Anatomy1

Bony Pelvis, Joints, and Ligaments

- The bony pelvis consists of **four bones**: right and left hip bones, sacrum, and coccyx. These are connected by **four joints**: two sacroiliac (plane synovial), the symphysis pubis, and the sacrococcygeal joint (both cartilaginous).

- The pelvis is stabilized by **four** main **ligaments**: iliolumbar, lumbosacral, sacrotuberous, and sacrospinous ligaments.

- In the normal erect posture, the anterior superior iliac spine and pubic tubercles align vertically, while the ischial spine and upper border of symphysis pubis are in the same horizontal plane.

- The **pelvic brim** (inlet) is an oblique plane from the sacral promontory to the upper margin of the symphysis pubis, **dividing** the pelvis into the greater (false) pelvis above and lesser (true) pelvis below.

➢ **Pelvic Diameters and Planes**

❖ **Pelvic Inlet:**

- Shape: Triangular/heart-shaped in males, transversely oval in females.

- Formed by: symphysis pubis (anterior), sacral promontory (posterior), ala of sacrum, arcuate line, pectineal line, and pubic crest (sides).

- Diameters:

  - Anteroposterior: 4 inches
  - Oblique: 4.5 inches
  - Transverse: 5 inches (widest)

❖ **Pelvic Outlet:**

- Formed by: pubic arch (anterior), coccyx (posterior), ischial tuberosities (lateral angles), ischiopubic rami (anterolateral), and sacrotuberous ligaments (posterolateral).

- Diameters:

  - Anteroposterior: **5** inches (widest at outlet)
  - Oblique: 4.5 inches
  - Transverse: **4** inches

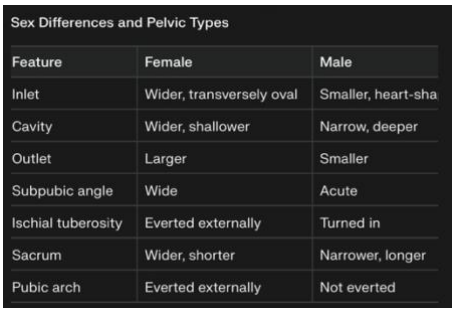
➢ **Pelvic Cavity**:

- Anterior wall: Short (2 inches, pubic bones and symphysis pubis)

- Posterior wall: Long (6 inches, sacrum and coccyx)
- Lateral walls: Pelvic surfaces of pubis, ischium, and ilium

➢ **Special Conjugates**: قياسات الحوض المهمة أثناء الحمل والولادة

- **Diagonal** conjugate: Sacral promontory to *lower* border of symphysis pubis; a shorter diagonal conjugate indicates a contracted pelvis.
- **Obstetric** conjugate لتحديد إمكانيه الولاده الطبيعيه : Sacral promontory to the most bulging point on the *back* of symphysis pubis; 1.5–2 cm less than diagonal conjugate.



Sex Differences and Pelvic Types

Feature	Female	Male
Inlet	Wider, transversely oval	Smaller, heart-sha
Cavity	Wider, shallower	Narrow, deeper
Outlet	Larger	Smaller
Subpubic angle	Wide	Acute
Ischial tuberosity	Everted externally	Turned in
Sacrum	Wider, shorter	Narrower, longer
Pubic arch	Everted externally	Not everted

➢ **Types of Female Pelvis:**

- **Gynaecoid**: Typical female, rounded.
- **Android**: Some male features.
- **Anthropoid**: Long anteroposterior, narrow transverse.
- **Platypelloid**: *Flat*, wide transverse.

➢ **Pelvic Fractures and Complications**

- أنواع الكسور Single-point fractures are stable; two-point fractures are unstable and can cause displacement.
- Complications include injury to male urethra, urinary bladder, bleeding, and nerve injury (especially **sciatic nerve** with greater sciatic notch involvement).
- **Coccydynia** is common after direct trauma to the coccyx.

➢ **Joints and Ligaments Details**

- Pubic Symphysis: Secondary cartilaginous; supported by١ superior and ٢arcuate pubic ligaments.
- Sacrococcygeal Joint: Secondary cartilaginous.
- Sacroiliac Joint: Plane synovial; supported by ١ventral, ٢interosseous (strongest)and ٣dorsal sacroiliac ligaments. Transmits weight and allows slight rotation.

