MEDICAL EDUCATION RESOURCE

Nerves, Arteries and Clinical Terms

Nerves of the Abdomen and Pelvis

Lower Intercostal Nerves

- The **lower six intercostal nerves (T7–T12)** continue into the abdominal wall after leaving the intercostal spaces.
- They supply the **anterior abdominal muscles** (rectus abdominis, external and internal oblique, and transversus abdominis) and the **skin** overlying them.
- The **subcostal nerve (T12)** runs below the 12th rib and contributes to the innervation of the **upper part of the gluteal region** and **lower abdominal wall**.

Upper Lumbar Nerves

- The **first three lumbar nerves (L1–L3)** supply both **somatic and visceral branches**.
- The **iliohypogastric and ilioinguinal nerves** (L1) innervate the **lower abdominal wall**, **skin of suprapubic area**, and **upper medial thigh**.
- The **genitofemoral nerve** (L1–L2) divides into **genital** and **femoral branches**, supplying the **cremaster muscle** and **upper thigh skin**.
- The **lateral femoral cutaneous nerve** (L2–L3) supplies the **skin over the lateral thigh**.

Lumbar Plexus

- Formed by the **ventral rami of L1–L4**, located within the **psoas major muscle**.

- Major branches include:
    - **Iliohypogastric and ilioinguinal nerves (L1)**
    - **Genitofemoral nerve (L1–L2)**
    - **Lateral femoral cutaneous nerve (L2–L3)**
    - **Femoral nerve (L2–L4; dorsal divisions)** – supplies **iliacus, quadriceps femoris, sartorius, and pectineus**.
    - **Obturator nerve (L2–L4; ventral divisions)** – supplies **adductor muscles of the thigh**.
    - **Lumbosacral trunk (L4–L5)** – descends into the pelvis to contribute to the **sacral plexus**

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Sacral Plexus

- Formed by **lumbosacral trunk (L4–L5)** and **ventral rami of S1–S4**.
- Lies on the **posterior pelvic wall** anterior to the piriformis muscle.
- Gives rise to the **sciatic nerve**, **superior and inferior gluteal nerves**, **posterior femoral cutaneous nerve**, and **pudendal nerve**.

Pudendal Nerve

- Root value: **S2, S3, S4**.

- Course: Leaves the pelvis through the **greater sciatic foramen**, crosses the **sacrospinous ligament**, and re-enters via the **lesser sciatic foramen** to reach the **pudendal canal**.

- Branches:

    1. **Inferior rectal nerve** – to external anal sphincter and perianal skin.

    2. **Perineal nerve** – to perineal muscles, scrotum/labia.

    3. **Dorsal nerve of penis/clitoris** – to skin of glans and body.

- **Clinical note:** Pudendal nerve block is given during vaginal delivery or minor perineal surgeries

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Abdominal Part of Sympathetic Trunk

- Lies along the **medial border of psoas major**, continuing from thoracic to pelvic region.

- Contains **four ganglia**; upper two receive **white rami communicantes** from L1 and L2.

- Branches:

    - **Grey rami communicantes** to lumbar spinal nerves (for sweat glands, vasomotor, and pilomotor control).

    - **Visceral branches** to the **aortic and hypogastric plexuses**

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Aortic Plexus

- A **network of sympathetic, parasympathetic, and visceral afferent fibres** around the abdominal aorta.
- Gives rise to major subsidiary plexuses:
    - **Coeliac plexus** – to liver, stomach, spleen.
    - **Superior and inferior mesenteric plexuses** – to intestines.
    - **Renal and gonadal plexuses** – to kidneys, testes, or ovaries.
- Continues below as the **superior hypogastric plexus**, linking with pelvic autonomic nerves

Pelvic Part of the Sympathetic Trunk

- The **pelvic sympathetic trunk** is the continuation of the lumbar part.
- It lies **in front of the sacrum**, **medial to the anterior sacral foramina**, and ends below as the **ganglion impar** in front of the coccyx.
- Contains **four small ganglia** on each side.

Branches:

1. **Grey rami communicantes** — join the **sacral and coccygeal nerves**, distributing sympathetic fibres to the **perineum, skin, and lower limb vessels**.
2. **Visceral branches** — form part of the **pelvic autonomic plexuses**, supplying **pelvic viscera** (rectum, bladder, uterus, prostate).

