MEDICAL EDUCATION RESOURCE

Female Reproductive Organs

Female Reproductive Organs

Introduction

- The **female reproductive system** includes both **internal** and **external** genital organs.
- **Internal genital organs:** ovaries, uterine tubes, uterus, and vagina.
- **External genital organs:** vulva (labia majora, labia minora, clitoris, vestibule).
- The **primary sex organs** are the **ovaries**, which produce **ova (oocytes)** and **hormones**—mainly **estrogen** and **progesterone**.
- These organs are located mainly within the **true pelvis** and are related closely to the **urinary bladder** and **rectum**.

Internal Genital Organs

- **Ovaries:** Produce ova and female sex hormones.
- **Uterine tubes (fallopian tubes):** Conduct ova from ovary to uterus and serve as the site of fertilization.
- **Uterus:** Receives, retains, and nourishes the fertilized ovum until childbirth.
- **Vagina:** Musculomembranous canal serving as the excretory duct for menstrual flow and as the copulatory organ.

Ovaries

External Features

- **Number and position:** Two, one on each side of the uterus, in the **ovarian fossa** of the lateral pelvic wall.
- **Shape:** Almond-shaped, flattened anteroposteriorly.
- **Size:** About **3 cm long, 2 cm wide, and 1 cm thick** in a nulliparous woman.
- **Color:** Grayish-pink; surface is smooth in young females and becomes scarred after repeated ovulations.
- **Ends:**
  - **Tubal (upper) end:** Related to the **fimbriae** of the uterine tube.
  - **Uterine (lower) end:** Gives attachment to the **ovarian ligament**.
- **Borders:**
  - **Mesovarian border (anterior):** Attached to **mesovarium**, a peritoneal fold from the broad ligament.
  - **Free border (posterior):** Faces backward, related to the uterine tube.
- **Surfaces:**
  - **Medial surface:** Related to uterine tube and fimbriae.
  - **Lateral surface:** Lies against the ovarian fossa on the lateral pelvic wall.

Relations

Lateral (parietal) surface:

- Lies in **ovarian fossa**, bounded by:
  - **Anteriorly:** Obliterated umbilical artery.
  - **Posteriorly:** Ureter and internal iliac vessels.
  - **Floor:** Formed by **obturator nerve and vessels**.

Medial surface:

- Related to the **fimbrial end of uterine tube** and the **infundibulopelvic ligament (suspensory ligament of ovary)**.

Peritoneal relations:

- The ovary is **intraperitoneal**, but **not covered by peritoneum**—instead, by a special germinal epithelium (modified mesothelium).

Arterial Supply

- **Ovarian artery** (from **abdominal aorta** below the renal artery).
- It passes in the **suspensory ligament of ovary** and anastomoses with a branch from the **uterine artery**.

Venous Drainage

- **Ovarian veins** form a **pampiniform plexus** around the artery.

- They unite to form a single vein on each side:
    - **Right ovarian vein** ? drains into the **inferior vena cava**.
    - **Left ovarian vein** ? drains into the **left renal vein**.

Histology

- **Covering epithelium:** Single layer of **germinal cuboidal cells**.
- **Tunica albuginea:** Dense connective tissue beneath the epithelium.
- **Cortex:** Contains **ovarian follicles** in different stages of development.
- **Medulla:** Contains **blood vessels, lymphatics, and nerves** in loose connective tissue.
- **Graafian follicle:** Mature follicle ready for ovulation.
- After ovulation, follicle converts to **corpus luteum**, which secretes **progesterone**.

Clinical Anatomy

- **Ovulation:** Occurs midway through the menstrual cycle (~14th day).
- **Mittelschmerz:** Mild pain during ovulation due to peritoneal irritation.
- **Ovarian cyst:** Common benign enlargement, may undergo torsion.
- **Ovarian torsion:** Twisting of ovarian pedicle causes pain and necrosis; surgical emergency.
- **Oophorectomy:** Surgical removal of ovary.

- **Ovarian malignancy:** Common site of metastasis from other pelvic or abdominal organs.
- **Ectopic ovarian tissue:** Occasionally found near uterus or in mesentery.
- **Ovarian failure:** Causes infertility and amenorrhea.

Dissection

- The ovary is identified by tracing the **suspensory ligament** laterally and the **ovarian ligament** medially.
- The **uterine tube** arches above it, and the **mesovarium** attaches it to the **broad ligament**.
- The **ovarian vessels** are found within the **infundibulopelvic (suspensory) ligament**.
- Dissection reveals the **pampiniform plexus** surrounding the artery and the fine **nerve fibers** forming the **ovarian plexus** (from renal and aortic plexuses).

Uterine Tubes

Introduction

- The **uterine tubes** (also called **fallopian tubes** or **oviducts**) are **paired muscular ducts** that convey ova from the **ovary** to the **uterus**.
- They are also the **site of fertilization** of the ovum by the spermatozoon.
- Each tube lies in the **upper free margin of the broad ligament** and connects the peritoneal cavity with the uterine cavity.

- **Length:** About **10 cm (4 inches)**.
- **Lumen:** Narrowest at uterine end and widest at the abdominal end.

Parts (From Lateral to Medial)

1. **Infundibulum:**
    - Funnel-shaped lateral end opening into the peritoneal cavity.
    - Margin bears **fimbriae** (finger-like processes); the longest is the **ovarian fimbria**, attached to the ovary.
    - Opens by the **abdominal ostium** near the ovary.
2. **Ampulla:**
    - Longest (about 5 cm) and widest part.
    - Site of **fertilization**.
    - Lies in the upper part of the broad ligament, often loosely coiled.
3. **Isthmus:**
    - Short, thick-walled narrow segment (about 2.5 cm).
    - Lies medial to ampulla; joins the uterus at the uterine cornu.
4. **Intramural (uterine) part:**
    - Short segment (about 1 cm) passing through the **uterine wall**.

- Opens into the **uterine cavity** by the **uterine ostium**.

Course and Relations

- Each tube extends from the **superolateral angle of the uterus** to the **ovary**, lying within the **upper free edge of the broad ligament**.

Relations:

- **Anteriorly:** Small intestine and vesical peritoneum.
- **Posteriorly:** Ovarian fimbriae and sigmoid colon (on the left side).
- **Medially:** Uterus.
- **Laterally:** Ovary and pelvic wall.

Peritoneal relation:

- Completely covered by peritoneum and suspended within the broad ligament (mesosalpinx).

Blood Supply

- **Arterial:**
  - **Uterine artery** (branch of internal iliac artery).
  - **Ovarian artery** (branch of abdominal aorta).
  - Both arteries form anastomoses in the mesosalpinx along the tube.

- **Venous Drainage:**
    - Corresponds to arteries, draining into **uterine and ovarian veins**.

Lymphatic Drainage

- Mainly to **lateral and para-aortic lymph nodes** through the **ovarian vessels**.
- Some lymphatics from the isthmus drain to **internal iliac lymph nodes**.

Nerve Supply

- From the **ovarian plexus** (sympathetic) and **pelvic splanchnic nerves (parasympathetic, S2–S4)**.
- Sensory fibers travel with sympathetic nerves to **T10–L2 segments**.
- The nerve supply helps regulate peristaltic movement of the tube during ovum transport.

Histology

- **Mucosa:** Highly folded, forming longitudinal ridges; lined by **ciliated columnar epithelium** and secretory (peg) cells.
    - **Cilia** beat toward the uterus, aiding ovum transport.
- **Muscular coat:** Two layers — **inner circular** and **outer longitudinal** smooth muscle.
    - Peristaltic contractions help move the ovum.
- **Serosa:** Outer peritoneal covering (part of the broad ligament).

