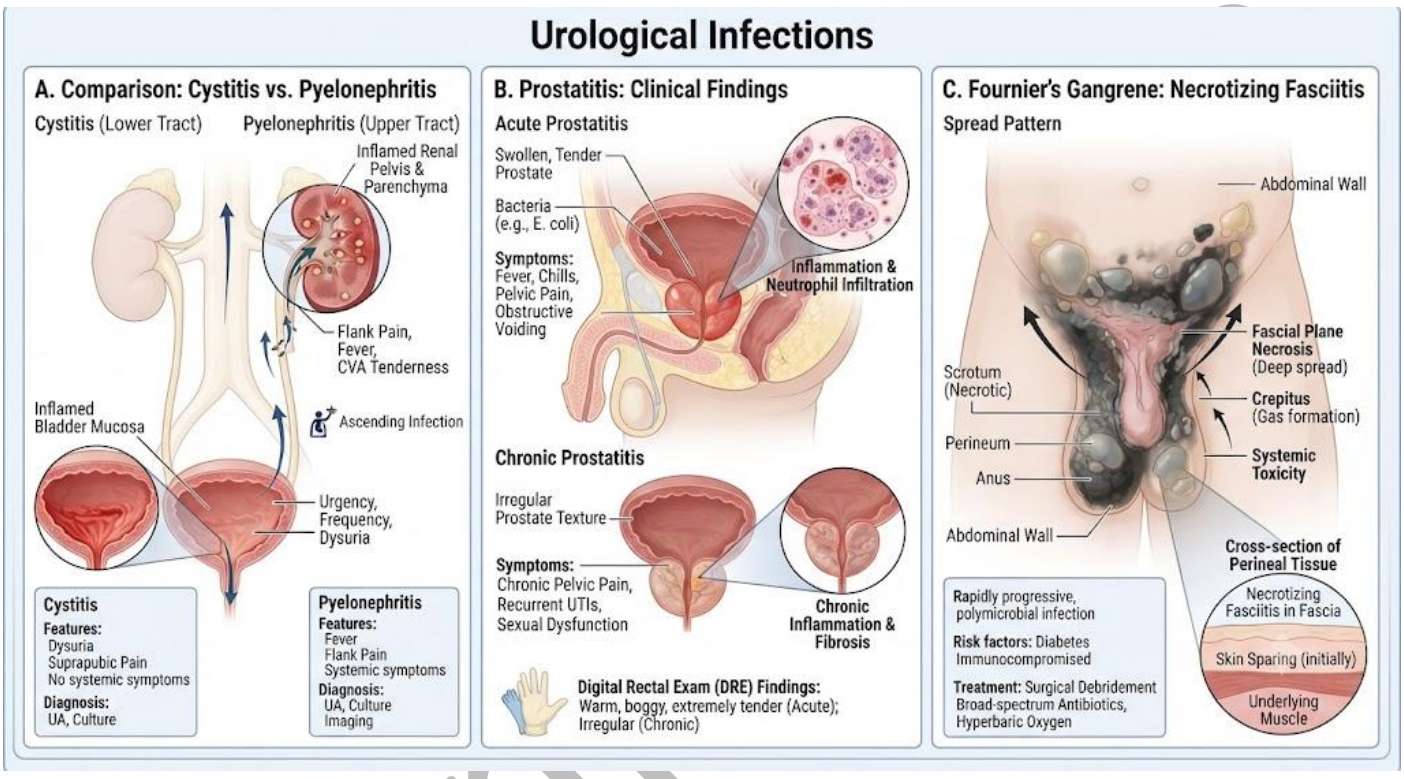

Figure 3.4: Comparison of urinary tract infection severity, prostatitis findings, and the spread pattern of Fournier's gangrene.

Pilot questions 3.4

1. Distinguish uncomplicated from complicated urinary tract infection. (Linked to SLO 3.3)
2. Compare the clinical features of cystitis and pyelonephritis. (Linked to SLO 3.3)
3. Describe the presentation and management of acute bacterial prostatitis. (Linked to SLO 3.3)
4. Describe Prehn's sign and its clinical significance in epididymo-orchitis. (Linked to SLO 3.3)
5. Describe the presentation and emergency management of Fournier's gangrene. (Linked to SLO 3.3)

Series Summary

This Series has covered renal tumours, from renal cell carcinoma and its paraneoplastic syndromes through to the less common benign and urothelial renal tumours, followed by bladder cancer, addressing its distinctive epidemiology in schistosomiasis-endemic regions and its staging and management. It went on to examine testicular tumours and the scrotal swellings that must be distinguished from them, before concluding with urological infections, from urinary tract infection and prostatitis through to the surgical emergency of Fournier's gangrene.

You should now be able to describe the classification, presentation, and management of renal tumours, describe the epidemiology and management of bladder cancer, distinguish testicular tumours from benign scrotal swellings, and describe the presentation and management of the common urological infections (Linked to SLOs 3.1 to 3.4).

Glossary of Terms

6. **Angiomyolipoma:** the most common benign renal tumour, composed of blood vessels, smooth muscle, and fat.
7. **Fournier's gangrene:** a rapidly progressive necrotising fasciitis of the perineal, genital, and perianal region.
8. **Hydrocoele:** an abnormal collection of serous fluid within the tunica vaginalis surrounding the testis.
9. **Muscle-invasive bladder cancer:** bladder cancer that has invaded the detrusor muscle, requiring radical treatment.
10. **Paraneoplastic syndrome:** a systemic effect of a tumour, such as hypercalcaemia or polycythaemia, occurring independently of direct tumour invasion or metastasis.
11. **Prehn's sign:** relief of scrotal pain on elevation of the testis, supporting a diagnosis of epididymo-orchitis over torsion.
12. **Radical inguinal orchidectomy:** surgical removal of a testicular tumour via a groin incision, avoiding a scrotal approach to preserve normal lymphatic drainage.
13. **Renal cell carcinoma:** the most common malignant renal tumour, arising from the renal tubular epithelium.
14. **Stauffer's syndrome:** reversible hepatic dysfunction associated with renal cell carcinoma in the absence of liver metastasis.

15. **TURBT:** transurethral resection of bladder tumour, both diagnostic and therapeutic for non-muscle-invasive bladder cancer.
16. **Varicocele:** dilatation of the pampiniform plexus veins of the scrotum, classically described as feeling like a bag of worms.
17. **Chronic pelvic pain syndrome:** persistent pelvic, perineal, or genital pain lasting more than three months, often without demonstrable infection.

Concept Check Questions [Series 3]

Objective questions

11. The most common histological subtype of renal cell carcinoma is _____ cell carcinoma.
12. In regions with endemic schistosomiasis, _____ cell carcinoma of the bladder is proportionally more common.
13. A hydrocoele characteristically _____ when a light source is applied.
14. The most common causative organism of urinary tract infection is _____.
15. Relief of pain on elevation of the testis in epididymo-orchitis is called a positive _____ sign.

Short-answer questions

1. Describe the paraneoplastic syndromes associated with renal cell carcinoma. (Linked to SLO 3.1)
2. Describe the role of TURBT in the diagnosis and management of bladder cancer. (Linked to SLO 3.1)
3. Describe the clinical features that distinguish a hydrocoele from other scrotal swellings. (Linked to SLO 3.2)
4. Describe the presentation and management of acute bacterial prostatitis. (Linked to SLO 3.3)
5. Describe the presentation and emergency management of Fournier's gangrene. (Linked to SLO 3.3)

Long-answer questions

6. Describe the presentation, investigation, and management of renal cell carcinoma. (Linked to SLO 3.1)
7. Describe the staging and management of bladder cancer. (Linked to SLO 3.1)
8. Describe the classification and management of testicular tumours. (Linked to SLO 3.2)
9. Distinguish the common scrotal swellings on clinical grounds. (Linked to SLO 3.2)
10. Describe the presentation and management of the common urological infections. (Linked to SLO 3.3)

Answers to Concept Check Questions [Series 3]

Objective questions

11. Clear.
12. Squamous.
13. Transilluminates.
14. Escherichia coli.
15. Prehn's.

Short-answer questions

16. Hypercalcaemia from parathyroid hormone-related peptide, polycythaemia from ectopic erythropoietin, and Stauffer's syndrome, a reversible hepatic dysfunction, typically resolving after tumour removal.
17. TURBT visualises and resects the tumour, providing histology and depth of invasion for diagnosis, and is curative for most non-muscle-invasive disease.
18. A hydrocoele is soft, non-tender, fluctuant, transilluminates, and the testis cannot be felt separately from the fluid within it.

19. Fever, perineal or suprapubic pain, marked lower urinary tract symptoms, and a tender, boggy prostate on gentle digital rectal examination, managed with prolonged antibiotics.

20. Disproportionate pain, systemic toxicity, and crepitus or skin necrosis, requiring immediate broad-spectrum antibiotics and urgent aggressive surgical debridement.

Long-answer questions

21. **Basic response:** Renal cell carcinoma often presents incidentally on imaging, investigated with contrast CT, and managed with partial or radical nephrectomy depending on size and location.

Value-added response: Paraneoplastic syndromes such as hypercalcaemia and polycythaemia may be the presenting feature and typically resolve after successful tumour removal.

22. **Basic response:** Bladder cancer is staged by TURBT into non-muscle-invasive and muscle-invasive disease, with the former managed by TURBT and intravesical therapy and the latter by radical cystectomy.

Value-added response: In schistosomiasis-endemic regions, squamous cell carcinoma is proportionally more common, an important epidemiological distinction relevant to Nigerian clinical practice.

23. **Basic response:** Testicular tumours are classified as seminoma or non-seminomatous germ cell tumour, managed by radical inguinal orchidectomy with preoperative tumour markers sent.

Value-added response: The inguinal, rather than scrotal, surgical approach avoids disrupting lymphatic drainage and altering the pattern of subsequent metastatic spread.

24. **Basic response:** Hydrocoele transilluminates with a separately impalpable testis. Varicocele feels like a bag of worms. Hernia cannot be got above on examination.

Value-added response: Any solid intratesticular mass should be considered malignant until proven otherwise, distinguishing it from the far more common benign extratesticular swellings.

25. **Basic response:** Urinary tract infection ranges from cystitis to pyelonephritis, managed with antibiotics; prostatitis presents with a tender prostate; epididymo-orchitis presents with gradual scrotal pain relieved by elevation.

Value-added response: Fournier's gangrene is a surgical emergency requiring immediate antibiotics and urgent debridement, as mortality rises sharply with any delay in surgical source control.