❖ **Vertebropelvic Ligaments**:

- Iliolumbar and lumbosacral prevent L5 displacement.
- Sacrotuberous and sacrospinous convert sciatic notches to foramina لمرور الأعصاب والأوعية الدموية and prevent sacral tilting ميله للخلف .

➢ **Pregnancy Adaptations:** تغيرات الحوض أثناء الحمل

- Ligament relaxation (due to hormones and relaxin) increases joint mobility and pelvic diameters, facilitating childbirth.

➢ **Muscles of the Pelvis :**

❖ **Pelvic Wall Muscles:**

- Piriformis
- Obturator internus

❖ **Pelvic Floor (Diaphragm) Muscles:**

- Levator ani (divided into pubococcygeus, puborectalis, iliococcygeus)
- Coccygeus

—The pelvic diaphragm divides the pelvis (above) from the perineum (below). **Levator ani** supports pelvic viscera, resists increased intra-abdominal pressure, and acts as a sphincter at the anorectal junction and vagina.

— Perineal Body: Fibrous mass between anal canal and bulb of penis (male) or vagina (female); crucial for pelvic floor integrity.

➢ **Injury to Pelvic Floor:**

- Can occur during difficult childbirth, leading to uterine/vaginal prolapse, cystocele(bladder prolapse), stress incontinence, and rectal prolapse.

- Functional Significance :The pelvic floor supports pelvic organs and plays a key role in childbirth, especially in fetal head rotation during labor.

Lecture 2

➢ **Arteries of the Pelvis**

- **Internal Iliac Artery**: Main pelvic artery, *begins* at the lumbosacral disc and splits into anterior and posterior divisions at the upper margin of the *greater sciatic foramen*.

❖ **Anterior** Division Branches:

- *Visceral*: ١Superior vesical, ٢inferior vesical (or vaginal in females),٣ middle rectal, ٤uterine (females only❗).
- *Parietal*: ١Obturator,٢ internal pudendal,٣ inferior gluteal.

❖ **Posterior** Division Branches:

- ١Iliolumbar(It divides into iliac and lumbar branches to supply iliacus, psoas major and quadratus lumborum), ٢two lateral sacral arteries (They enter the ventral sacral foramina to SUPPly contents of sacral canal and then come through the dorsal sacral Toramina to supply the overlying muscles) ,٣ superior gluteal.

❖ **Other** Pelvic Arteries:

- Superior rectal artery: Continuation of inferior mesenteric artery, supplies rectum and upper anal canal.
- Median sacral artery: From aorta, runs over sacrum and coccyx.
- Ovarian arteries: From aorta at L2, supply ovaries.

➢ **Venous Drainage of the Pelvis**

- **Internal Iliac Vein**: Begins at the greater sciatic foramen, joins **external** iliac vein to form the common iliac vein , وظيفته؟Drains pelvic viscera and internal vertebral venous plexuses " مسار مهم لانتشار سرطانات الحوض إلى الفقرات"allowing for potential cancer spread to *lumbar vertebrae.*

❖ **Other** Pelvic Veins:

- Superior rectal vein: Drains to inferior mesenteric vein (portal system).
- Median sacral vein: Joins left common iliac vein.
- Ovarian veins: **Right** drains to IVC , **left** to left renal vein. مهم سريريا

➢ **Nerves in the Pelvis**

❖ **Somatic Nerves:**

- **Sacral plexus(L4-S4)**: Formed by١ lumbosacral trunk (L4-L5) and ٢S1-S4, lies between piriformis and pelvic fascia. Supplies pelvic muscles and perineum.

-Branches: To levator ani/coccygeus, pelvic splanchnic nerves (S2-S4), pudendal nerve (perineum), perforating cutaneous nerve (buttock skin).

- **Coccygeal plexus**: From S4, S5, and coccygeal nerves; supplies skin from coccyx to anus.

❖ **Autonomic Nerves:**

- **Sympathetic**: Sacral sympathetic trunks (with 4-5 ganglia), unite to form ganglion impar; supply blood vessels, glands, and pelvic viscera.

- **Parasympathetic**: Pelvic splanchnic nerves (S2-S4), synapse in hypogastric plexus or viscera walls, supply pelvic organs and hindgut.

❖ **Plexuses**:

- Superior hypogastric plexus (in front of sacral promontory, contains sympathetic and parasympathetic fibers).

