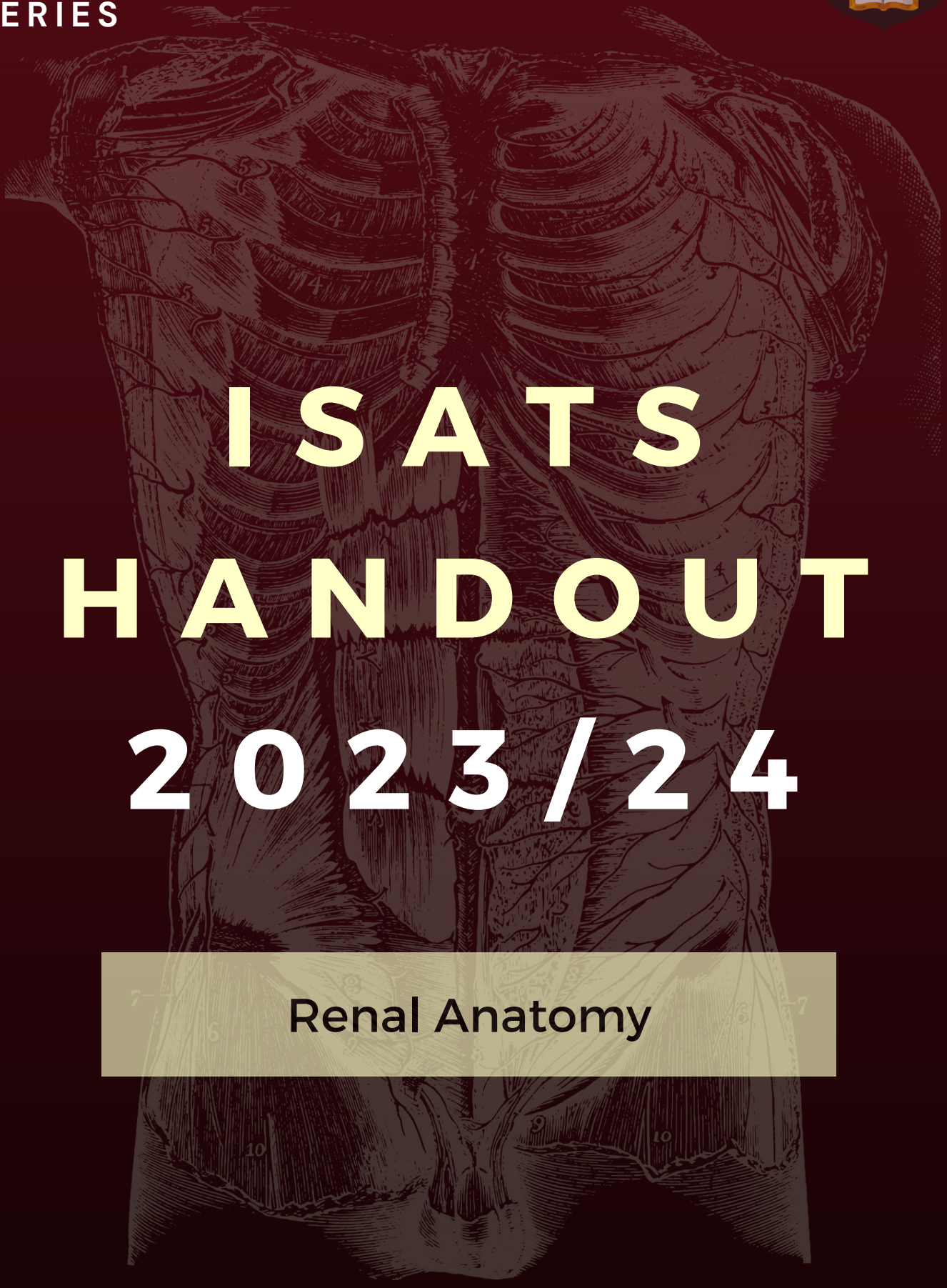
INTERNATIONAL SURGICAL ANATOMY TEACHING SERIES



ISATS HANDOUT 2023/24

Renal Anatomy

High Yield | Surgical Relevance | CPD Accredited

RENAL ANATOMY

Objectives: *Objectives: Understand the anatomy of the kidneys, ureters, bladder, urethra, the male reproductive system and their respective neurovascular supply. Apply anatomical knowledge in context of common urological procedures*