Answers to Pilot Questions [Series 3]

Part 3.1

1. Clear cell RCC arises from renal tubular epithelium, associated with smoking, obesity, and hypertension, often now detected incidentally on imaging.
2. Hypercalcaemia, polycythaemia, and Stauffer's syndrome, all of which typically resolve after successful tumour removal.
3. Angiomyolipoma is composed of blood vessels, smooth muscle, and fat, managed conservatively unless large, when embolisation or partial nephrectomy is considered.
4. The entire urothelial lining from renal pelvis to bladder is at risk of synchronous or metachronous tumour, requiring excision of a bladder cuff.
5. Partial nephrectomy preserves renal function and is preferred where feasible; radical nephrectomy remains appropriate for larger or centrally located tumours.

Part 3.2

1. Chronic schistosomal infection causes field-change inflammation of the urothelium favouring squamous rather than urothelial carcinoma development.
2. Smoking, occupational exposure to aromatic amines, prior pelvic radiotherapy, and schistosomiasis in endemic regions.
3. Painless visible haematuria is the most common feature, sometimes with irritative storage symptoms mimicking a urinary tract infection.
4. TURBT visualises and resects the tumour, providing diagnostic histology and depth of invasion, and treating non-muscle-invasive disease.
5. Non-muscle-invasive disease is managed with TURBT and intravesical therapy with surveillance; muscle-invasive disease requires radical cystectomy or bladder-preserving chemoradiotherapy.

Part 3.3

1. Seminomas, which are slower growing and radiosensitive, and non-seminomatous germ cell tumours, including teratoma, yolk sac tumour, and choriocarcinoma.
2. Cryptorchidism, a personal or family history of testicular cancer, and infertility.
3. A hydrocoele is soft, transilluminates, and the testis cannot be felt separately from the surrounding fluid.
4. Varicocele feels like a bag of worms; epididymal cyst is separate from the testis; hernia cannot be got above on examination.
5. The inguinal approach avoids disrupting lymphatic drainage and altering the pattern of subsequent metastatic spread, unlike a scrotal incision.

Part 3.4

1. Uncomplicated UTI occurs in an otherwise healthy urinary tract, predominantly in women. Complicated UTI occurs with a structural, functional, or immunosuppressive predisposing factor.
2. Cystitis causes dysuria, frequency, and suprapubic discomfort. Pyelonephritis adds fever, rigors, and loin pain, representing more serious upper tract infection.
3. Fever, perineal pain, marked LUTS, and a tender boggy prostate, managed with prolonged antibiotic therapy to prevent abscess or chronic prostatitis.
4. Prehn's sign is relief of pain on elevation of the testis, supporting epididymo-orchitis over torsion, though ultrasound Doppler remains essential if uncertain.
5. Disproportionate pain, systemic toxicity, and skin necrosis, requiring immediate antibiotics and urgent aggressive surgical debridement given rapidly rising mortality with delay.

References and Attributions [Series 3]

Textual References

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- Witjes, J. A., Bruins, H. M., Cathomas, R. et al. (2021). EAU Guidelines on Muscle-Invasive and Metastatic Bladder Cancer. European Urology, 79(1), 82 to 104.

Figures, Plates, Tables, and Boxes

- Figure 3.1: Comparison of renal tumour types and the surgical management pathway for renal cell carcinoma. AI-generated using the prompt: "Create a professional two-panel medical diagram titled Renal Tumours, comparing renal cell carcinoma, angiomyolipoma, and transitional cell carcinoma, and showing a management pathway by stage. Clean clinical surgical diagram style."
- Table 3.2: Comparison of non-muscle-invasive and muscle-invasive bladder cancer. AI-generated using the prompt: "Create a clean reference table titled Non-Muscle-Invasive versus Muscle-Invasive Bladder Cancer, comparing depth of invasion, management, and surveillance. Simple clinical reference table style with outside border."
- Box 3.3: Distinguishing features of common scrotal swellings. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Distinguishing Features of Scrotal Swellings, comparing hydrocoele, varicocele, epididymal cyst, and hernia. Clinical reference box style."
- Figure 3.4: Comparison of urinary tract infection severity, prostatitis findings, and the spread pattern of Fournier's gangrene. AI-generated using the prompt: "Create a professional three-panel medical diagram titled Urological Infections, comparing cystitis and pyelonephritis, showing prostatitis findings, and illustrating the spread pattern of Fournier's gangrene. Clean clinical surgical diagram style."

Course code: SUG 404

Course title: Urology

Course credit load: 2 Units

Series 4: Paediatric and Congenital Urology

1. **Part 4.1: Undescended Testis and Related Anomalies**
    1. Sub Part 4.1.1: Embryology and classification of undescended testis
    2. Sub Part 4.1.2: Clinical assessment of undescended testis
    3. Sub Part 4.1.3: Management of undescended testis
2. **Part 4.2: Hypospadias and Penile Anomalies**
    1. Sub Part 4.2.1: Classification and embryology of hypospadias
    2. Sub Part 4.2.2: Clinical assessment and associated anomalies
    3. Sub Part 4.2.3: Management of hypospadias
3. **Part 4.3: Posterior Urethral Valves and Vesicoureteric Reflux**
    1. Sub Part 4.3.1: Posterior urethral valves
    2. Sub Part 4.3.2: Vesicoureteric reflux
    3. Sub Part 4.3.3: Investigation and management of PUV and VUR
4. **Part 4.4: Pelvi-ureteric Junction Obstruction and Other Congenital Anomalies**
    1. Sub Part 4.4.1: Pelvi-ureteric junction obstruction
    2. Sub Part 4.4.2: Bladder exstrophy and epispadias
    3. Sub Part 4.4.3: Circumcision and its complications

Introduction

In the last Series, we explored urological tumours and infections, conditions that predominantly affect adults. We now turn our attention to the youngest patients in urological practice: infants and children born with congenital anomalies of the urinary and genital tract. These conditions, from an undescended testis noticed at a routine newborn check to hydronephrosis detected on an antenatal scan, require early recognition and, in many cases, carefully timed surgical intervention

to protect renal function, fertility, and long-term wellbeing, making this an area of practice where a confident, systematic approach genuinely changes a child's future.

The aim of this Series is to equip you with the knowledge to recognise, investigate, and manage the common congenital and paediatric urological conditions encountered in surgical practice.

We shall commence this Series by examining undescended testis, from its embryological basis through to clinical assessment and management. Next, we will consider hypospadias, covering its classification, associated features, and surgical repair. Following that, our attention turns to posterior urethral valves and vesicoureteric reflux, two important causes of obstructive and refluxing uropathy in childhood. Finally, we will conclude by examining pelvi-ureteric junction obstruction, bladder exstrophy, and the practical issue of circumcision and its complications.

Series Learning Outcomes

Upon completing this Series, you should be able to:

1. **SLO 4.1:** describe the classification, assessment, and management of undescended testis,
2. **SLO 4.2:** describe the classification, assessment, and management of hypospadias,
3. **SLO 4.3:** describe the presentation, investigation, and management of posterior urethral valves and vesicoureteric reflux, and
4. **SLO 4.4:** describe the presentation and management of pelvi-ureteric junction obstruction and other congenital urological anomalies.

4.1 Undescended Testis and Related Anomalies

4.1.1 Embryology and classification of undescended testis

The testis develops in the abdomen and normally descends through the inguinal canal into the scrotum by the third trimester, guided by the gubernaculum under hormonal influence, so that most term boys are born with both testes fully descended; cryptorchidism, the failure of this descent, is common in preterm infants but affects only a small minority of term infants, many of whom achieve spontaneous descent within the first few months of life as postnatal hormonal surges complete the process.

Undescended testis is classified by location along the normal path of descent, as palpable (found in the inguinal canal or high scrotum, the majority of cases) or impalpable (intra-abdominal, absent, or atrophic, requiring further imaging or laparoscopy to localise), a distinction that has considerable bearing on the surgical approach and complexity of the eventual orchidopexy required.

Fill in the blank: The structure that guides testicular descent through the inguinal canal is the _____. Undescended testis is classified as palpable or _____, depending on whether it can be felt on examination.

4.1.2 Clinical assessment of undescended testis

Clinical examination should be performed in a warm room with the child relaxed, as a cold environment or an anxious child can trigger a brisk cremasteric reflex that retracts an otherwise normally descended testis, mimicking cryptorchidism and leading to the important differential of a retractile testis, which requires no treatment but does warrant periodic review, as it carries a small risk of true ascent over time.

A truly undescended testis cannot be manipulated into a stable scrotal position without immediate retraction upward once released, distinguishing it from a retractile testis, which can be gently guided into the scrotum and will remain there, at least transiently; bilateral impalpable testes in a newborn should always prompt urgent evaluation for a disorder of sexual development, particularly if accompanied by hypospadias or ambiguous genitalia.

Fill in the blank: A testis that retracts on examination but can be manipulated back into a stable scrotal position is termed _____. Bilateral impalpable testes in a newborn should prompt evaluation for a disorder of _____ development.

4.1.3 Management of undescended testis

Orchidopexy (surgical mobilisation and fixation of the testis within the scrotum) is the definitive treatment for a persistently undescended testis, ideally performed between six and eighteen months of age, as earlier surgical correction is associated with better long-term testicular growth and function, reduced risk of subfertility, and easier future clinical examination for testicular malignancy, which carries a persistently elevated risk even after successful surgery.

Impalpable testes require diagnostic laparoscopy as the definitive investigation to localise an intra-abdominal testis or confirm its absence, and may require a staged (Fowler-Stephens) orchidopexy when the testicular vessels are too short to allow single-stage mobilisation into the scrotum, dividing the vessels in a first stage to allow collateral blood supply to develop before definitive fixation in a second procedure some months later.

Fill in the blank: The definitive surgical treatment for undescended testis is _____. A staged procedure used when testicular vessels are too short for single-stage mobilisation is the _____ orchidopexy.