- Inferior hypogastric plexus (medial to internal iliac vessels, lateral to rectum; supplies pelvic and perineal organs).

➢ **Lymph Drainage of the Pelvis**

- Lymph from pelvic viscera and deep perineum drains into:
  - Internal iliac lymph nodes (near internal iliac vessels)
  - External iliac lymph nodes (near external iliac vessels)
  - Sacral lymph nodes (near lateral sacral vessels)
- Final drainage is to **common iliac lymph nodes.**

- Some organs (ovaries, uterine tubes, fundus of uterus) drain **directly** to **lateral aortic lymph nodes.**

➢ **Peritoneum of the Pelvis**

Forms the sigmoid mesocolon and covers:

- Rectum: Front and sides of upper third, front of middle third.

- Male: Upper part of bladder (forming rectovesical pouch) and *reflected* onto anterior abdominal wall.

- Female: *Reflected* onto posterior vaginal wall (recto-vaginal pouch **or** pouch of Douglas), covers upper uterus, then *reflected* onto bladder (uterovesical pouch), then to anterior abdominal wall.

❖ **Clinical Notes**

- Venous drainage: **Valveless** lateral sacral veins allow for possible tumor spread from pelvis to lumbar vertebrae.

- Nerve compression: During late pregnancy, fetal head may compress sacral plexus, causing lower limb pain.

- Autonomic function: **Ejaculation** القذفis sympathetic; **erection** الانتصابis parasympathetic.

Anatomy3 kidney

➢ Urinary System

- Components: 2 kidneys, 2 ureters, urinary bladder, and urethra.

❖ **Main Functions:**

- Excretion of metabolic waste.
- Regulation of water and electrolyte balance.
- Maintenance of acid–base balance in blood.

Kidneys: Location and Anatomy

❖ **Location**:

- Retroperitoneal (behind the peritoneum) on the posterior abdominal wall.
- Positioned from **T12 to L3** vertebrae.❗
- **Right** kidney is lower than the left due to the liver.
- Upper pole of right kidney at 12th rib, left at 11th rib.
- **Hilum**: Right kidney just below, left just above the transpyloric plane (L1).
- Can be palpated in thin individuals.

❖ **General Features:**

- 2 **Poles**: Upper (closer to midline) and lower.
- 2 **Borders**: Lateral (smooth, convex) and medial (concave, with hilum).
- 2 **Surfaces**: Anterior and posterior.
- **Hilum**: Entry/exit for renal vein (anterior), artery (middle), and pelvis (posterior), The hilum leads to a space within the Kidney , called the **sinus** of the kidney.

Coverings and Support of the Kidneys

❖ Layers (from inside out):

1. **Fibrous Capsule (**Gerota's fascia**)**: Directly surrounds the kidney.
2. **Perirenal Fat**: Cushions the kidney.

3. **Renal Fascia**: Two layers, continuous with surrounding fascia, Renal fascia separates the kidney from the suprarenal gland and surrounding tissues. Limits the spread of a perinephric abscess

4. **Pararenal Fat**: External, especially posteriorly.

❖ Supporting Factors:

- Adjacent organs, abdominal pressure, fat layers, fascia, blood vessels, and ureters.
- Nephroptosis: Downward displacement if fat is lost rapidly.

Clinical Notes

- **Nephroptosis**: Causes intermittent renal pain, relieved by lying down❗. الألم ناتج عن شدّ الأوعية الدموية الكلوية بسبب حركة الكلية للأسفل عند الوقوف، مما يسبب ضغط عليها
- **Kidney Transplantation**: Typically placed in the iliac fossa of the pelvis.

تتم زراعة الكلية في (iliac fossa) وليس في مكان الكليتين الأصلي في منطقة الخاصرة❗

- **Perinephric Abscess**: Renal fascia helps contain pus or blood, limiting spread.

Relations of the Kidneys

❖ Posterior Relations: (Similar for both kidneys)

- 4 **Muscles**: Diaphragm sup., psoas major, quadratus lumborum, transversus abdominis.
- **Nerves 3/Vessels**: Subcostal vessels, subcostal n., iliohypogastric n., ilioinguinal nerve.
- **Pleura and ribs**: Diaphragm separates upper kidney from pleura and ribs.