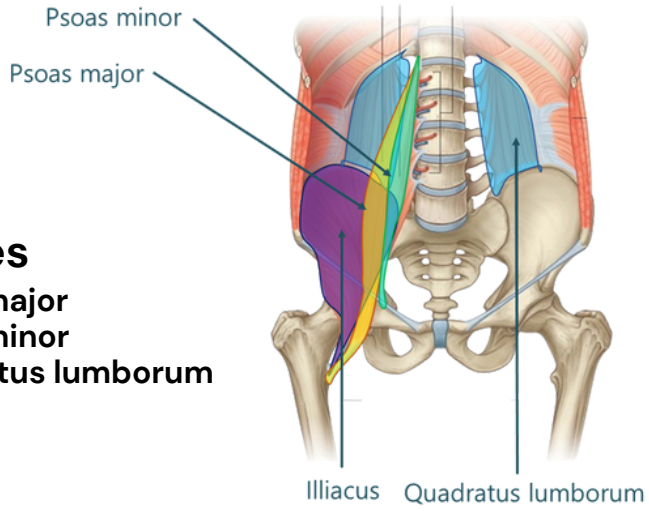
Posterior Abdominal Wall

Important Structures

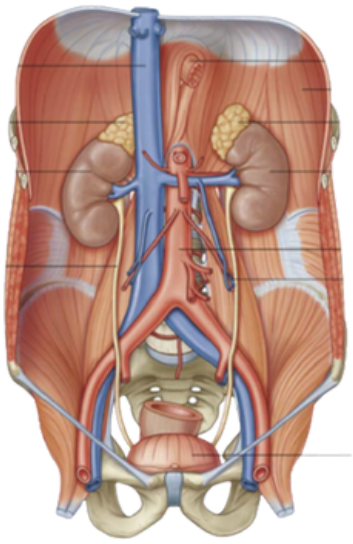
- Posterior abdominal wall skeleton
- Muscles
- Lymphatics
- Vasculature:
  - Abdominal aorta
  - Inferior vena cava
- Innervation:
  - Sympathetic trunks
  - Lumbar plexus

Muscles

- Psoas major
- Psoas minor
- Quadratus lumborum
- Iliacus



Muscle	Origin	Insertion
Psoas major	• **Lateral surfaces of T12, L1-L5 vertebrae & discs**	○ **Lesser trochanter of femur**
Psoas minor	• **Lateral surfaces of T12, L1-L5 vertebrae & discs**	○ Pelvic brim, iliopubic eminence
Quadratus lumborum	• Transverse process of L5, iliac crest, iliolumbar ligament	○ Transverse processes L1-L4, inferior border of rib 12
Iliacus	• Iliac fossa, sacroiliac and iliolumbar ligaments, upper sacrum	○ **Lesser trochanter of femur**

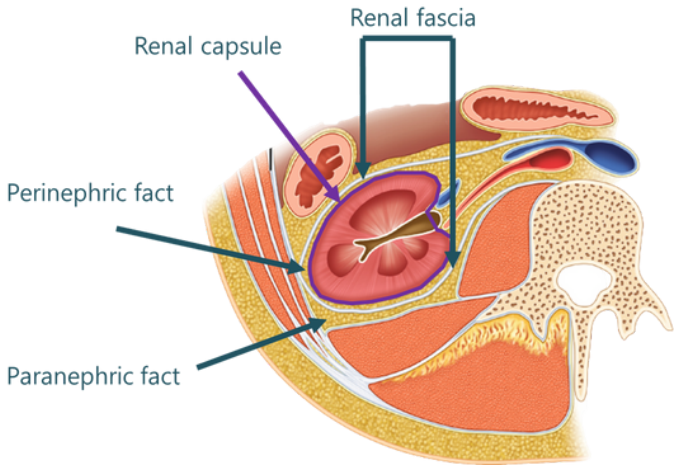


Urinary System

- Kidneys
- Ureters
- Bladder
- Urethra

The Kidneys

- Retroperitoneal
- Immediately lateral to vertebrae
- T12 – L3
- Encapsulated by renal fascia



