# Reproductive anatomy

## Part 2: Internal generative organs

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OBSTETRICS AND GYNECOLOGY
REPRODUCTIVE ENDOCRINOLOGY AND INFERTILITY

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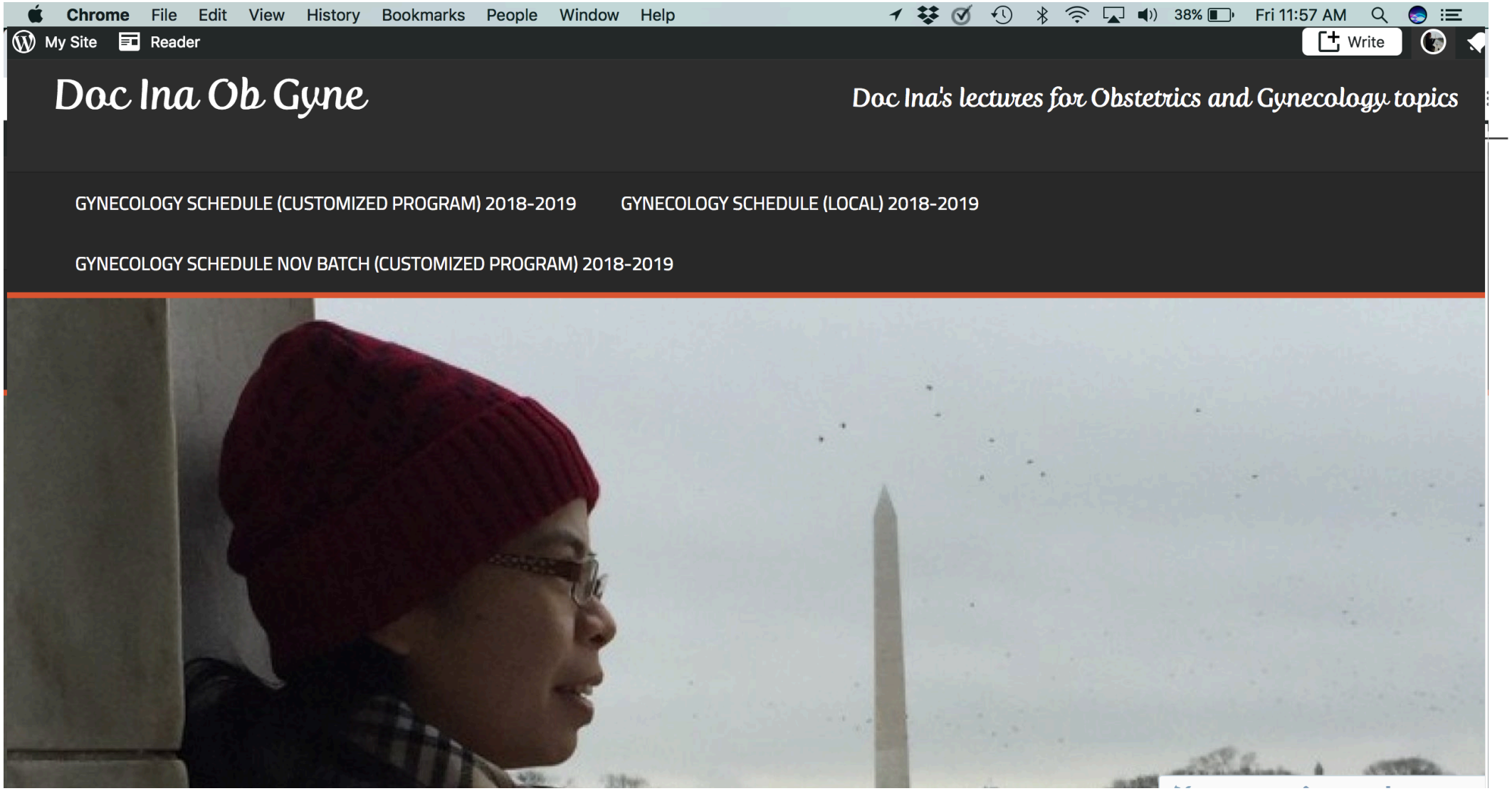
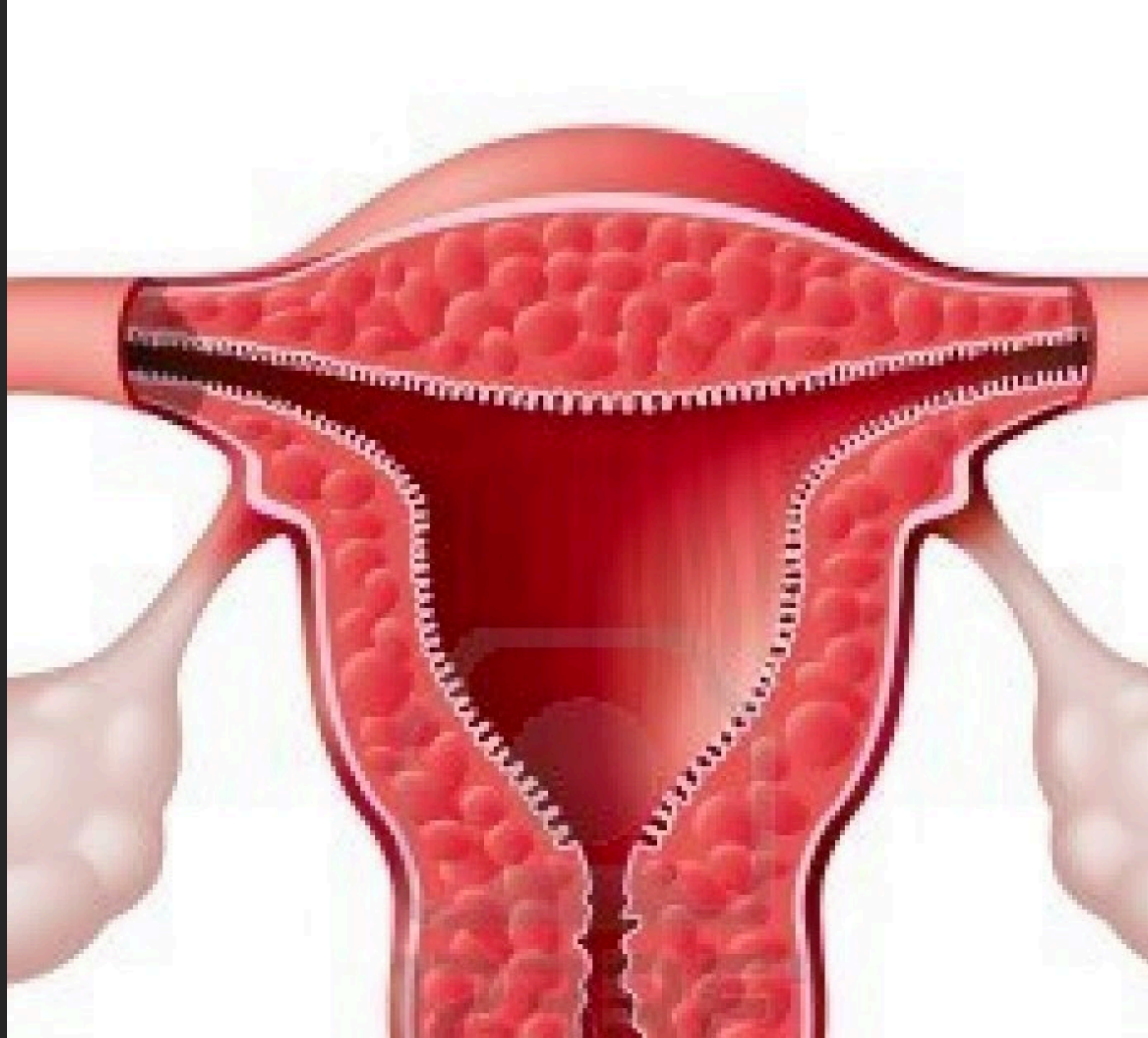


# Reference

Comprehensive Gynecology 7th edition, 2017 (Lobo RA, Gershenson DM, Lentz GM, Valea FA *editors)* chapter 3, Reproductive anatomy

# Outline

1. Cervix
2. Uterus
3. Oviducts
4. Ovaries
5. Vascular system



# 1. Cervix

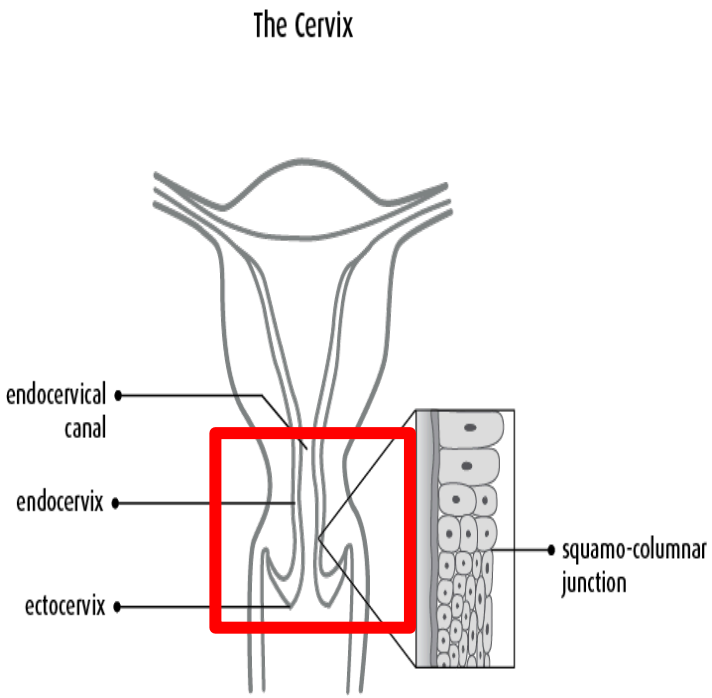
The lower, narrow portion of the uterus is the cervix.