—> pleura injury:During Renal surgical operations Due to close relation between costo-diaphragmatic recess of the pleura and kidney —>pneumothorax تسرب الهواء وانكماش للرئة

❖ Anterior Relations:

- Right Kidney: Right suprarenal gland, liver, 2nd part duodenum, right colic flexure (hepatic flexure), Right lobe of liver (with hepatorenal pouch in between) small intestine, Ascending branch of right colic artery

- Left Kidney: Left suprarenal gland, spleen with lienorenal ligament, body of pancreas with splenic vessels,post. Stomach (with lesser sac in between) , descending colon, small intestine, ascending branch of left colic artery

Peritoneal Covering

- **Retroperitoneal**: Most of the kidney is behind the peritoneum. يعني مغطاه من الأمام
- **Bare Areas**: Regions **not** covered by peritoneum, related to adjacent organs

(Suprarenal، ↓ Duodenal area، Colic area (hepatic flexure) ->**Rt. Kidney**

(Suprarenal area, Pancreatic area, Colic area (↓descending colon))->**Lt.kidney**

❗رغم أن الكلى خلف هذا الغطاء، إلا أن السطح الأمامي غير مغطى تماماً ،هناك ثلاث مناطق مكشوفة

Internal Structure of the Kidney

❖ Zones:

- **Cortex**: Outer, pale, forms caps (arches) over medullary pyramids.
- **Medulla**: Inner, darker, consists of 7–14 pyramids.
- **Each pyramid** has a base (toward cortex) and apex (renal papilla).
- Cortex between pyramids = renal columns.
- Each pyramid + cap of cortex = a renal lobule (7–14 per kidney).

❖ Collecting System:

- **Minor Calyces**: 5–12 per kidney, receive papillae.
- **Major Calyces**: 2–3 per kidney, formed by union of minor calyces.
- Renal Pelvis: Formed by major calyces.

Blood Supply and Drainage

❖ Arterial Supply:

- Renal arteries: From abdominal aorta at L2.
- **Right** artery longer, passes behind IVC.
- Each divides into 5 segmental arteries (end arteries).

- Blood flow: **Renal artery** → **Segmental** → **Lobar** → **Interlobar** → **Arcuate** → **Interlobular** → **Glomerular arterioles.**
- **Cortex** receives **>10x blood** than **medulla**.

❖ Venous Drainage:

- Renal veins drain into **IVC**.
- **Left** renal vein is longer, passes in front of aorta, receives ١left suprarenal and ٢gonadal veins.
- Lymphatics: Drain to lateral aortic lymph nodes.

❖ Nerve Supply: **Renal plexus** (from coeliac plexus and lowest splanchnic nerve), mainly vasomotor.

Clinical Syndromes

- **Nutcracker Syndrome**: Compression of **left renal vein** between SMA and aorta, causing **haematuria**.
- **Renal Pain**: From capsule stretching or smooth muscle spasm; referred to flank and anterior abdominal wall (T12).

Surface Anatomy

- **Morris Rectangle**: Used to map kidney position on the back.
- **Vertical lines**: 1 and 3 inches from midline.
- **Horizontal**: T11 (upper), L3 (lower).
- **Hilum**: 2 inches from midline at L1 (**transpyloric plane L1**), The hilum of right kidney is just below transpyloric plane (L1), and that of the left kidney is just above it.

Kidney Trauma

- Protection: Lower ribs, lumbar muscles, vertebral column.
- Injury: Can range from bruising to laceration; high blood flow means injury risks rapid blood loss.

Anatomy4

The Ureter حالبان

- Definition: The ureters are muscular tubes that convey urine from the kidneys to the urinary bladder.

- Location: Each ureter lies behind and adheres to the parietal peritoneum of the posterior abdominal wall.
- Length: About 10 inches (25 cm), **divided into two parts:**
- **Abdominal part:** ~5 inches
- **Pelvic part**: ~5 inches

Course of the Ureter

➢ **Abdominal Part**

- Origin: Begins at the lower end of the renal pelvis (pelvi-ureteric junction).
- Path.: Descends downwards and medially on the psoas major muscle toward the pelvic brim.
- Transition: Crosses the end of the common or beginning of the external iliac artery to become the pelvic part.

➢ **Pelvic Part**

- Path: Descends downwards and backwards along the anterior margin of the greater sciatic foramen to the ischial spine (posterior boundary of the ovarian fossa).
- Final Course: Runs forward on the pelvic floor to *open into* the wall of the urinary bladder.