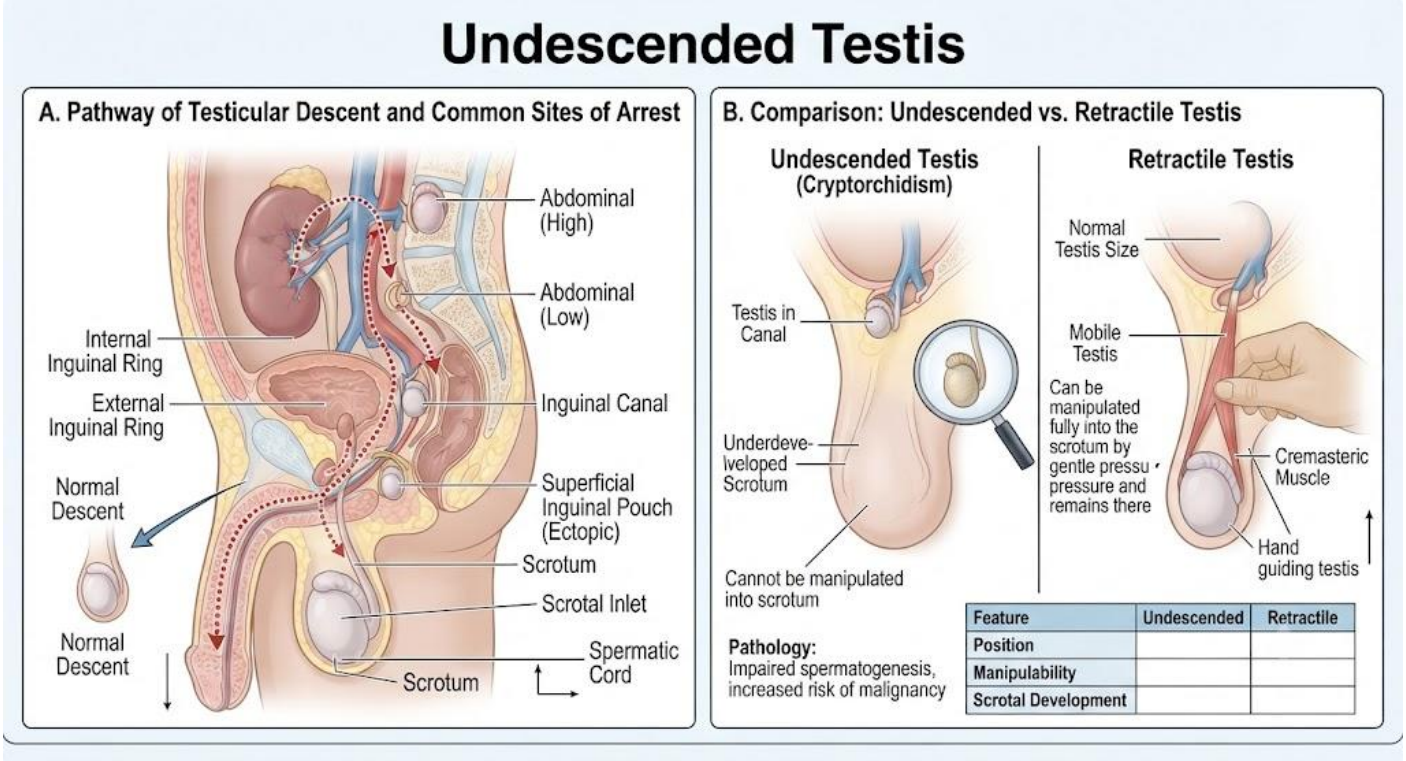

Figure 4.1: Pathway of testicular descent and common sites of arrest in undescended testis.

Pilot questions 4.1

1. Describe the normal process of testicular descent. (Linked to SLO 4.1)
2. Classify undescended testis as palpable or impalpable. (Linked to SLO 4.1)
3. Distinguish a truly undescended testis from a retractile testis on examination. (Linked to SLO 4.1)
4. Explain the significance of bilateral impalpable testes in a newborn. (Linked to SLO 4.1)
5. Describe the timing and rationale for orchidopexy in undescended testis. (Linked to SLO 4.1)

4.2 Hypospadias and Penile Anomalies

4.2.1 Classification and embryology of hypospadias

Hypospadias results from incomplete fusion of the urethral folds during embryological development, causing the urethral meatus to open on the ventral (underside) surface of the penis proximal to its normal glanular position, rather than at the tip, and is classified by the anatomical position of the meatus as distal (glanular or coronal, the majority of cases and generally the least

complex to repair), midshaft, or proximal (penoscrotal or perineal, the most severe and surgically complex form).

Associated features commonly include chordee (ventral curvature of the penis from tethering fibrous tissue), a hooded, incompletely formed foreskin that is deficient ventrally and excessive dorsally, and, in more proximal or severe cases, a bifid scrotum, all of which are assessed together with meatal position when planning the surgical approach and counselling the family on the expected outcome.

Fill in the blank: Hypospadias results from incomplete fusion of the urethral _____ during embryological development. Ventral curvature of the penis associated with hypospadias is termed _____.

4.2.2 Clinical assessment and associated anomalies

Clinical assessment documents the position of the meatus, the degree of chordee (best assessed with an artificial erection test at the time of surgery), the quality and distribution of the foreskin, and the size of the glans and calibre of the urethral plate, all of which influence the choice of surgical technique and the number of stages required for complete repair.

Associated anomalies become more likely with increasingly proximal hypospadias and include undescended testis and inguinal hernia, and any child with proximal hypospadias combined with bilateral impalpable testes should be evaluated for a disorder of sexual development before proceeding with surgical planning, as this combination raises the possibility of an underlying intersex condition requiring multidisciplinary assessment.

Fill in the blank: The degree of chordee is best assessed using an artificial _____ test at the time of surgery. Proximal hypospadias combined with bilateral impalpable testes should prompt evaluation for a disorder of sexual _____.

4.2.3 Management of hypospadias

Surgical repair aims to correct chordee, position the meatus at the tip of the glans, and achieve a cosmetically acceptable, functionally normal penis capable of a forward-directed urinary stream and future sexual function, generally performed between six and eighteen months of age, before the child develops body-image awareness, using foreskin tissue that would otherwise be discarded at circumcision, making circumcision inappropriate and contraindicated in a child with hypospadias.

Distal hypospadias is usually correctable in a single-stage procedure using techniques such as the tubularised incised plate (TIP) urethroplasty, while more proximal or severe cases with significant chordee may require a staged repair, correcting chordee and creating a straight penile shaft in the first procedure, followed by urethroplasty some months later once local tissue has healed and matured.

Fill in the blank: Circumcision is contraindicated in a child with hypospadias because the foreskin is needed for future _____. A common single-stage technique for distal hypospadias repair is _____ urethroplasty.

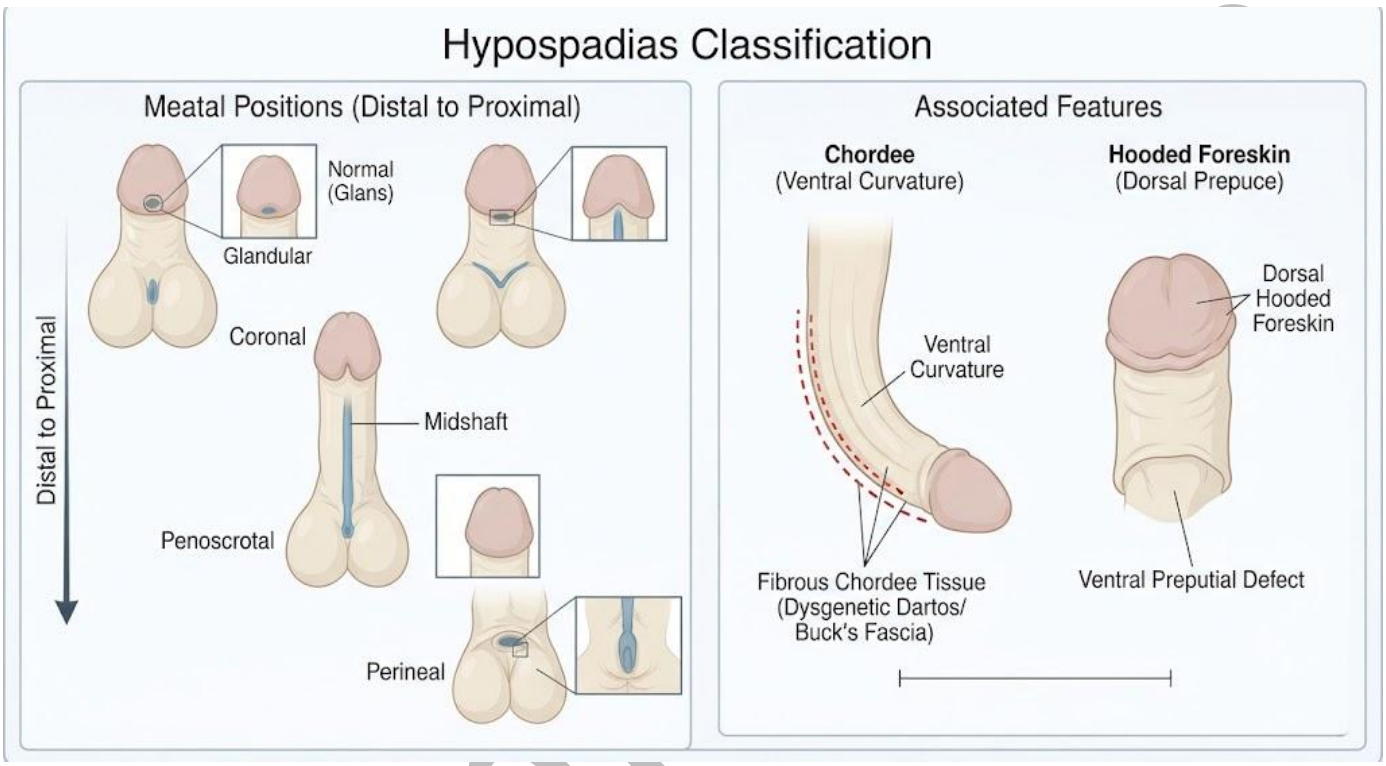

Figure 4.2: Classification of hypospadias by meatal position and associated anatomical features.

Pilot questions 4.2

- Describe the embryological basis of hypospadias. (Linked to SLO 4.2)
- Classify hypospadias by the position of the urethral meatus. (Linked to SLO 4.2)
- Describe the associated anatomical features assessed alongside meatal position in hypospadias. (Linked to SLO 4.2)
- Explain why circumcision is contraindicated in a child with hypospadias. (Linked to SLO 4.2)
- Compare single-stage and staged surgical repair of hypospadias. (Linked to SLO 4.2)

4.3 Posterior Urethral Valves and Vesicoureteric Reflux

4.3.1 Posterior urethral valves

Posterior urethral valves (PUV) are obstructing membranous folds within the posterior urethra of male infants, the most common cause of severe lower urinary tract obstruction in male neonates, often detected antenatally on ultrasound as bilateral hydronephrosis, a dilated bladder with a thickened wall, and, in severe cases, oligohydramnios from reduced fetal urine output, which itself risks pulmonary hypoplasia if severe and longstanding.

Postnatally affected infants may present with a poor urinary stream, a palpable distended bladder, urosepsis, or, in severe cases, respiratory distress from pulmonary hypoplasia, and prompt bladder drainage with a fine urethral catheter is the first priority in any infant with suspected PUV, both to relieve obstruction and to allow renal function to be reassessed once decompressed, before definitive diagnosis and treatment planning proceed.

