

# Internal female genital organs

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**MD6 program**

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# Disclosure



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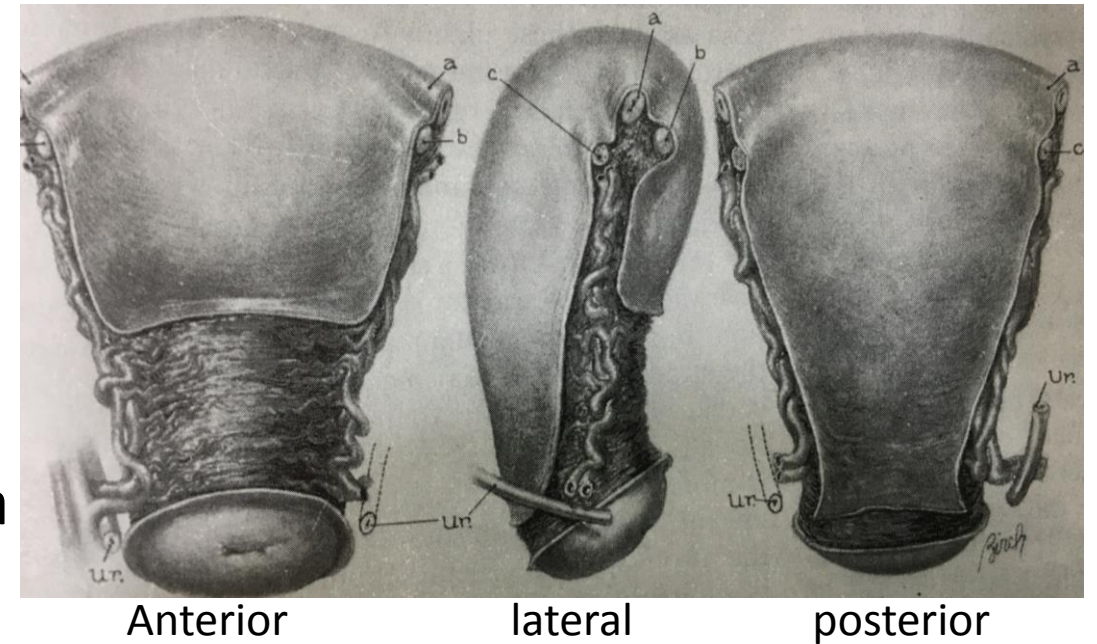
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# Uterus

- Muscular organ
- Covered partially by peritoneum / serosa
- Cavity – endometrium

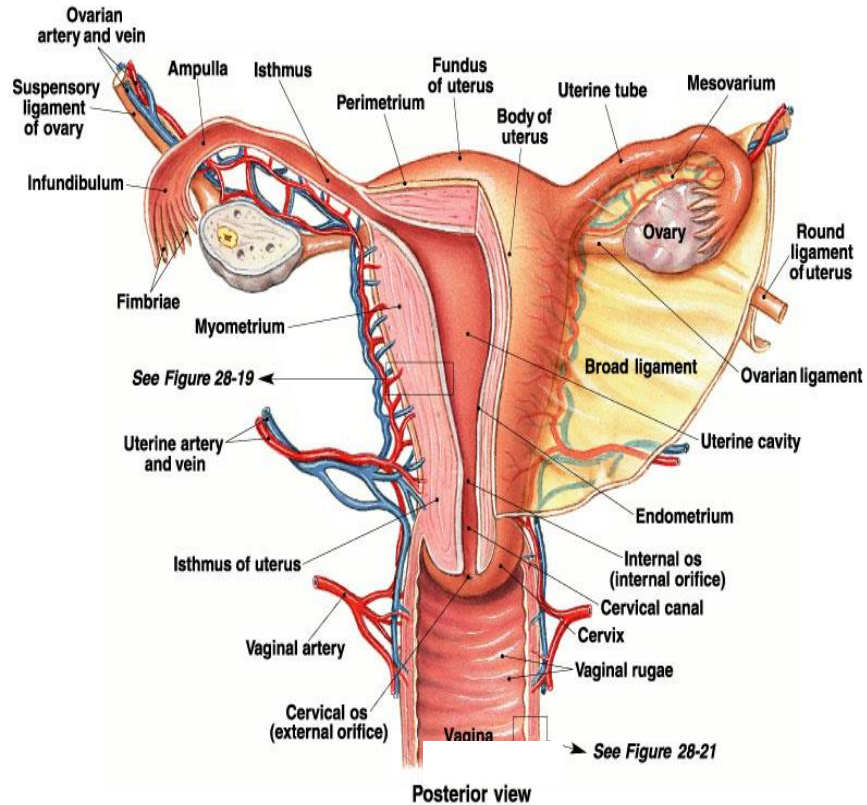


- Found in the pelvic cavity between the bladder anteriorly and rectum posteriorly
- Lower anterior wall portion is united to the posterior wall of the bladder
- Posterior wall - covered by peritoneum, and lower portion forms the anterior boundary of the recto – uterine cul-de-sac or Pouch of Douglas

# Position of the uterus in stand up position in a non pregnant woman

- Is almost horizontal, flexed somewhat anteriorly
- Fundus resting upon the bladder
- Partially mobile organ corpus moves in the anteroposterior plane
- Anteflexed, level, and retroflexed positions are considered normal
  
- cervix is anchored, directed backwards toward the tip of the sacrum
- external os is at the level of the ischial spines

# Uterus consists of 2 main layers



- Round ligaments
- uterosacral ligament
- cardinal ligament
- 80% anteverted
- 20% retroverted

## outer muscular myometrium (myoma origin)

- grows gradually throughout childhood
- increases rapidly in size and configuration during puberty
- changes in size through the cycle
- capable of vast expansion during pregnancy

## inner layer, endometrium (endometrial Ca)

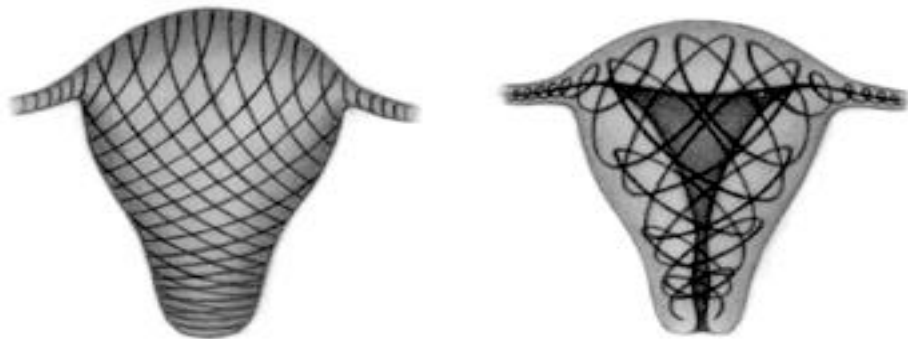
- Very thin in childhood
- Begins to thicken at puberty
- Dependent on steroids
- Responds cyclically to hormone changes
- Can be seen and measured on an ultrasound scan
- Good 'bioassay' of oestradiol level

# Uterus – anatomical landmarks

- Resembles a flattened pear in shape
- **Corpus** uteri (body)
- **Cervix** (cylindrical fusiform structure)
- **Isthmus** = between internal cervical os and the endometrial cavity  
*(forms the lower uterine segment during pregnancy)*
- **oviducts** *(or fallopian tubes)* emerge from the cornua of the uterus at the junction of the superior and lateral margins
- the convex upper segment is the **fundus**
- Laterally below the insertion of the tubes is the site of the attachments of the **broad ligaments**

# Myometrium – corpus uteri

- Smooth muscle united by connective tissue and elastic fibers
- Progressively diminishes caudally towards the cervix
- More muscle **in the inner wall than in the outer layers and in the anterior and posterior walls than in the lateral walls**



**The Double Spiral Arrangement of Most Myometrial Fibers Along the Uterus**

Inner layer circular fibres.  
Middle layer figure of 8 or spiral fibres.  
Outer layer longitudinal fibres.