The word *cervix* originates from the Latin word for *neck*. The Greek word for *neck* is *trachelos (*when the cervix is removed, the surgical procedure is termed *trachelectomy)*

mostly fibrous tissue (in contrast to the mostly muscular corpus of the uterus.)

The vagina is attached obliquely around the middle of the cervix → this divides the cervix into an upper, supravaginal portion and a lower segment in the vagina called the *portio vaginalis*

The supravaginal segment is covered by peritoneum posteriorly and is surrounded by loose, fatty connective tissue—the parametrium—anteriorly and laterally.



# 1. Cervix

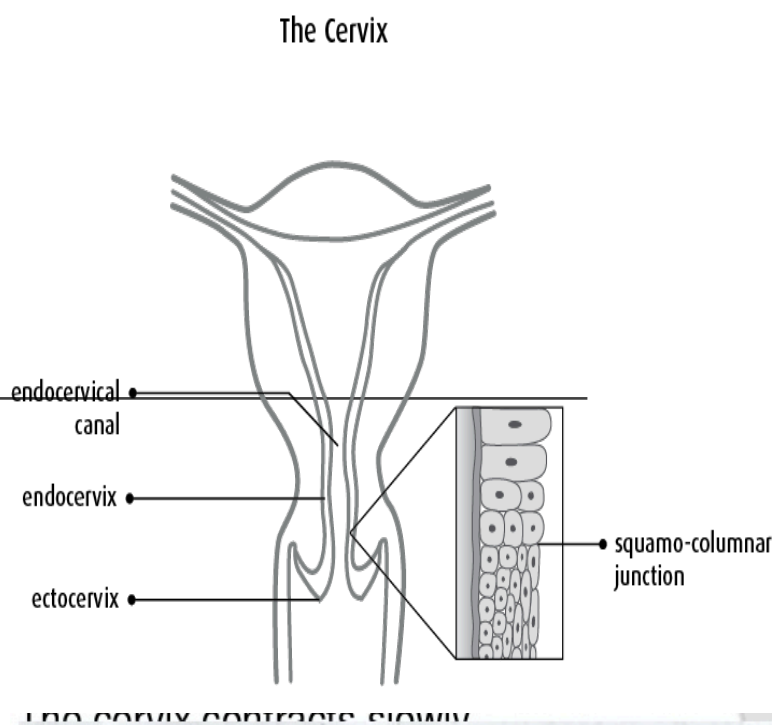
The canal of the cervix is fusiform, with the widest diameter in the middle.

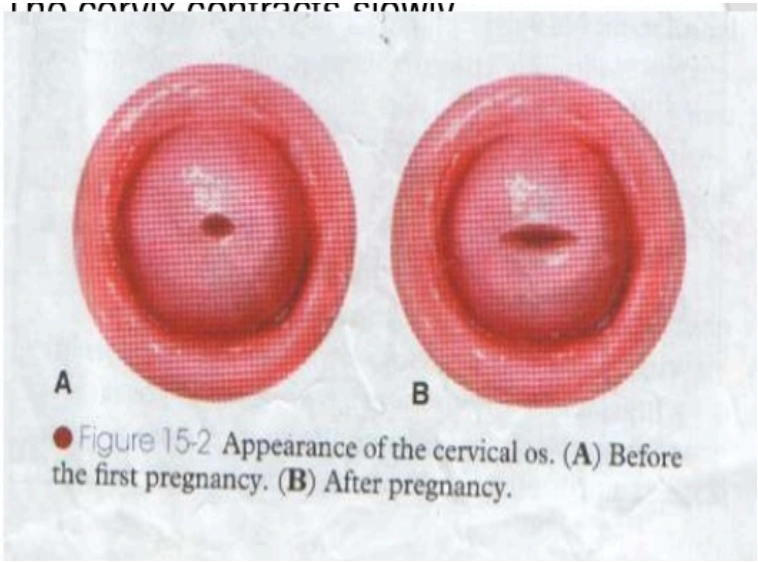
The width of the canal varies with the parity of the woman and changing hormonal levels.

The cervical length increases in pregnancy, with maximal length in the second trimester.

The cervical canal opens into the vagina at the external os of the cervix. In the majority of women, the external os is in contact with the posterior vaginal wall.

The external os is small and round in nulliparous women. The os is wider and gaping following vaginal delivery.



# 1. Cervix

The mucous lining of the endocervical canal of nulliparous women is arranged in longitudinal folds, called *plicae palmatae*, with secondary branching folds, the *arbor vitae*. These folds, which form a herringbone pattern, disappear following vaginal delivery.

A single layer of columnar epithelium lines the endocervical canal and the underlying glandular structures.

This specialized epithelium secretes mucus, which facilitates sperm transport

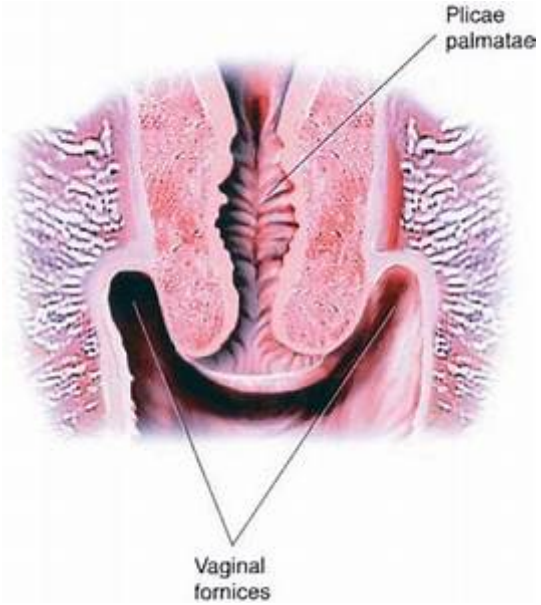



Photo from: http://gineendoscopia.blogspot.com/2008/03/anatomia-del-utero.html

# 1. Cervix

An abrupt transformation usually is seen at the junction of the columnar epithelium of the endocervix and the nonkeratinized stratified squamous epithelium of the portio vaginalis.

The dense, fibromuscular cervical stroma is composed primarily of collagenous connective tissue and mucopolysaccharide ground substance.

The collagen framework and ground substance are sensitive to hormonal effects.

The connective tissue contains approximately 15% smooth muscle cells and a small amount of elastic tissue.

# 1. Cervix

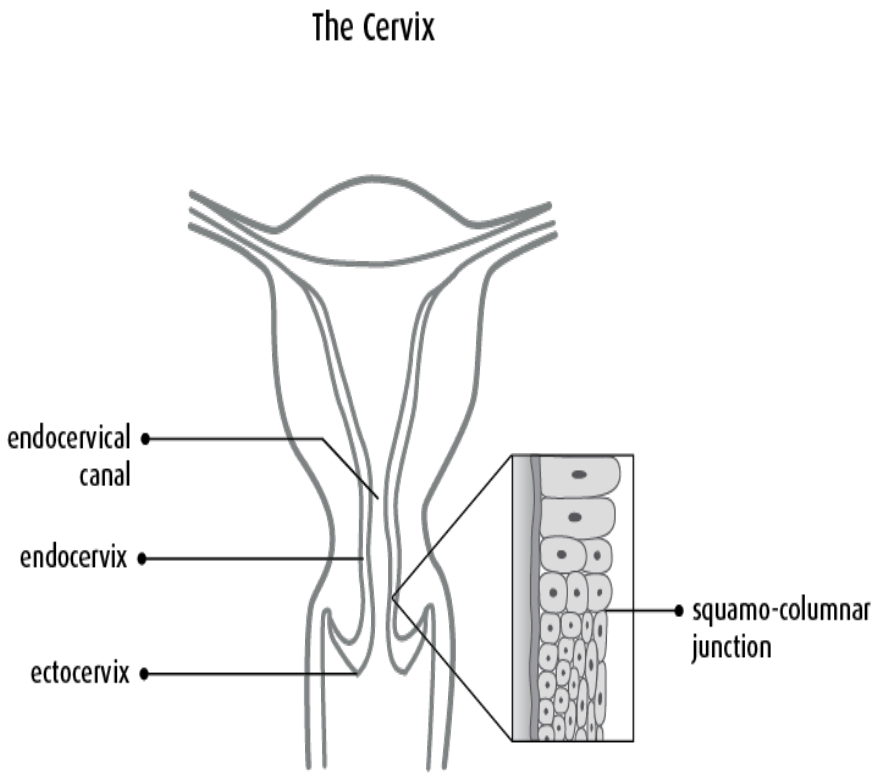
the cervical and uterine vascular supplies are interrelated.

The arterial supply of the cervix arises from the descending branch of the uterine artery.

The cervical arteries run on the lateral side of the cervix and form the coronary artery, which encircles the cervix.

The azygos arteries run longitudinally in the middle of the anterior and posterior aspects of the cervix and the vagina. There are numerous anastomoses between these vessels and the vaginal and middle hemorrhoidal arteries.

The venous drainage accompanies these arteries.