Fill in the blank: Posterior urethral valves are the most common cause of severe lower urinary tract obstruction in male _____. Oligohydramnios in severe PUV risks fetal pulmonary _____.

4.3.2 Vesicoureteric reflux

Vesicoureteric reflux (VUR) is the retrograde flow of urine from the bladder into the ureter and, in more severe grades, up to the renal pelvis, resulting from an incompetent or short intramural ureteric tunnel that normally acts as a one-way valve during bladder filling and voiding, graded I to V by severity on micturating cystourethrogram according to the degree of ureteric and pelvicalyceal dilatation observed.

VUR predisposes to recurrent febrile urinary tract infection and, if longstanding and associated with infection, to reflux nephropathy with renal scarring that can progress to hypertension and chronic kidney disease in adulthood, making early recognition, typically prompted by investigation after a first febrile UTI in a young child, important for preventing this long-term complication wherever possible.

Fill in the blank: Vesicoureteric reflux is graded I to V on _____ (a specific imaging study). Renal scarring associated with VUR and infection is termed reflux _____.

4.3.3 Investigation and management of PUV and VUR

Micturating cystourethrogram (MCUG) is central to the diagnosis of both conditions, directly visualising the valve leaflets or the trabeculated bladder in PUV, and grading the severity of reflux in VUR, while renal ultrasound assesses upper tract dilatation and cortical thickness, and a DMSA scan may be used to assess differential renal function and identify scarring in longstanding or recurrent cases.

Management of PUV is initial catheter drainage followed by endoscopic valve ablation once the infant is stable, with close long-term follow-up for renal function, as some degree of bladder dysfunction and chronic kidney disease may persist despite successful ablation; management of VUR ranges from prophylactic antibiotics and observation for lower grades, which frequently

resolve spontaneously with growth, to surgical ureteric reimplantation for higher grades or breakthrough infection despite prophylaxis.

Fill in the blank: The imaging investigation central to diagnosing both PUV and VUR is the _____. Definitive treatment of posterior urethral valves is endoscopic valve _____.

Comparison Point	Posterior Urethral Valves (PUV)	Vesicoureteric Reflux (VUR)
Typical Presentation	Male infants with poor urinary stream, recurrent UTIs, palpable bladder, renal impairment	Recurrent UTIs, hydronephrosis, sometimes asymptomatic until later childhood
MCUG Findings	Dilated posterior urethra, bladder trabeculation, possible reflux	Retrograde flow of contrast into ureters/kidneys, graded severity of reflux
First-line Management	Endoscopic valve ablation, supportive care for renal function	Long-term antibiotic prophylaxis, surveillance, surgical correction if severe

Table 4.3: Comparison of posterior urethral valves and vesicoureteric reflux.

Pilot questions 4.3

1. Describe the antenatal and postnatal presentation of posterior urethral valves. (Linked to SLO 4.3)
2. Describe the immediate management priority in an infant with suspected PUV. (Linked to SLO 4.3)
3. Describe the grading of vesicoureteric reflux and the investigation used. (Linked to SLO 4.3)
4. Explain the long-term renal risk associated with vesicoureteric reflux. (Linked to SLO 4.3)
5. Compare the management of low-grade and high-grade vesicoureteric reflux. (Linked to SLO 4.3)

4.4 Pelvi-ureteric Junction Obstruction and Other Congenital Anomalies

4.4.1 Pelvi-ureteric junction obstruction

Pelvi-ureteric junction (PUJ) obstruction is a functional or anatomical narrowing at the junction between the renal pelvis and ureter that impairs urine drainage, the most common cause

of antenatally detected hydronephrosis, arising from an intrinsic abnormality of ureteric muscle development in most cases, or, less commonly, from an extrinsic crossing vessel compressing the junction from outside.

Postnatal assessment of antenatally detected hydronephrosis includes a repeat ultrasound after birth (as mild antenatal dilatation frequently resolves), and, where significant dilatation persists, a diuretic renogram (MAG3 scan) to assess differential renal function and the drainage pattern, distinguishing true obstruction requiring intervention from non-obstructive dilatation that can be safely observed with serial follow-up imaging.

Fill in the blank: PUJ obstruction is the most common cause of antenatally detected _____. The nuclear medicine study used to assess differential renal function and drainage in PUJ obstruction is the _____ scan.

4.4.2 Bladder exstrophy and epispadias

Bladder exstrophy is a rare, severe congenital anomaly in which the anterior abdominal wall and bladder fail to close during embryological development, exposing the posterior bladder wall on the surface of the abdomen at birth, typically associated with epispadias (a dorsal urethral meatal defect, the mildest form of the same spectrum of anomalies) and pubic diastasis, requiring complex, staged reconstructive surgery, ideally beginning in the newborn period at a specialist centre.

The exstrophy-epispadias complex carries significant long-term implications for urinary continence, sexual function, and psychosocial wellbeing, and affected children require lifelong, coordinated multidisciplinary follow-up extending well beyond the initial reconstructive procedures, reflecting the complexity and rarity of this condition, which in Nigerian practice often necessitates referral to a specialist paediatric urology centre with the necessary expertise.

Fill in the blank: Bladder exstrophy occurs when the anterior abdominal wall and bladder fail to _____ during embryological development. The mildest form of the exstrophy-epispadias complex is isolated _____.

4.4.3 Circumcision and its complications

Circumcision (surgical removal of the foreskin) is performed for religious or cultural reasons in much of Nigeria, as well as for medical indications such as phimosis (an inability to retract the foreskin, pathological if scarring is present, as opposed to normal physiological non-retractility in young boys) and recurrent balanoposthitis, and, as previously noted, is contraindicated in the presence of hypospadias, where the foreskin is required for later reconstructive surgery.

Complications of circumcision, whether performed traditionally or in a formal medical setting, include bleeding (the most common early complication), infection, excessive skin removal, meatal stenosis from chronic irritation of the exposed meatus, and, rarely, more serious injury to the glans or urethra, underscoring the importance of the procedure being performed by an appropriately trained provider under sterile conditions with adequate analgesia.

Fill in the blank: The most common early complication of circumcision is _____. Circumcision should never be performed in the presence of _____, as the foreskin is needed for later repair.

Condition	One-line Description
Undescended Testis	Failure of one or both testes to descend into the scrotum.
Hypospadias	Abnormal opening of the urethra on the underside of the penis.
Posterior Urethral Valves (PUV)	Obstructing membranous folds in the male posterior urethra causing bladder outlet obstruction.
Vesicoureteric Reflux (VUR)	Retrograde flow of urine from bladder into ureters/kidneys.
Pelviureteric Junction (PUJ) Obstruction	Blockage at the junction of renal pelvis and ureter, impairing urine drainage.
Bladder Exstrophy	Congenital defect with bladder exposed outside the abdominal wall.

Box 4.4: Summary of key congenital urological anomalies.

Pilot questions 4.4

6. Describe the pathophysiology and postnatal assessment of PUJ obstruction. (Linked to SLO 4.4)
7. Describe the investigation used to distinguish true obstruction from non-obstructive hydronephrosis. (Linked to SLO 4.4)
8. Describe the features of bladder exstrophy and its associated anomalies. (Linked to SLO 4.4)
9. Distinguish physiological non-retractility from pathological phimosis. (Linked to SLO 4.4)
10. List the complications of circumcision. (Linked to SLO 4.4)

Series Summary

This Series has covered undescended testis, from its embryological basis through to clinical assessment and orchidopexy, followed by hypospadias, addressing its classification, associated features, and staged or single-stage surgical repair. It went on to examine posterior urethral valves and vesicoureteric reflux, two important causes of obstructive and refluxing uropathy in

childhood, before concluding with pelvi-ureteric junction obstruction, bladder exstrophy, and the practical considerations around circumcision.

You should now be able to describe the classification, assessment, and management of undescended testis and hypospadias, describe the presentation and management of posterior urethral valves and vesicoureteric reflux, and describe the presentation and management of pelvi-ureteric junction obstruction and other congenital urological anomalies (Linked to SLOs 4.1 to 4.4).

Glossary of Terms

11. **Chordee:** ventral curvature of the penis from tethering fibrous tissue, commonly associated with hypospadias.
12. **Cryptorchidism:** failure of normal testicular descent into the scrotum.
13. **Fowler-Stephens orchidopexy:** a staged surgical procedure used for an intra-abdominal testis when the vessels are too short for single-stage mobilisation.
14. **Hypospadias:** a congenital anomaly in which the urethral meatus opens on the ventral surface of the penis proximal to its normal position.
15. **MCUG:** micturating cystourethrogram, an imaging study used to diagnose and grade posterior urethral valves and vesicoureteric reflux.
16. **Orchidopexy:** surgical mobilisation and fixation of an undescended testis within the scrotum.
17. **Phimosis:** an inability to retract the foreskin, pathological when due to scarring rather than normal physiological non-retractility.
18. **Posterior urethral valves (PUV):** obstructing membranous folds within the posterior urethra, the most common cause of severe lower urinary tract obstruction in male neonates.
19. **Pelvi-ureteric junction (PUJ) obstruction:** a functional or anatomical narrowing between the renal pelvis and ureter that impairs urine drainage.
20. **Reflux nephropathy:** renal scarring resulting from longstanding vesicoureteric reflux associated with infection.
21. **Retractile testis:** a testis that retracts on examination but can be manipulated into a stable scrotal position, requiring no treatment.

22. **Vesicoureteric reflux (VUR):** retrograde flow of urine from the bladder into the ureter and, in severe grades, the renal pelvis.

Concept Check Questions [Series 4]

Objective questions

1. The structure that guides testicular descent through the inguinal canal is the _____.
2. Ventral curvature of the penis associated with hypospadias is termed _____.
3. Posterior urethral valves are the most common cause of severe lower urinary tract obstruction in male _____.
4. PUJ obstruction is the most common cause of antenatally detected _____.
5. The most common early complication of circumcision is _____.