❖ Crossed By:

- Male: **Vas deferens**
- Female: **Uterine artery**

○ Bladder Entry: Pierces the bladder wall obliquely at the superolateral angle of the trigone, preventing urine regurgitation.

Relations of the Abdominal Part

❖ **Posterior Relations** (Both Sides) :

1. **Psoas major muscle** (separates ureter from tips of transverse processes of lumbar vertebrae 2-5)
2. **Genitofemoral nerve**
3. Termination of common **or** beginning of external **iliac artery**

- Common Iliac Artery (from abdominal aorta)

↳ External Iliac Artery → continues to supply the lower limb (becomes the femoral artery)

↳ Internal Iliac Artery → supplies the pelvic organs, gluteal region, and perineum

❖ Anterior & Medial Relations

	Right Ureter	Left Ureter
Anterior	- Third part of duodenum (beginning)	- Sigmoid colon (near pelvic brim)
	- Terminal ileum (near pelvic brim)	
Peritoneal	- Parietal peritoneum (posterior abdominal wall)	- Parietal peritoneum (posterior abdominal wall)
	- Root of the mesentery	- Apex of sigmoid mesocolon with intersigmoid recess
Vessels	- Right gonadal vessels	- Left gonadal vessels
	- Superior mesenteric vessels	- Left colic vessels
	- Right colic vessels	- Sigmoid vessels
	- Ilio-colic vessels	
Medial	- Inferior vena cava	- Inferior mesenteric vein
		- Left ovarian vein

Site of Constriction	Corresponding Bony Level
Pelvi-ureteric junction	Near tip of transverse process of L2 vertebra
At pelvic brim	In front of sacroiliac joint
In the wall of urinary bladder	Just medial to the ischial spine (narrowest)

Constrictions of the Ureter

Nerve Supply

- **Sympathetic fibers:** T11–L2 segments of the spinal cord.
- **Sensory fibers:** Enter spinal cord through same segments.
- **Pain Referral:** Ureteric colic begins in the **loin** بالخاصرة and is referred to the groin, anterior thigh (via genitofemoral nerve, L1, L2), and scrotum/labium majora.
- عندما يحدث انسداد (مثل وجود حصوة) يتقلص الحالب بشدة في محاولة دفع البول مما يسبب مغص الحالِب (ureteric colic)

Surface Markings

- Start: Point on the **transpyloric plane** **L1**, 5 cm from the midline.
- End: Enters the bladder at the **pubic tubercle** يدخل بشكل مائل .

Ureteric Pain

- Afferent Nerve: Sympathetic, spinal cord levels T11–L2.

- Pain Distribution: Along the genitofemoral nerve **(L1, L2)** to groin, anterior thigh, scrotum, or labium majora.

Blood Supply

- **Abdominal part**: Renal artery, abdominal aorta, gonadal, and common iliac arteries.
- **Pelvic part:** Vesical, middle rectal, and uterine arteries.

Lymphatic Drainage

- Drains to lateral aortic and common iliac lymph nodes.

Imaging

- **KUB**: Kidney, Ureter, Bladder X-ray
- **IVU:** Intravenous Urogram
- **MRI Abdomen**: Magnetic Resonance Imaging of the abdomen

Anatomy5

the Urinary Bladder المثانة

- The urinary bladder is a hollow, muscular organ that acts as a reservoir for urine.
- Its average adult capacity is about 300 ml, but it can tolerate up to 500 ml before pain occurs.
- In infants, the bladder is in the abdomen; it descends into the pelvis with age and lies within the lesser pelvis in adults.

Anatomical Features and Relations

- The empty bladder has an **apex**, **base** (fundus), **three surfaces** (superior, right and left inferolateral), and a **neck**.
    - **Apex**: Continuous with the median umbilical ligament (remnant of the urachus).
    - **Base** (Fundus):

In males: Related to the **rectum**, separated by the **rectovesical pouch**, **seminal vesicles**, and **ampullae of the vas deferens.**

In females: Related to the upper part of the anterior vaginal wall.

- ❖ Superior Surface: Covered by peritoneum.

In males: Related to sigmoid colon and ileum.

In females: Related to the uterus and cervix, with the **uterovesical pouch** in between.