Function of urinary system: filters blood, removes waste and excess water

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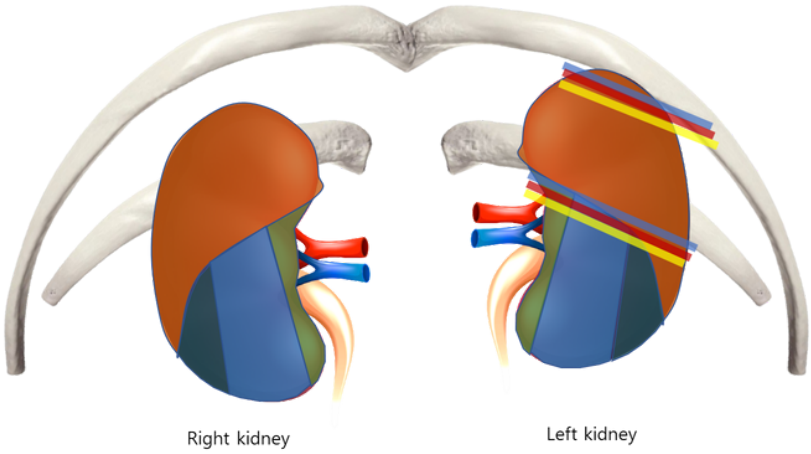
The Kidneys

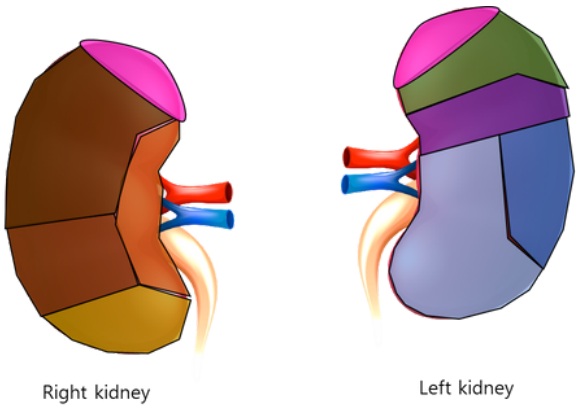
Posterior Relations:

- Superior: diaphragm
- Medial to lateral:
  - Psoas major
  - Quadratus lumborum
  - Transversus abdominis
- Ribs
  - + subcostal bundle



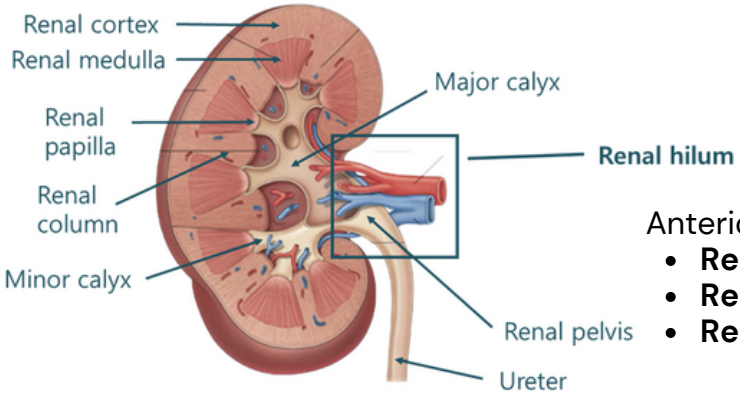
Anterior Relations:

- Superior: suprarenal glands
- Right kidney:
  - Liver
  - Descending duodenum
  - Right colic flexure
  - Small intestine
- Left kidney:
  - Stomach and spleen
  - Pancreas
  - Left colic flexure and descending colon
  - Jejunum



Structure

- Outer renal cortex
- Inner renal medulla
- Renal papilla
- Renal column
- Minor renal calyx
- Major renal calyx
- Renal pelvis
- Ureter
- Hilum of kidney



Anterior to posterior:

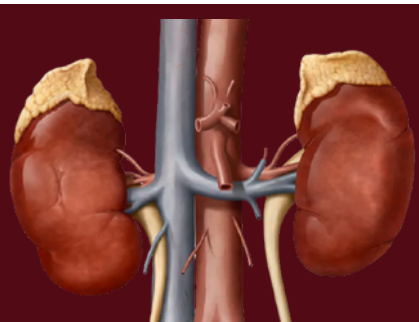
- **Renal vein**
- **Renal artery**
- **Renal pelvis**