Collateral or Prevertebral Ganglia and Plexuses

These are autonomic ganglia situated **in front of the vertebral column** and are associated with major branches of the abdominal aorta.
They include:

- **Coeliac plexus**
- **Superior mesenteric plexus**
- **Inferior mesenteric plexus**
- **Aortic plexus**

These plexuses contain **sympathetic (postganglionic)**, **parasympathetic (preganglionic)**, and **visceral afferent fibres**.

Coeliac Plexus (Solar Plexus)

- The **largest autonomic plexus** in the body, lying around the **coeliac trunk** and root of the **superior mesenteric artery**.
- Composed of the **right and left coeliac ganglia**, which receive:
  - **Greater and lesser splanchnic nerves** (sympathetic)
  - **Vagal fibres** (parasympathetic)
  - **Phrenic nerve filaments**

Secondary plexuses arising from the coeliac plexus:

- **Phrenic plexus** – diaphragm and suprarenal gland

- **Hepatic plexus** – liver, gallbladder, bile ducts
- **Splenic plexus** – spleen
- **Left gastric plexus** – stomach
- **Renal plexus** – kidneys and upper ureters
- **Gonadal plexus** – testis or ovary
- **Superior mesenteric plexus** – midgut
- **Aortic plexus** – continues downward to form the **superior hypogastric plexus**

Superior Hypogastric Plexus

- Lies **between the two common iliac arteries**, in front of the lower part of the **abdominal aorta** and **L5 vertebral body**.
- Formed by the **aortic plexus** and branches from the **third and fourth lumbar sympathetic ganglia**.
- Divides into **right and left inferior hypogastric plexuses**, which descend into the pelvis.
- These plexuses supply **pelvic viscera**—rectum, bladder, uterus, and prostate.

Autonomic Nerve Supply of Various Organs

Gastrointestinal Tract

- **Sympathetic fibres:**

- Derived from **thoracic and lumbar splanchnic nerves** (T5–L2).
- Function: Decrease peristalsis, contract sphincters, and reduce glandular secretion.

- **Parasympathetic fibres:**
  - Supplied by the **vagus nerve** up to the mid-transverse colon and **pelvic splanchnic nerves (S2–S4)** beyond it.
  - Function: Increase peristalsis and glandular secretion.

Genitourinary Tract

- **Kidney:** Renal plexus (sympathetic) regulates vascular tone and renin secretion.
- **Ureter:** Mixed autonomic supply; sympathetic inhibits peristalsis, parasympathetic enhances it.
- **Urinary bladder:**
  - Parasympathetic (S2–S4): Detrusor contraction and internal sphincter relaxation.
  - Sympathetic (T11–L2): Internal sphincter contraction and detrusor relaxation.
- **Uterus:**
  - Dual autonomic control; sympathetic causes contraction during orgasm, parasympathetic during parturition.
- **Prostate and seminal vesicles:**
  - Sympathetic control dominates during ejaculation.

Clinical Anatomy

- **Referred pain:**
    - Abdominal pain may be referred to dermatomes sharing the same spinal segments as the visceral afferents (e.g., appendix ? T10 ? umbilicus).
- **Sympathetic block:** Used to relieve intractable pelvic pain.
- **Pudendal nerve block:** Common during labour or perineal surgery.
- **Autonomic dysfunction:** Can cause bowel or bladder incontinence, impotence, and loss of vascular tone.

Arteries of Abdomen and Pelvis

- **Abdominal aorta** begins at the aortic opening of the diaphragm (T12) and ends at L4, dividing into **common iliac arteries**.
- **Major branches:**
    - *Anterior branches:* Coeliac, superior mesenteric, inferior mesenteric.
    - *Lateral branches:* Renal, gonadal, inferior phrenic.
    - *Posterior branches:* Lumbar arteries.
    - *Terminal branches:* Common iliac arteries.
- **Clinical relevance:** Aneurysm (common near bifurcation), occlusion (causing lower limb ischemia), and collateral circulation through internal thoracic and lumbar arteries.

Clinical Terms

- **Celiac ganglion block:** Pain relief in pancreatic and upper abdominal malignancy.
- **Hypogastric plexus block:** Used in chronic pelvic pain.
- **Aortic aneurysm:** Pathological dilation of the abdominal aorta, often detected by pulsatile mass above the umbilicus.
- **Sciatica:** Pain due to compression of the sacral plexus or its branches.
- **Meralgia paresthetica:** Entrapment of the lateral femoral cutaneous nerve causing pain in the lateral thigh.