- ❖ Inferolateral Surfaces: **Not** covered by peritoneum, related to the pubic body, retropubic fat, levator ani, and obturator internus.
- ❖ Neck: Lowest and most fixed part.❗

In males: Rests on the prostate.

In females: Rests in the pelvic fascia surrounding the urethra.

Peritoneal Covering and Ligaments

- In males, the superior surface and part of the base are covered by peritoneum; in females, **only** the superior surface.

Ligaments include:

- **Median umbilical** (remnant of **urachus**في الفترة الجنينية)
- **Medial umbilical** (obliterated umbilical artery)
- **Puboprostatic** (males) / **Pubovesical** (females)
- **Lateral ligaments** (contain vessels and nerves)
- **Posterior ligaments** (contain vesical veins).

Internal Structure of the Bladder

- The mucosa is loosely attached, forming folds (**rugae**) when empty, which disappear when distended.
- **Trigone**: A smooth triangular area between the ureteric orifices and internal urethral meatus; always smooth, sensitive, and vascular.
- In males, overlies the **median lobe of the prostate**, which can form the **uvula vesicae** if enlarged.

- المثلث المثاني يقع مباشرة فوق الفص الأوسط من البروستاتا (median lobe of the prostate).
- عندما يتضخم هذا الفص (كما في حالات تضخم البروستاتا الحميد)، قد يبرز في المثانة مكونًا: Uvula vesicae نتوء يشبه "اللسان" داخل المثانة خلف فتحة الإحليل

Muscular Coat

- Composed of three layers of smooth muscle (**detrusor muscle**).
- The detrusor forms the internal urethral **sphincter** at the **neck**.

Blood Supply, Venous Drainage, and Lymphatics

Arterial Supply:

- Males: Superior and inferior **vesical arteries.**
- Females: **Superior vesical** and **vaginal arteries.**
- Venous Drainage: Vesical venous plexus, draining into **internal iliac veins;** communicates with prostatic plexus in males and vaginal plexus in females.
- Lymphatic Drainage: Internal and external iliac nodes; from the neck, directly to sacral nodes.

Nerve Supply

- **Vesical nerve plexus** from the **inferior hypogastric plexus.**
- **Para**sympathetic (S2–S4): Motor to detrusor, inhibitory to sphincter vesicae (promotes micturition).
- Sympathetic (L1–L2): Inhibitory to detrusor, stimulant to sphincter vesicae.
- Sensory: For bladder distension and pain.

Clinical Notes: Bladder Injuries

- **Intra**peritoneal rupture: Usually involves the **superior wall,** occurs when the bladder is full; urine and blood escape into the **peritoneal cavity.**
- **Extra**peritoneal rupture: Involves the **anterior wall** below the peritoneal reflection, often due to pelvic fractures; urine/blood escape into the **retropubic space.**

The Urethra الاحليل

Male Urethra:

- About 20 cm long, extends from the neck of the bladder to the external urethral meatus.

Divided into four parts:

1. **Pre-prostatic** (1–1.5 cm): Surrounded by **internal sphincter.**
2. **Prostatic** (3 cm): Passes through prostate; contains urethral crest, seminal colliculus, prostatic sinuses.
3. **Membranous** (2 cm): Surrounded by **external sphincter**; least dilatable.❗
4. **Spongy** (15 cm): In bulb and corpus spongiosum of penis; dilates at beginning (intrabulbar fossa) and end (navicular fossa).

Two sphincters:

- **Internal** (smooth muscle, autonomic, involuntary)
- **External** (striated muscle, somatic, voluntary).

Female Urethra:

- About 4 cm long, more distensible, **only urinary function.**
- Extends from the neck of the bladder to the external urethral orifice in the vestibule, anterior to the vaginal opening.
- Embedded in the anterior vaginal wall.
- **Paraurethral glands** (homologous to male prostate) present.
- Infections more common due to short length and proximity to exterior.❗

Vessels, Nerves, and Lymphatics of the Urethra

- Blood and nerve supply from those of prostate and penis.
- Lymphatics: Prostatic/membranous parts **to** internal/external iliac nodes; spongy part **to** deep/superficial inguinal nodes.

Clinical: Urinary Retention

- **More common in males** due to prostate enlargement or urethritis.
- In females, usually due to acute urethral inflammation.