Arterial Supply

- **Renal arteries** (abdominal aorta)
  - Just inferior of SMA (between L1 & L2)
  - Right artery > left artery
  - Divides into anterior and posterior branches at hilum
  - Accessory arteries are common

Venous drainage

- **Renal veins** (IVC)
  - Anterior to renal arteries
  - Left vein > right vein
    - Anterior to aorta
    - Posterior to SMA
    - Aneurysms = nutcracker



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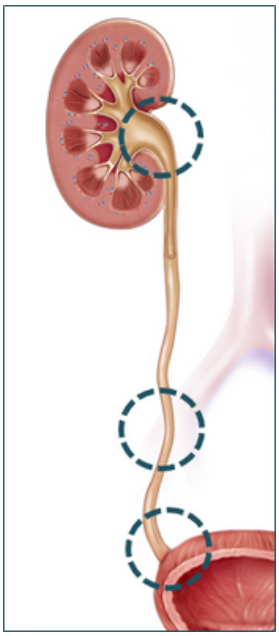
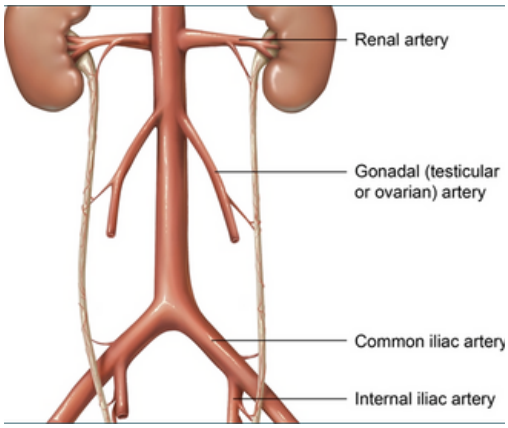
Ureters

- **Muscular tubes transporting urine to the bladder**
  - Continuous with renal pelvis
  - 3 major points of constriction
    - Ureteropelvic junction
    - Pelvic inlet
    - Ureterovesical junction
  - **Clinical implication**: stones!





- **3 parts:**
  - Abdominal ureter
  - Pelvic ureter
  - Intravesical / intramural
- Receiving vascular supply from nearby major arteries

Minor calices → **Major calices** → **Renal pelvis** → **Ureters**

BLADDER

- Most anterior pelvic organ
- 3-sided pyramid
  - Apex
  - Body
  - Fundus
  - Neck

Innervation

- Hypogastric nerve
  - T12-L2
  - Sympathetic
  - **Relaxes** detrusor
  - Urine retention
- Pelvic splanchnic nerve
  - S2-S4
  - Parasympathetic
  - **Contracts** detrusor
  - Micturition
- Pudendal nerve
  - Voluntary, somatic
  - **Control**: External urethral sphincter

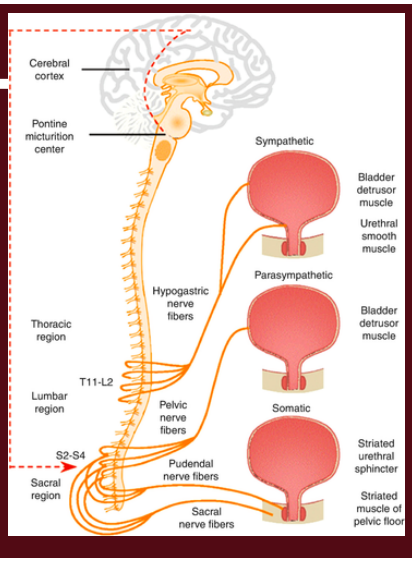
- Trigone = smooth area
  - Formed by ureteric orifices and internal urethral orifice
- Detrusor muscle - smooth muscle
- Internal urethral sphincter
  - Smooth muscle
  - Continuous with detrusor