Clinical Anatomy

- **Fertilization:** Normally occurs in the **ampulla**.
- **Ectopic pregnancy:**
  - Implantation of a fertilized ovum in the uterine tube (usually ampulla).
  - May rupture ? severe hemorrhage and shock (surgical emergency).
- **Tubal ligation:**
  - Surgical procedure for **female sterilization**, involving division and ligation of tubes near isthmus.
- **Salpingitis:**
  - Inflammation of the uterine tubes, often due to infection (commonly gonorrhea).
  - May cause adhesions leading to **infertility**.
- **Hydrosalpinx:**
  - Distension of the tube with serous fluid following chronic obstruction.
- **Pyosalpinx:**
  - Collection of pus in the tube due to infection.
- **Hysterosalpingography (HSG):**
  - Radiographic imaging of uterine cavity and tubes after dye injection; assesses patency.

- **Patency test:**
    - Methylene blue dye test done during laparoscopy to check tube openness.

Summary Insight:
The uterine tubes provide the vital link between **ovary and uterus**, serving as both the **pathway for ovum transport** and the **site of fertilization**.
Their close peritoneal relationships explain the spread of **pelvic infections** and the potential for **ectopic gestation**, making their anatomy clinically critical in both **fertility and surgical practice**.

Uterus

Introduction

- The **uterus** is a **hollow, muscular, pear-shaped organ** situated in the **pelvic cavity** between the **urinary bladder (in front)** and the **rectum (behind)**.
- It serves to **receive, retain, and nourish** the fertilized ovum, and later expel the fetus during parturition.
- It also undergoes **cyclical changes** during the menstrual cycle under hormonal control.

Size and Shape

- **In nulliparous women:** About **7.5 cm long**, **5 cm broad**, and **2.5 cm thick**.
- **Weight:** Approximately **30–40 g**.

- **In multiparous women:** Slightly larger and heavier (~50–60 g).
- **Shape:** Pear-shaped, with its broad upper end (fundus) and narrow lower end (cervix).
- The cavity of the uterus is **triangular** in coronal section, with the apex directed downward toward the cervix.

Normal Position and Angulation

- The uterus is **anteverted and anteflexed** in its normal position.
- **Anteversion:** The uterus is tilted forward at the junction between the **cervix and vagina** (about 90° angle).
- **Anteflexion:** The body of the uterus is bent forward on the cervix (about 125° angle).

Functional significance:

- This position supports the uterus over the bladder and prevents downward displacement.

Abnormal positions:

- **Retroversion:** Uterus tilted backward.
- **Retroflexion:** Uterine body bent backward on cervix.
- These positions may lead to **backache**, **dyspareunia**, and sometimes **infertility**.

Parts of Uterus

1. **Fundus:**

- Dome-shaped upper part above the openings of the uterine tubes.
- Lies against the loops of intestine.

2. **Body (Corpus):**
   - Middle major portion of uterus.
   - Contains the uterine cavity, lined by **endometrium**.
   - Undergoes **cyclical changes** in response to ovarian hormones.
3. **Isthmus:**
   - Narrow region between body and cervix.
   - Corresponds to the **internal os** internally.
   - During pregnancy, it forms the **lower uterine segment**.
4. **Cervix:**
   - Lower cylindrical part of the uterus projecting into the vagina.
   - Divided into **supravaginal** and **vaginal** parts.

Cervix of Uterus

- **Length:** About **2.5 cm**.
- **Canal of cervix:**

- Communicates with uterine cavity via **internal os**.
- Opens into vagina via **external os**.
- **External os** is circular in nullipara, transverse slit in multipara.

Epithelium:

- **Endocervical canal:** Lined by **columnar epithelium** forming mucus-secreting glands.
- **Ectocervix:** Lined by **stratified squamous epithelium** continuous with vaginal mucosa.
- **Transformation zone:** Area where columnar epithelium meets squamous — common site for **carcinoma cervix**.

Ligaments of the Uterus

1. Fibromuscular (true) ligaments:

- **Round ligament of uterus:**
  - Remnant of gubernaculum; extends from uterine cornu to labia majora via the inguinal canal.
  - Keeps uterus **anteverted**.
- **Uterosacral ligaments:**
  - From cervix to sacrum; hold uterus **posteriorly**.
- **Transverse cervical (cardinal or Mackenrodt's) ligaments:**
  - From cervix and lateral vagina to lateral pelvic wall.

- Contain **uterine artery and vein**; provide **lateral support**.

- **Pubocervical ligaments:**
  - From cervix to posterior surface of pubis; support uterus **anteriorly**.

2. Peritoneal (false) ligament:

- **Broad ligament:**
  - Double layer of peritoneum extending from lateral margin of uterus to pelvic wall.
  - Contains uterine tube, ovary (via mesovarium), round ligament, and uterine vessels.
  - Subdivided into:
    - **Mesometrium:** Uterine part.
    - **Mesosalpinx:** Tubal part.
    - **Mesovarium:** Ovarian part.

Arterial Supply

- **Uterine artery:** Branch of **internal iliac artery** (via anterior division).
- **Ovarian artery:** Branch of **abdominal aorta**, anastomoses with uterine artery near the uterine tube.
- **Vaginal artery:** Gives accessory supply to lower part of uterus and cervix.

Venous Drainage

- Uterine veins form a **uterine venous plexus** on either side of the uterus.
- Drain into **internal iliac veins**.
- Plexuses of uterus, vagina, and bladder communicate freely — significant in **pelvic venous congestion** and **infection spread**.

Lymphatic Drainage

- **Fundus:** Along ovarian vessels ? **para-aortic (lumbar) lymph nodes**.
- **Body:** ? **external iliac lymph nodes**.
- **Cervix:** ? **internal iliac and sacral lymph nodes**.
- **Round ligament region:** ? **superficial inguinal lymph nodes**.

Nerve Supply

- **Sympathetic fibers:** From **T10–L1**, via **hypogastric plexus**; cause **uterine contraction** and **vasoconstriction**.
- **Parasympathetic fibers:** From **pelvic splanchnic nerves (S2–S4)**; cause **uterine relaxation** and **vasodilatation**.
- **Sensory fibers:** Travel via sympathetic nerves to **T10–L1 segments**, explaining **referred pain** to lower abdomen and back during menstruation or labor.

Summary Insight:
The **uterus** is the central organ of female reproduction, dynamically supported by **muscular and ligamentous structures** that maintain its **anteverted position**. Its **vascular and lymphatic networks** are crucial in menstruation, pregnancy, and pathology like **fibroids,**

prolapse, and carcinoma cervix.
Understanding its **segmental anatomy** aids in gynecological surgery and obstetric interventions.

Age and Reproductive Changes

- The **uterus** undergoes significant structural and functional changes throughout life in response to **hormonal activity** and **reproductive events**.

1. At Birth:

- Uterus relatively **large**, due to maternal hormone influence.
- **Cervix larger than body**.

2. Childhood:

- Uterus small, cervix remains larger than body (ratio 2:1).
- Endometrium thin and inactive.

3. Puberty:

- Estrogen stimulation causes uterus to **enlarge**; body becomes larger than cervix (ratio 2:1).
- Menstrual cycles begin; endometrium becomes cyclically active.

