Chapter 5: Pelvis
Female Reproductive Tract

I. Overview
   A. Broad Ligament
      ▪ Components of female reproductive tract: ovaries, fallopian tubes, uterus and vagina
      ▪ Supported in the pelvis by ligaments and folds of connective tissue
      ▪ Broad ligament: double layer of peritoneum that maintains the uterus position by attaching it to the pelvis
      ▪ Contains three parts:
          – Mesometrium: largest subsection, which surrounds the uterus and extends laterally to cover the round ligament of the uterus and external iliac vessels
          – Mesovarium: projects posteriorly from the main body of the broad ligament to the anterior surface of the ovary and covers its neurovascular supply at its hilum
          – Mesosalpinx: fold that projects superiorly relative to the mesovarium to enclose and suspend the fallopian tubes
          – Three ligaments enclosed in broad ligament: round ligament of uterus, ovarian ligament and suspensory ligament of ovary
   B. Pelvic Recesses
      ▪ Formed in the pelvis by the peritoneum
      ▪ Rectouterine Pouch (Pouch of Douglas): formed by peritoneum descending between the uterus and rectum, lying just posterior to the posterior fornix of the vagina
          – Lowest point in the female abdominopelvic cavity
          – Site of collection for fluids and infection within the peritoneum
      ▪ Vesicouterine Pouch: formed by peritoneum descending between the bladder and the uterus

II. Ovaries
   A. Structure and Function
      ▪ Paired female gonads that function to produce oocytes (female gametes), which are released during ovulation into the fallopian tubes where fertilization occurs
      ▪ Also, function to produce sex steroid hormones and androgens in response to Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) released from the pituitary gland
      ▪ Anterior surface is anchored to the posterior surface of the broad ligament via the mesovarium
      ▪ Not covered by the peritoneum, but anchored in place by two peritoneal ligaments:
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- Suspensory ligament of the ovary extends from the mesovarium to the pelvic wall and contains neurovascular structures
- Ovarian ligament extends from the ovary to the fundus of the uterus and continues to the laboria majus as the round ligament of the uterus
  - Developed from the gubernaculum
- During ovulation, the oocyte is released from the ovary into the peritoneal cavity, then is swept into the fallopian tube by its fimbriae
- Three structural components:
  - Surface formed by simple cuboidal epithelium (germinal epithelium)
  - Cortex consisting of connective tissue and thousands of follicles in various stages of folliculogenesis to create preovulatory follicles to enter the menstrual cycle
  - Medulla contains supporting stroma and neurovascular network that directly enters the ovary via the hilum from the mesovarium

B. Neurovascular and Lymphatics
- Blood supply via paired ovarian arteries, which branch directly off the abdominal aorta at the L2 vertebral level
- Venous drainage via paired ovarian veins – left ovarian vein drains into the left renal vein; right ovarian vein drains directly into the IVC
- Sympathetic and parasympathetic nerve fibers from the ovarian (sympathetic) and pelvic plexuses (parasympathetic)
- Lymph drains into the para-aortic nodes
- All ovarian vessels and nerve fibers travel to the ovary via the suspensory ligament of the ovary

C. Clinical Pearls
- Oophorectomy: ligation of suspensory ligament containing vessels and separation of ureter
- Ovarian Cysts: fluid-filled masses on the ovary, usually benign and can grow larger to cause bleeding and significant pain
- Ovarian Torsion: mass effect of ovarian mass (cyst, tumor) twists the ovary causing torsion of the fallopian tube
  - Treatment: laparoscopy to unwind the twisted ovary and possible oophoropexy
- Ovarian Tumors: develop from germ cells, stromal cells and epithelial cells (majority)
  - Potential to metastasize to distant sites in the pelvis and abdomen including bowel, spleen and gallbladder

III. Fallopian Tubes
A. Structure and Function
- Pair of muscular tubes that extend laterally through the upper border of the broad ligament from the uterus toward the ovaries and open into the peritoneal cavity
- Functions to transport the oocyte from ovary to the ampulla where fertilization occurs, then transport the formed zygote to the uterus for implantation
- Provides assistance to sperm by transporting it toward the ampulla where fertilization occurs
- Consists of four anatomical parts:
  - Fimbriae: finger like projections, which sweep the oocyte ejected during ovulation into the fallopian tube
  - Infundibulum: lateral most portion that is the opening into the peritoneal cavity and where the fimbriae are attached
  - Ampulla: section with largest luminal diameter and as a result is the most common site for fertilization to occur
  - Isthmus: most medial section that connects the ampulla to the uterine cavity