# 1. Cervix

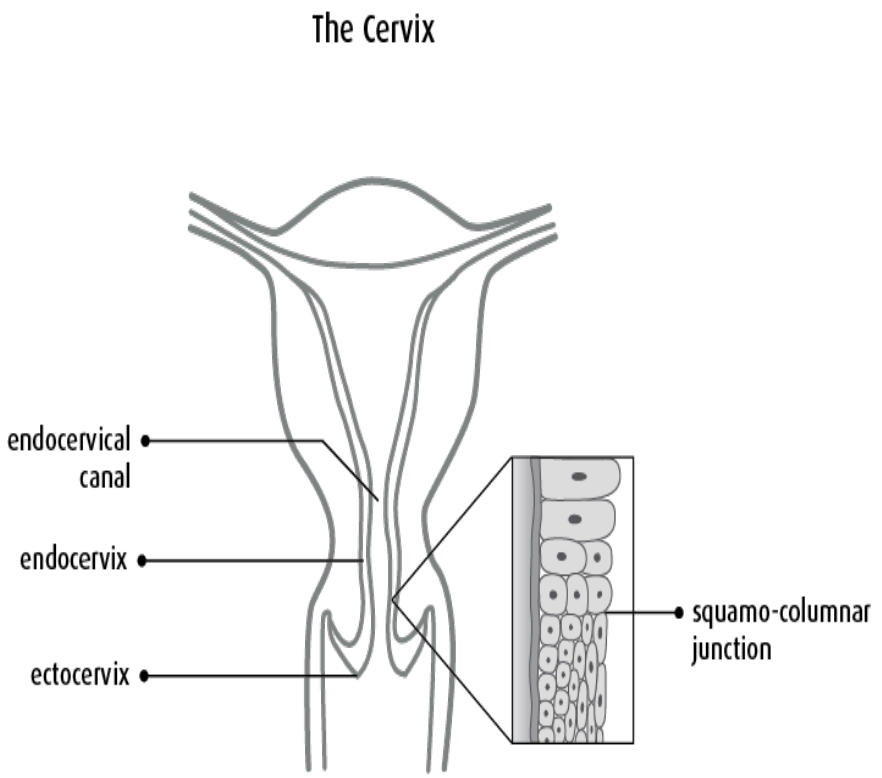
The lymphatic drainage of the cervix is complex, involving multiple chains of nodes.

The principal regional lymph nodes are the obturator, common iliac, internal iliac, external iliac, and visceral nodes of the parametria.

Other possible lymphatic drainage includes the following chains of nodes: superior and inferior gluteal, sacral, rectal, lumbar, aortic, and visceral nodes over the posterior surface of the urinary bladder.

The stroma of the endocervix is rich in free nerve endings.

Pain fibers accompany the parasympathetic fibers to the second, third, and fourth sacral segments.



# 2. Uterus

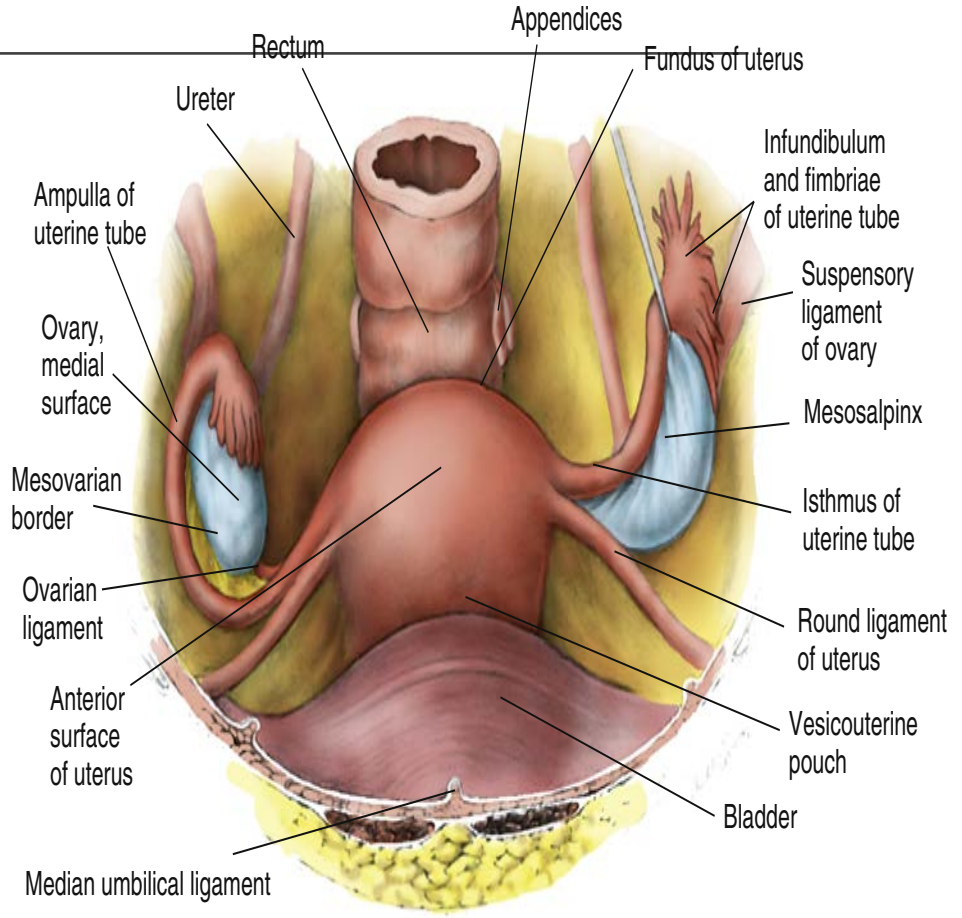
The uterus is a thick-walled, hollow, muscular organ located centrally in the female pelvis.

Adjacent to the uterus are the urinary bladder anteriorly, the rectum posteriorly, and the broad ligaments laterally

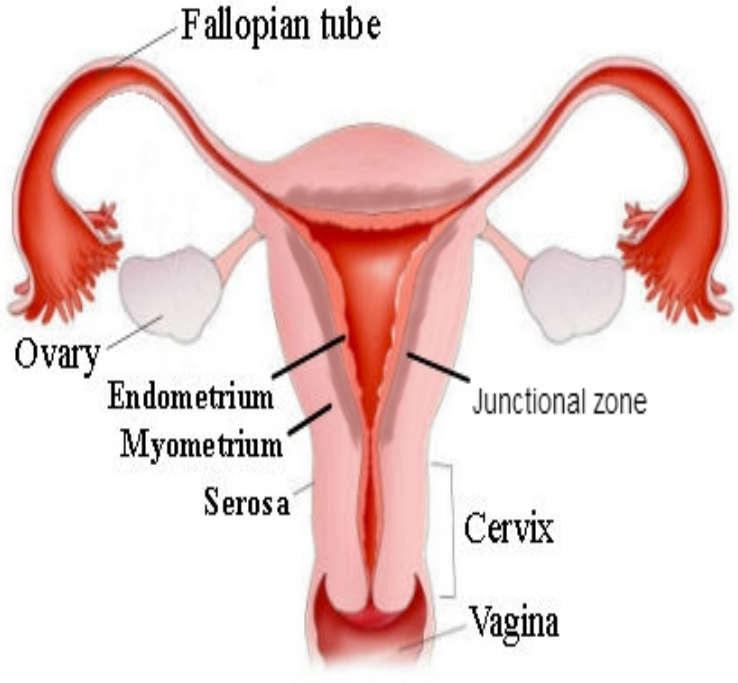
it has the general configuration of an inverted pear.

The short area of constriction in the lower uterine segment is termed the *isthmus*

The dome- shaped top of the uterus is termed the *fundus.*



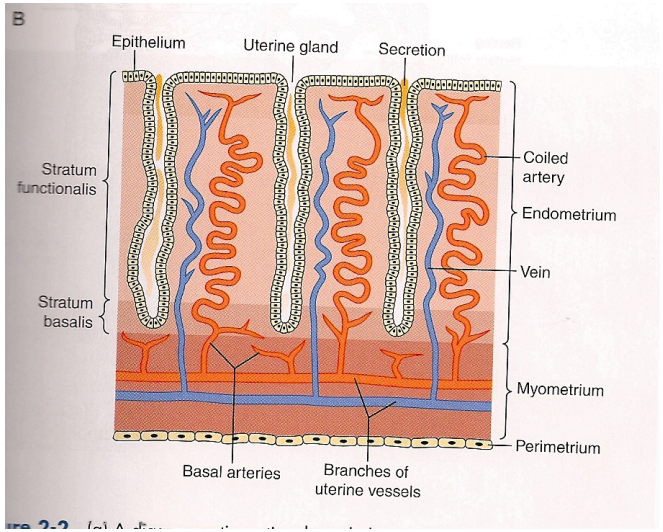
# 2. Uterus



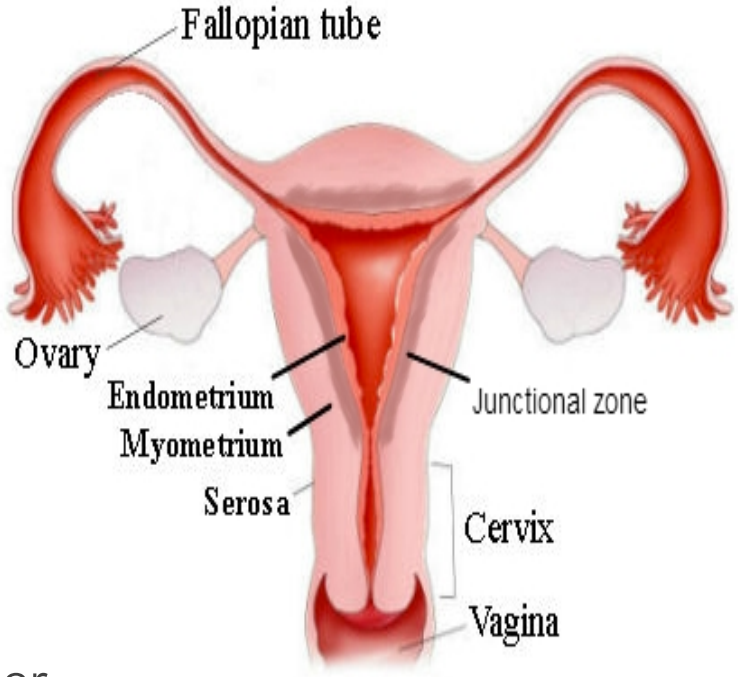

The oviducts enter the uterine cavity at the cornua.

The uterus has three layers:

1. The thin, external serosal layer makes up the visceral peritoneum.
2. The muscular layer (myometrium) is composed of 3 indistinct layers of smooth muscle. The outer longitudinal layer is contiguous with the muscle layers of the oviduct and vagina. The middle layer has interlacing oblique, spiral bundles of smooth muscle and large venous plexuses. The inner muscular layer is also longitudinal.