4. During Pregnancy:

- Uterus enlarges greatly due to **hypertrophy and hyperplasia** of smooth muscle.

- Cavity expands to accommodate the fetus.
- Blood vessels, nerves, and lymphatics increase markedly.
- The **isthmus** becomes the **lower uterine segment** in late pregnancy.

5. After Parturition:

- The uterus undergoes **involution** — returns to nearly pre-pregnant size within ~6 weeks.
- Some muscular hypertrophy and fibrotic thickening persist.

6. After Menopause:

- Hormonal withdrawal leads to **uterine atrophy**.
- Body shrinks, becoming smaller than cervix again.
- Endometrium becomes thin and inactive; menstrual cycles cease.

Supports of the Uterus

The uterus is maintained in its normal **anteverted and anteflexed** position by a combination of **muscular tone**, **fibromuscular ligaments**, and **peritoneal folds**.

1. Muscular Supports (Primary):

- **Pelvic diaphragm (levator ani):** Main support; forms a muscular floor for pelvic viscera.
- **Perineal body:** Provides additional support to cervix and vagina.
- **Urogenital diaphragm:** Supports lower part of vagina and indirectly the uterus.

2. Fibromuscular Ligaments:

- **Uterosacral ligaments:** From cervix to sacrum; hold uterus posteriorly.
- **Transverse cervical (cardinal/Mackenrodt's) ligaments:** From cervix to lateral pelvic wall; prevent downward displacement.
- **Pubocervical ligaments:** From cervix to pubis; maintain anterior position.
- **Round ligaments:** Keep uterus anteverted and prevent retroversion.

3. Peritoneal Fold (Secondary):

- **Broad ligament:** Double peritoneal fold supporting uterus, uterine tube, and ovary, but offers little mechanical strength.

Role of Individual Supports

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1. Pelvic Diaphragm:

- The **levator ani muscle (especially pubococcygeus and pubovaginalis)** forms a sling around vagina and rectum.
- Supports the uterus from below and resists intra-abdominal pressure.
- Damage during childbirth ? uterine prolapse.

2. Urogenital Diaphragm and Perineal Body:

- Provide additional **pelvic floor reinforcement**.
- Maintain the angle between vagina and cervix, preventing descent.

3. Uterosacral Ligaments:

- Pull the cervix backward, maintaining the anteverted position.
- Relaxation causes **retroversion or prolapse** of the uterus.

4. Transverse Cervical (Cardinal) Ligaments:

- Contain **uterine vessels**; act as the **chief mechanical support** preventing descent of cervix and uterus.
- Weakening (after childbirth or aging) ? uterine prolapse.

5. Pubocervical Ligaments:

- Support the uterus anteriorly; maintain position over the bladder.
- Prevents the uterus from falling backward.

6. Round Ligaments:

- Keep uterus tilted forward (anteverted).
- During pregnancy, stretch considerably and may cause **round ligament pain**.

7. Broad Ligament:

- Keeps uterus centrally placed but does not prevent prolapse.
- Acts mainly as a **peritoneal fold for passage of vessels and nerves**.

Histology

Wall of the Uterus consists of three layers:

1. **Perimetrium:**
    - Outer **serous coat** (visceral peritoneum).
    - Covers fundus and body, continuous laterally with broad ligament.
2. **Myometrium:**
    - **Thick muscular layer** composed of interlacing smooth muscle fibers.
    - Divided into three ill-defined layers:
        - **Outer longitudinal layer** (continuous with round ligament).
        - **Middle circular layer (stratum vasculare)** — contains large blood vessels.
        - **Inner longitudinal layer.**
    - Undergoes **hypertrophy and hyperplasia** during pregnancy.
3. **Endometrium:**
    - Inner mucous membrane lining the uterine cavity.
    - Composed of **simple columnar epithelium** with **uterine glands** opening onto surface.
    - Divided into:
        - **Stratum functionale:** Superficial layer shed during menstruation.
        - **Stratum basale:** Deep layer that regenerates the endometrium.

Cyclical Changes in Endometrium:

- **Menstrual phase (Days 1–4):** Shedding of functional layer.
- **Proliferative phase (Days 5–14):** Estrogen causes regrowth and gland elongation.
- **Secretory phase (Days 15–28):** Progesterone from corpus luteum causes glands to become coiled and secretory.

Clinical Anatomy

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1. Uterine Prolapse:

- Downward displacement of uterus into vaginal canal due to **weakening of pelvic floor or ligaments**.
- Classified as:
  - **First degree:** Cervix descends into vagina.
  - **Second degree:** Cervix appears at vaginal orifice.
  - **Third degree (procidentia):** Entire uterus projects outside.

2. Retroversion and Retroflexion:

- Uterus tilted or bent backward; may cause infertility, dysmenorrhea, or backache.

3. Fibroids (Leiomyomas):

- Benign tumors from smooth muscle of myometrium.
- Common cause of **menorrhagia (heavy bleeding)** and **infertility**.

4. Carcinoma Cervix:

- Originates from **transformation zone** (squamocolumnar junction).
- Detected early by **Pap smear**.
- Spreads to **internal iliac and sacral lymph nodes**.

5. Endometriosis:

- Presence of **endometrial tissue outside uterus** (e.g., ovary, peritoneum).
- Causes pelvic pain and infertility.

6. Asherman’s Syndrome:

- Endometrial scarring following curettage ? **amenorrhea and infertility**.

7. Hysterectomy:

- Surgical removal of uterus; uterine artery ligated near its course over ureter ("**water under the bridge**").

8. Adenomyosis:

- Invasion of endometrial glands into myometrium ? heavy painful menses.

9. Uterine Perforation:

- Accidental puncture during dilation and curettage or IUCD insertion.

10. Uterine Rupture:

- May occur during labor in scarred uterus; causes massive intraperitoneal bleeding.

Summary Insight:

The uterus is a **dynamic organ** — changing in **size, position, and structure** with age, menstrual cycle, and pregnancy.

Its **support system** (muscles and ligaments) preserves its alignment, and their failure results in prolapse.

Clinically, uterine pathology encompasses a wide spectrum — from **functional disturbances** (menstrual irregularities) to **structural and neoplastic lesions** (fibroids, carcinoma). Understanding its anatomy is thus essential for diagnosis, surgery, and obstetric management.

Vagina

Extent and Situation

- The **vagina** is a **fibromuscular canal** that extends from the **cervix of the uterus** to the **vaginal orifice** in the vestibule of vulva.
- Serves as the **female copulatory organ**, **excretory passage for menstrual flow**, and **birth canal** during parturition.
- **Length:** About **7–9 cm** (anterior wall shorter than posterior).
- **Direction:** Directed upward and backward; forms an angle of about 60° with the horizontal plane.
- Lies between **urinary bladder and urethra (anteriorly)** and **rectum and anal canal (posteriorly)**.
- The upper part surrounds the cervix forming **fornices**.

Fornices of Vagina

- The cervix projects into the upper end of vagina forming **four fornices** — anterior, posterior, and two lateral.
- **Posterior fornix:** Deepest and related to the **rectouterine pouch (pouch of Douglas)** — site for **culdocentesis** (aspiration of peritoneal fluid).
- **Anterior fornix:** Shallow, related to base of urinary bladder.
- **Lateral fornices:** Related to uterine arteries and ureters in the broad ligament.

Relations

Anteriorly:

- Upper part ? Cervix and base of bladder.
- Lower part ? Urethra.

Posteriorly:

- Upper one-third ? Pouch of Douglas and rectum.
- Lower two-thirds ? Rectal ampulla and perineal body.