B. Neurovascular Supply
- Blood supply via the uterine (ant. division of internal iliac a.) and ovarian arteries (aorta)
- Venous drainage via the uterine and ovarian veins
- Lymph drains to the iliac, sacral and aortic lymph nodes
- Sympathetic and parasympathetic innervation provided by the ovarian and pelvic plexus, respectively
- Sensory afferent afferents travel through the T11-L1 spinal roots
C. Clinical Pearls
- **Salpingitis (Pelvic Inflammatory Disease):** inflammation of fallopian tubes that can lead to adhesions within the lumen that partially or completely obstruct the lumen, increasing risk for infertility and ectopic pregnancy
  - Majority of cases caused by bacterial infections, *Neisseria gonorrhoeae, Chlamydia trachomatis*
  - Treat with antibiotics to cover both bacteria – ceftriaxone + azithromycin
- **Ectopic Pregnancy:** implantation of fertilized ovum at a site other than the uterus, most often in ampulla of fallopian tubes
  - Acute presentation is an emergency treated with urgent surgery
- **Ligation of Fallopian Tubes:** method of permanent contraception involving surgical ligation of the fallopian tubes, which prevents passage of the oocyte into the uterus
- **Salpingectomy:** surgical removal of the fallopian tube often used to treat ectopic pregnancy that is combined concurrently with an oophorectomy and a hysterectomy for gynecological cancers

![Image](image1.png)

**IV. Uterus**

A. Structure
- Muscular organ that is the site of fertilized ovum implantation
- Expands to accommodate the growing fetus
- Provides muscular contractions to help push the baby out through the vagina during delivery
- Oocyte is ejected during ovulation into the fallopian tube where it is fertilized and subsequently, the zygote is propelled by muscular contractions of the fallopian tubes into the uterus for implantation into the endometrium
- Proximally is connected to the fallopian tubes and the vagina distally
- Contains four parts:
  - Fundus: dome shaped superior region
  - Body: main part that contains the lumen that is continuous with the lumen of the fallopian tubes and with the cervical lumen
  - Isthmus: constricted part that connects the body and cervix
  - Cervix: inferior most part that connects to the vagina
  - Internal os: junction of cervical canal and uterine body
  - Cervical canal (endocervix): internal luminal passageway between the internal and external os
  - External os: opening of cervical canal into the vagina
  - Exocervix: lower end of cervix, visible on vaginal exam and simple columnar epithelium
  - Endocervix: upper portion of cervix, non-keratinizing squamous epithelium
  - Transformation Zone: junction between exocervix and endocervix

B. Histological Layers
- Body and fundus of comprised of three histological tissue layers
- Perimetrium: doubled layered membrane consisting of thick connective tissue and continuous with the peritoneum

![Image](image2.png)

**Figure 5.38: Anterior View of Uterus, Fallopian Tube and Ovary**
**Figure 5.39: Internal View of Uterus and Cervix**
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- Myometrium: thickest layer, dense smooth muscle that undergoes hypertrophy and hyperplasia during pregnancy
- Endometrium: inner mucous membrane lining the lumen

C. Ligaments
- Round ligament of uterus: extends from the uterus through the broad ligament and enters the inguinal canal through the deep inguinal ring
  - Exits the inguinal canal through the superficial inguinal ring to insert onto the labia majora to maintain the anteverted position
- Ovarian ligament: attaches ovaries to the uterus
- Cardinal ligament: pair of ligaments located at the base of the broad ligament and attaches the cervix to the lateral pelvic wall
  - Contains uterine artery and vein
- Uterosacral ligament: extends from the cervix to the sacrum
- Pubocervical ligament: extends from posterior surface of pubic symphysis to the cervix
- Pubovesical ligament: extends from the neck of the bladder to the pubic symphysis

D. Positions of the Uterus
- Can be in various anatomical positions and is described using the following:
  - Anteverted: rotated forward, towards the anterior surface of the body
  - Anteflexed: flexed, towards the anterior surface of the body
- Normally considered anteverted with respect to the vagina and anteflexed with respect to the cervix
- During pregnancy, uterus compresses the right ureter more than the left ureter because it receives cushion from the rectum on the left

E. Neurovascular Supply
- Blood supply is via uterine artery
- Venous drainage is through a venous plexus within the broad ligament and drains into the uterine veins
- Lymph drains to the iliac, sacral, aortic and inguinal lymph nodes
- Sympathetic nerve fibers originate in the uterovaginal plexus within the inferior hypogastric plexus
- Parasympathetic nerve fibers derive from the pelvic splanchnic nerves (S2-S4)