Short-answer questions

6. Distinguish a truly undescended testis from a retractile testis on examination. (Linked to SLO 4.1)
7. Explain why circumcision is contraindicated in a child with hypospadias. (Linked to SLO 4.2)
8. Describe the immediate management priority in an infant with suspected PUV. (Linked to SLO 4.3)
9. Explain the long-term renal risk associated with vesicoureteric reflux. (Linked to SLO 4.3)
10. Distinguish physiological non-retractility from pathological phimosis. (Linked to SLO 4.4)

Long-answer questions

11. Describe the classification, assessment, and management of undescended testis. (Linked to SLO 4.1)
12. Describe the classification and surgical management of hypospadias. (Linked to SLO 4.2)

13. Describe the presentation and management of posterior urethral valves. (Linked to SLO 4.3)
14. Describe the grading and management of vesicoureteric reflux. (Linked to SLO 4.3)
15. Describe the presentation and postnatal assessment of PUJ obstruction. (Linked to SLO 4.4)

Answers to Concept Check Questions [Series 4]

Objective questions

1. Gubernaculum.
2. Chordee.
3. Neonates.
4. Hydronephrosis.
5. Bleeding.

Short-answer questions

6. A truly undescended testis retracts upward once released and cannot be held stably in the scrotum, unlike a retractile testis, which can be gently guided into the scrotum and remains there.
7. The foreskin provides the tissue required for later hypospadias reconstructive surgery, and its removal by circumcision would compromise the eventual repair.
8. Prompt bladder drainage with a fine urethral catheter to relieve obstruction and allow reassessment of renal function before definitive treatment.
9. Longstanding reflux with infection can cause reflux nephropathy with renal scarring, which may progress to hypertension and chronic kidney disease in adulthood.
10. Physiological non-retractility is normal in young boys and resolves with age, while pathological phimosis results from scarring and does not resolve spontaneously.

Long-answer questions

11. **Basic response:** Undescended testis is classified as palpable or impalpable, assessed by careful examination, and managed with orchidopexy between six and eighteen months of age.

Value-added response: Impalpable testes require diagnostic laparoscopy, with a staged Fowler-Stephens orchidopexy used when testicular vessels are too short for single-stage mobilisation.

12. **Basic response:** Hypospadias is classified as distal, midshaft, or proximal by meatal position, with distal cases usually correctable by single-stage TIP urethroplasty.

Value-added response: Proximal hypospadias with significant chordee often requires staged repair, and any child with proximal hypospadias and bilateral impalpable testes needs evaluation for a disorder of sexual development.

13. **Basic response:** PUV presents antenatally with bilateral hydronephrosis or postnatally with a poor stream, managed with urgent catheter drainage followed by endoscopic valve ablation.

Value-added response: Long-term follow-up is essential even after successful ablation, as bladder dysfunction and chronic kidney disease may persist despite relief of the initial obstruction.

14. **Basic response:** VUR is graded I to V on MCUG, with lower grades often resolving spontaneously and higher grades or breakthrough infection requiring surgical reimplantation.

Value-added response: Early recognition after a first febrile UTI in a young child is important, as longstanding reflux with infection can cause reflux nephropathy and later chronic kidney disease.

15. **Basic response:** PUJ obstruction is the most common cause of antenatal hydronephrosis, assessed postnatally with repeat ultrasound and, if significant dilatation persists, a diuretic renogram.

Value-added response: The diuretic renogram distinguishes true obstruction requiring surgical correction from non-obstructive dilatation that can be safely managed with observation and serial imaging.

Answers to Pilot Questions [Series 4]

Part 4.1

1. The testis develops in the abdomen and descends through the inguinal canal into the scrotum by the third trimester, guided by the gubernaculum.
2. Palpable (found in the inguinal canal or high scrotum) or impalpable (intra-abdominal, absent, or atrophic, requiring imaging or laparoscopy).
3. A truly undescended testis retracts upward once released, while a retractile testis can be manipulated into a stable scrotal position and remains there.
4. Bilateral impalpable testes in a newborn should prompt urgent evaluation for a disorder of sexual development, particularly with associated hypospadias.
5. Orchidopexy is performed between six and eighteen months of age, as earlier correction improves testicular growth, function, and future fertility.

Part 4.2

1. Hypospadias results from incomplete fusion of the urethral folds during embryological development.
2. Distal (glanular or coronal), midshaft, or proximal (penoscrotal or perineal), by the position of the urethral meatus.
3. Chordee, a hooded foreskin deficient ventrally, and, in proximal cases, a bifid scrotum.
4. The foreskin is needed as tissue for the later reconstructive surgery, so circumcision would compromise the eventual repair.
5. Single-stage repair (such as TIP urethroplasty) suits distal hypospadias, while staged repair suits proximal or severe cases with significant chordee.

Part 4.3

1. Antenatally, bilateral hydronephrosis and oligohydramnios; postnatally, a poor stream, palpable bladder, urosepsis, or respiratory distress.
2. Prompt bladder drainage with a fine urethral catheter to relieve obstruction and allow renal function reassessment.

3. Graded I to V on micturating cystourethrogram, reflecting the degree of ureteric and pelvicalyceal dilatation.
4. Longstanding reflux with infection can cause reflux nephropathy with scarring, progressing to hypertension and chronic kidney disease.
5. Low-grade reflux is managed with prophylactic antibiotics and observation, as it often resolves spontaneously; high-grade reflux may need surgical reimplantation.

Part 4.4

- A narrowing at the renal pelvis to ureter junction impairing drainage, most commonly from intrinsic ureteric muscle abnormality.
- A diuretic renogram (MAG3 scan) assesses differential function and drainage pattern to distinguish true obstruction from non-obstructive dilatation.
- Exposure of the posterior bladder wall on the abdominal surface, typically with epispadias and pubic diastasis, requiring staged reconstruction.
- Physiological non-retractility is normal in young boys and resolves with age; pathological phimosis results from scarring and persists.
- Bleeding, infection, excessive skin removal, meatal stenosis, and, rarely, injury to the glans or urethra.

References and Attributions [Series 4]

Textual References

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- Radmayr, C., Bogaert, G., Dogan, H. S. et al. (2022). EAU Guidelines on Paediatric Urology. European Association of Urology.

- Tekgul, S., Riedmiller, H., Hoebeke, P. et al. (2012). EAU Guidelines on Vesicoureteral Reflux in Children. European Urology, 62(3), 534 to 542.

Figures, Plates, Tables, and Boxes

- Figure 4.1: Pathway of testicular descent and common sites of arrest in undescended testis. AI-generated using the prompt: "Create a professional medical diagram titled Undescended Testis, showing the pathway of testicular descent with common sites of arrest, and a comparison panel distinguishing undescended from retractile testis. Clean clinical surgical diagram style."
- Figure 4.2: Classification of hypospadias by meatal position and associated anatomical features. AI-generated using the prompt: "Create a professional medical diagram titled Hypospadias Classification, showing meatal positions from distal to proximal and illustrating chordee and hooded foreskin. Clean clinical surgical diagram style."
- Table 4.3: Comparison of posterior urethral valves and vesicoureteric reflux. AI-generated using the prompt: "Create a clean reference table titled Posterior Urethral Valves versus Vesicoureteric Reflux, comparing presentation, MCUG findings, and management. Simple clinical reference table style with outside border."
- Box 4.4: Summary of key congenital urological anomalies. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Summary of Key Congenital Urological Anomalies, listing each condition with a one-line description. Clinical reference box style."

Course code: SUG 404

Course title: Urology

Course credit load: 2 Units

Series 5: Advanced Urology and Systemic Complications

1. **Part 5.1: Male Sexual Dysfunction**
    1. Sub Part 5.1.1: Erectile dysfunction
    2. Sub Part 5.1.2: Priapism
    3. Sub Part 5.1.3: Male infertility
2. **Part 5.2: Neurogenic Bladder and Urinary Diversion**
    1. Sub Part 5.2.1: Neurogenic bladder
    2. Sub Part 5.2.2: Urodynamics
    3. Sub Part 5.2.3: Urinary diversion
3. **Part 5.3: Renal Failure and Transplantation**
    1. Sub Part 5.3.1: Chronic kidney disease in urological practice
    2. Sub Part 5.3.2: Dialysis access
    3. Sub Part 5.3.3: Renal transplantation
4. **Part 5.4: Urological Complications of Systemic Disease**
    1. Sub Part 5.4.1: Diabetes and the urinary tract
    2. Sub Part 5.4.2: Sickle cell disease and urology
    3. Sub Part 5.4.3: HIV and urological practice

Introduction

In the last Series, we explored paediatric and congenital urology, the conditions that present at the very beginning of life. We conclude this course by turning to some of the most complex areas

of urological practice: sexual and reproductive dysfunction, the neurologically impaired bladder, the surgical management of end-stage renal disease, and the urological complications of the systemic diseases, diabetes, sickle cell disease, and HIV, that are so prevalent in Nigerian clinical practice. These topics draw together threads from across this entire course and demand a broad, integrated understanding of how urological and systemic disease intersect.

The aim of this Series is to equip you with the knowledge to recognise and manage male sexual dysfunction, neurogenic bladder, the urological aspects of renal failure and transplantation, and the urological complications of common systemic diseases.

We shall commence this Series by examining male sexual dysfunction, covering erectile dysfunction, priapism, and male infertility. Next, we will consider neurogenic bladder, from its classification and urodynamic assessment through to management, including clean intermittent self-catheterisation and urinary diversion. Following that, our attention turns to chronic kidney disease, dialysis access, and renal transplantation. Finally, we will conclude by examining the urological complications of diabetes, sickle cell disease, and HIV, bringing this course to a close.

Series Learning Outcomes

Upon completing this Series, you should be able to:

5. **SLO 5.1:** describe the causes and assessment of erectile dysfunction and priapism,
6. **SLO 5.2:** describe the classification and investigation of male infertility,
7. **SLO 5.3:** describe the classification and assessment of neurogenic bladder,
8. **SLO 5.4:** describe the management of neurogenic bladder, including urinary diversion,
9. **SLO 5.5:** describe the urological aspects of chronic kidney disease and dialysis access,
10. **SLO 5.6:** describe the surgical principles of renal transplantation,
11. **SLO 5.7:** describe the urological complications of diabetes and sickle cell disease, and
12. **SLO 5.8:** describe the urological manifestations and perioperative considerations in HIV-positive patients.

5.1 Male Sexual Dysfunction

5.1.1 Erectile dysfunction

Erectile dysfunction (ED) is the persistent inability to achieve or maintain an erection sufficient for satisfactory sexual intercourse, arising from vascular, neurogenic, hormonal, psychogenic, or drug-related causes, often overlapping in the same patient; vascular causes (atherosclerosis affecting the penile arteries) predominate with increasing age and frequently coexist with, or even precede, cardiovascular disease, making ED an important marker of systemic vascular health that should prompt broader cardiovascular risk assessment.

Assessment includes a detailed sexual, medical, and psychosocial history, examination for signs of hypogonadism or vascular disease, and baseline investigations including fasting glucose, lipid profile, and testosterone, reflecting the frequent association between ED and diabetes, dyslipidaemia, and hypogonadism, all of which should be actively sought and treated as part of a comprehensive management plan rather than addressing erectile function in isolation.

Fill in the blank: Vascular erectile dysfunction frequently coexists with, or precedes, _____ disease. Baseline investigation for ED should include fasting glucose, lipid profile, and serum _____.