Laterally:

- Urethra and levator ani muscles.
- Uterine arteries and ureters pass close to lateral vaginal wall.

Arterial Supply

- **Uterine artery** ? vaginal branches.
- **Vaginal artery** (branch of internal iliac).
- **Internal pudendal artery** ? lower part.

Venous Drainage

- Form **vaginal venous plexuses** around the vagina.
- Communicate freely with **uterine, vesical, and rectal venous plexuses**.
- Drain into **internal iliac veins**.

Lymphatic Drainage

- **Upper third:** Internal and external iliac nodes.
- **Middle third:** Internal iliac nodes.
- **Lower third:** Superficial inguinal nodes.

Nerve Supply

- **Autonomic:**
  - **Sympathetic (T12–L2):** Vasoconstriction.
  - **Parasympathetic (S2–S4):** Vasodilation and secretion.
- **Somatic:**

- **Pudendal nerve (S2–S4):** Sensation from lower one-third.
- Upper two-thirds — largely **insensitive to pain**, supplied by visceral afferents.

Ureter in Female Pelvis

- Each **ureter** passes downward and forward in the **base of the broad ligament**.
- Crossed **superiorly by the uterine artery** about **2 cm lateral to the cervix** — surgical relation known as **“water under the bridge”**.
- Important landmark during **hysterectomy** — ureter must be identified to avoid injury.

Histology

- **Mucosa:**
  - Lined by **stratified squamous non-keratinized epithelium** (rich in glycogen).
  - Under estrogen influence, glycogen ? lactic acid ? maintains acidic pH (3.8–4.5), protecting against infection.
  - No true glands; lubrication provided by **cervical and vestibular glands**.
- **Muscular layer:**
  - **Inner circular** and **outer longitudinal** smooth muscle layers.
  - Allows marked distensibility during coitus and childbirth.
- **Adventitia:**

- Dense connective tissue rich in elastic fibers and venous plexuses.

Clinical Anatomy

1. **Vaginal Examination:**
   - Provides valuable diagnostic information about **uterus, cervix, and pelvic organs**.
   - Used for assessing position of uterus, pregnancy, or tumors.
2. **Speculum Examination:**
   - Visual inspection of cervix and upper vagina.
3. **Culdocentesis:**
   - Needle inserted through **posterior fornix** to aspirate fluid from **rectouterine pouch (Douglas pouch)**.
4. **Vaginal Prolapse:**
   - Due to **weakness of pelvic floor muscles** and **perineal body**.
   - Often associated with uterine prolapse.
5. **Vaginismus:**
   - Involuntary spasm of vaginal muscles causing painful intercourse.
6. **Congenital Atresia or Septum:**
   - Failure of canalization of vaginal plate ? imperforate hymen or septate vagina.

7. **Infections:**
    - Common due to warm, moist environment.
    - Candida, Trichomonas, and bacterial vaginosis are frequent causes.
8. **Carcinoma Vagina:**
    - Rare, but can result from spread of cervical carcinoma.
    - Lymphatic spread depends on site: upper (to iliac nodes) or lower (to inguinal nodes).
9. **Episiotomy:**
    - Surgical incision of posterior vaginal wall and perineum during childbirth to prevent irregular tears.
10. **Foreign Bodies or IUCD Displacement:**
    - Occasionally retained, may cause chronic infection or perforation.

Development

- The **vagina** develops mainly from the **paramesonephric (Müllerian) ducts** and the **urogenital sinus**.

1. Upper two-thirds:

- Derived from **fused caudal ends of paramesonephric ducts**.

2. Lower one-third:

- Develops from **endodermal sinovaginal bulbs**, which proliferate from the **urogenital sinus** and form the **vaginal plate**.
- The plate canalizes to form the lower vagina.

3. Hymen:

- Formed at the junction of urogenital sinus and vaginal plate; usually ruptures at puberty or coitus.

4. Epithelium:

- Entire lining replaced by **stratified squamous epithelium** derived from endoderm of urogenital sinus.

Molecular Regulation

- **HOX genes** regulate regional differentiation of the Müllerian ducts:
  - **HOXA9:** Fallopian tube formation.
  - **HOXA10:** Uterine body.
  - **HOXA11:** Cervix.
  - **HOXA13:** Vagina.
- **WNT4** gene controls **Müllerian duct formation** and **ovarian differentiation**.
- **?-catenin** and **RSPO1** signaling essential for maintaining female pathway (inhibit testicular differentiation).

- **Estrogen receptor signaling** promotes epithelial proliferation and glycogen deposition in vaginal mucosa.

- Abnormal HOX or WNT4 expression can lead to **Müllerian anomalies** (e.g., vaginal agenesis or duplication).

Summary Insight:
The **vagina** forms a vital passage between the **uterus and external genitalia**, enabling **sexual intercourse, childbirth, and menstrual flow**.
Its **acidic environment** and **elastic wall** serve both protective and reproductive functions.
Embryologically, it bridges **Müllerian and urogenital sinus derivatives**, and its **molecular regulation** under HOX and WNT genes underscores the precision of female genital tract development.

Mnemonics

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1. Parts of the Uterine Tube – "F.A.I.U."

- **F** – **Fimbriae / Infundibulum**

- **A** – **Ampulla**

- **I** – **Isthmus**

- **U** – **Uterine (intramural) part**

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2. Layers of the Uterine Wall – "P.M.E."

- **P** – **Perimetrium** (outer serous coat)

- **M** – **Myometrium** (middle muscular coat)
- **E** – **Endometrium** (inner mucous coat)

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3. Phases of the Menstrual Cycle – "M.P.S."

- **M** – **Menstrual phase** (Days 1–4)
- **P** – **Proliferative phase** (Days 5–14)
- **S** – **Secretory phase** (Days 15–28)

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4. Uterine Ligaments – "Please Remember To Use Support"

- **P** – **Pubocervical ligament**
- **R** – **Round ligament**
- **T** – **Transverse cervical (cardinal) ligament**
- **U** – **Uterosacral ligament**
- **S** – **Supports from pelvic diaphragm and perineal body**

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5. Relations of Ovary in Ovarian Fossa – "AUP F.O."

- **A** – **Anterior:** Obliterated umbilical artery
- **U** – **Upper:** External iliac vessels
- **P** – **Posterior:** Ureter and internal iliac vessels

- **F.O.** – **Floor:** Obturator nerve and vessels

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6. Uterine Artery and Ureter Relation – “Water Under the Bridge”

- **Water** = Ureter
- **Bridge** = Uterine artery
  (The uterine artery crosses **above** the ureter ~2 cm lateral to the cervix.)

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7. Lymphatic Drainage of Uterus – “F.B.C.R.”