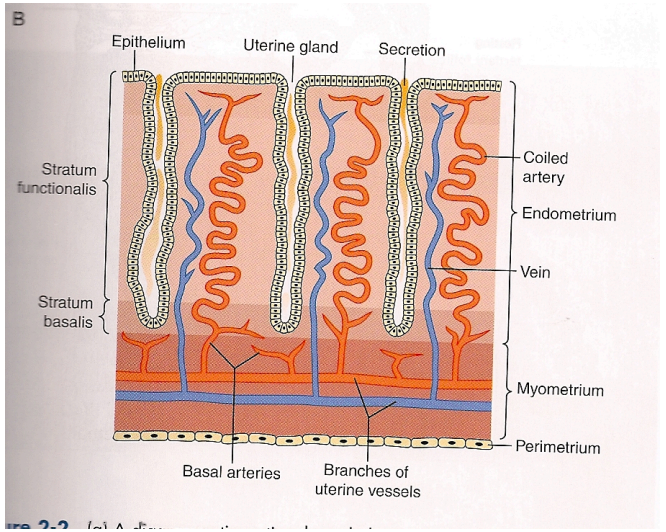


# 2. Uterus




3. The endometrium is a reddish mucous membrane that varies in thickness, depending on hormonal stimulation.

- The endometrium is divided into an inner stratum basale and an outer stratum functionale.
- The stratum functionale is subdivided into an inner compact stratum and a more superficial spongy stratum.
- Only the stratum functionale responds to fluctuating hormonal levels.



# 2. Uterus

The uterine and ovarian arteries provide the arterial blood supply of the uterus.

- The uterine arteries are large branches of the hypogastric arteries
- ovarian arteries originate directly from the aorta.

The veins of the pelvic organs accompany the arteries. Therefore venous drainage from the fundus goes to the ovarian veins and blood from the corpus exits via the uterine veins into the iliac veins.

# 2. Uterus

The lymphatics from the fundus and the body of the uterus go to the aortic, lumbar, or pelvic nodes surrounding the iliac vessels, especially the internal iliac nodes.

- the lymphatic drainage of the uterus is not that different from the lymphatic drainage of the cervix.

In contrast to other pelvic organs, the afferent sensory nerve fibers from the uterus are in close proximity to the sympathetic nerves.

# 2. Uterus

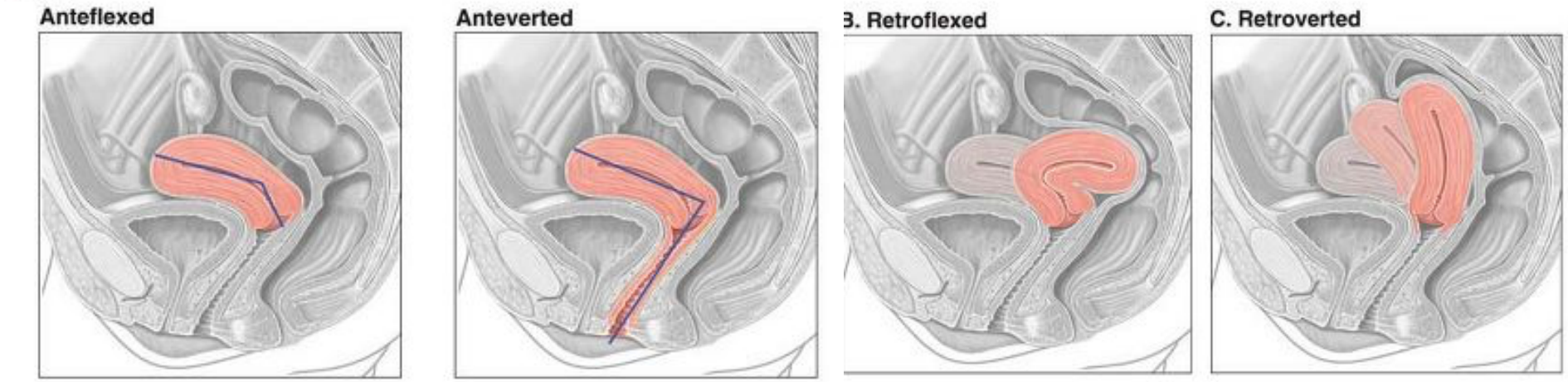
Afferent nerve fibers from the uterus enter the spinal cord at the eleventh and twelfth thoracic segments.

The sympathetic nerve supply to the uterus comes from the hypogastric and ovarian plexus.

The parasympathetic fibers are largely derived from the pelvic nerve and from the second, third, and fourth sacral segments.

# 2. Uterus

In some women the uterus is anteflexed or anteverted, whereas in others the uterus is retroflexed or retroverted.



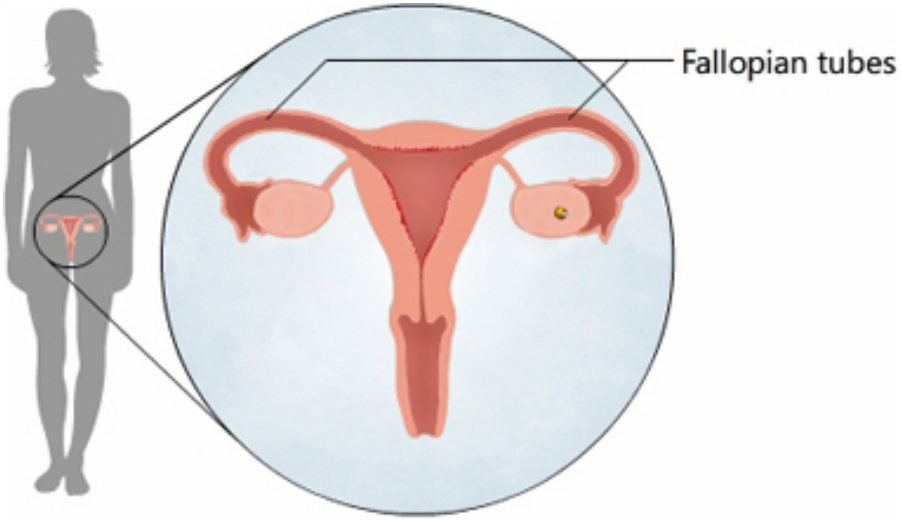
# 3.Oviducts (fallopian tubes)

The paired uterine tubes extend outward from the superolateral portion of the uterus and end by curling around the ovary.

The oviducts are also referred to using the prefix *salpingo-*, from the Greek *salpinx*, meaning a tube.

The tubes are contained in a free edge of the superior portion of the broad ligament. The mesentery of the tubes, the mesosalpinx, contains the blood supply and nerves.

The uterine tubes connect the cornua of the uterine cavity and the peritoneal cavity. The ostia into the endometrial cavity are 1.5 mm in diameter, whereas the ostia into the abdominal cavity are approximately 3 mm in diameter.

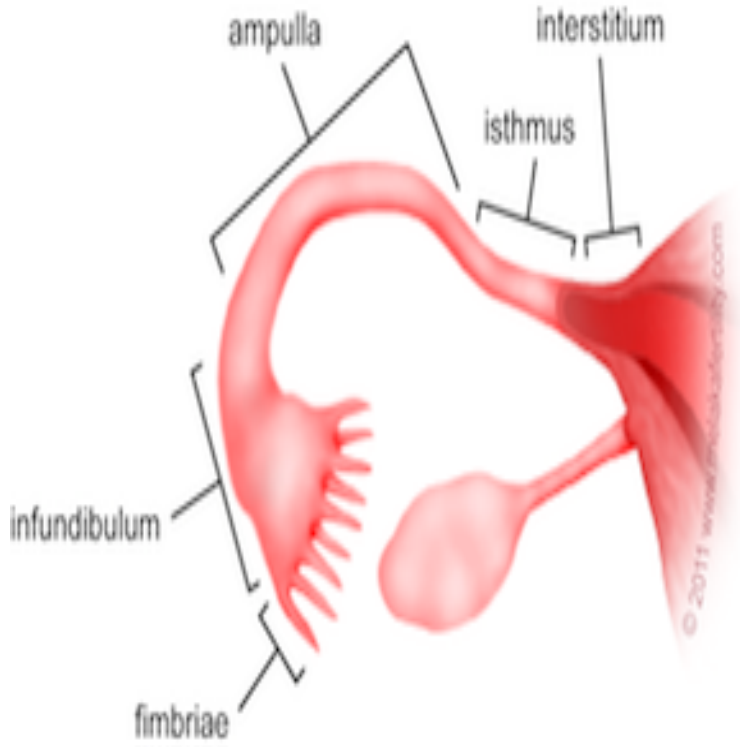



www.menstrupedia.com

# 3. Oviducts (fallopian tubes)

Each tube is divided into four anatomic sections.

- The uterine intramural, or interstitial, segment is 1 to 2 cm in length and is surrounded by myometrium.
- The isthmic segment begins as the tube exits the uterus and is approximately 4 cm in length. This segment is narrow, 1 to 2 mm in inside diameter, and straight; has the most highly developed musculature.
- The ampullary segment is 4 to 6 cm in length and approximately 6 mm in inside diameter. It is wider and more tortuous in its course than other segments. Fertilization normally occurs in the ampullary portion of the tube.
- The infundibulum is the distal trumpet-shaped portion of the oviduct. From 20 to 25 irregular finger-like projections, termed *fimbriae,* surround the abdominal ostia of the tube. One of the largest fimbriae is attached to the ovary, the fimbria ovarica.



# 3.Oviducts (fallopian tubes)

The tube contains numerous longitudinal folds, called *plicae,* of mucosa and underlying stroma.

Plicae are most prominent in the ampullary segment

The mucosa of the oviduct has three different cell types.

- Columnar ciliated epithelial cells are most prominent near the ovarian end of the tube and overall compose 25% of the mucosal cells
- Secretory cells, also columnar in shape, compose 60% of the epithelial lining and are more prominent in the isthmic segment.
- Narrow peg cells are found between secretory and ciliated cells and are believed to be a morphologic variant of secretory cells.
- The smooth muscle of the tube is arranged into inner circular and outer longitudinal layers.
- Between the peritoneal surface of the tube and the muscular layer is an adventitial layer that contains blood vessels and nerves.