# Measurements of the uterus

- Before puberty : length 2.5 - 3.5cm,
  - Adult nulliparous : length 6-8cm
  - Multiparous women : length 9-10 cm
- 
- Weight of uterus
  - Nonparous 50-70gr
  - Parous 80 gr or more
- 
- Premenarcheal girls cervix is x 2 in length of corpus
  - Nulliparous corpus and cervix are equal in length
  - Multiparous the cervix is  $\frac{1}{3}$  of the total length of the organ

# Muscular layers and shape of the uterus

- Corpus uteri is comprised of muscle layers (on frontal section is triangular)
- Inner surfaces of the anterior and posterior walls lie almost in contact
- Cervical canal is fusiform with the internal and external os
  
- Nulliparous uteri margins : convex
- Parous uteri margins : concave
- Postmenopausal : size is decreased due to atrophy
  
- Congenital uterine anomalies due to Mullerian fusion or absorption defect

# Pregnant Uterus

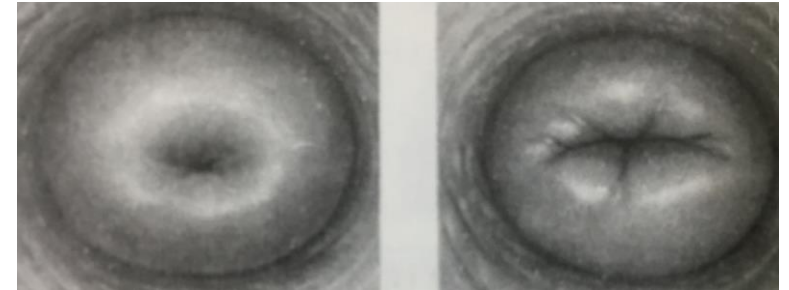
- Remarkable growth
- During pregnancy

*myometrium increases greatly via hypertrophy of the muscle fibers  
without any significant change in the muscle content of the cervix*

- Weight from 70gr to 1100 gr at term
- Total volume on average is 5 liters
- Uteroplacental blood flow estimated at 500 to 700 ml/min

# Uterine Cervix

- Supra vaginal portion
  - Anteriorly is separated by the overlying bladder by loose connective tissue
  - laterally is attached to the cardinal lig
- Vaginal portion
- External cervical os
- Nulligravidas – oval opening
- Parous women – transverse slit (anterior and posterior lip)
- Menopause – stenotic / occluded



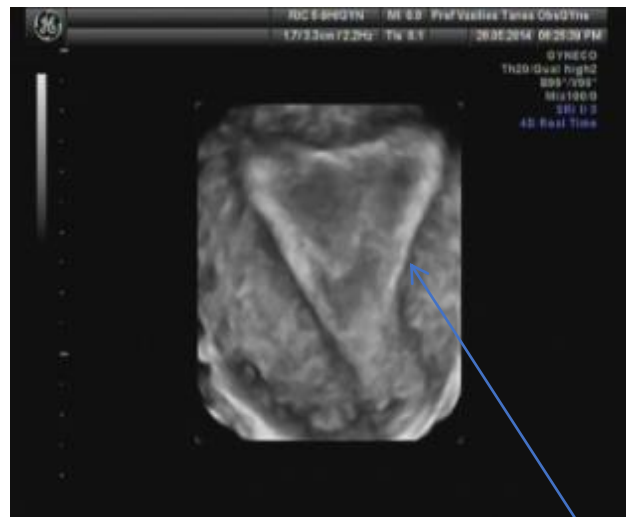
# Cervical composition

- Predominantly collagenous tissue
- Elastic tissue and blood vessels
- Some muscle fibers 10% (in incompetent Cx is much more)
  - Transition of the collagenous to muscular tissue of corpus uteri generally is abrupt but may be gradual and may extend over as much as 10mm
- Remarkable ability to dilate, (determined by the state of the connective tissue and dissociation of collagen)
- Mucosa of a single layer, very high columnar epithelium, rests upon a thin basement membrane
- Cells are covered with cilia
- Numerous cervical glands ( from the cx mucosa to the subjacent connective tissue) when occluded form the Nabothian cysts
- Squamous columnar junction ( external os congenital ectropion)

# Endometrium

- Thin, pink, velvet-like membrane
- uterine glands (in close examination appear as large number of minute openings)
- Repetitive cyclical changes (menstrual, proliferative, secretory)
- Varies greatly in thickness
- In menopause (atrophic endometrium, glands disappear become fibrotic)
  
- Surface epithelium (single layer of closely packed, high columnar ciliated cells)
- Glands
- Interglandular mesenchymal tissue with numerous blood vessels