- **F** – **Fundus:** Para-aortic nodes
- **B** – **Body:** External iliac nodes
- **C** – **Cervix:** Internal iliac and sacral nodes
- **R** – **Round ligament:** Superficial inguinal nodes

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8. Fornices of the Vagina – “A P L L”

- **A** – Anterior fornix
- **P** – Posterior fornix (deepest)
- **L L** – Two lateral fornices

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9. HOX Gene Control of Müllerian Ducts – “9–13 = Tube to Vagina”

- **HOXA9 ?** Fallopian tube

- **HOXA10 ?** Uterine body
- **HOXA11 ?** Cervix
- **HOXA13 ?** Vagina

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10. Ovarian Vein Drainage – “L for Left, L for Renal”

- **Left ovarian vein ? Left renal vein**
- **Right ovarian vein ? Inferior vena cava**

Facts to Remember

- The **ovary** is an **intraperitoneal organ**, but **not covered by peritoneum**; instead, it has a **germinal epithelium**.
- **Ovarian artery** arises from the **abdominal aorta**, below the renal artery; its veins show **asymmetrical drainage** (right ? IVC, left ? left renal vein).
- The **uterine tube** provides the **site of fertilization** (ampulla); obstruction leads to **infertility** or **ectopic pregnancy**.
- The **uterus** is normally **anteverted and anteflexed**, resting over the urinary bladder.
- **Round ligaments** maintain the forward position (anteversion) of the uterus.
- **Cardinal (transverse cervical) ligaments** provide the **chief support** of the uterus; their weakening causes **uterine prolapse**.

- The **broad ligament** is a **peritoneal fold** that transmits the uterine tubes, vessels, and nerves but gives **no mechanical support**.

- **Myometrium** forms the **thickest layer** of the uterus; its muscle fibers hypertrophy during pregnancy.

- **Endometrium** undergoes cyclical changes: proliferative (estrogenic), secretory (progestational), and menstrual (degenerative).

- The **uterine artery** crosses **above the ureter** at the base of the broad ligament — a key landmark in hysterectomy ("**water under the bridge**").

- The **cervix** has two epithelial types — columnar (endocervical canal) and stratified squamous (vaginal part); their junction (transformation zone) is prone to **carcinoma cervix**.

- **Pelvic diaphragm (levator ani)** and **perineal body** are the **primary supports** preventing prolapse of pelvic organs.

- The **vagina** is lined by **stratified squamous epithelium**, rich in **glycogen**, producing **acidic pH** protective against infection.

- The **posterior vaginal fornix** is related to the **rectouterine pouch (pouch of Douglas)** — important for culdocentesis.

- The **vaginal epithelium** is **endodermal** in origin (from urogenital sinus).

- The **uterus and upper vagina** develop from the **fused paramesonephric (Müllerian) ducts**; defects cause **uterine anomalies** (septate or bicornuate uterus).

- **WNT4 and HOX genes** regulate female genital tract differentiation; their mutation can result in **Müllerian agenesis** or **fusion defects**.

- The **ureter** passes **beneath** the **uterine artery** in the female pelvis, about **2 cm lateral to the cervix**.
- The **acidic vaginal pH (3.8–4.5)** is due to **lactic acid** produced by bacterial metabolism of glycogen.
- **Postmenopausal uterus** becomes **atrophic**, with the body smaller than cervix, and **endometrium inactive**.
- **Cervical smear (Pap test)** detects early cellular changes of carcinoma cervix — lifesaving in early diagnosis.

Clinicoanatomical Problem

Case 1: Uterine Prolapse

A 45-year-old multiparous woman complains of a mass descending from the vagina and a sensation of pelvic heaviness. On examination, the cervix is seen at the vaginal opening.

Question:

What structures are weakened, and what is the anatomical basis of this condition?

Explanation:

- The condition is **uterine prolapse**, due to weakening of **pelvic floor muscles (levator ani, especially pubococcygeus)** and **fibromuscular ligaments** (chiefly **cardinal** and **uterosacral ligaments**).
- Loss of tone in these supports allows the uterus to descend through the vaginal canal.
- Risk factors include multiple childbirths, obesity, and postmenopausal atrophy.

Clinical significance:

- Treated with **pelvic floor exercises**, **pessary**, or **surgical suspension/hysterectomy** depending on severity.

Case 2: Ectopic (Tubal) Pregnancy
A 30-year-old woman presents with sudden severe lower abdominal pain and signs of internal bleeding. Ultrasonography shows rupture of a fallopian tube.

Question:
What is the anatomical and embryological explanation for this?

Explanation:

- Fertilization normally occurs in the **ampulla** of the uterine tube.
- If the fertilized ovum fails to reach the uterus, it may implant in the **tubal mucosa**—most often in the ampullary or isthmic part.
- As the embryo grows, the thin tube ruptures causing **intra-abdominal hemorrhage**, leading to shock.

Clinical significance:

- Surgical emergency; requires **salpingectomy** (removal of affected tube).
- Common cause of **acute abdomen** in early pregnancy.

Case 3: Carcinoma Cervix
A 40-year-old woman presents with postcoital bleeding. Pap smear reveals malignant cells at the squamocolumnar junction of cervix.

Question:
Why is this site particularly prone to carcinoma?

Explanation:

- The **transformation zone** of cervix (where **columnar epithelium** of endocervix meets **stratified squamous epithelium** of ectocervix) is hormonally sensitive and prone to **metaplasia**.
- Continuous irritation or HPV infection can cause **dysplastic change** ? **cervical cancer**.

Clinical significance:

- Early detection by **Pap smear** and **colposcopy** is life-saving.
- Metastasis spreads to **internal iliac and sacral lymph nodes**.

Case 4: Ureteric Injury During Hysterectomy
During hysterectomy, a surgeon accidentally ligates the ureter, leading to postoperative anuria and flank pain.

Question:
Why is the ureter at risk during this surgery?

Explanation:

- In the female pelvis, the **ureter passes beneath the uterine artery** ("**water under the bridge**") about **2 cm lateral to the cervix**.
- During ligation of the uterine artery, the ureter may be inadvertently tied, obstructing urine flow.

Clinical significance:

- Meticulous identification of ureter before clamping is essential to avoid **hydronephrosis** and **renal damage**.

Case 5: Culdocentesis
A woman with suspected ruptured ectopic pregnancy is subjected to a needle aspiration

through the **posterior fornix** of vagina to confirm presence of blood in peritoneal cavity.

Question:
Why is the posterior fornix chosen for this procedure?

Explanation:

- The **posterior fornix** is related directly to the **rectouterine pouch (pouch of Douglas)**, the **lowest point of peritoneal cavity in erect position**.
- Blood or fluid collects here first during internal bleeding.
- Thus, it provides an **accessible route** for diagnosis and drainage without abdominal incision.

Case 6: Retroversion of Uterus
A 32-year-old woman complains of backache, dysmenorrhea, and dyspareunia. Pelvic examination reveals a uterus tilted backward.

Question:
What is the anatomical basis and consequence of this condition?

Explanation:

- **Retroversion** = uterus tilted backward; **retroflexion** = body bent backward on cervix.
- May be congenital or due to weakening of **uterosacral ligaments** and **pelvic diaphragm** .
- Leads to backache, difficulty in conception, and sometimes **uterine prolapse**.

Case 7: Endometriosis
A young woman presents with cyclical pelvic pain and infertility. Laparoscopy shows endometrial tissue on ovary and pouch of Douglas.

Question:
Explain the anatomical basis of this condition.

Explanation:

- **Endometriosis** = ectopic presence of endometrial tissue outside the uterus (commonly ovaries, uterosacral ligaments, pouch of Douglas).
- The tissue responds to hormonal changes ? cyclic bleeding ? adhesions and pelvic pain.

Clinical significance:

- Leads to **infertility and chronic pelvic pain**.
- Treated with hormonal therapy or surgical excision.

Case 8: Vaginal Prolapse and Cystocele
A postmenopausal woman complains of urinary incontinence and a bulge in the anterior vaginal wall.

Question:
Which structures are involved?

Explanation:

- **Cystocele:** Herniation of **urinary bladder** into **anterior vaginal wall** due to weakening of **pubocervical fascia** and **pelvic diaphragm**.
- **Rectocele:** Posterior vaginal wall protrusion due to rectal bulging.