Catheterization Procedure القسطرة

- Describes patient position, technique, and anatomical considerations (e.g., resistance at membranous urethra due to sphincter and perineal membrane).

Part	Arterial Supply	Venous Drainage	Innervation
Kidney	Renal arteries (from abdominal aorta)	Renal veins (to IVC)	**Sympathetic:** T10–T12 (renal plexus) **Parasympathetic:** Vagus nerve (CN X) **Pain:** Flank, T10–T12 dermatomes
Ureter	Upper: Renal artery Middle: Gonadal, aortic, common iliac Lower: Internal iliac branches	Corresponding veins	**Sympathetic:** T11–L2 **Parasympathetic:** Pelvic splanchnic (S2–S4) **Pain:** Flank to groin (T11–L2)
Bladder	Superior vesical arteries Inferior vesical (♂) / Vaginal artery (♀)	Vesical venous plexus → Internal iliac	**Sympathetic:** T11–L2 (hypogastric plexus) **Parasympathetic:** S2–S4 (pelvic splanchnic) **Somatic:** Pudendal nerve (S2–S4)
Urethra (♂)	Prostatic: Inferior vesical Membranous: Bulbourethral Spongy: Pudendal	Internal pudendal vein	**Autonomic:** Pelvic/ prostatic plexus **Somatic:** Pudendal nerve (S2–S4)
Urethra (♀)	Internal pudendal and vaginal arteries	Internal pudendal vein	**Autonomic:** Pelvic plexus **Somatic:** Pudendal nerve (S2–S4)

Anatomy6

Male External Genital Organs

- Components5: Scrotum, Testis, Epididymis, Spermatic cord, Penis.

The Scrotum

- Definition: A cutaneous pouch containing the testis, epididymis, and lower spermatic cord.

Layers:

- **Skin**: Pigmented, rugose, with a median raphe.
- **Superficial fascia:** Lacks fat; contains **dartos muscle** for temperature regulation.
- **Colles' fascia**: Deep membranous layer, continuous with **Scarpa's fascia.**

Muscles:

- **Dartos muscle**: Smooth muscle aiding heat regulation.
- **Cremaster muscle**: Derived from internal oblique; **elevates testis in response to cold.**
- **Cremasteric Reflex**: Stroking the thigh causes testis elevation(to same slide),(**Afferent**: **ilioinguinal nerve**; **Efferent**: genital branch of genitofemoral nerve).
- Comparison with Abdominal Wall: Each scrotal layer corresponds to a layer in the abdominal wall, **except** the **transversus abdominis** has **no** scrotal equivalent.

Blood Supply: Cremasteric branch of inferior epigastric, superficial/deep external pudendal, and scrotal branches of internal pudendal arteries.

Nerve Supply:

- Anterior **1/3**: Ilioinguinal and genital branch of **genitofemoral nerves.**
- Posterior **2/3**: **Pudendal** and **posterior cutaneous nerve of thigh**.
- Lymphatic Drainage: Superficial inguinal lymph nodes.

Testis

- Description: **Primary male sex organ**, suspended by spermatic cord; develops in abdomen, descends into scrotum.❗
- Structure: 2 poles, 2 borders, 2 surfaces; covered by **tunica vaginalis,** tunica **albuginea**, and tunica **vasculosa**.
- Tunica Vaginalis: Parietal and visceral layers; forms a **cavity except at the posterior border.**❗
- Tunica Albuginea: **Tough**, white fibrous coat.
- Tunica Vasculosa: Vascular connective tissue beneath albuginea.

Internal Structure:

- Mediastinum testis forms **septa** dividing testis into 200-300 **lobules.**
- **Each lobule** contains **2-3 seminiferous tubules** (spermatogenesis) and **Leydig cells** (testosterone).
- Seminiferous tubules → straight tubules → rete testis → efferent ductules → epididymis.

Epididymis

- Structure: Highly coiled, **comma-shaped tube** (1.5 inches coiled, 6 meters uncoiled).
- Parts: **Head** (cap at upper pole), **body**, **tail** (continues as vas deferens).
- Function: **Sperm reservoir** and **maturation**.❗

Blood Supply, Venous Drainage, Nerve and Lymphatics:

- Testicular Artery: From abdominal aorta (L2), supplies **testis** and **epididymis**.
- Venous Drainage: **Pampiniform plexus** → single testicular vein (right to IVC, left to left renal vein).
- **Varicocele**: **Dilated** pampiniform plexus, **more common on left** ❗due to anatomical reasons.
- Nerve Supply: Superior, middle, and inferior spermatic nerves from renal, hypogastric, and pelvic plexuses.
- Lymphatic Drainage: Lateral aortic lymph nodes.