5.1.2 Priapism

Priapism is a persistent penile erection lasting more than four hours, unrelated to sexual stimulation, classified as ischaemic (low-flow, a true urological emergency from impaired venous outflow causing a painful, rigid erection with a risk of irreversible corporal fibrosis and erectile dysfunction if not promptly treated) or non-ischaemic (high-flow, typically from perineal trauma, less painful and rarely requiring emergency intervention).

Ischaemic priapism is common in patients with sickle cell disease, a particularly relevant association in Nigerian practice, and is managed with corporal aspiration and irrigation, followed by intracavernosal phenylephrine if aspiration alone is insufficient, with surgical shunting reserved for cases refractory to these measures; delay beyond several hours substantially worsens the prognosis for preserved erectile function, making this a genuine time-critical urological emergency.

Fill in the blank: Priapism is defined as a persistent erection lasting more than _____ hours unrelated to sexual stimulation. Ischaemic priapism is a recognised complication of _____ disease.

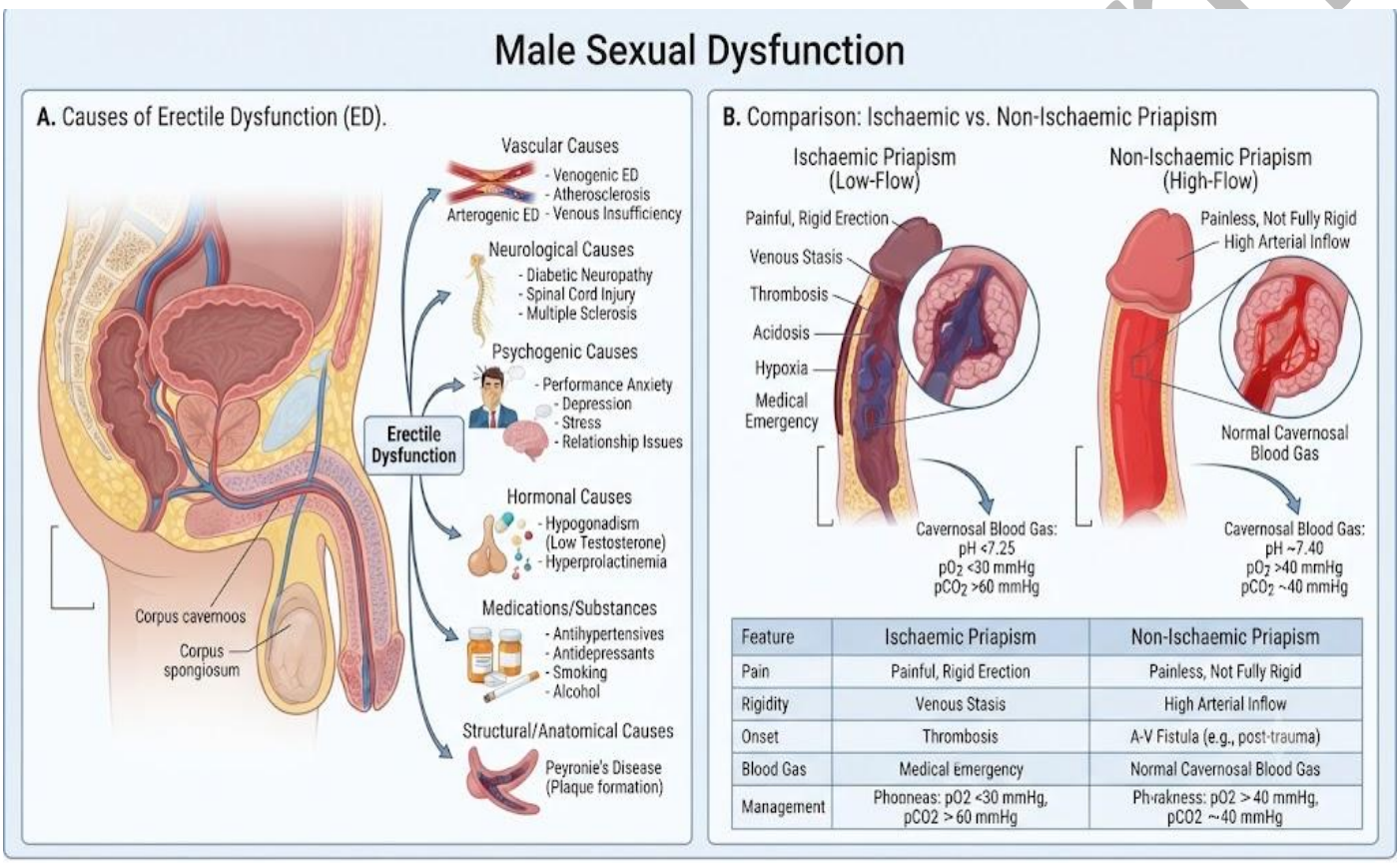
5.1.3 Male infertility

Male factor infertility contributes to roughly half of all cases of couple infertility, arising from pre-testicular (hormonal, such as hypogonadotropic hypogonadism), testicular (primary spermatogenic failure, often from varicocele, cryptorchidism, or infection), or post-testicular (obstructive, from vasal or epididymal blockage, including after infection or previous surgery) causes, each requiring a distinct diagnostic and management approach once identified.

Semen analysis is the cornerstone investigation, assessing sperm concentration, motility, and morphology against World Health Organization reference values, supplemented by hormonal

profile (FSH, LH, and testosterone) to distinguish pre-testicular from testicular causes, and scrotal examination to identify a clinically significant varicocele, which remains one of the most common correctable causes of male subfertility encountered in practice.

Fill in the blank: Male factor infertility contributes to roughly _____ of all cases of couple infertility. The cornerstone investigation for male infertility is _____ analysis.



Feature	Ischaemic Priapism	Non-Ischaemic Priapism
Pain	Painful, Rigid Erection	Painless, Not Fully Rigid
Rigidity	Venous Stasis	High Arterial Inflow
Onset	Thrombosis	A-V Fistula (e.g., post-trauma)
Blood Gas	Medical Emergency	Normal Cavernosal Blood Gas
Management	Phoneas: pO2 <30 mmHg, pCO2 >60 mmHg	Phrakness: pO2 >40 mmHg, pCO2 ~40 mmHg

Figure 5.1: Causes of erectile dysfunction and comparison of ischaemic with non-ischaemic priapism.

Pilot questions 5.1

1. Describe the causes of erectile dysfunction. (Linked to SLO 5.1)
2. Explain why erectile dysfunction is considered a marker of systemic vascular health. (Linked to SLO 5.1)
3. Distinguish ischaemic from non-ischaemic priapism. (Linked to SLO 5.1)
4. Describe the emergency management of ischaemic priapism. (Linked to SLO 5.1)
5. Describe the classification and investigation of male infertility. (Linked to SLO 5.2)

5.2 Neurogenic Bladder and Urinary Diversion

5.2.1 Neurogenic bladder

Neurogenic bladder refers to bladder dysfunction resulting from a disorder of the nervous system controlling micturition, from causes including spinal cord injury, spina bifida, multiple sclerosis, diabetic autonomic neuropathy, and stroke, broadly classified as a failure to store (overactive, hyper-reflexic bladder), a failure to empty (underactive, hypocontractile or acontractile bladder), or a combination of both, depending on the level and completeness of the neurological lesion.

The clinical consequences of neurogenic bladder extend well beyond incontinence and urinary symptoms, as unrecognised or poorly managed high storage pressures can be transmitted to the upper urinary tracts, causing hydronephrosis and progressive renal impairment over time, making the primary goal of management the protection of renal function, with symptomatic improvement and continence as important but secondary objectives in the overall treatment plan.

Fill in the blank: Neurogenic bladder is broadly classified as a failure to store or a failure to _____. The primary goal of neurogenic bladder management is protection of _____ function.

5.2.2 Urodynamics

Urodynamic studies objectively assess bladder storage and voiding function by measuring pressure and flow relationships during controlled bladder filling and voiding, providing essential information on bladder compliance, detrusor overactivity, and detrusor-sphincter coordination that cannot reliably be inferred from history and examination alone, and forming the cornerstone investigation in the assessment of any patient with suspected neurogenic bladder dysfunction.

Videourodynamics combines pressure-flow measurement with simultaneous fluoroscopic imaging of the bladder and urethra, allowing direct visualisation of vesicoureteric reflux and bladder neck or sphincter behaviour during filling and voiding, and is particularly valuable in complex neurogenic cases where anatomical and functional information together are needed to guide safe, individualised management decisions.

Fill in the blank: Urodynamic studies measure pressure and _____ relationships during bladder filling and voiding. Videourodynamics combines pressure-flow measurement with simultaneous _____ imaging.

5.2.3 Urinary diversion

Clean intermittent self-catheterisation (CISC) is the first-line management for a failure-to-empty neurogenic bladder, allowing regular, low-pressure bladder emptying that protects the upper tracts and can be taught to most motivated patients or carers, avoiding the complications

associated with a long-term indwelling catheter, including recurrent infection, stone formation, and, over years, an increased risk of squamous cell bladder carcinoma.

Urinary diversion (such as an ileal conduit, in which a segment of small bowel is used to channel urine to a cutaneous stoma) is reserved for patients in whom less invasive measures have failed to protect the upper tracts or preserve continence, or following cystectomy for malignancy, and requires careful patient selection and counselling given its permanence and the lifelong stoma care it demands.

Fill in the blank: The first-line management for a failure-to-empty neurogenic bladder is clean intermittent _____. An ileal conduit uses a segment of small bowel to channel urine to a cutaneous _____.

Comparison Point	Failure-to-Store Pattern	Failure-to-Empty Pattern
Typical Cause	Detrusor overactivity, loss of inhibitory control (e.g., suprapontine lesions, spinal cord injury above sacral level)	Detrusor underactivity or outlet obstruction due to sphincter dyssynergia (e.g., sacral cord lesions, peripheral nerve damage)
Clinical Presentation	Urgency, frequency, nocturia, urge incontinence	Hesitancy, weak stream, incomplete emptying, retention, overflow incontinence
First-line Management	Anticholinergic medications, bladder training, intermittent catheterization if needed	Clean intermittent catheterization, alpha-blockers, sometimes surgical intervention

Table 5.2: Comparison of failure-to-store and failure-to-empty neurogenic bladder patterns.