Clinical significance:

- Both conditions indicate **pelvic floor weakness**; managed by physiotherapy or surgical repair.

Case 9: Mayer-Rokitansky-Küster-Hauser Syndrome (MRKH)
A 17-year-old girl presents with **primary amenorrhea** but normal secondary sexual characters and normal ovaries.

Question:
What is the embryological basis of this condition?

Explanation:

- Caused by **failure of Müllerian duct development**, leading to **absence of uterus and upper vagina**.
- Ovaries and external genitalia develop normally (from gonadal ridge and urogenital sinus respectively).

Clinical significance:

- No menstruation; fertility not possible due to uterine absence.
- Managed with counseling and creation of neovagina if required.

Case 10: Vaginal Agenesis or Septate Vagina
A young woman has menstrual symptoms but no external bleeding. Examination reveals an imperforate hymen or transverse vaginal septum.

Question:
What is the developmental cause?

Explanation:

- Due to **failure of canalization of the vaginal plate** formed from **sinovaginal bulbs (urogenital sinus)**.
- Leads to retention of menstrual blood (**hematocolpos**).

Clinical significance:

- Surgical opening of the hymen or septum relieves obstruction and restores menstrual flow.

Frequently Asked Questions

Q1. What are the main functions of the vagina?
A.

- Serves as the **copulatory organ** during intercourse.
- Acts as the **excretory passage for menstrual flow**.
- Functions as the **birth canal** during parturition.

Q2. What structures form the fornices of the vagina?
A. The **cervix projects into the upper part of the vagina**, creating **four fornices** — one **anterior**, one **posterior**, and two **lateral fornices**.
The **posterior fornix** is the deepest and is related to the **pouch of Douglas**.

Q3. Why is the posterior fornix of clinical importance?
A. It is closely related to the **rectouterine pouch (pouch of Douglas)** — the **lowest point of the peritoneal cavity** in the erect position.
Hence, it is used for **culdocentesis** (needle aspiration of peritoneal fluid) in cases like ruptured ectopic pregnancy.

Q4. What are the relations of the vagina?
A.

- **Anteriorly:** Urinary bladder and urethra.

- **Posteriorly:** Rectouterine pouch and rectum.
- **Laterally:** Levator ani and pelvic fascia containing uterine arteries and ureters.

Q5. What type of epithelium lines the vagina?
A. Stratified squamous non-keratinized epithelium rich in glycogen, which helps maintain an **acidic pH** through lactic acid production.

Q6. Why is the vaginal pH acidic, and what is its significance?
A. The **glycogen** in epithelial cells is converted to **lactic acid** by **Döderlein's bacilli**.
This **acidic environment (pH 3.8–4.5)** prevents pathogenic bacterial growth and protects against infection.

Q7. What is the blood supply of the vagina?
A.

- **Uterine artery** (vaginal branches)
- **Vaginal artery** (from internal iliac artery)
- **Internal pudendal artery** (to lower part)

Q8. What are the lymphatic drainage pathways of the vagina?
A.

- **Upper third:** Internal and external iliac nodes
- **Middle third:** Internal iliac nodes
- **Lower third:** Superficial inguinal nodes

Q9. What is the nerve supply of the vagina?
A.

- **Autonomic nerves:** Sympathetic (T12–L2) and parasympathetic (S2–S4).
- **Somatic nerve:** Pudendal nerve (S2–S4) supplying the **lower one-third**, which is **sensitive to pain and touch**.

Q10. Why is the upper part of the vagina relatively insensitive to pain?
A. Because it is supplied by **visceral autonomic nerves** rather than somatic fibers, making it suitable for **painless vaginal procedures** such as colpotomy.

Q11. What is the developmental origin of the vagina?
A.

- **Upper two-thirds:** From **paramesonephric (Müllerian) ducts**.
- **Lower one-third:** From **urogenital sinus (endodermal)** via **sinovaginal bulbs**.

Q12. What is the embryological origin of the hymen?
A. Formed at the junction of the **urogenital sinus and vaginal plate**; usually ruptures spontaneously or during first coitus.

Q13. What is the most common developmental anomaly of the vagina?
A. Imperforate hymen, caused by **failure of canalization** of the vaginal plate, leading to **retention of menstrual blood (hematocolpos)**.

Q14. What are the main supports of the vagina?
A.

- **Levator ani muscles (especially pubovaginalis)**

- **Perineal body and urogenital diaphragm**
- **Pubocervical and uterosacral ligaments** (indirectly via cervix and uterus)

Q15. What are the main supports of the uterus?
A.

- **Pelvic diaphragm (levator ani)** — primary muscular support.
- **Cardinal (transverse cervical) and uterosacral ligaments** — fibromuscular supports.
- **Round ligament** — maintains anteversion.
- **Pubocervical ligament** — supports cervix anteriorly.

Q16. What are the consequences of pelvic floor weakness?
A.

- **Uterine prolapse**
- **Cystocele (bladder herniation)**
- **Rectocele (rectal herniation)**
- **Enterocele (intestinal herniation)**

Q17. What is the relation between the ureter and the uterine artery?
A. The **uterine artery crosses above the ureter** at the base of the broad ligament about **2 cm lateral to the cervix** — remembered as **“water under the bridge.”**

Q18. Why is the ureter liable to injury during hysterectomy?
A. Because it lies **immediately beneath the uterine artery** in the operative field; accidental

ligation or transection can cause **hydronephrosis or renal failure**.

Q19. Which hormones regulate the uterus and vagina?
A.

- **Estrogen:** Proliferation of endometrium and vaginal epithelium.
- **Progesterone:** Secretory changes in endometrium.
- **Oxytocin:** Uterine contractions during labor.

Q20. What are the three layers of the uterus?
A.

1. **Perimetrium:** Serous outer coat.
2. **Myometrium:** Thick muscular coat.
3. **Endometrium:** Inner mucosal lining undergoing cyclical changes.

Q21. What is the site of fertilization?
A. The **ampulla** of the uterine tube.

Q22. What is the cause of ectopic pregnancy?
A. Failure of the fertilized ovum to reach the uterine cavity, commonly due to **tubal blockage** or **infection (salpingitis)**.

Q23. What are the main blood vessels supplying the uterus?
A.

- **Uterine artery** (from internal iliac artery)

- **Ovarian artery** (from abdominal aorta)
- **Vaginal artery** (from internal iliac)

Q24. How does the uterus change after menopause?
A.

- Uterus **atrophies**; body smaller than cervix.
- Endometrium becomes **thin and inactive**.
- Ovaries also shrink and hormone levels decline.

Q25. What is the importance of the HOX gene family in female reproductive development?
A.

- **HOXA9 ?** Fallopian tubes
- **HOXA10 ?** Uterus
- **HOXA11 ?** Cervix
- **HOXA13 ?** Vagina
  Abnormal HOX expression can cause **Müllerian duct anomalies** such as bicornuate uterus or vaginal agenesis.

Q26. What is the WNT4 gene responsible for?
A. Regulates **Müllerian duct development** and **ovarian differentiation**; its absence may cause **Müllerian agenesis** and **streak gonads**.

Q27. What are common causes of female infertility related to anatomy?
A.

- Tubal obstruction or salpingitis
- Uterine malformations (septate or bicornuate uterus)
- Endometriosis
- Uterine fibroids
- Cervical stenosis

Q28. What are the common sites of endometriosis?
A. Ovaries, pouch of Douglas, uterosacral ligaments, uterine serosa, and peritoneum.