# 3.Oviducts (fallopian tubes)

The arterial blood supply to the oviducts is derived from terminal branches of the uterine and ovarian arteries.

The arteries anastomose in the mesosalpinx.

Blood from the uterine artery supplies the medial two thirds of each tube.

The venous drainage runs parallel to the arterial supply.

The lymphatic system is separate and distinct from the lymphatic drainage of the uterus. Lymphatic drainage includes the internal iliac nodes and the aortic nodes surrounding the aorta and the inferior vena cava at the level of the renal vessels.

The tubes are innervated by both sympathetic and parasympathetic nerves from the uterine and ovarian plexuses. Sensory nerves are related to spinal cord segments T11, T12, and L1.

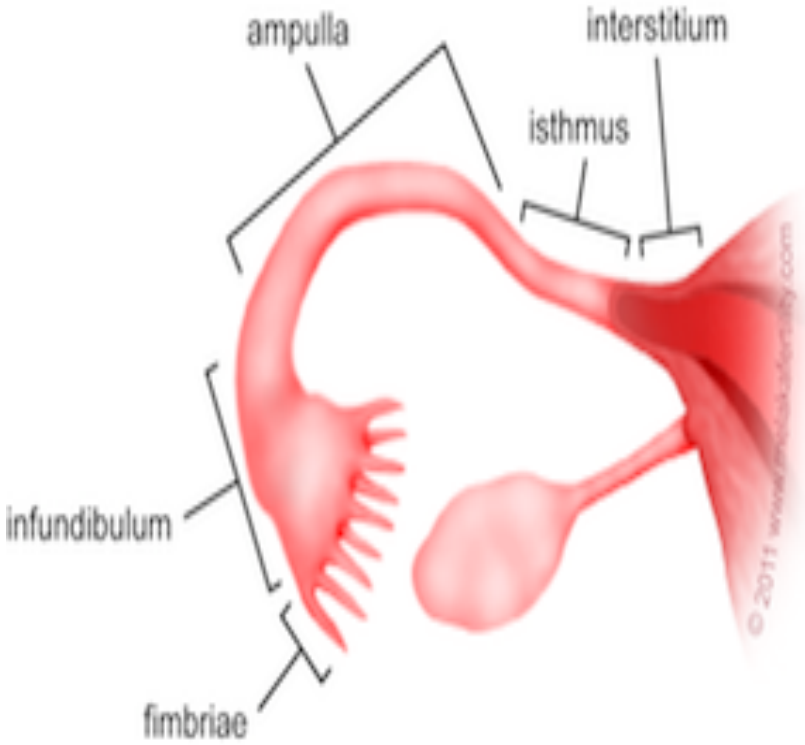
# 3.Oviducts (fallopian tubes)

The majority of ectopic pregnancies occur in the oviduct. The acute abdominal and pelvic pain that women with an ectopic pregnancy experience is believed to be caused by hemorrhage.

The most catastrophic bleeding associated with ectopic pregnancy occurs when the implantation site is in the intramural segment of the tube.

The isthmic segment of the oviduct is the preferred site to apply an occlusive device, such as a clip, for female sterilization.

The right oviduct and appendix are often adjacent. Clinically it may be difficult to differentiate inflammation of the tube from acute appendicitis.

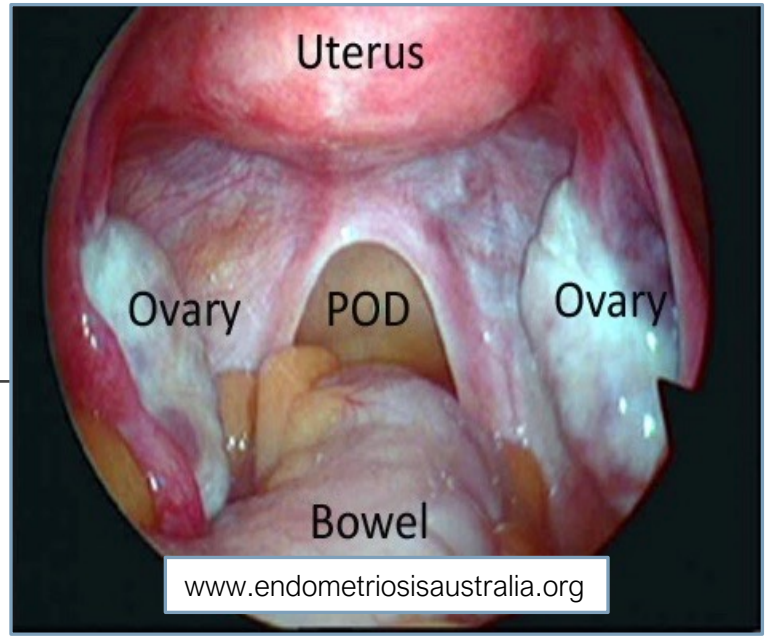


# 4. Ovaries

The paired ovaries are light gray, and each one is approximately the size and configuration of a large almond.

The surface of the ovary of adult women is pitted and indented from previous ovulations.

The ovaries contain approximately 1 to 2 million oocytes at birth. During a woman's reproductive lifetime, about 8000 follicles begin development. however, approximately only 300 ova eventually are released.



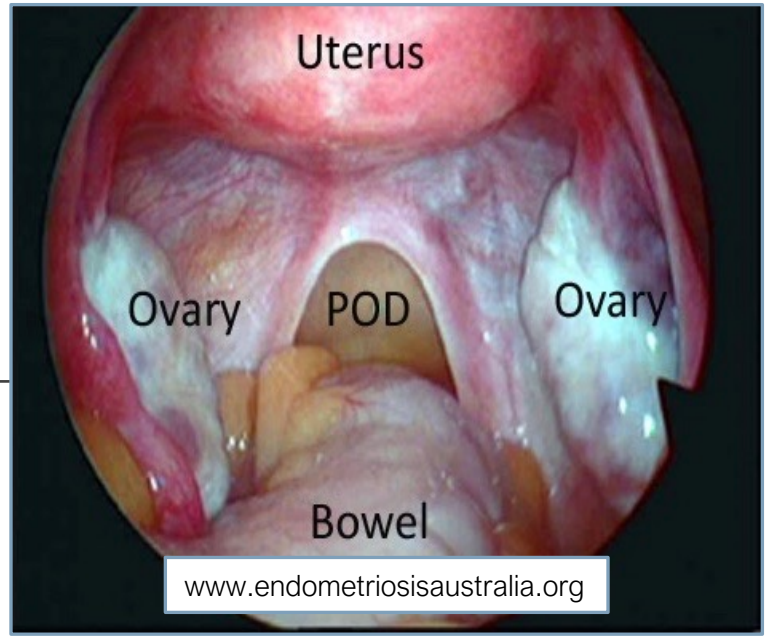

https://www.std-gov.org/blog/ovary-pain/

# 4. Ovaries

As a woman ages, the ovaries become smaller and firmer in consistency.

The long axis of the ovary is vertical in a nulliparous woman who is standing, and the ovary rests in a depression of peritoneum named the ovarian fossa.

Immediately adjacent to the ovarian fossa are the external iliac vessels, the ureter, and the obturator vessels and nerves.




https://www.std-gov.org/blog/ovary-pain/

# 4. Ovaries

Three prominent ligaments determine the anatomic mobility of the ovary:

1. The posterior portion of the broad ligament forms the mesovarium, which attaches to the anterior border of the ovary. The mesovarium contains the arterial anastomotic branches of the ovarian and uterine arteries, a plexus of veins, and the lateral end of the ovarian ligament.
2. The ovarian ligament is a narrow, short, fibrous band that extends from the lower pole of the ovary to the uterus.
3. The infundibulopelvic ligament, or suspensory ligament of the ovary, forms the superior and lateral aspect of the broad ligament. This ligament contains the ovarian artery, ovarian veins, and accompanying nerves. It attaches the upper pole of the ovary to the lateral pelvic wall.

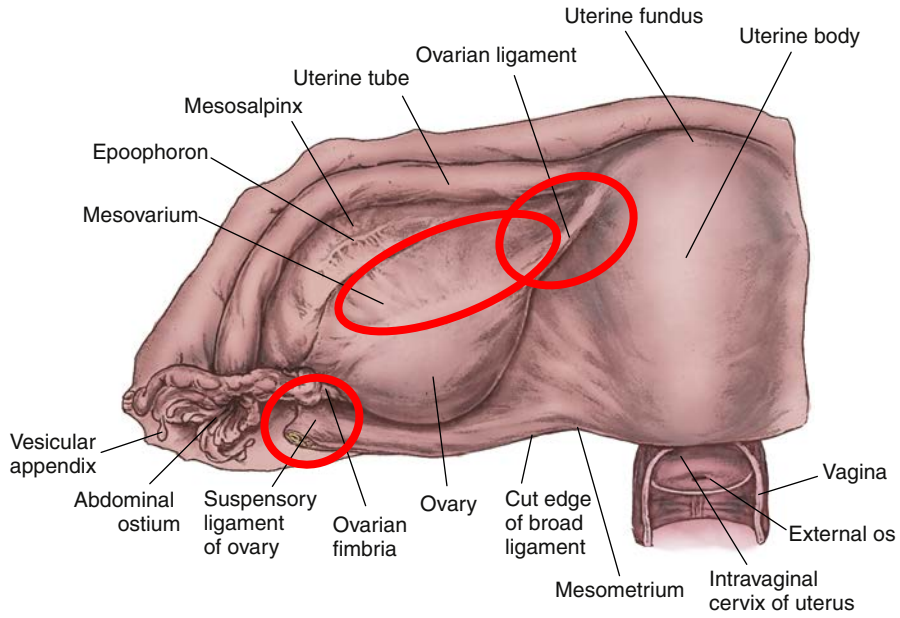



**Figure 3.21** The posterior aspect of the broad ligament—spread out to demonstrate the ovary. (From Standring S, ed. *Gray's Anatomy.* 39th ed. Edinburgh: Churchill Livingstone; 2005:1322.)