# Triple layer Endometrium and Junctional zone



JZ endometrium clearly seen in  
4D US and MRI

## Endometrial and JZ peristalsis



Courtesy Jan Brosens

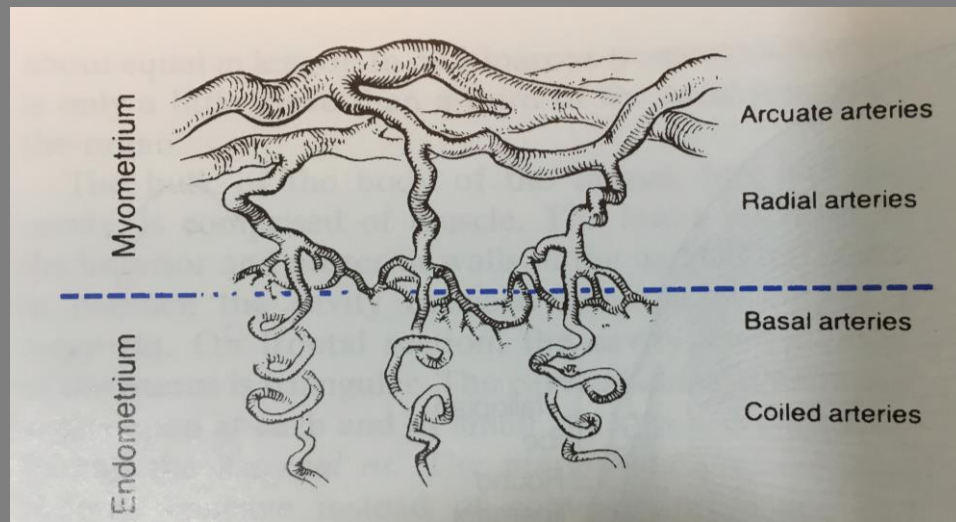
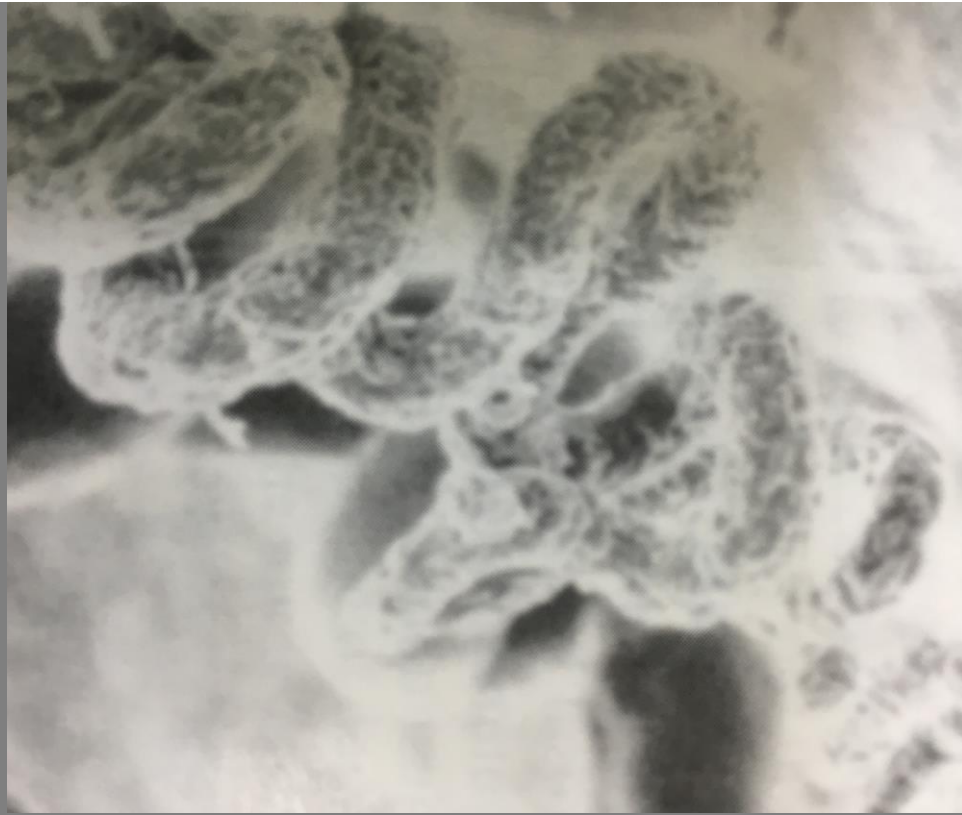
## Myoma induce abnormal uterine peristalsis and decreases the PR

- 15 infertile patients with IM fibroids
- uterine peristalsis frequency measured in MRI (normal 0-1/3min)
- After myomectomy
  - 14/15 normal peristalsis
  - 6/15 40% pregnant

(Yoshino O et al 2012 JMI Gyn AAGL)

# Endometrial vascular architecture

- Arterial blood is transported to the uterus by uterine and ovarian arteries
- Arcuate arteries: penetrate the uterine wall upto to its middle 1/3
- Radial branches: from arcuate aa at right angle to the endometrium
- Basal arteries:
- Spiral arteries: (supply most of the midportion and all the superficial third of the endometrium affected by the hormonal changes)



# Ligaments

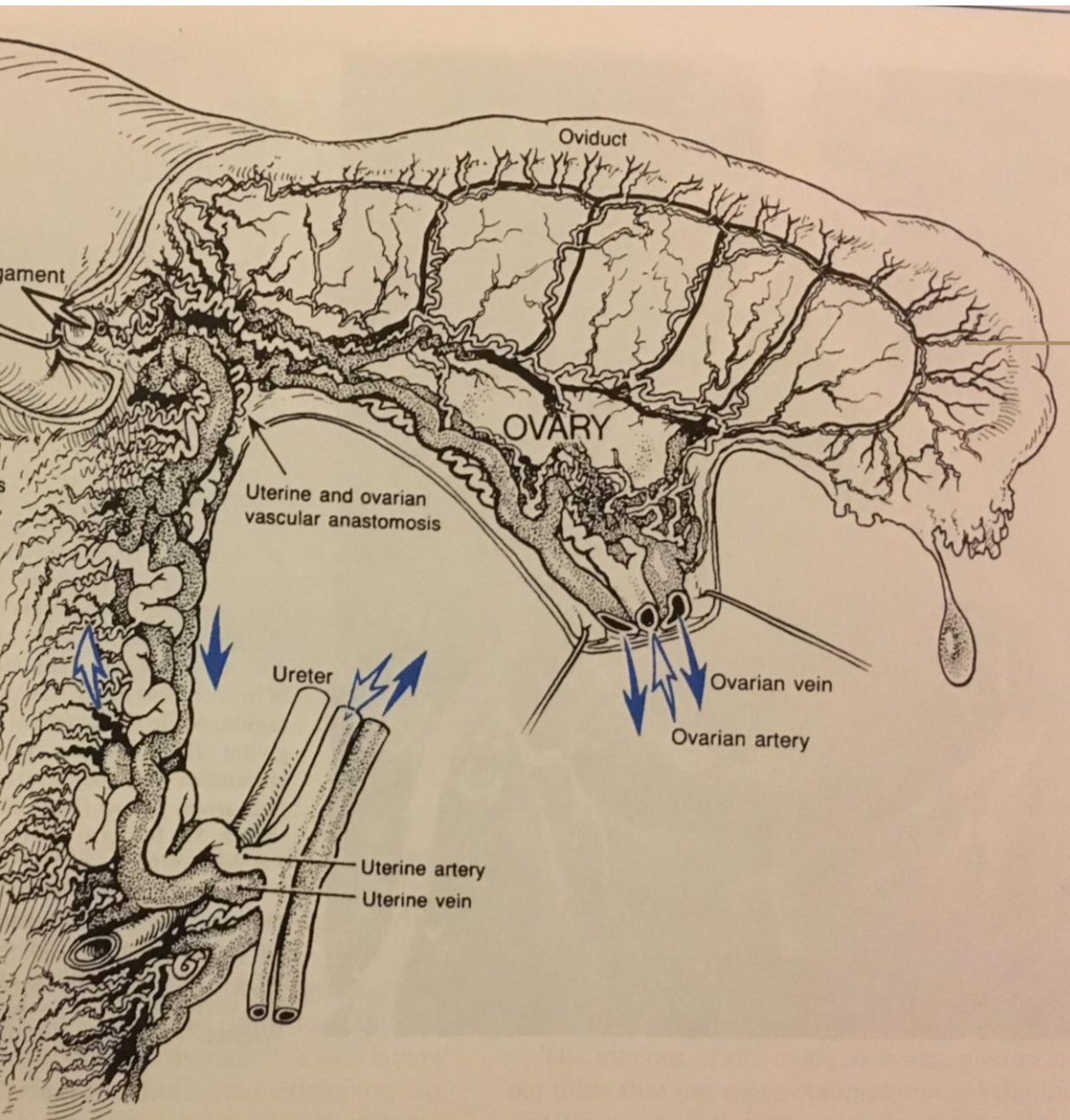
- Broad ligaments (fold of peritoneum)
  - extend from the uterine lateral margins to the pelvic walls
  - dividing the pelvis in anterior and posterior compartments
- Inner 2/3 of the superior margins form the **mesosalpinx**
- Outer 1/3 of the superior margin form the **infundibulopelvic ligament**  
*(suspensory lig of the ovary, through which ovarian vessels transverse)*
- Base is thick continuous with the connective tissue of the pelvic floor forming the **cardinal lig**
- Lower part is widely attached to the connective tissues adjacent to cervix forming the **Parametrium**