Q29. What is a bicornuate uterus?
A. A **uterine malformation** resulting from **partial failure of fusion of Müllerian ducts**, giving the uterus a **heart-shaped (double-horned)** appearance.

Q30. Why are vaginal and cervical smears important?
A.
They detect **precancerous and malignant changes**, particularly **carcinoma cervix**, at an early and treatable stage.

Multiple Choice Questions

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1. The normal position of the uterus is:
A. Retroverted and anteflexed
B. Anteverted and anteflexed
C. Retroverted and retroflexed
D. Vertically placed

? **Answer: B. Anteverted and anteflexed**

---

2. The uterus receives its chief blood supply from:

A. Vaginal artery

B. Ovarian artery

C. Uterine artery

D. Inferior epigastric artery

? **Answer: C. Uterine artery**

---

3. The uterine artery is a branch of:

A. External iliac artery

B. Abdominal aorta

C. Internal iliac artery

D. Common iliac artery

? **Answer: C. Internal iliac artery**

---

4. The uterine artery crosses the ureter:

A. Anteriorly and above it

B. Posteriorly and below it

C. Above and anteriorly

D. Above and posteriorly

? **Answer: A. Anteriorly and above it**

(*Remember: "Water under the bridge" – ureter under uterine artery.*)

---

5. The fundus of the uterus drains lymph into:

A. Internal iliac nodes

B. External iliac nodes

C. Para-aortic (lumbar) nodes

D. Superficial inguinal nodes

? **Answer: C. Para-aortic (lumbar) nodes**

---

6. The cervix of the uterus drains lymph mainly into:

A. Sacral and internal iliac nodes

B. External iliac nodes

C. Superficial inguinal nodes
D. Para-aortic nodes

? **Answer: A. Sacral and internal iliac nodes**

---

7. The vaginal artery is a branch of:
A. External iliac artery
B. Uterine artery
C. Internal iliac artery
D. Pudendal artery

? **Answer: C. Internal iliac artery**

---

8. The upper part of the vagina develops from:
A. Urogenital sinus
B. Sinovaginal bulbs
C. Müllerian (paramesonephric) ducts
D. Wolffian (mesonephric) ducts

? **Answer: C. Müllerian (paramesonephric) ducts**

---

9. The lower one-third of the vagina develops from:
A. Paramesonephric duct
B. Urogenital sinus
C. Yolk sac
D. Cloacal membrane

? **Answer: B. Urogenital sinus**

---

10. The hymen is derived from:
A. Cloacal membrane
B. Endoderm of urogenital sinus
C. Ectoderm of vulva
D. Mesoderm of urogenital ridge

? **Answer: B. Endoderm of urogenital sinus**

---

11. The posterior fornix of the vagina is related to:

A. Urinary bladder

B. Pouch of Douglas

C. Rectum

D. Urethra

? **Answer: B. Pouch of Douglas**

---

12. The epithelial lining of the vagina is:

A. Stratified squamous keratinized

B. Simple columnar

C. Stratified squamous non-keratinized

D. Transitional

? **Answer: C. Stratified squamous non-keratinized**

---

13. The acidic pH of the vagina is maintained by:

A. Cervical mucus

B. Lactic acid formed from glycogen

C. Acid secretion from glands

D. Bacterial ammonia

? **Answer: B. Lactic acid formed from glycogen**

---

14. Which of the following supports the uterus most effectively?

A. Broad ligament

B. Round ligament

C. Pelvic diaphragm and cardinal ligaments

D. Pubocervical ligament alone

? **Answer: C. Pelvic diaphragm and cardinal ligaments**

---

15. During hysterectomy, ureteric injury is most likely to occur:

A. Near the pelvic brim

B. Where the ureter enters the bladder

C. Beneath the uterine artery near the cervix

D. Near the origin from kidney

? **Answer: C. Beneath the uterine artery near the cervix**

---

16. The transformation zone of the cervix is prone to:

A. Endometriosis

B. Carcinoma

C. Tubal blockage

D. Fibroid formation

? **Answer: B. Carcinoma**

---

17. Fertilization normally occurs in the:

A. Infundibulum

B. Ampulla

C. Isthmus

D. Uterine cavity

? **Answer: B. Ampulla**

---

18. The epithelial lining of the uterus is:

A. Simple squamous

B. Simple columnar

C. Stratified squamous

D. Pseudostratified

? **Answer: B. Simple columnar**

---

19. The vagina receives sensory innervation mainly from:

A. Hypogastric plexus

B. Pudendal nerve

C. Pelvic splanchnic nerves

D. Ilioinguinal nerve

? **Answer: B. Pudendal nerve**

(*Specifically the lower one-third; upper two-thirds are autonomic.*)

---

20. The most common site of ectopic pregnancy is:

A. Isthmus of uterine tube

B. Ampulla of uterine tube

C. Fimbrial end

D. Interstitial part

? **Answer: B. Ampulla of uterine tube**

---

21. The uterus is related anteriorly to:

A. Rectum

B. Sigmoid colon

C. Urinary bladder

D. Pubic symphysis

? **Answer: C. Urinary bladder**

---

22. The pelvic floor is mainly formed by:

A. Coccygeus

B. Levator ani

C. Obturator internus

D. Piriformis

? **Answer: B. Levator ani**

---

23. The broad ligament transmits all except:

A. Uterine tube

B. Ureter

C. Round ligament of uterus

D. Uterine vessels

? **Answer: B. Ureter**

(*Ureter lies beneath the base of the broad ligament, not within it.*)

---

24. The WNT4 gene is essential for:

A. Testis formation

B. Müllerian duct development

C. Kidney development

D. Brain differentiation

? **Answer: B. Müllerian duct development**

---

25. Which nerve is responsible for pain during childbirth?

A. Pudendal nerve

B. Ilioinguinal nerve

C. Hypogastric plexus

D. Pelvic splanchnic nerves

? **Answer: A. Pudendal nerve** (for lower vagina and perineum)

---

26. The most common congenital anomaly of the vagina is:

A. Vaginal atresia

B. Septate vagina

C. Imperforate hymen

D. Double vagina

? **Answer: C. Imperforate hymen**

---

27. The round ligament of uterus is a remnant of:

A. Mesonephric duct

B. Müllerian duct

C. Gubernaculum

D. Urogenital ridge

? **Answer: C. Gubernaculum**

---

28. The lower limit of the peritoneal cavity in females is:

A. Vesicouterine pouch

B. Rectouterine pouch (Douglas pouch)

C. Lateral pelvic wall

D. Uterosacral fold

? **Answer: B. Rectouterine pouch (Douglas pouch)**

---

29. The cervical canal opens into the uterus through:

A. External os

B. Internal os

C. Fornix

D. Isthmus

? **Answer: B. Internal os**

---

30. The epithelial lining of the cervix changes at the:

A. Internal os

B. External os

C. Isthmus

D. Fornix

? **Answer: B. External os**

(*Columnar epithelium of endocervix meets stratified squamous epithelium here — transformation zone.*)

Viva Voce

Q1. What is the normal position of the uterus?

A. The uterus is **anteverted** (tilted forward on the vagina) and **anteflexed** (bent forward on the cervix).

Q2. What is the length of the uterus in an adult female?

A. About **7.5 cm long**, **5 cm broad**, and **2.5 cm thick** in nulliparous women.

Q3. Name the different parts of the uterus.