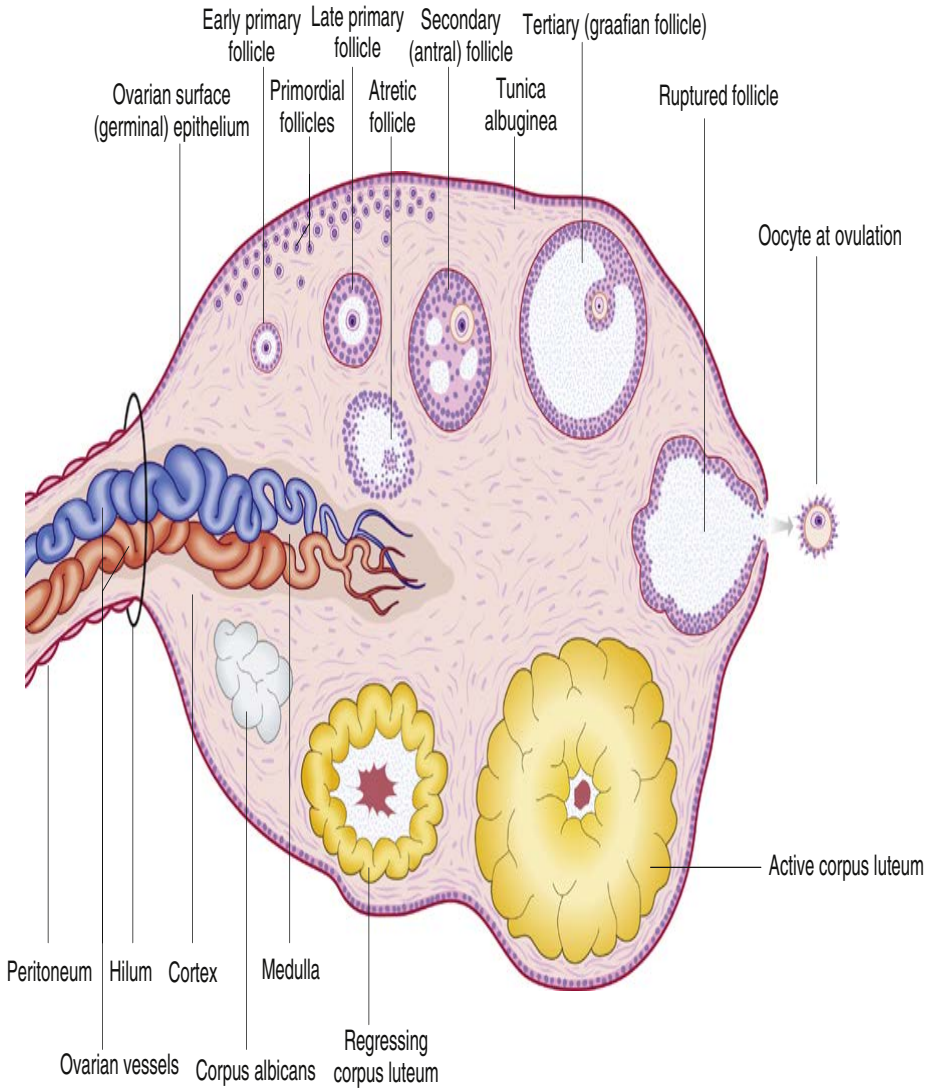



**Figure 3.22** A schematic drawing of the ovary. Note the single layer of cuboidal epithelium called the *germinal epithelium*. Note the graafian follicles in different stages of development. (From Standring S, ed. *Gray's Anatomy*. 39th ed. Edinburgh: Churchill Livingstone; 2005:1324.)

# 4. Ovaries

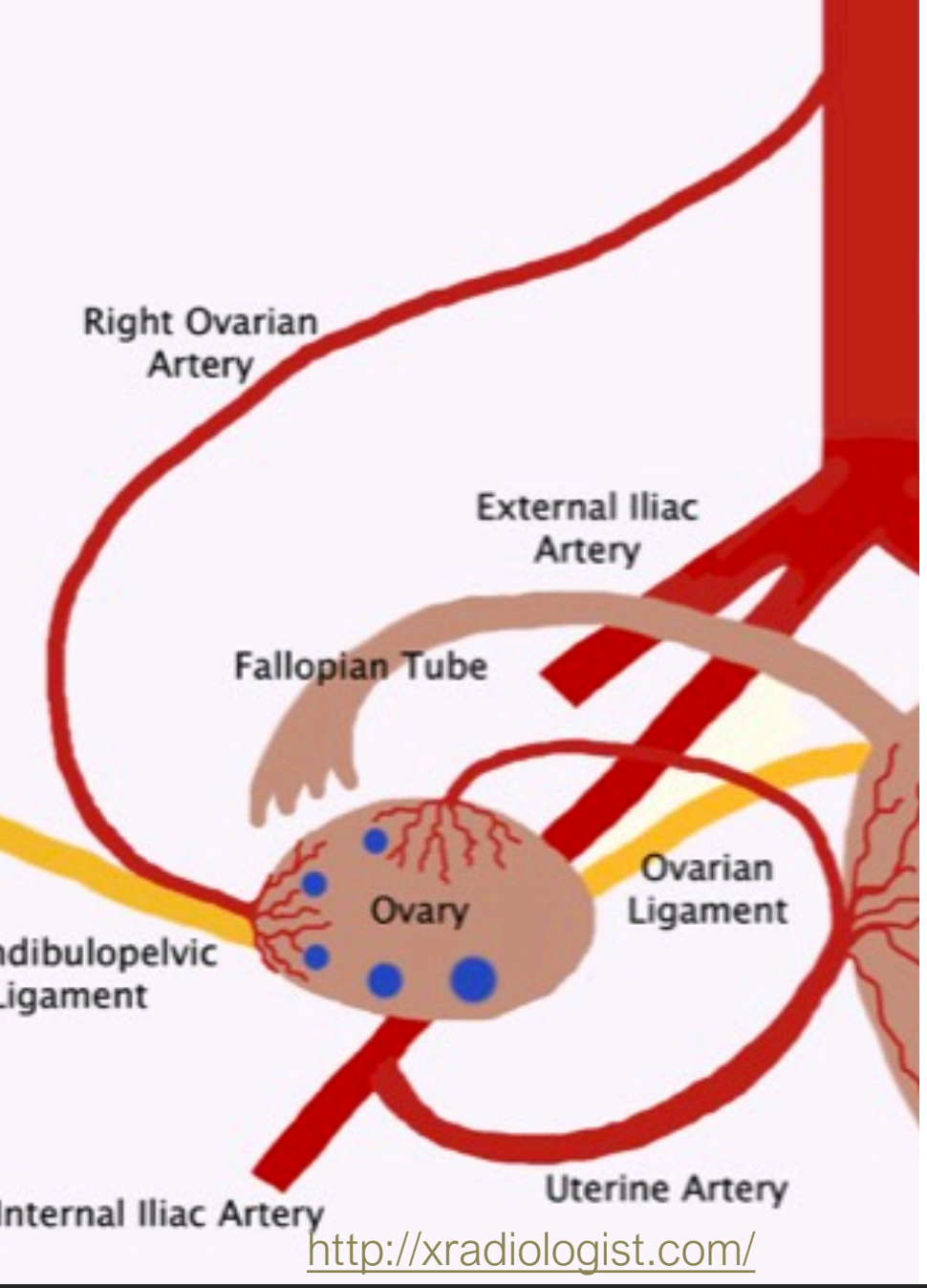
The ovary is subdivided histologically into an outer cortex and an inner medulla;

The ovarian surface is covered by a single layer of cuboidal epithelium, (*germinal epithelium).*

If the ovary is transected, numerous transparent, fluid-filled cysts are noted throughout the cortex. Microscopically these are graafian follicles in various stages of development, active or regressing corpus luteum, and atretic follicles.

The stroma of the cortex is composed primarily of closely packed cells around the follicles. These specialized connective tissue cells form the theca.

The medulla contains the ovarian vascular supply and a loose stroma. The specialized polyhedral hilar cells are similar to the interstitial cells of the testis.

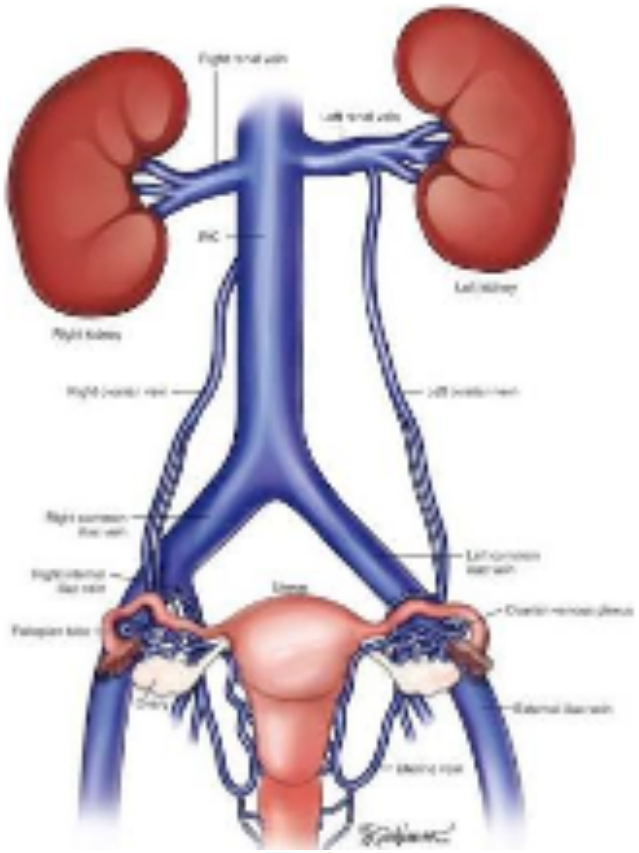



http://xradiologist.com/

# 4. Ovaries

Each of the ovarian arteries arises directly from the aorta just below the renal arteries. They descend in the retroperitoneal space, cross anterior to the psoas muscles and internal iliac vessels, and enter the infundibulopelvic ligaments, reaching the mesovarium in the broad ligament.