Pilot questions 5.2

- Describe the causes and classification of neurogenic bladder. (Linked to SLO 5.3)
- Explain why protection of renal function is the primary goal of neurogenic bladder management. (Linked to SLO 5.3)
- Describe the purpose and components of urodynamic studies. (Linked to SLO 5.3)
- Describe the role of clean intermittent self-catheterisation in neurogenic bladder management. (Linked to SLO 5.4)
- Describe the indications for urinary diversion. (Linked to SLO 5.4)

5.3 Renal Failure and Transplantation

5.3.1 Chronic kidney disease in urological practice

Chronic kidney disease (CKD) of urological origin arises from longstanding obstruction, recurrent stone disease, reflux nephropathy, or urological malignancy affecting a solitary or bilateral kidneys, and is staged I to V based on estimated glomerular filtration rate, with the urologist's role centred on identifying and correcting any reversible urological contribution, such as relieving obstruction, before CKD progresses to a stage requiring renal replacement therapy.

Close collaboration with nephrology is essential in managing urological patients with CKD, particularly around the timing of intervention, contrast use in imaging (given the risk of contrast-induced nephropathy in patients with reduced renal function), and perioperative medication adjustment, ensuring that urological treatment does not inadvertently accelerate renal decline in patients already living with a reduced renal reserve.

Fill in the blank: Chronic kidney disease is staged I to V based on estimated _____ rate. The urologist's key role in urological CKD is identifying and correcting any reversible _____ contribution.

5.3.2 Dialysis access

Haemodialysis requires reliable vascular access, most commonly an arteriovenous fistula (AVF), a surgically created direct connection between an artery and vein, typically at the wrist or forearm, allowing the vein to arterialise and thicken over several weeks (a process called maturation) before it can be reliably cannulated for dialysis, offering the best long-term patency and lowest infection risk of all access options.

Where native vessels are unsuitable for a fistula, an arteriovenous graft (using synthetic or biological conduit material) or a tunnelled central venous catheter may be used, though both carry higher rates of infection and thrombosis than a mature native fistula, making early referral for fistula creation, well before dialysis is anticipated to be needed, an important principle in the timely management of progressive chronic kidney disease.

Fill in the blank: The preferred form of vascular access for haemodialysis is the arteriovenous _____. A newly created fistula requires several weeks of _____ before it can be safely cannulated.

5.3.3 Renal transplantation

Renal transplantation offers the best long-term outcomes and quality of life for suitable patients with end-stage renal disease, compared with long-term dialysis, with donor kidneys sourced from either living donors (offering better graft survival and allowing planned, elective surgery) or deceased donors, and recipient and donor compatibility assessed through blood group

and human leukocyte antigen (HLA) matching alongside crossmatch testing to minimise rejection risk.

The transplanted kidney is typically placed extraperitoneally in the iliac fossa, with the renal vessels anastomosed to the external iliac vessels and the ureter implanted directly into the bladder, and recipients require lifelong immunosuppression to prevent rejection, alongside regular monitoring for surgical complications, rejection episodes, and the long-term risks of chronic immunosuppression, including infection and malignancy.

Fill in the blank: The transplanted kidney is typically placed extraperitoneally in the _____ fossa. Renal transplant recipients require lifelong _____ to prevent rejection.

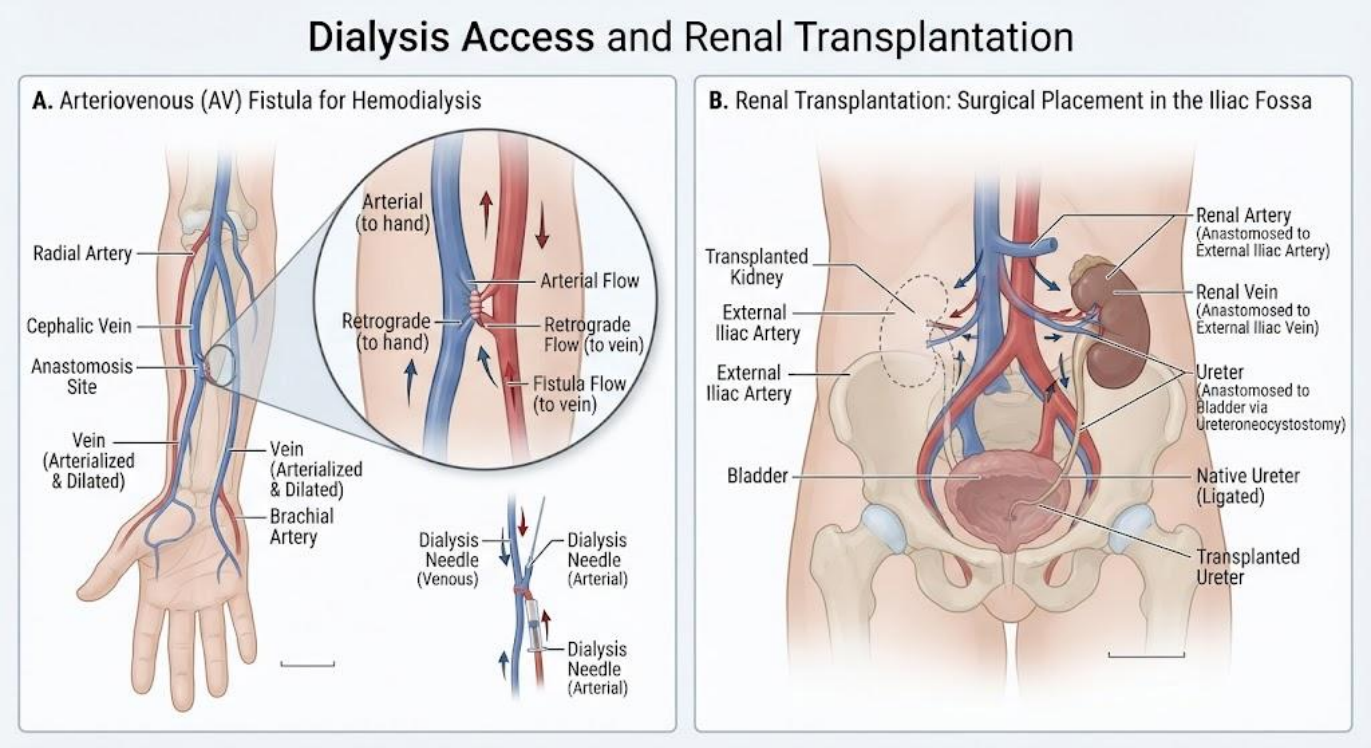


Figure 5.3: Arteriovenous fistula anatomy and surgical placement of a renal transplant.

Pilot questions 5.3

1. Describe the urological causes of chronic kidney disease. (Linked to SLO 5.5)
2. Explain the urologist's role in managing a patient with urological chronic kidney disease. (Linked to SLO 5.5)
3. Describe the process of arteriovenous fistula creation and maturation. (Linked to SLO 5.5)
4. Compare arteriovenous fistula, graft, and tunnelled catheter as forms of dialysis access. (Linked to SLO 5.5)

5. Describe the surgical principles of renal transplantation. (Linked to SLO 5.6)

5.4 Urological Complications of Systemic Disease

5.4.1 Diabetes and the urinary tract

Diabetes mellitus predisposes to a wide range of urological complications, including an increased susceptibility to urinary tract infection (from glycosuria promoting bacterial growth and impaired leucocyte function), diabetic cystopathy (autonomic neuropathy causing impaired bladder sensation and incomplete emptying, itself a form of neurogenic bladder), and a markedly increased risk of emphysematous pyelonephritis, a rare but life-threatening gas-forming renal infection seen almost exclusively in poorly controlled diabetic patients.

Diabetic patients also have an elevated risk of Fournier's gangrene and other severe soft tissue infections of the genitalia and perineum, and erectile dysfunction from diabetic vascular and neurogenic disease is both common and often an early marker of otherwise silent microvascular and macrovascular complications elsewhere, making its presence a useful prompt for broader diabetic complication screening.

Fill in the blank: A rare but life-threatening gas-forming renal infection seen almost exclusively in poorly controlled diabetics is emphysematous _____. Autonomic neuropathy causing impaired bladder sensation and emptying in diabetes is termed diabetic _____.

5.4.2 Sickle cell disease and urology

Sickle cell disease is strongly associated with several urological complications of particular relevance in Nigerian practice, including recurrent ischaemic priapism (from sickled red cells causing microvascular occlusion within the corpora cavernosa), papillary necrosis (from vaso-occlusion in the relatively hypoxic renal medulla, presenting with haematuria and loin pain), and an increased susceptibility to urinary tract infection.

Renal medullary carcinoma is a rare but highly aggressive malignancy strongly associated with sickle cell trait, and should be considered in any young patient with sickle cell trait or disease presenting with haematuria and a renal mass, given its typically advanced stage at diagnosis and poor prognosis, underscoring the importance of prompt, thorough investigation of new urological symptoms in this patient population.

Fill in the blank: Vaso-occlusion in the renal medulla in sickle cell disease can cause papillary _____. A rare, aggressive malignancy strongly associated with sickle cell trait is renal _____ carcinoma.

5.4.3 HIV and urological practice

HIV-positive patients may present with a range of urological manifestations, including an increased susceptibility to urinary tract infection and unusual or opportunistic genitourinary infections at lower CD4 counts, and a higher reported incidence of certain urological malignancies, reflecting the impact of immunosuppression on both infection risk and tumour surveillance in this population.

Perioperative considerations in HIV-positive patients undergoing urological surgery include optimising antiretroviral therapy adherence and CD4 status where elective surgery allows, attention to drug interactions between antiretrovirals and commonly used surgical medications, and standard universal precautions during any procedure, with modern evidence showing that well-controlled HIV infection, on effective antiretroviral therapy, is not in itself a contraindication to routine urological surgery.

Fill in the blank: Well-controlled HIV infection on effective antiretroviral therapy is not in itself a _____ to routine urological surgery. Perioperative planning in HIV-positive patients should consider drug interactions with _____.

Condition	Key Urological Complications
Diabetes	**Diabetic cystopathy (neurogenic bladder with impaired sensation and emptying), increased risk of urinary tract infections, erectile dysfunction.**
Sickle Cell Disease	**Haematuria (often due to papillary necrosis), hyposthenuria (impaired urine concentration), priapism.**
HIV	**Opportunistic genitourinary infections, HIV-associated nephropathy, increased risk of malignancies (e.g., Kaposi sarcoma, lymphoma involving GU tract).**

Box 5.4: Urological complications of diabetes, sickle cell disease, and HIV.

Pilot questions 5.4

6. Describe the urological complications of diabetes mellitus. (Linked to SLO 5.7)
7. Explain why emphysematous pyelonephritis is particularly associated with poorly controlled diabetes. (Linked to SLO 5.7)
8. Describe the urological complications of sickle cell disease. (Linked to SLO 5.7)
9. Explain the significance of renal medullary carcinoma in a patient with sickle cell trait. (Linked to SLO 5.7)
10. Describe the urological manifestations and perioperative considerations in HIV-positive patients. (Linked to SLO 5.8)

Series Summary

This Series has covered male sexual dysfunction, from erectile dysfunction and priapism through to male infertility, followed by neurogenic bladder, addressing its classification, urodynamic assessment, and management including urinary diversion. It went on to examine chronic kidney disease, dialysis access, and renal transplantation from a urological perspective, before concluding with the urological complications of diabetes, sickle cell disease, and HIV, bringing this course on General Surgery Urology to a close.