# Round Ligaments

- extend from lateral portion below and anterior to the origin of the oviducts
- Located in the fold of peritoneum that is continuous with the broad ligament and extends outward and downward to the inguinal canal through which it passes and terminates in the upper portion of the labium majus
- During pregnancy undergo considerable hypertrophy and increase in both length and diameter

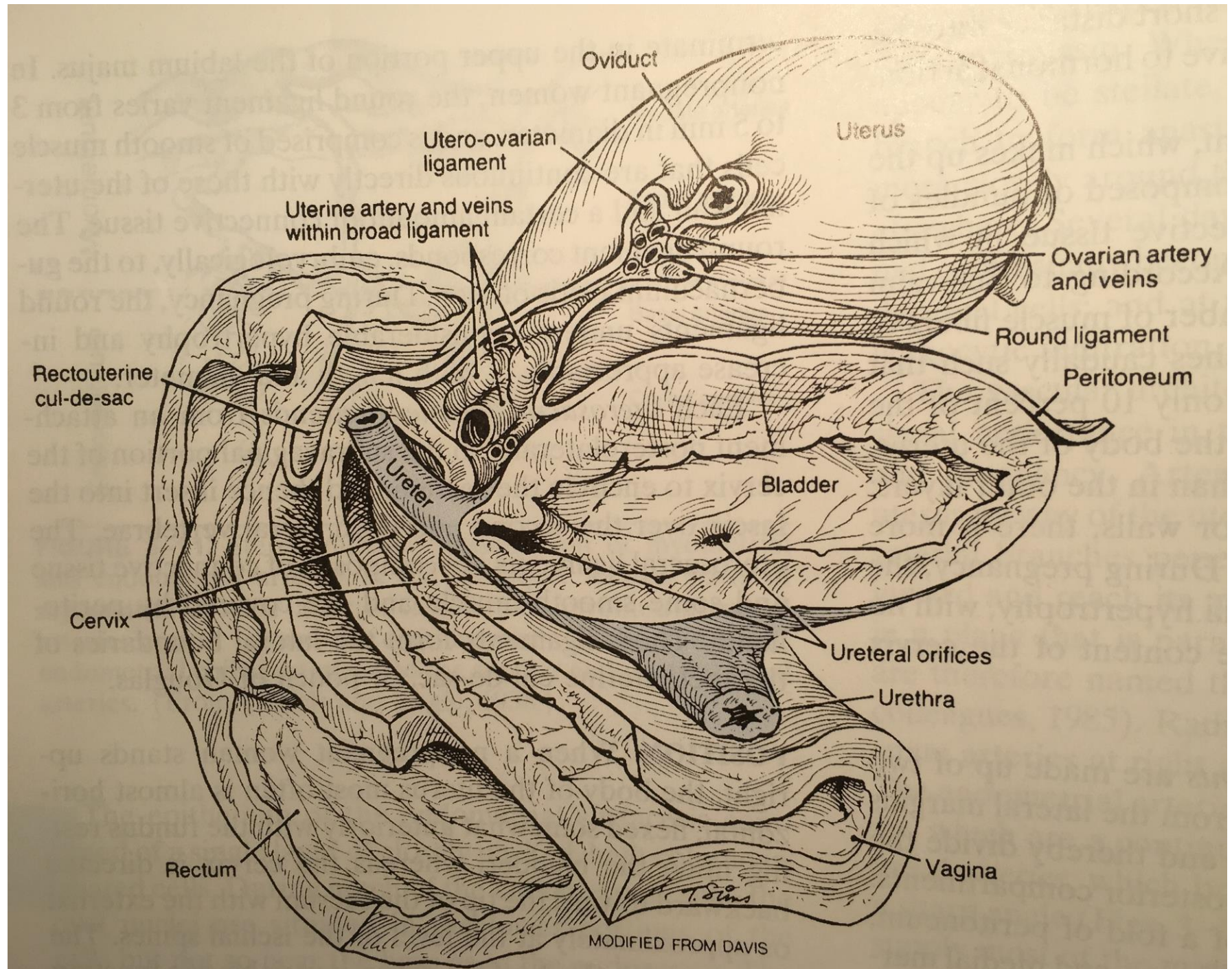
# Uterosacral ligaments

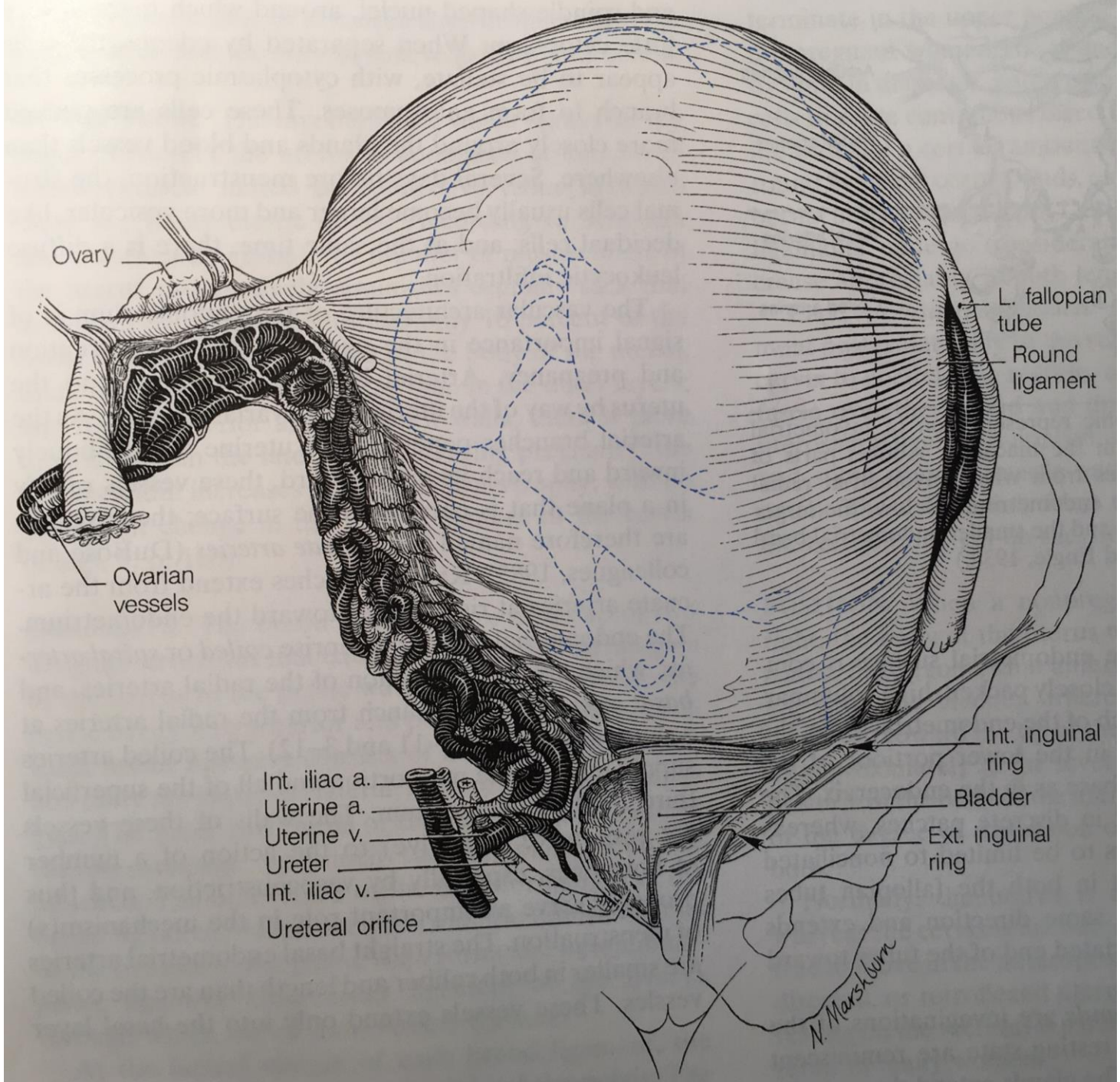
- extend posterolaterally to the supravaginal portion of the cervix
- encircle the rectum
- insert into the fascia over the 2nd and 3<sup>rd</sup> sacral vertebrae
- form the lateral boundaries of the rectouterine cul-de-sac PoD