The ovarian blood supply enters through the hilum of the ovary.



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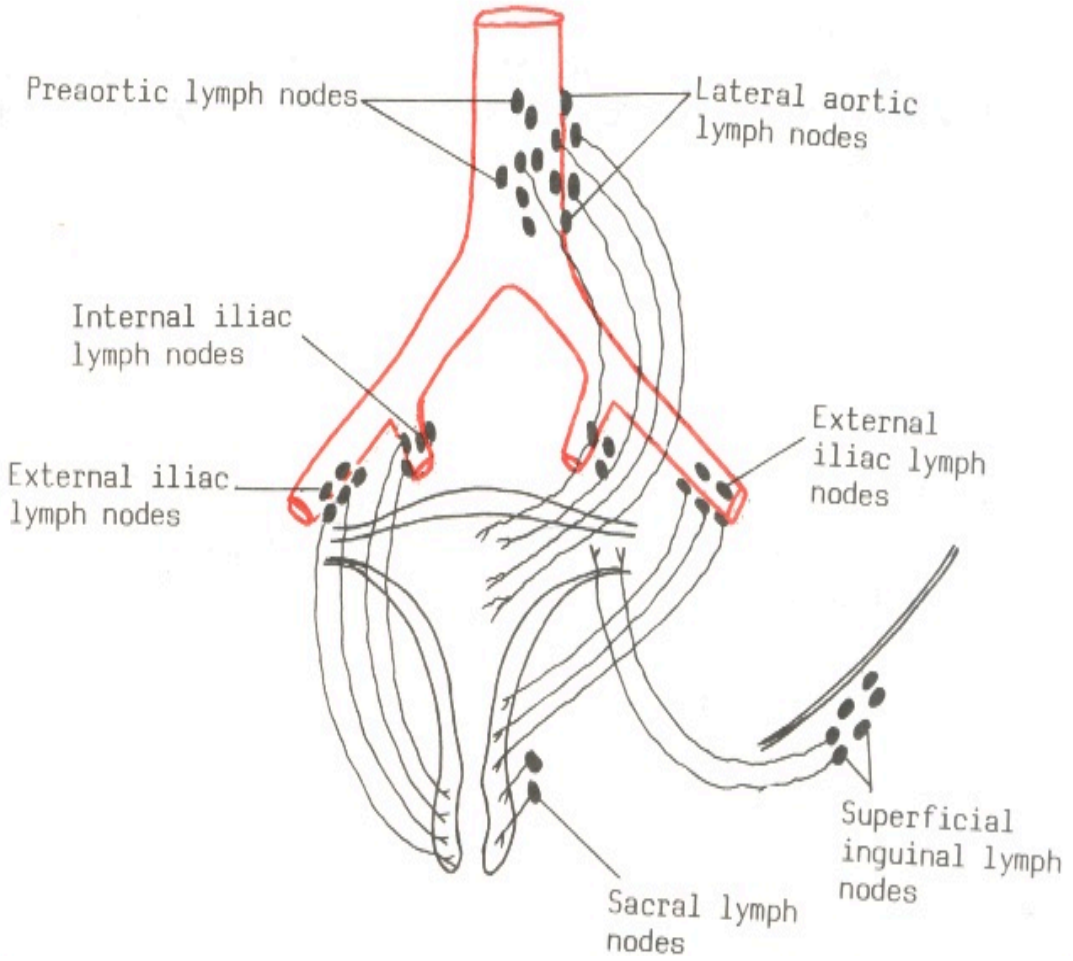
# 4. Ovaries

The venous drainage of the ovary collects in the pampiniform plexus and consolidates into several large veins as it leaves the hilum of the ovary.

The ovarian veins accompany the ovarian arteries, with the left ovarian vein draining into the left renal vein

The right ovarian vein connects directly with the inferior vena cava.

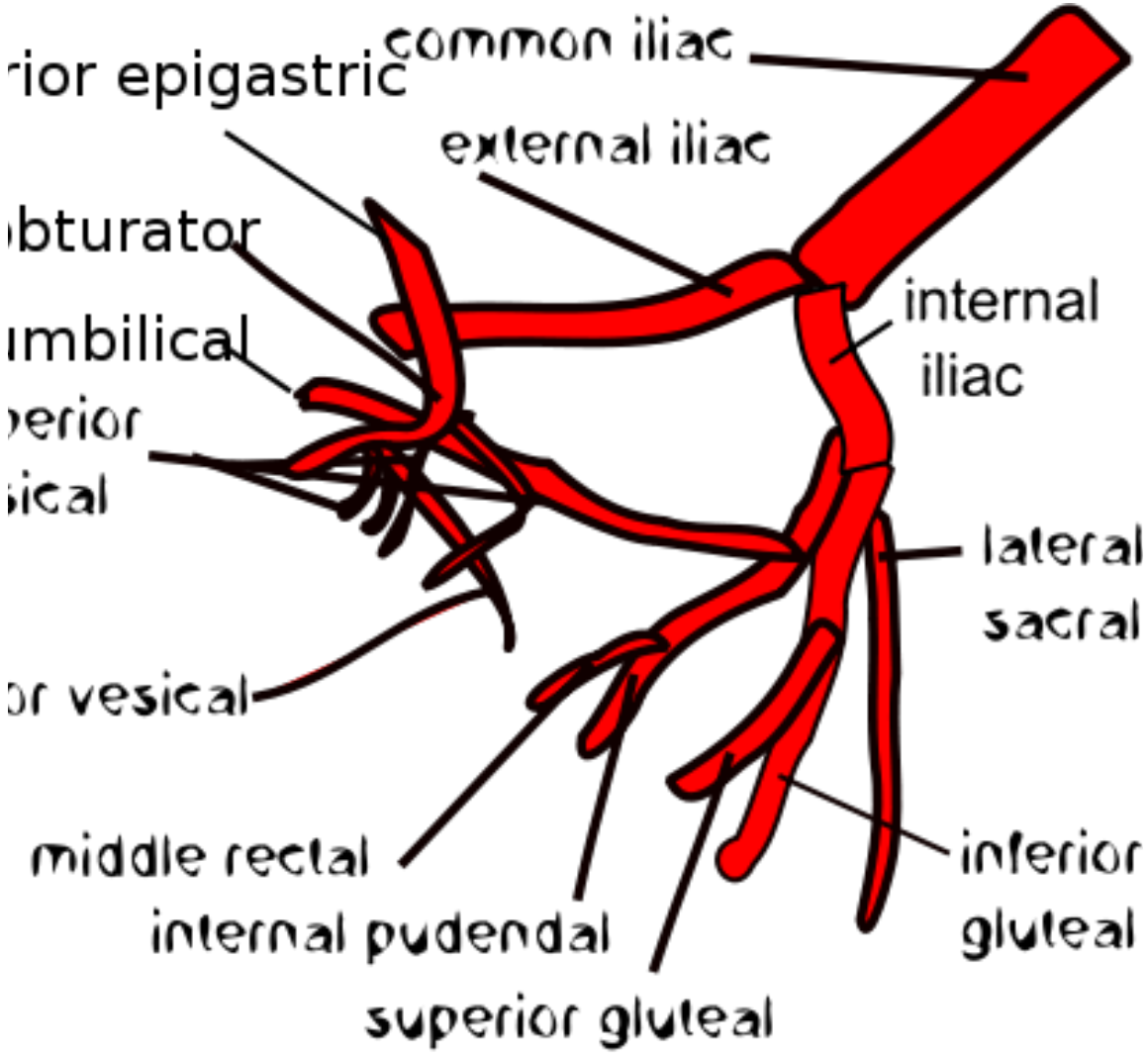



# 4. Ovaries

The lymphatic drainage of the ovaries is primarily to the aortic nodes adjacent to the great vessels at the level of the renal veins.

Metastatic disease from the ovary occasionally takes a shorter course to the iliac nodes.

The autonomic and sensory nerve fibers accompany the ovarian vasculature in the infundibulopelvic ligament. They connect with the ovarian, hypogastric, and aortic plexuses.




# Vascular system of the pelvis

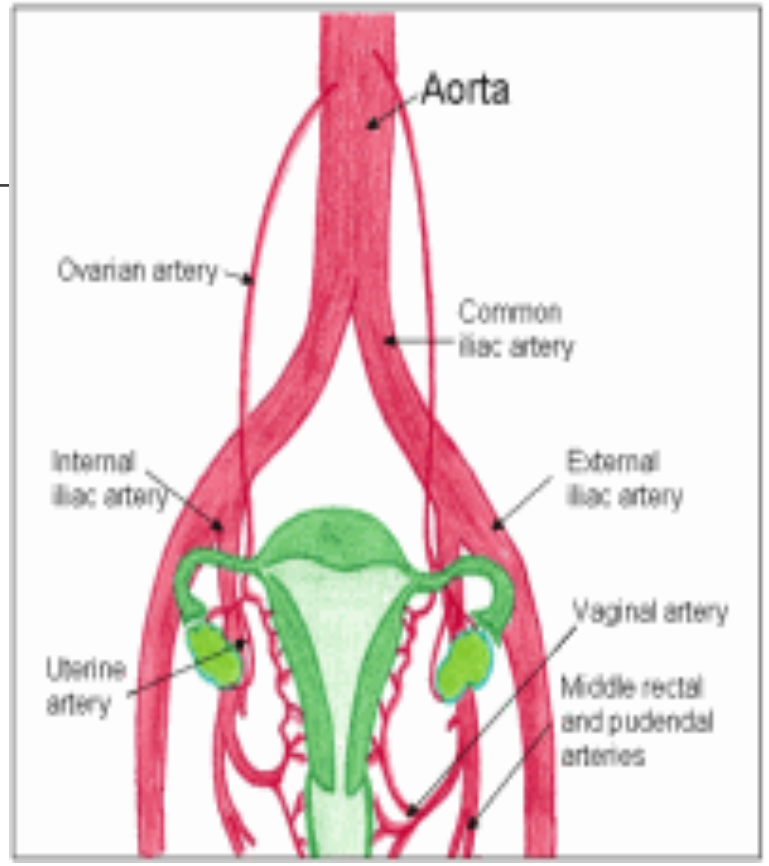
# *ARTERIES*

## *Ovarian Artery*

The ovarian arteries originate from the aorta just below the renal vessels. Each one courses in the retroperitoneal space, crosses anterior to the ureter, and enters the infundibulopelvic ligament. The ovarian artery unites with the ascending branch of the uterine artery in the mesovarium just under the suspensory ligament of the ovary.