Multiple Choice Questions

1. The pelvic part of the sympathetic trunk ends below as:
A. Inferior hypogastric plexus
B. Ganglion impar
C. Sacral plexus
D. Pudendal nerve
Answer: B. Ganglion impar

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2. The coeliac plexus is also known as the:
A. Cardiac plexus
B. Renal plexus
C. Solar plexus
D. Aortic plexus
Answer: C. Solar plexus

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3. Which of the following nerves carries parasympathetic fibres to the hindgut?
A. Vagus nerve
B. Pelvic splanchnic nerves

C. Greater splanchnic nerve

D. Lesser splanchnic nerve

Answer: B. Pelvic splanchnic nerves

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4. The lumbar plexus is formed within the substance of which muscle?

A. Psoas major

B. Iliacus

C. Quadratus lumborum

D. Piriformis

Answer: A. Psoas major

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5. The nerve supplying the cremaster muscle is:

A. Ilioinguinal nerve

B. Genitofemoral nerve

C. Obturator nerve

D. Pudendal nerve

Answer: B. Genitofemoral nerve

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6. The pudendal nerve arises from which spinal segments?

A. L3, L4

B. S1, S2

C. S2, S3, S4

D. L5, S1, S2

Answer: C. S2, S3, S4

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7. The superior hypogastric plexus is located:

A. On the posterior surface of the bladder

B. Between the common iliac arteries

C. On the anterior wall of the rectum

D. Lateral to the uterus

Answer: B. Between the common iliac arteries

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8. Which of the following nerves passes through the greater and lesser sciatic foramina?

A. Sciatic nerve

B. Obturator nerve

C. Pudendal nerve

D. Posterior femoral cutaneous nerve

Answer: C. Pudendal nerve

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9. Which of the following provides sympathetic innervation to the adrenal medulla?

A. Greater splanchnic nerve

B. Lesser splanchnic nerve

C. Least splanchnic nerve

D. Preganglionic sympathetic fibres directly from thoracic spinal cord

Answer: D. Preganglionic sympathetic fibres directly from thoracic spinal cord

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10. The iliohypogastric and ilioinguinal nerves are derived from which spinal root?

A. T12

B. L1

C. L2

D. L3

Answer: B. L1

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11. The main function of sympathetic stimulation on the gastrointestinal tract is to:

A. Increase peristalsis

B. Stimulate secretion

C. Relax sphincters

D. Inhibit peristalsis

Answer: D. Inhibit peristalsis

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12. The parasympathetic supply to the urinary bladder originates from:

A. T12–L1

B. S2–S4

C. L1–L2

D. T10–T12

Answer: B. S2–S4

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13. Which of the following nerves forms part of the sacral plexus?

A. Femoral nerve

B. Obturator nerve

C. Sciatic nerve

D. Genitofemoral nerve

Answer: C. Sciatic nerve

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14. Which is the largest autonomic plexus in the body?

A. Coeliac plexus

B. Superior hypogastric plexus

C. Cardiac plexus

D. Renal plexus

Answer: A. Coeliac plexus

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15. Which artery is commonly involved in an abdominal aortic aneurysm?

A. Superior mesenteric artery

B. Inferior mesenteric artery

C. Abdominal aorta near bifurcation

D. Coeliac trunk

Answer: C. Abdominal aorta near bifurcation

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16. Which of the following is *not* a branch of the lumbar plexus?

A. Iliohypogastric nerve

B. Lateral femoral cutaneous nerve

C. Inferior gluteal nerve

D. Obturator nerve

Answer: C. Inferior gluteal nerve

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17. Pain from appendicitis is initially referred to which dermatome?

A. T6

B. T8

C. T10

D. L1

Answer: C. T10

18. The function of the pelvic splanchnic nerves is:
A. Vasoconstriction
B. Decrease glandular secretion
C. Increase peristalsis and bladder contraction
D. Inhibit detrusor contraction
Answer: C. Increase peristalsis and bladder contraction

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19. The pudendal canal (Alcock's canal) transmits:
A. Internal pudendal vessels and pudendal nerve
B. Sciatic nerve and gluteal artery
C. Posterior femoral cutaneous nerve
D. Inferior gluteal nerve and vein
Answer: A. Internal pudendal vessels and pudendal nerve

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20. Meralgia paresthetica is due to compression of which nerve?
A. Iliohypogastric nerve
B. Lateral femoral cutaneous nerve
C. Femoral nerve
D. Obturator nerve
Answer: B. Lateral femoral cutaneous nerve

Spots on Abdomen and Pelvis

Spot 1: Identify the surface marking of the *spleen* and describe its anatomical relations.
Answer: The spleen lies along the long axis of the 10th rib, between the 9th and 11th ribs, and is related anteriorly to the stomach, medially to the left kidney, and inferiorly to the left colic flexure.