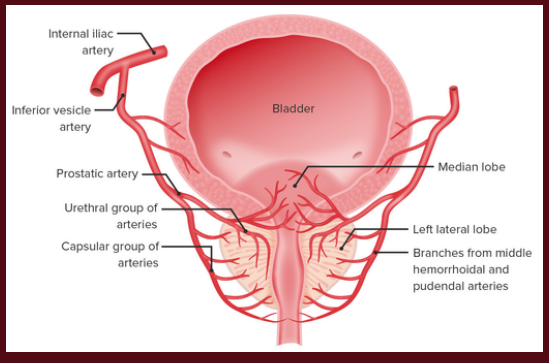
Arterial Supply

- Upper part:
  - Superior vesical branches
- Lower part:
  - **Male:** inferior vesical branches
  - **Female:** vaginal arteries

Venous Drainage

- Network of vesical veins
- Draining into internal iliac





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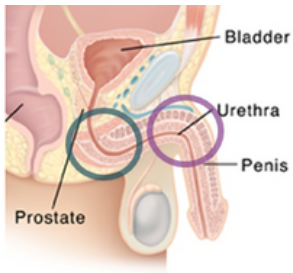
Urethra

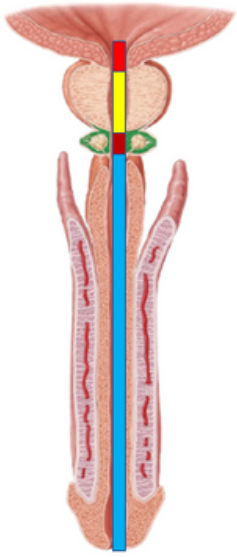
- **Begins at the base of the bladder - surrounded by internal urethral sphincter**
- **Ends with external urethral orifice**
- **Women:**
  - Short (4cm)
  - Anterior to vaginal opening
  - **Skene's glands** - lubrication
- **Men:**
  - Long (20cm)
  - Bends twice
  - **4 parts**

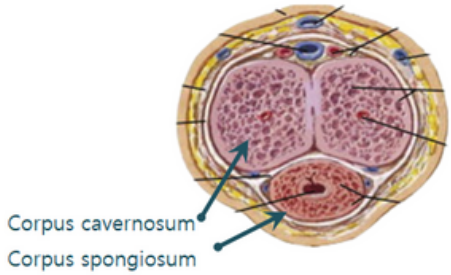


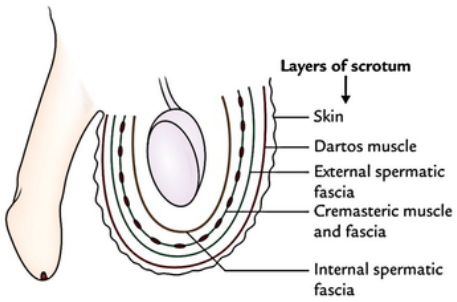
Prepubic angle Infrapubic angle

Parts of the Male Urethra

- **Pre-prostatic**
  - Short (4cm)
  - Anterior to vaginal opening
- **Prostatic**
  - Several openings: ejaculatory ducts, prostatic ducts
- **Membranous**
  - Through deep perineal pouch
  - Narrowest part
  - Passes through external urethral sphincter
- **Spongy**
  - Surrounded by erectile tissue
  - Distal navicular fossa







Male Reproductive System

- **Testes**
- **Epididymis**
- **Vas deferens**
- **Ejaculatory ducts**
- **Accessory glands:**
  - Prostate
  - Paired seminal vesicles
  - Paired bulbo-urethral glands

Prostate

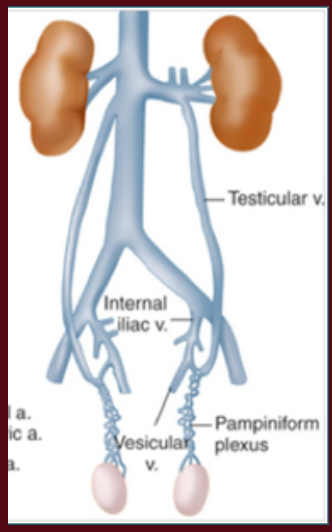
- Unpaired accessory structure
- Surrounds the prostatic urethra
- Discrete zones:
  - **Transitional zone** = BPH
  - **Peripheral zone** = Prostate cancer

Testes

- Develop in the abdomen
- Descends through inguinal canal
- Covered by peritoneal sac