## *Common Iliac Artery*

The bifurcation of the aorta occurs at the level of the fourth lumbar vertebra, forming the two common iliac arteries. Each common iliac artery is approximately 5 cm in length before the vessel divides into the external iliac and hypogastric arteries.




https://www.studyblue.com/notes/note/n/pelvic-vasculature deck/14835018

# *ARTERIES*

*Hypogastric Artery (Internal Iliac Artery)*

The hypogastric arteries are short vessels, approximately 3 to 4 cm in length. Throughout their course they are in close proximity to the ureters. Each hypogastric artery branches into an anterior and a posterior division (or trunk).

The posterior trunk gives off three parietal branches: the iliolumbar, lateral sacral, and superior gluteal arteries.

The anterior trunk has nine branches. The three parietal branches are the obturator, internal pudendal, and inferior gluteal arteries. The six visceral branches include the umbilical, middle vesical, inferior vesical, middle hemorrhoidal, uterine, and vaginal arteries.

The superior vesical artery usually arises from the umbilical artery.

# ARTERIES

*Uterine Artery*

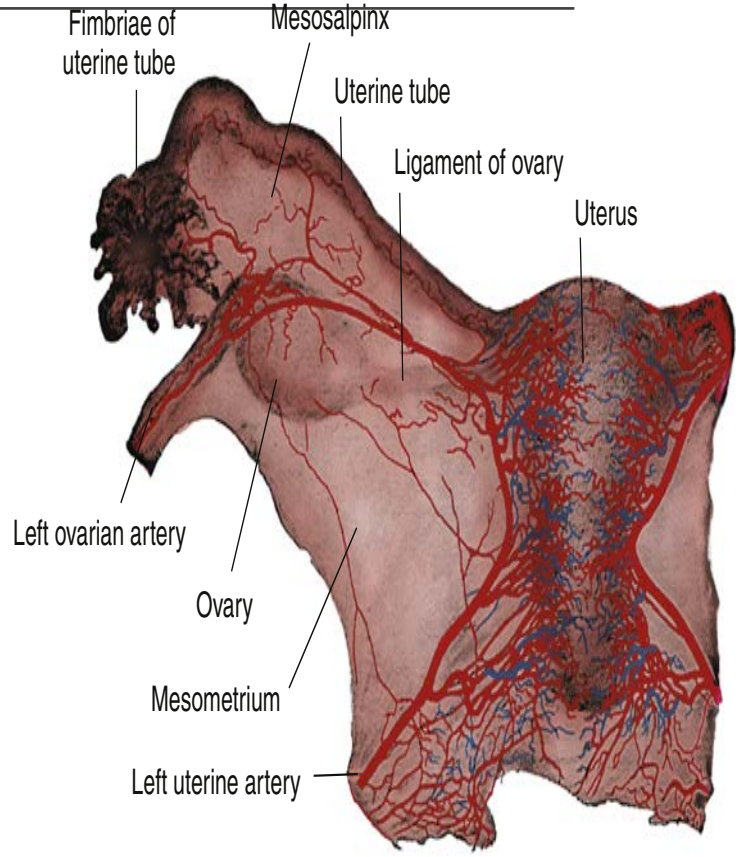
The uterine artery arises from the anterior division of the hypogastric artery and courses medially toward the isthmus of the uterus.

Approximately 2 cm lateral to the endocervix, it crosses over the ureter and reaches the lateral side of the uterus. The ascending branch of the uterine artery courses in the broad ligament, running a tortuous route to finally anastomose with the ovarian artery in the mesovarium

Through its circuitous route in the parametrium, the uterine artery gives off numerous branches that unite with arcuate arteries from the other side. This series of arcuate arteries develops radial branches that supply the myometrium and the basalis layer of the endometrium.

The arcuate arteries also form the spiral arteries of the functional layer of the endometrium.

The descending branch of the uterine artery produces branches that supply both the cervix and the vagina.



## Box 3.1 Collateral Arterial Circulation of the Pelvis

### Branches from Aorta

*Ovarian artery*—anastomoses freely with uterine artery

*Inferior mesenteric artery*—continues as superior hemorrhoidal artery to anastomose with middle and inferior hemorrhoidal arteries from hypogastric and internal pudendal

*Lumbar and vertebral arteries*—anastomose with iliolumbar artery of hypogastric

*Middle sacral artery*—anastomoses with lateral sacral artery of hypogastric

### Branches from External Iliac Artery

*Deep iliac circumflex artery*—anastomoses with iliolumbar and superior gluteal of hypogastric

*Inferior epigastric artery*—gives origin to obturator artery in 25% of cases, providing additional anastomoses of external iliac with medial femoral circumflex and communicating pelvic branches

### Branches from Femoral Artery

*Medial femoral circumflex artery*—anastomoses with obturator and inferior gluteal arteries from hypogastric

*Lateral femoral circumflex artery*—anastomoses with superior gluteal and iliolumbar arteries from hypogastric

From Mattingly RF, Thompson JD. *Te Linde's Operative Gynecology.* 6th ed. Philadelphia: JB Lippincott; 1985.

# *VEINS*

The venous drainage of the pelvis begins in small sinusoids that drain to numerous venous plexuses contained within or immediately adjacent to the pelvic organs.

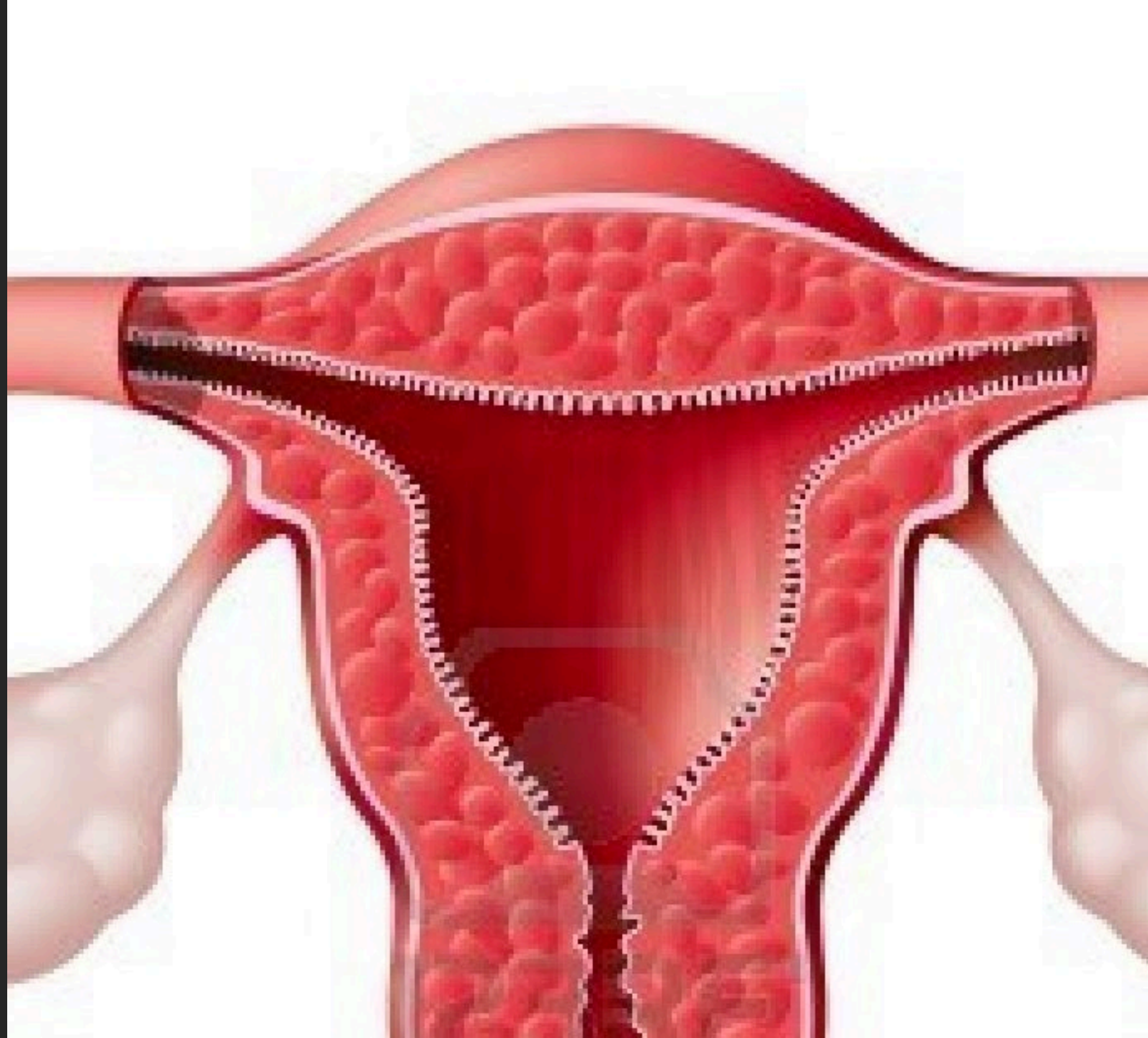
In general the veins of the female pelvis and perineum are thin walled and have few valves.

The veins that drain the pelvic plexuses follow the course of the arterial supply. Their names are similar to those of the accompanying arteries.

The left ovarian vein empties into the left renal vein, whereas the right ovarian vein connects directly with the inferior vena cava.

# Summary

1. cervix
2. Uterus
3. Oviducts
4. Ovaries
5. Vascular system




# Thank you!

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