# Vascular supply of the uterus

- Uterine and ovarian arteries
- Uterine artery is a main branch of the internal iliac (hypogastric) artery
- enters the base of the broad lig. and directed medially to the side of the uterus
- Adjacent to the supravaginal portion of the cervix the uterine artery divides into 2 main branches
  - Cervicovaginal artery – supply blood to lower portion of the cx and upper vagina
  - The main branch turns abruptly upwards, transverse along the margin of the uterus
- Just below the oviduct divides into 3 terminal branches a) Fundal b) Tubal and c) Ovarian
- Ovarian branch from the uterine a. anastomoses with the terminal branch of the ovarian a.
- About 2cm lateral to the cx the uterine a. crosses over the ureter  
*(significant anatomical point during surgery – radical hysterectomy)*





Ovary

Ovarian vessels

L. fallopian tube

Round ligament

Int. iliac a.

Uterine a.

Uterine v.

Ureter

Int. iliac v.

Ureteral orifice

Int. inguinal ring

Bladder

Ext. inguinal ring

*N. Marshallburn*

Major portion of blood supply to the pelvis is from the internal iliac artery branches

▪ **Anterior division**

- uterine
- umbilical
- middle and inferior vesical
- middle rectal
- obturator
- internal pudendal
- middle haemorrhoidal
- vaginal
- inferior gluteal

▪ **Posterior division**

- Lateral sacral,
- superior gluteal
- Iliolumbar

# Lymphatics

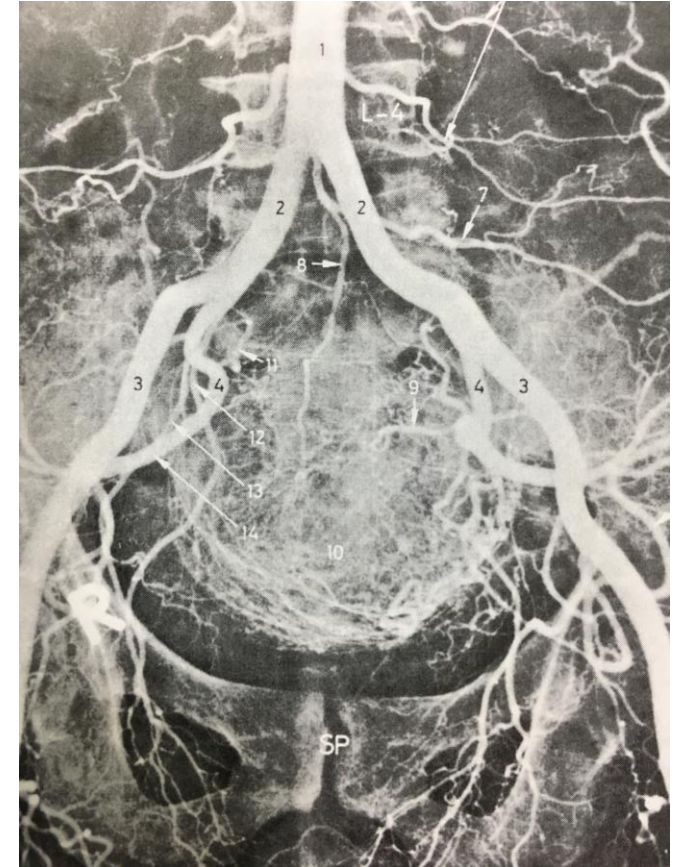
- **Endometrium** lymph is confined largely to the **basal layer**
- **Myometrium** increased in number towards the serosa forming a lymphatic plexus just beneath it especially in the posterior wall and lesser in the anterior wall of the uterus
- **Corpus uteri** drains into:
  - **Internal iliac** nodes
  - Joins certain lymphatics from ovarian region, terminates in the **paraortic LNs**
- **Cervix** terminate in **hypogastric LNs**  
(near bifurcation of the **common iliac vessels**)

# Innervation

- Derives from the sympathetic nervous system
  - Enters the pelvis by way of the internal iliac plexus, that arise from the aortic plexus just below the sacral promontory
  - Also enters the uterovaginal plexus
- Partly from the cerebrospinal and
- parasympathetic system (represented either side by the pelvic nerve)
  
- Pelvic nerve derives from the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> sacral nerves
  - Fibers end in the cervical ganglion of Frankenhauser
  - Branches from these plexuses supply the uterus bladder and upper vagina some terminate into the muscular fibers others accompany the arteries into the endometrium

# Innervation

- In the 11<sup>th</sup> and 12<sup>th</sup> thoracic nerve roots sensory fibers from the uterus transmit the painful stimuli from the uterine contractions to the CNS
- Sensory nn from the cx and upper part of the vagina pass through the pelvic nerves to the 2<sup>nd</sup> 3<sup>rd</sup> and 4<sup>th</sup> sacral nerves
- The lower 2/3 of the vagina pass primarily through the pudendal nn



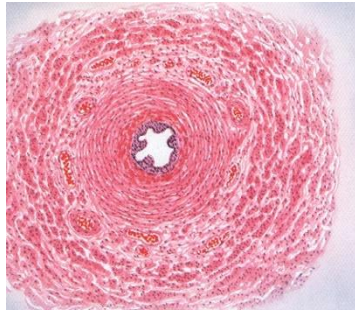


Gabriel Fallopio

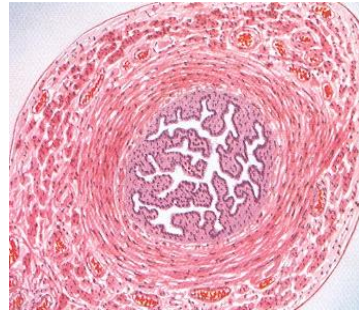
# Fallopian Tube (Salpings)