Testes - Neurovascular Supply

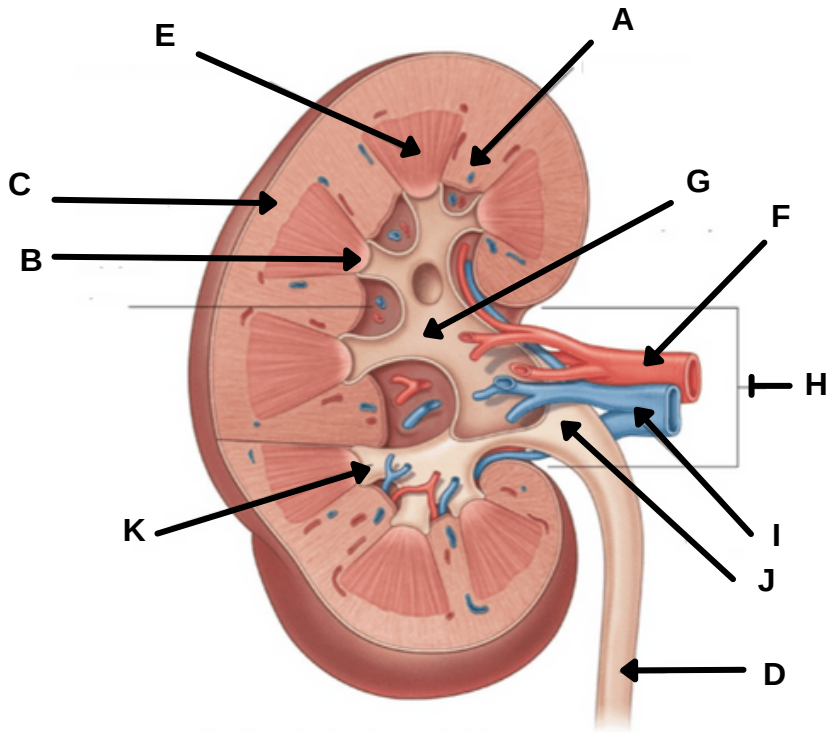
- **A** - testicular arteries (abdominal aorta) + cremasteric artery + artery of vas deferens
- **V** - testicular veins
- **N** - testicular plexus
- **L** - lumbar and para-aortic nodes



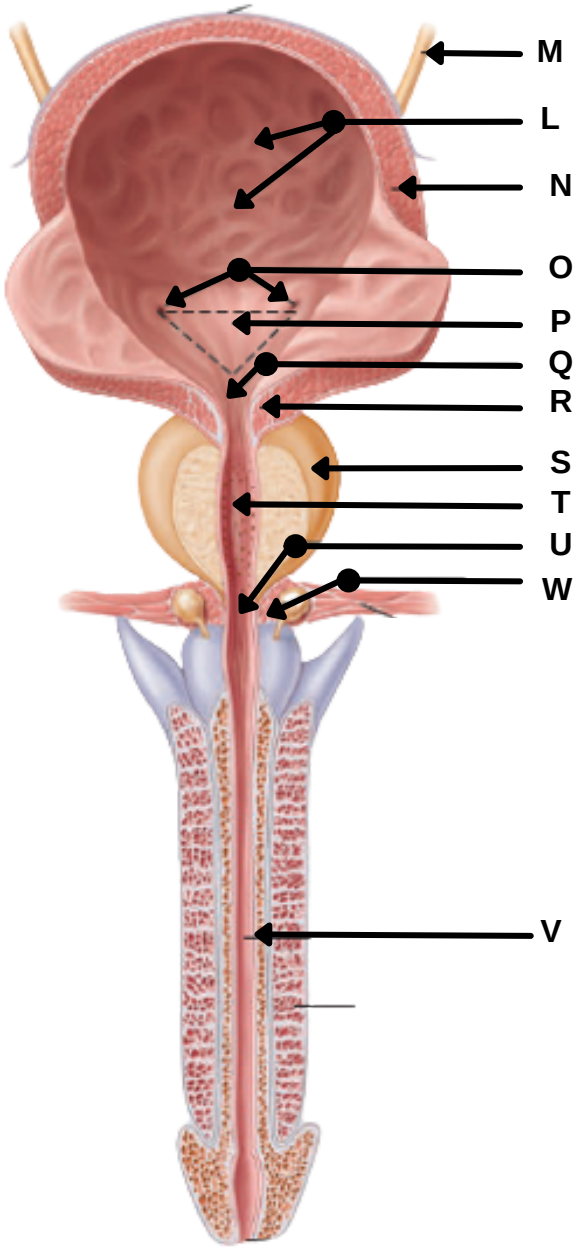
RENAL ANATOMY

Test yourself

1) Label the structures of the kidney



2) Label the structures of the bladder and parts of the male urethra



RENAL ANATOMY

Test yourself

MCQ 1

The upper part of the ureter is supplied via?