Spot 2: Mark the *McBurney's point* and explain its clinical importance.
Answer: McBurney's point is located one-third of the distance from the right anterior superior iliac spine to the umbilicus. It corresponds to the base of the appendix and is tender in acute appendicitis.

Spot 3: Identify and trace the *inguinal canal* on the body surface.
Answer: The inguinal canal is a 3.7 cm oblique passage in the lower anterior abdominal wall, lying above the medial half of the inguinal ligament, extending from the deep inguinal ring (1 cm above the midinguinal point) to the superficial inguinal ring above the pubic crest.

Spot 4: Show the *fundus of the gallbladder* on the surface of the abdomen.
Answer: It is marked at the tip of the right 9th costal cartilage, at the junction of the lateral border of the rectus abdominis with the costal margin. Clinically important in cholecystitis and gallstone palpation (Murphy's sign).

Spot 5: Demonstrate the *transpyloric plane* and mention the structures it passes through.
Answer: The transpyloric plane lies midway between the suprasternal notch and the upper border of the pubic symphysis, passing through the L1 vertebra. Structures crossing it include the pylorus, neck of pancreas, origin of the superior mesenteric artery, and fundus of the gallbladder.

Spot 6: Identify the *surface marking of the kidneys*.
Answer: On the back, each kidney lies between T12 and L3 vertebrae. The upper pole corresponds to the 11th rib, and the hilum lies just above the transpyloric plane, 5 cm from the midline.

Spot 7: Show the *course of the ureter* on the surface of the abdomen.
Answer: A line drawn from the tip of the 9th costal cartilage to the pubic tubercle represents the ureter's course. The upper 5 cm of this line corresponds to the renal pelvis.

Spot 8: Identify the *site of the coeliac trunk*.
Answer: The coeliac trunk arises from the abdominal aorta just below the transpyloric plane, about 1.25 cm to the left of the midline.

Spot 9: Demonstrate the *site of the abdominal aortic bifurcation*.
Answer: The abdominal aorta bifurcates into the common iliac arteries at the level of the L4 vertebra, corresponding to a point 2.5 cm below and slightly left of the umbilicus.

Spot 10: Identify the *pubic symphysis* and mention its type.
Answer: Located in the midline between the two pubic bones. It is a **secondary cartilaginous joint (amphiarthrosis)** with a fibrocartilaginous disc.

Spot 11: Identify the *rectus sheath* and its contents.
Answer: It encloses the rectus abdominis and pyramidalis muscles, containing the superior and inferior epigastric vessels and the lower six thoracoabdominal nerves.

Spot 12: Identify the *inguinal ligament* and its attachments.
Answer: The inguinal ligament runs from the anterior superior iliac spine to the pubic tubercle, forming the lower border of the external oblique aponeurosis.

Spot 13: Identify the *pelvic brim* on the surface.
Answer: A line drawn from the sacral promontory to the upper border of the symphysis pubis represents the pelvic brim, separating the false and true pelvis.

Spot 14: Show the *fundus of the urinary bladder* on the anterior abdominal wall.
Answer: When empty, the bladder lies behind the pubic symphysis. When full, its fundus rises above the pubis, reaching midway between the umbilicus and symphysis pubis.

Spot 15: Identify the *uterus* in a female subject on surface anatomy.
Answer: The uterus lies in the midline, midway between the bladder and rectum. In a non-pregnant woman, its fundus lies just above the upper border of the pubic symphysis.

Spot 16: Identify the *pudendal nerve course*.
Answer: The pudendal nerve leaves the pelvis through the greater sciatic foramen, crosses the sacrospinous ligament, and enters the perineum via the lesser sciatic foramen, running in the pudendal canal.

Spot 17: Identify the *coeliac plexus* region.
Answer: It lies behind the stomach and in front of the aorta, around the origin of the coeliac trunk, roughly at the L1 vertebral level.

Spot 18: Mark the *site of the superior hypogastric plexus*.

Answer: It is located over the lower part of the abdominal aorta between the two common iliac arteries, opposite the L5 vertebra.

Spot 19: Identify the *course of the femoral artery*.

Answer: It begins midway between the anterior superior iliac spine and pubic symphysis (at the midinguinal point) and descends vertically through the femoral triangle.

Spot 20: Identify the *site of the appendix in a retrocaecal position*.

Answer: The base is still at McBurney's point, but the tip extends posteriorly and upward behind the caecum toward the right kidney.