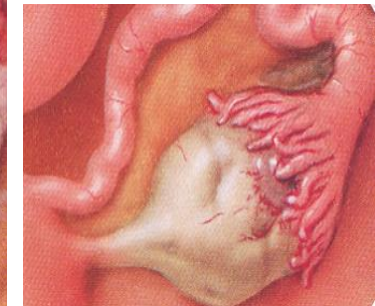
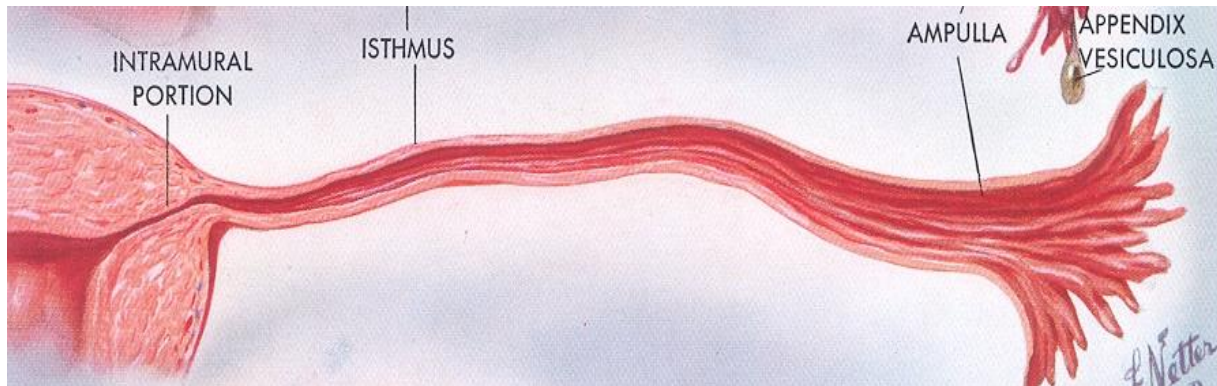
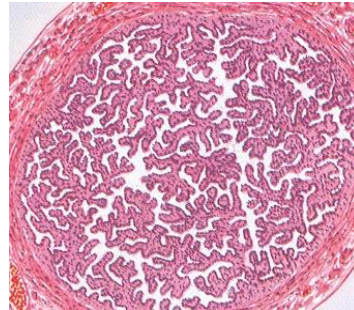
Intramural



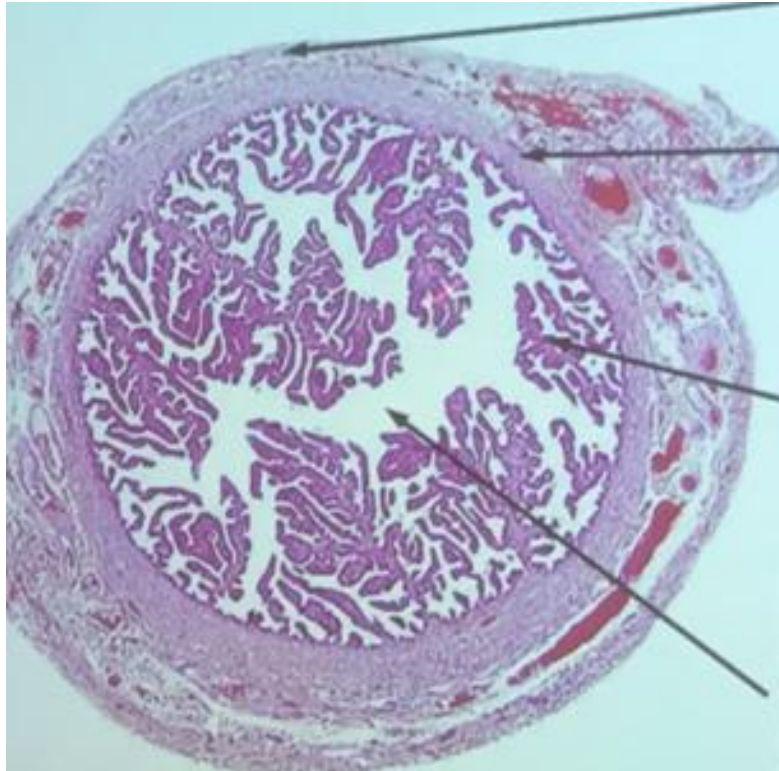
Isthmus



Ampullary



# Uterine tube section



## Serosa

## Muscularis

Inner oblique  
Middle circular  
Outer longitudinal  
Blood vessels & lymphatics.

## Mucosa

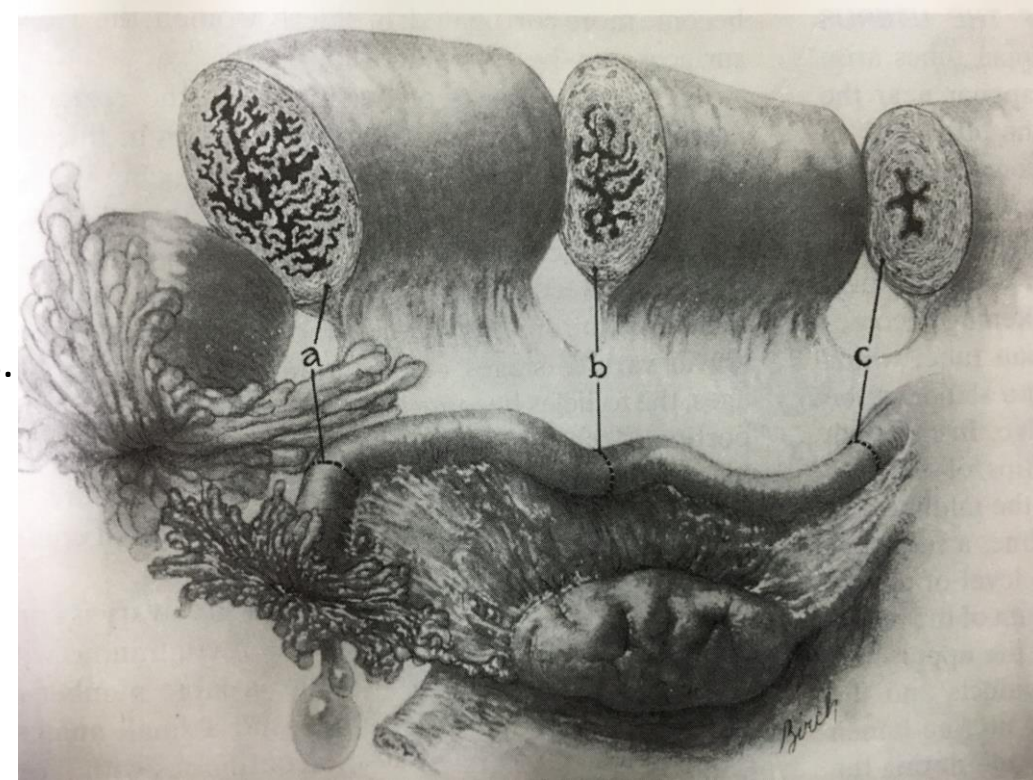
Single layer of columnar  
epithelium  
Secretory (60%)  
Ciliated (25%)  
Intercalated