You should now be able to describe the causes and management of erectile dysfunction, priapism, and male infertility, describe the classification and management of neurogenic bladder, describe the urological aspects of chronic kidney disease and renal transplantation, and describe the urological complications of diabetes, sickle cell disease, and HIV (Linked to SLOs 5.1 to 5.8).

Glossary of Terms

11. **Arteriovenous fistula:** a surgically created connection between an artery and vein, the preferred form of vascular access for haemodialysis.
12. **Clean intermittent self-catheterisation (CISC):** regular, low-pressure bladder emptying by self-catheterisation, first-line for a failure-to-empty neurogenic bladder.
13. **Emphysematous pyelonephritis:** a rare, life-threatening gas-forming renal infection seen almost exclusively in poorly controlled diabetic patients.
14. **Ischaemic priapism:** a persistent, painful erection from impaired venous outflow, a urological emergency associated with sickle cell disease.
15. **Neurogenic bladder:** bladder dysfunction resulting from a disorder of the nervous system controlling micturition.
16. **Renal medullary carcinoma:** a rare, highly aggressive renal malignancy strongly associated with sickle cell trait.
17. **Semen analysis:** the cornerstone investigation for male infertility, assessing sperm concentration, motility, and morphology.
18. **Urinary diversion:** a surgical procedure, such as an ileal conduit, that channels urine to a cutaneous stoma.

19. **Urodynamic studies:** investigations that measure pressure and flow relationships during bladder filling and voiding.
20. **Videourodynamics:** urodynamic studies combined with simultaneous fluoroscopic imaging of the bladder and urethra.
21. **Diabetic cystopathy:** bladder dysfunction from diabetic autonomic neuropathy, causing impaired sensation and incomplete emptying.
22. **Papillary necrosis:** ischaemic necrosis of the renal papillae, associated with vaso-occlusion in sickle cell disease.

Concept Check Questions [Series 5]

Objective questions

1. Vascular erectile dysfunction frequently coexists with, or precedes, _____ disease.
2. Priapism is defined as a persistent erection lasting more than _____ hours unrelated to sexual stimulation.
3. The primary goal of neurogenic bladder management is protection of _____ function.
4. The preferred form of vascular access for haemodialysis is the arteriovenous _____.
5. A rare, aggressive malignancy strongly associated with sickle cell trait is renal _____ carcinoma.

Short-answer questions

6. Distinguish ischaemic from non-ischaemic priapism. (Linked to SLO 5.1)
7. Describe the role of clean intermittent self-catheterisation in neurogenic bladder management. (Linked to SLO 5.4)
8. Compare arteriovenous fistula, graft, and tunnelled catheter as forms of dialysis access. (Linked to SLO 5.5)
9. Explain why emphysematous pyelonephritis is particularly associated with poorly controlled diabetes. (Linked to SLO 5.7)
10. Describe the urological manifestations and perioperative considerations in HIV-positive patients. (Linked to SLO 5.8)

Long-answer questions

11. Describe the causes and management of erectile dysfunction and priapism. (Linked to SLO 5.1)
12. Describe the classification, assessment, and management of neurogenic bladder. (Linked to SLO 5.3, SLO 5.4)
13. Describe the urological aspects of chronic kidney disease, dialysis access, and renal transplantation. (Linked to SLO 5.5, SLO 5.6)
14. Describe the urological complications of sickle cell disease. (Linked to SLO 5.7)
15. Describe the urological complications of diabetes mellitus. (Linked to SLO 5.7)

Answers to Concept Check Questions [Series 5]

Objective questions

1. Cardiovascular.
2. Four.
3. Renal.
4. Fistula.
5. Medullary.

Short-answer questions

6. Ischaemic priapism is painful, low-flow, and a urological emergency. Non-ischaemic priapism is high-flow, usually from trauma, less painful, and rarely an emergency.
7. CISC allows regular, low-pressure bladder emptying, protecting the upper tracts and avoiding the complications of a long-term indwelling catheter.
8. A native fistula offers the best long-term patency and lowest infection risk. A graft and tunnelled catheter are alternatives when native vessels are unsuitable, but with higher infection and thrombosis rates.

9. Glycosuria and impaired leucocyte function increase infection susceptibility, and poor glycaemic control specifically predisposes to this rare, life-threatening gas-forming infection.

10. Increased susceptibility to infection and certain malignancies at lower CD4 counts, with well-controlled HIV on antiretroviral therapy not itself a contraindication to surgery.

Long-answer questions

11. **Basic response:** Erectile dysfunction has vascular, neurogenic, hormonal, psychogenic, and drug-related causes, assessed with history, examination, and baseline investigations including glucose and testosterone.

Value-added response: Priapism, when ischaemic, is a true emergency managed with aspiration and irrigation, with delay substantially worsening the prognosis for preserved erectile function.

12. **Basic response:** Neurogenic bladder is classified as failure to store or failure to empty, assessed by urodynamics, and managed to protect renal function above all else.

Value-added response: Clean intermittent self-catheterisation is first-line for failure to empty, while urinary diversion is reserved for cases where less invasive measures fail to protect the upper tracts.

13. **Basic response:** Urological chronic kidney disease requires correction of any reversible cause, with dialysis access via arteriovenous fistula preferred, and renal transplantation offering the best long-term outcome.

Value-added response: Close nephrology collaboration and early referral for fistula creation, well before dialysis is needed, are key principles in managing progressive urological chronic kidney disease.

14. **Basic response:** Sickle cell disease causes ischaemic priapism, papillary necrosis, and increased infection risk, with renal medullary carcinoma an important rare but aggressive association.

Value-added response: Any young patient with sickle cell trait or disease presenting with haematuria and a renal mass should be promptly investigated given the poor prognosis of renal medullary carcinoma.

Answers to Pilot Questions [Series 5]

Part 5.1

1. Vascular, neurogenic, hormonal, psychogenic, and drug-related causes, often overlapping in the same patient.
2. Vascular ED shares the same atherosclerotic process as cardiovascular disease and often precedes or coexists with it, prompting broader risk assessment.
3. Ischaemic priapism is painful, low-flow, and an emergency; non-ischaemic priapism is high-flow, usually traumatic, less painful, and rarely an emergency.
4. Corporal aspiration and irrigation, followed by intracavernosal phenylephrine if needed, with surgical shunting for refractory cases.
5. Semen analysis is the cornerstone investigation, supplemented by hormonal profile and scrotal examination to distinguish pre-testicular, testicular, and post-testicular causes.

Part 5.2

1. Spinal cord injury, spina bifida, multiple sclerosis, diabetic autonomic neuropathy, and stroke, classified as failure to store, failure to empty, or both.
2. Unrecognised high storage pressures can be transmitted to the upper tracts, causing hydronephrosis and progressive renal impairment if unaddressed.
3. Urodynamics objectively measures pressure and flow relationships during bladder filling and voiding, assessing compliance and detrusor activity.
4. CISC allows regular, low-pressure emptying, protecting the upper tracts and avoiding indwelling catheter complications.
5. Failure of less invasive measures to protect the upper tracts or preserve continence, or following cystectomy for malignancy.

Part 5.3

1. Longstanding obstruction, recurrent stone disease, reflux nephropathy, and urological malignancy affecting the kidneys.

2. Identifying and correcting any reversible urological contribution, such as relieving obstruction, before progression to renal replacement therapy.
3. A direct surgical connection between an artery and vein, typically at the wrist, allowed to mature over several weeks before cannulation.
4. Fistula offers the best patency and lowest infection risk; graft and tunnelled catheter are alternatives with higher infection and thrombosis rates.
5. The kidney is placed extraperitoneally in the iliac fossa with vascular anastomosis to the iliac vessels and ureteric implantation into the bladder.

Part 5.4

- Increased urinary tract infection risk, diabetic cystopathy, emphysematous pyelonephritis, and erectile dysfunction as a marker of vascular disease.
- Poor glycaemic control creates a favourable environment for gas-forming organisms in renal tissue, a rare but life-threatening complication.
- Recurrent ischaemic priapism, papillary necrosis, increased infection susceptibility, and the rare but aggressive renal medullary carcinoma.
- It should prompt urgent investigation for renal medullary carcinoma, a rare but highly aggressive malignancy typically diagnosed at an advanced stage.
- Increased susceptibility to infection and certain malignancies at lower CD4 counts, with well-controlled HIV on antiretroviral therapy not a contraindication to surgery, though drug interactions require attention.

References and Attributions [Series 5]

Textual References

- Bailey, H. and Love, R. J. M. (2018). Bailey and Love's Short Practice of Surgery (27th ed.). CRC Press.
- Wein, A. J., Kavoussi, L. R., Partin, A. W. and Peters, C. A. (2020). Campbell-Walsh-Wein Urology (12th ed.). Elsevier.

- Salonia, A., Bettocchi, C., Boeri, L. et al. (2021). EAU Guidelines on Sexual and Reproductive Health. European Association of Urology.
- Blok, B., Castro-Diaz, D., Del Popolo, G. et al. (2022). EAU Guidelines on Neuro-Urology. European Association of Urology.

Figures, Plates, Tables, and Boxes

- Figure 5.1: Causes of erectile dysfunction and comparison of ischaemic with non-ischaemic priapism. AI-generated using the prompt: "Create a professional two-panel medical diagram titled Male Sexual Dysfunction, showing causes of erectile dysfunction and a comparison of ischaemic versus non-ischaemic priapism. Clean clinical surgical diagram style."
- Table 5.2: Comparison of failure-to-store and failure-to-empty neurogenic bladder patterns. AI-generated using the prompt: "Create a clean reference table titled Neurogenic Bladder Patterns, comparing failure-to-store and failure-to-empty by cause, presentation, and management. Simple clinical reference table style with outside border."
- Figure 5.3: Arteriovenous fistula anatomy and surgical placement of a renal transplant. AI-generated using the prompt: "Create a professional medical diagram titled Dialysis Access and Renal Transplantation, showing arteriovenous fistula anatomy and the surgical placement of a transplanted kidney in the iliac fossa. Clean clinical surgical diagram style."
- Box 5.4: Urological complications of diabetes, sickle cell disease, and HIV. AI-generated using the prompt: "Create a simple single-column reference box with an outside border titled Urological Complications of Systemic Disease, listing key complications by condition (diabetes, sickle cell disease, HIV). Clinical reference box style."