Thermoregulation of the Testis

Mechanisms:

1. **Cutaneous**: Vascular, sweat glands, **no** fat for heat loss ↓ فقدان الحرارة.
2. **Muscular**: **Dartos** and **cremaster** muscles adjust testis position.
3. **Vascular**: **Pampiniform plexus** dissipates heat. ↓

Spermatic Cord

- Definition: Bundle of structures passing from deep inguinal ring to testis.
- Coverings: Internal spermatic fascia, cremasteric muscle/fascia, external spermatic fascia.

Contents:

1. Testicular artery
2. Cremasteric artery
3. Artery of vas deferens

4. **Vas deferens**
5. Pampiniform plexus
6. Vestige of processus vaginalis
7. Genital branch of genitofemoral nerve
8. Sympathetic plexus
9. Lymphatics

Clinical Correlations

- **Torsion of Testis**: Twisting of spermatic cord, emergency due to risk of **necrosis**.❗
- **Hydrocele**: Fluid accumulation in **tunica vaginalis**.
- **Haematocele**: Blood accumulation in tunica vaginalis.

Vas Deferens (**Ductus Deferens**)

- Structure: Thick-walled, 45 cm long tube from epididymis to ejaculatory duct.
- Course: Ascends from tail of epididymis, through inguinal canal, enters pelvis, crosses ureter, forms ampulla, joins seminal vesicle duct.❗
- Blood Supply: Artery from inferior vesical artery; veins to vesical plexus.
- Nerve Supply: Sympathetic fibers from prostatic plexus.
- Function: **Transports sperm.**❗
- Applied Anatomy: **Vasectomy** for sterilization "منع الحمل للتعقيم"

Seminal Vesicles

- Structure: Sacculated tube, 5 cm long, behind bladder base.
- Relations: Anterior-bladder; posterior-rectum; superior-peritoneum; medial-vas deferens.
- Function: Produces alkaline, fructose-rich secretion for **sperm nourishment.**❗

- Clinical Note: Palpable on rectal exam; abscess may rupture into peritoneum.

Ejaculatory Ducts

- Structure: 2 cm long, formed by **union** of vas deferens and seminal vesicle duct.
- Course: Pass through prostate, open into prostatic urethra.

Bulbourethral Glands

- Location: **Lateral** to membranous urethra in deep perineal pouch.
- Ducts: Open into **spongy urethra.**
- Function: Secrete alkaline mucus (**pre-ejaculate**).

The Prostate

The prostate is an accessory gland surrounding the prostatic urethra, located in the lower pelvis **behind** the pubic symphysis.

Structure	Arterial Supply	Venous Drainage	Innervation
Testes	Testicular arteries (from abdominal aorta)	Testicular veins → Right: IVCLeft: Left renal vein	**Sympathetic:** T10–T11 via testicular plexus **No parasympathetic**
Epididymis	Testicular artery and cremasteric artery	Pampiniform plexus	Same as testes
Vas deferens (ductus)	Artery to vas deferens (from superior/inferior vesical artery)	Vesical/prostatic venous plexus	**Sympathetic:** Hypogastric plexus **Parasympathetic:** Pelvic splanchnic nerves (S2–S4)
Seminal vesicles	Inferior vesical and middle rectal arteries	Vesical/prostatic venous plexus	**Sympathetic:** Hypogastric plexus
Prostate	Inferior vesical artery Middle rectal and internal pudendal (minor contributions)	Prostatic venous plexus → Internal iliac vein	**Sympathetic & Parasympathetic:** Pelvic plexus
Penis	Internal pudendal artery → Dorsal, deep, and bulbourethral arteries	Deep dorsal vein → Prostatic venous plexus	**Somatic (motor & sensory):** Pudendal nerve (S2–S4) **Autonomic:** Cavernous nerves (pelvic plexus)
Scrotum	External pudendal (femoral), internal pudendal, and cremasteric arteries	Corresponding veins	**Sensory:** Ilioinguinal nerve, Genitofemoral nerve, Posterior scrotal nerves (from pudendal)