## Lumen

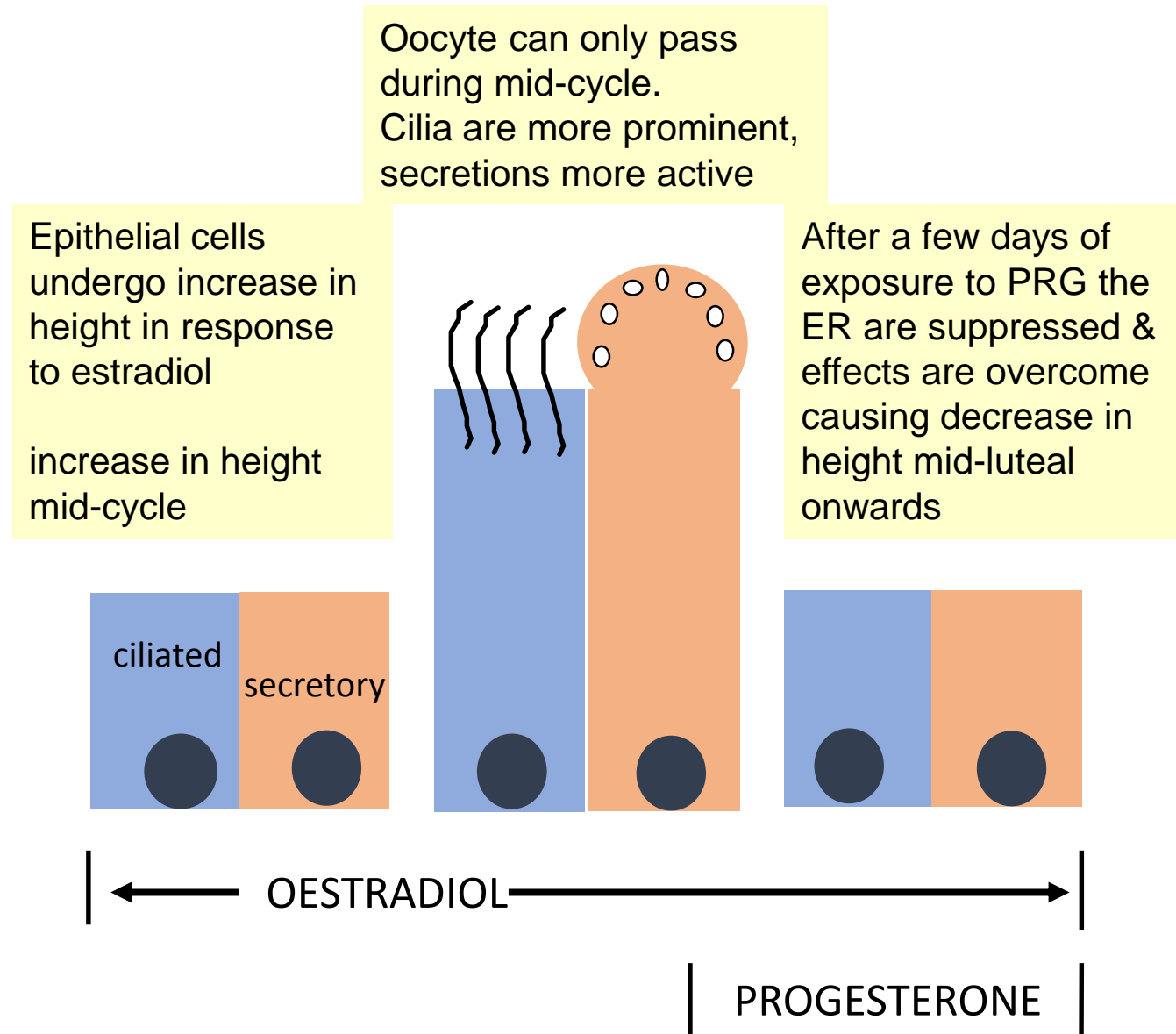
Tubal fluid

Rich in potassium, bicarbonate, arginine, alanine, glutamate, glucose & prostaglandins.

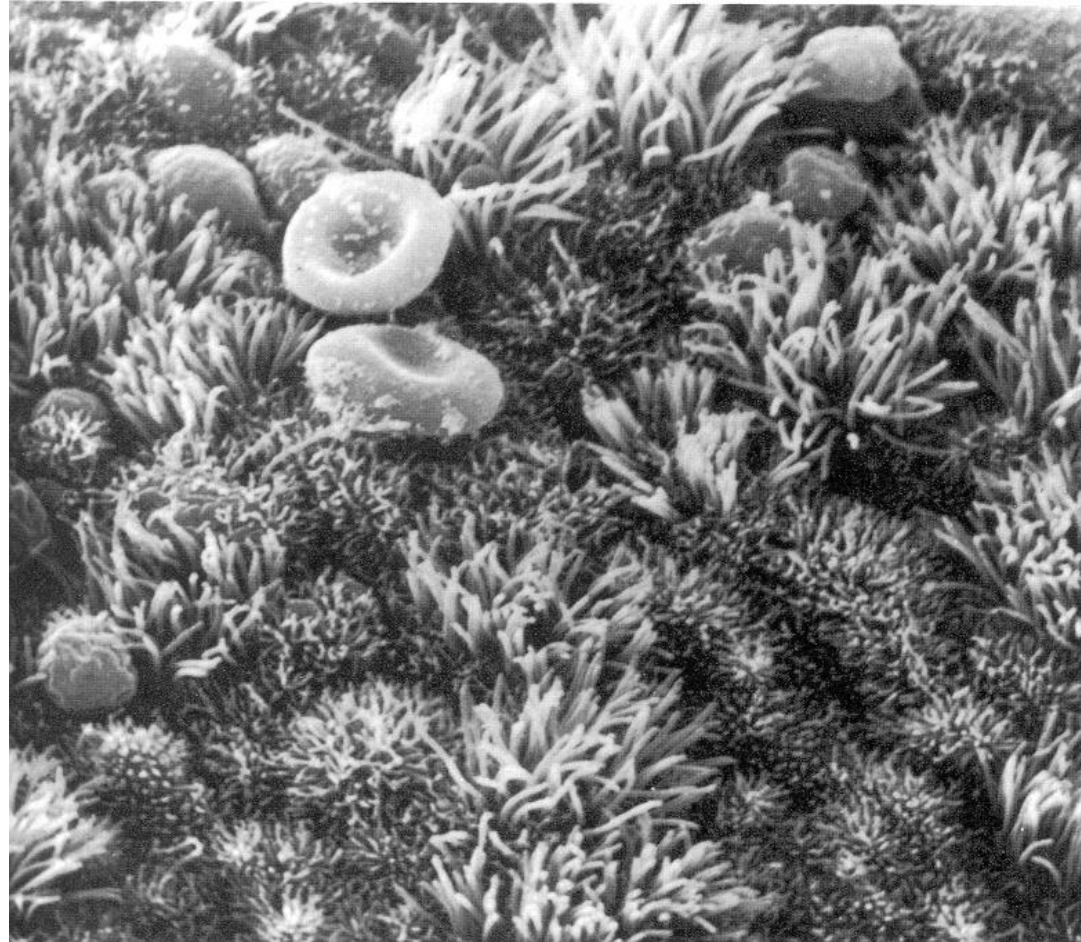
Unique tubal epithelial proteins of unknown function