A. Fundus, **body**, **isthmus**, and **cervix**.

Q4. What is the importance of the isthmus of uterus?

A. It forms the **lower uterine segment** during pregnancy and is the site of **internal os** internally.

Q5. What are the main supports of the uterus?
A.

- **Pelvic diaphragm (levator ani)**
- **Cardinal (transverse cervical) ligaments**
- **Uterosacral ligaments**
- **Pubocervical ligaments**
- **Round ligaments**

Q6. What is the chief mechanical support of the uterus?
A. The **cardinal (transverse cervical or Mackenrodt's) ligaments**.

Q7. What are the peritoneal relations of the uterus?
A.

- Covered by peritoneum on **fundus and body**.
- Peritoneum reflects anteriorly to form **vesicouterine pouch**, and posteriorly to form **rectouterine pouch (Douglas pouch)**.

Q8. What is the uterine artery a branch of?
A. The **internal iliac artery** (anterior division).

Q9. Describe the relation of the uterine artery to the ureter.
A. The **uterine artery crosses above the ureter** about **2 cm lateral to the cervix** — "**water under the bridge**".

Q10. What is the nerve supply of the uterus?
A.

- **Sympathetic fibers (T10–L1)** from hypogastric plexus – cause contraction.
- **Parasympathetic fibers (S2–S4)** from pelvic splanchnic nerves – cause relaxation.

Q11. What are the three layers of the uterine wall?
A.

1. **Perimetrium** – outer serous layer
2. **Myometrium** – middle muscular layer
3. **Endometrium** – inner mucous layer

Q12. Which layer of the uterus undergoes cyclical changes during menstruation?
A. The **endometrium**, particularly its **functional layer (stratum functionale)**.

Q13. Name the three phases of the menstrual cycle.
A.

1. **Menstrual phase**
2. **Proliferative phase**
3. **Secretory phase**

Q14. What is the lining epithelium of the endometrium?
A. Simple columnar epithelium with uterine glands.

Q15. What is the histological feature of the myometrium?
A. Thick layer of **smooth muscle fibers** arranged in **outer longitudinal, middle circular, and inner longitudinal layers**.

Q16. What are the functions of the uterus?
A.

- Receives and nourishes the fertilized ovum.
- Provides environment for fetal development.
- Contracts to expel the fetus during labor.
- Undergoes cyclical changes during menstrual cycle.

Q17. What is uterine prolapse and its cause?
A. Downward displacement of the uterus into the vagina due to **weakening of pelvic diaphragm and ligaments**.

Q18. What is retroversion of uterus?
A. The uterus is tilted **backward** on the vagina instead of forward (anteverted).

Q19. What is endometriosis?
A. Presence of **endometrial tissue outside the uterus** (e.g., ovaries, pouch of Douglas) causing cyclic pain and infertility.

Q20. What are fibroids?
A. Benign smooth muscle tumors of the uterus (leiomyomas), causing menorrhagia and infertility.

Q21. What are the different fornices of the vagina?
A. One **anterior**, one **posterior**, and two **lateral fornices** around the cervix.

Q22. Which fornix is the deepest and most important clinically?
A. The **posterior fornix**, related to the **pouch of Douglas** (site for culdocentesis).

Q23. What is the epithelial lining of the vagina?
A. Stratified squamous non-keratinized epithelium rich in glycogen.

Q24. Why is the vaginal environment acidic?
A. Because **lactic acid** is produced from **glycogen** by **Döderlein's bacilli**, maintaining a pH of **3.8–4.5**.

Q25. What is the blood supply of the vagina?
A. Uterine, vaginal, and internal pudendal arteries.

Q26. Which lymph nodes drain the vagina?
A.

- Upper third ? Internal and external iliac nodes
- Middle third ? Internal iliac nodes
- Lower third ? Superficial inguinal nodes

Q27. What is the nerve supply of the vagina?
A.

- **Autonomic (T12–S4)** – upper two-thirds (insensitive to pain)
- **Pudendal nerve (S2–S4)** – lower one-third (somatic sensation)

Q28. What is the developmental origin of the vagina?
A.

- **Upper two-thirds:** Müllerian (paramesonephric) ducts
- **Lower one-third:** Urogenital sinus (endodermal sinovaginal bulbs)

Q29. What is the embryological origin of the hymen?
A. Formed at the junction of **urogenital sinus and vaginal plate**, derived from **endoderm**.

Q30. What is the clinical importance of the transformation zone of the cervix?
A. It is the **common site for carcinoma cervix** and **Pap smear sampling**.

Q31. Which ligament keeps the uterus anteverted?
A. The **round ligament of the uterus**.

Q32. Which ligament contains the uterine vessels?
A. The **cardinal (transverse cervical) ligament**.

Q33. What is the broad ligament?
A. A **double layer of peritoneum** extending from the uterus to the lateral pelvic wall, enclosing uterine tube, round ligament, and vessels.

Q34. What is the developmental significance of the HOXA genes in female genital tract?
A.

- **HOXA9:** Fallopian tubes
- **HOXA10:** Uterus
- **HOXA11:** Cervix
- **HOXA13:** Vagina

Q35. What are the functions of the vagina?

A.

- Copulatory organ.
- Channel for menstrual flow.
- Passage for childbirth.

Q36. What is the clinical importance of the ureter in relation to the uterus?

A. The **ureter passes beneath the uterine artery** and is at risk of **injury during hysterectomy**.

Q37. Which nerve supplies sensation to the perineum?

A. The **pudendal nerve (S2–S4)**.

Q38. What is the length of the vagina in an adult female?

A. About **7–9 cm**, with the **anterior wall shorter** than the posterior.

Q39. What is the developmental cause of an imperforate hymen?

A. Failure of canalization of the **vaginal plate** derived from the urogenital sinus.

Q40. What is the function of the perineal body in females?

A. Provides **support to vagina and uterus**, maintaining pelvic floor integrity; injury during childbirth leads to **prolapse**.

Q41. What is the term for absence of uterus and upper vagina due to Müllerian duct failure?

A. Mayer-Rokitansky-Küster-Hauser (MRKH) syndrome.

Q42. What are the main arteries supplying the female reproductive organs?

A. Ovarian artery, **uterine artery**, **vaginal artery**, and **internal pudendal artery**.

Q43. What is the site of implantation of a fertilized ovum?
A. Endometrium of the uterus, usually on the **posterior wall** of the fundus.

Q44. Which muscle forms the chief component of the pelvic floor?
A. Levator ani muscle, especially **pubococcygeus** and **pubovaginalis** parts.

Q45. What is a culdocentesis and why is it done?
A. A procedure to **aspirate fluid from pouch of Douglas** through the **posterior vaginal fornix** — used in suspected **ruptured ectopic pregnancy**.

Q46. What is adenomyosis?
A. Invasion of **endometrial glands into the myometrium**, causing heavy, painful menstruation.

Q47. What is a bicornuate uterus?
A. A **uterine malformation** due to **partial failure of fusion of Müllerian ducts**, giving the uterus two horns.

Q48. Which vessels form the uterine venous plexus?
A. Uterine veins, which drain into **internal iliac veins**.

Q49. What is the histological feature of the vagina?
A. Stratified squamous non-keratinized epithelium with no glands; submucosa rich in elastic tissue and venous plexus.

Q50. What are the main changes in the uterus after menopause?
A.

- **Atrophy** of myometrium and endometrium.
- **Cervix larger than body**.
- **Cessation of menstruation** due to hormonal decline.