F. Clinical Pearls
- Endometriosis: presence of endometrial glands and stroma outside the uterine endometrium
  - Believed to be caused by retrograde menstruation products with implantation at an ectopic site
  - Undergoes menstrual cycles just like normal endometrium
  - Presents as painful menstrual bleeding and pelvic pain
  - Ectopic sites
    - Ovary, chocolate cyst: abdominal/pelvic pain
    - Fallopian tubes: increased risk of infertility, ectopic pregnancy
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- Uterine ligaments: pelvic pain
- Pouch of Douglas: pain with defecation
- Bladder wall: pain with urination
- Bowel: adhesions and abdominal pain

- Endometrial Carcinoma: malignant proliferation of endometrial epithelium that commonly presents as post-menopausal bleeding
- Uterine Prolapse: pelvic floor muscles and/or uterine ligaments stretch and weaken resulting in the uterus sliding into or even out of the vagina
  - Uterosacral ligaments are most important in preventing prolapse
  - Most common cause is trauma during childbirth
  - Conservative treatment: Kegel exercises to strengthen pelvic floor muscles
  - Surgical treatment: hysterectomy, hysteropexy
- Pregnant patients have increased risk for thromboembolisms because of two reasons:
  - Increased production of clotting factors – hypercoagulable state
  - Compression of the IVC by the pregnant uterus causing venous stasis
- Hysterectomy: surgical removal of uterus
  - Indications: chronic pelvic pain, persistent vaginal bleeding, gynecological cancers, intractable endometriosis, removal of post-partum tissue
  - Ligation of uterine artery – surgeon must ensure protection of ureter
- Uterine Fibroids: firm benign tumors comprised of fibrous connective tissue and smooth muscle cells
  - Present with heavy or prolonged menstrual periods, abnormal vaginal bleeding and pelvic pain
  - Symptoms dependent on compression of adjacent structures in the pelvis:
    - Increased urinary frequency and/or incontinence due to bladder compression
    - Constipation due to compression of the rectum
    - Back pain due compression of lumbar nerves
- Cervical Intraepithelial Neoplasia: abnormal growth of cervical epithelium that is a potentially pre-malignant transformation
  - Caused by Human Papilloma Virus (HPV)
- Cervical Carcinoma: invasive carcinoma that arises due to progression of cervical intraepithelial neoplasia
  - Presentation: vaginal bleeding, especially after intercourse and cervical discharge
  - Risk factors: HPV infection, smoking and risky sexual behavior
  - Common cause of death: advanced tumor invades through uterine wall and into ureters causing backflow, hydronephrosis and subsequent renal failure
  - Pap Smear: screening test done in clinic that involves collecting cells from the transformation zone and examined under the microscope for signs of pre-cancerous changes
  - Goal is to catch cervical intraepithelial neoplasia before it develops into cervical carcinoma

V. Vagina

A. Structure
   - Muscular tube extending approximately 10cm from the cervix to the external genitalia
   - Receives the penis during intercourse and assists sperm transport to the uterus
   - Serves as the birth canal for a newborn during delivery
   - Passageway for menstrual fluid and tissue to leave the body
   - Superiorly forms four recesses with the vaginal portion of the cervix:
     - Posterior Fornix: posterior to cervix, adjacent to recto-uterine pouch
     - Anterior Fornix: anterior to cervix, adjacent to vesico-uterine pouch
     - Two lateral fornices

B. Neurovascular Supply
   - Blood supply is provided by the vaginal and uterine arteries
   - Venous drainage via vaginal venous plexus draining into the uterine vein and lastly into the internal iliac veins
   - Lymph drains into the iliac and superficial inguinal lymph nodes
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- Superior part receives innervation from sympathetic and parasympathetic fibers from the inferior hypogastric plexus and pelvic splanchnic nerves
- Inferior part receives somatic innervation from the deep perineal nerve, a branch of the pudendal nerve

C. Clinical Pearls

- Vaginal Carcinoma: arises from squamous epithelial lining and usually related to HPV
  - Spread from lower ⅓ goes to inguinal nodes
  - Spread from upper ⅔ goes to regional iliac nodes
- Vaginal Fistula: open communication between vagina and an adjacent organ:
  - Most often caused by prolonged child labor because baby presses against vaginal wall
  - Limits blood supply → results in necrosis and a weak wall
  - Vesicovaginal Fistula: vagina and bladder, urine can flow into vagina
  - Rectovaginal Fistula: vagina and rectum, stool can flow into vagina
  - Urethrovaginal: vagina and urethra, urine only enters vagina during urination
- Culdocentesis: insertion of a needle through the posterior fornix of the vagina between the uterosacral ligaments to aspirate fluid collected in the rectouterine pouch