A. Ureteric Artery
B. Internal iliac artery
C. Abdominal Aorta
D. Testicular artery
E. External iliac artery

MCQ 2

Which 3 muscles are posterior to the right kidney?

A. Psoas major, iliacus and diaphragm
B. Psoas major, psoas minor and diaphragm
C. Psoaj major, psoas minor and transverse abdominis
D. Psoas major, transverse abdominus and gerotas fascia
E. Psoas major, psoas minor and transverse abdominis

MCQ 3

The parasympathetic supply of the bladder is via the splanchnic nerve. What does this allow for?

A. relaxation of the detrusor and thus micturition
B. relaxation of the detrusor and thus urine retention
C. Contraction of the detrusor and thus micturition
D. Voluntary release of urine

MCQ 4

A patient presents with painless macroscopic haematuria and thus a cystoscopy is performed. During the cystoscopy the trigone of the bladder contains a tumour. Which structure allowed for adequate identification of the trigone?

A. Ureterovesical junction
B. Renal pelvis
C. Ureteric orifices
D. Ureter-testicular artery cross-point
E. Ureteropelvic junction

MCQ5

A patient comes into clinic with poor urinary stream and a feeling of incomplete micturition. He also says that he is waking up around 6 times a night to pass urine. A DRE is conducted and it BPH is confirmed. Which part of the prostate is BPH most commonly confined to?

A. Transitional zone
B. Peripheral zone
C. Central zone
D. Anterior zone

MCQ 6

The corpus cavernosum contains which structure?

A. Superficial dorsal vein
B. Cavernosal bundle
C. Cavernosal artery
D. Urethra
E. Transversalis fascia

RENAL ANATOMY

Test yourself

OSCE Station - Case Based Discussion

A 75-year old male patient presents to the urologist after a referral from his GP. He has been referred due to lower back pain, weight loss and night sweats. He describes the back pain as 9/10 and has said it is present all the time. When asked about his urinary habits he says there has been no change and there is no blood. He seems very stressed.
The following questions relate to the investigations and management of this patient.

Q1. What would be the initial assessment of this patient?

Q2. What are the potential differential diagnoses from this presentation?

Q3. Which investigations will be useful in confirming a diagnosis?

Q4. What are the surgical management options and potential complications of these?

Q5. This patient is most likely to receive palliative care due to spread of the cancer to the Batson plexus. What will this consist of?

Answers
Labels 1: A = renal cortex/column, B = renal papilla, C = renal cortex, D = ureter, E = renal pyramid/medulla, F = renal artery, G = major calyx, H = renal hilum, I = renal vein , J = renal pelvis, K = minor calyx;
Labels 2: L = rugae/bladder wall, M = (left) ureter, N = detrusor, O = ureteric orifices, P = trigone, Q = internal urethral orifice, R = internal urethral sphincter, S = prostate, T = prostatic urethra, U = membranous urethra , V = spongy urethra, W = external urethral sphincter
MCQs. 1) A, 2) E, 3) C, 4) C, 5)A, 6) C
OSCEs: 1) Detailed history, including medication review, examination of the abdomen, external genitalia and DRE . 2) Prostate cancer (most likely), pyelonephritis, prostatitis, chronic urinary retention, bladder cancer, urethral stricture 3) prostate biopsy, urine dipstick to detect blood, glucose, protein, leukocytes, nitrites, PSA test, MP MRI scan (pre-biopsy) Q4) Radical prostatectomy (open, or robotic). S/E: haematuria, urinary incontinence, erectile dysfunction, UTI. Hyponatraemia/TURP syndrome, retrograde ejaculation, erectile dysfunction, urinary incontinence, urethral stricture Q5) pain management i.e. morphine, nutritional requirements i.e. dietician referral, Marie Curie referral to help with mental health/counsellor.