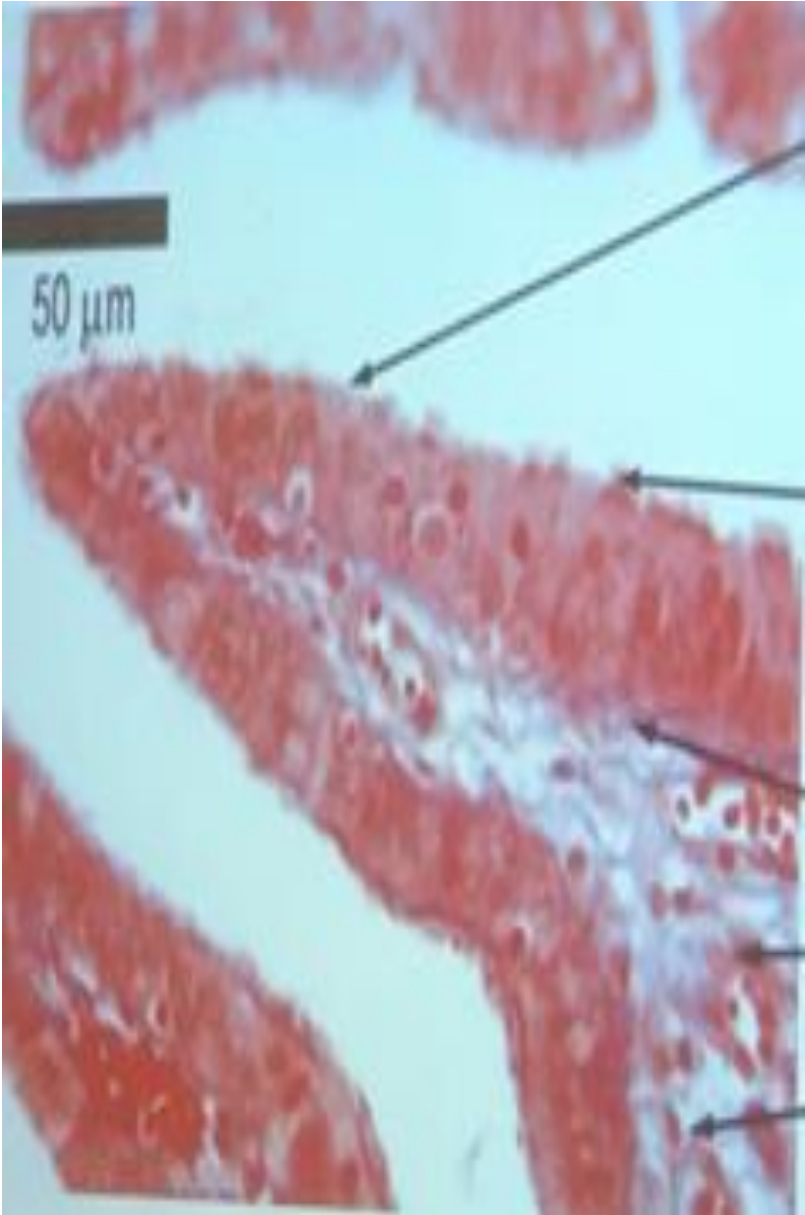
# Changes in cells lining of the tubes



# Tubal lining by electron microscopy



**Mucosal detail**



**Secretory cells**

Non-ciliated containing granules

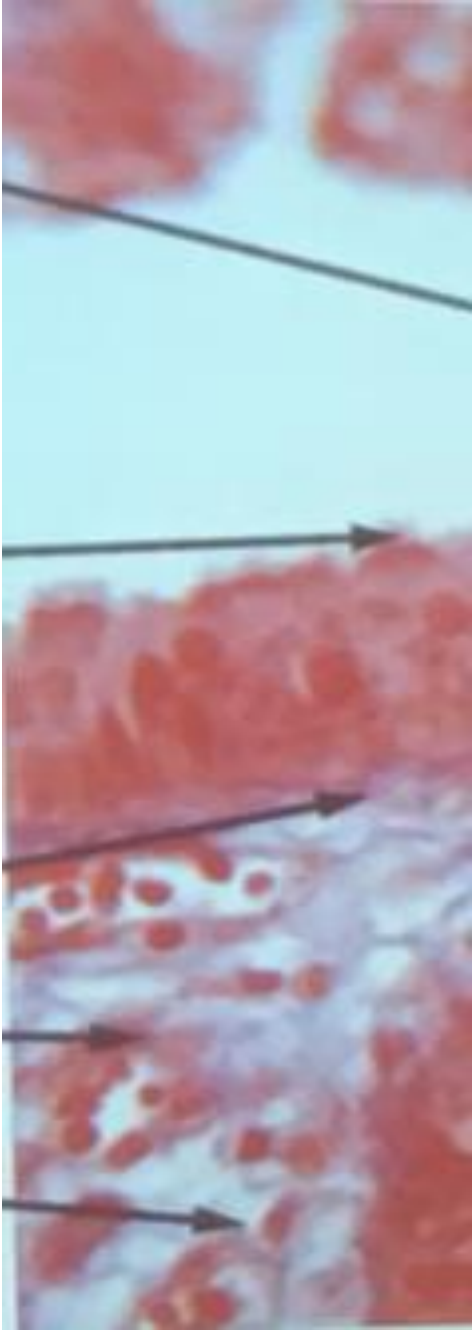
**Ciliated cells**

B-adrenergic receptors  
Angiotensin II receptors  
Ovarian steroids  
Adrenomedulin (ADM)  
Inflammatory cytokines

**Basal membrane**

**Blood vessels**

**Lamina propria**



# Function of the Salpings (tube)

Oocyte is transported along the uterine tube by...

beating of cilia, stimulated to grow by oestrogen

rapid contractions of muscular layer caused by oestrogen

remains in the tube for approximately 5 days

Fertilisation occurs in ampulla

High number of estrogen receptors present in follicular phase

Estrogen receptors suppressed by progesterone

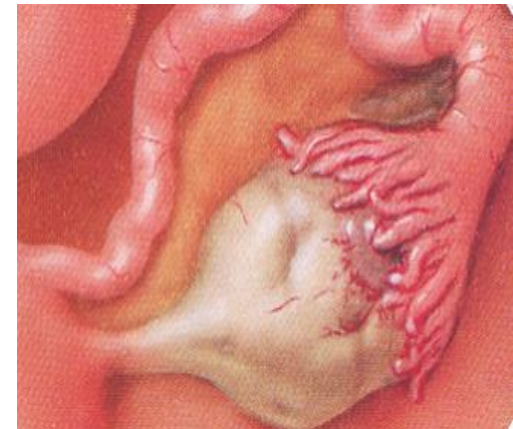
All of above stops by mid- luteal phase, even if an egg was released  
it would be unable to pass

Damage to lining of the tube by infection, endometriosis, surgery or  
adhesions may cause blockage or damage to ciliated epithelia, resulting in...

pain

infertility

ectopic pregnancy



Many pathologies cause tubal inflammation

- Direct toxic destruction of tubal mucosa
- Cilia damaged by many pathological conditions
- Role of immune response needs further work to attempt to develop modulation

# Ovaries

During reproductive years

- Length = 2.5 -5cm, breadth = 1.5 -3cm, thickness = 0.6 – 1.5cm
- Dull white surface, glisten several small clear follicles
- Cortex – follicles and oocytes and medulla – loose connective tissue

Located on

- the upper part and lateral wall of the pelvis
- Between the divergent external and internal iliac vessels = ovarian fossa

# Ovaries

- Attached to the broad ligament by the mesovarium
- Utero – ovarian ligament extends from the lateral and posterior portion of the uterus
- Infundibulopelvic ligament – extends from the tubal pole to the pelvis wall (through it the ovarian vessels and nerves)