Reproduction Block

Embryology Team

Lecture 2: Development of the Female Reproductive System

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Objectives:

At the end of the lecture, students should be able to:

- ✓ Describe the development of gonads (indifferent& different stages)
- ✓ Describe the development of the female gonad (ovary).
- ✓ Describe the development of the internal genital organs (uterine tubes, uterus & vagina).
- ✓ Describe the development of the external genitalia(labia minora, labia majora& clitoris).
- ✓ List the main congenital anomalies.

Red = Important

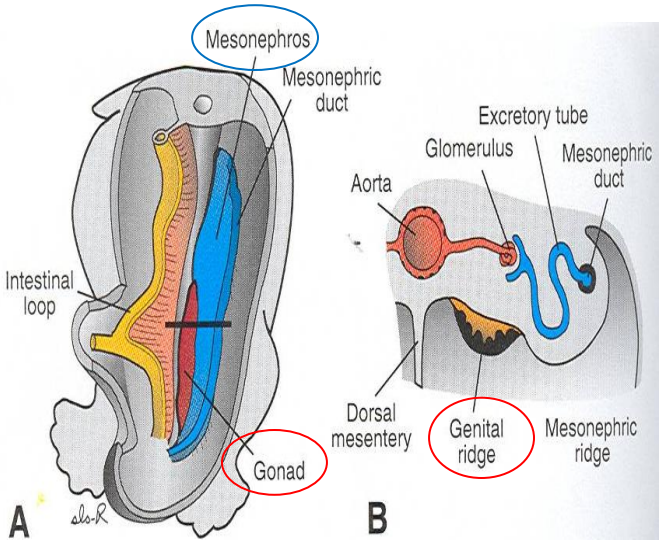
Green = Team Notes

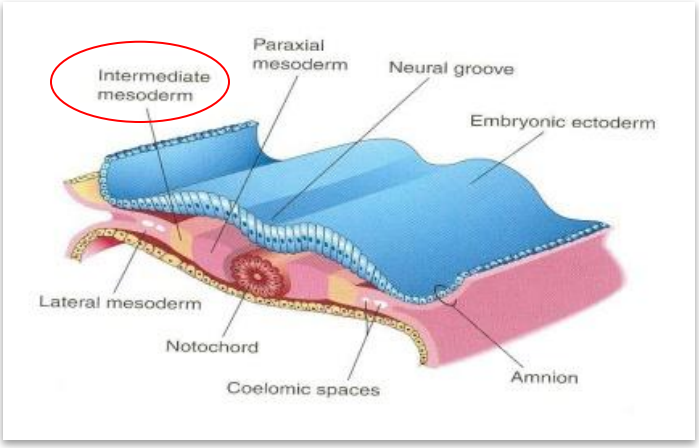
Sex Determination

- Chromosomal and genetic sex is established at fertilization and depends upon the presence of Y or X chromosome of the sperm.
- Development of male phenotype requires a Y chromosome, and development of female phenotype requires two X chromosomes.
- Testosterone produced by the fetal testes determines maleness.
- Absence of Y chromosome results in development of the Ovary.
- The X chromosome has genes for ovarian development.
- The type of sex chromosomes complex established at fertilization determines the type of gonad differentiated from the indifferent gonads. (Testis determining factor)
- The type of gonad determines the type of sexual differentiation in the Sexual Ducts and External Genitalia.

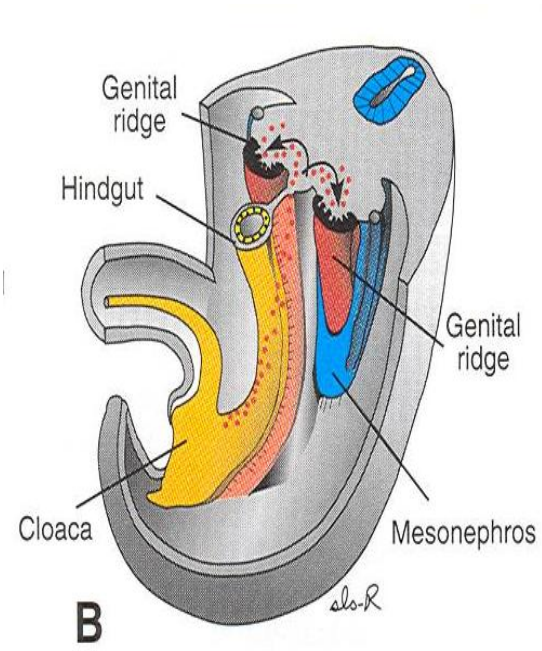
Genital (Gonadal) Ridge

- Appears during the 5th week.
- As a pair of longitudinal ridges (from the intermediate mesoderm).
- On the medial side of the Mesonephros (nephrogenic cord).



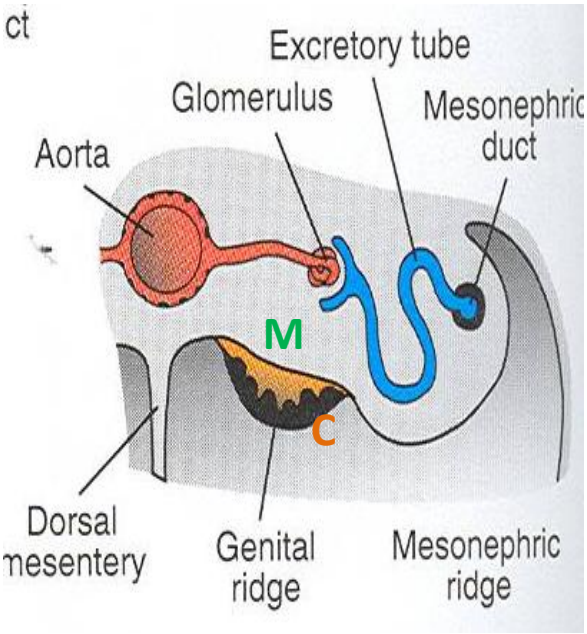


- The Primordial germ cells appear early in the 4th week among the endodermal cells in the wall of the yolk sac near origin of the allantois.
- In the In the 6th week, the Primordial germ cells migrate to the Gonadal Ridges
- The primordial germ cells have an Inductive Influenceon the differentiation of the gonad into ovary or testis.
- If they fail to reach the ridges, the gonad remains Indifferent or Absent.



Structure of Indifferent Gonad

- The indifferent gonad consists of an External Cortex (C) and Internal Medulla (M).
- In embryos with XX chromosomes, the Cortex differentiates into the Ovary and the medulla regresses.
- In embryos with XY chromosomes, the Medulla differentiates into Testis and the cortex regresses.
- The gonad acquires the Female or Male morphological characteristics about the 7th week.

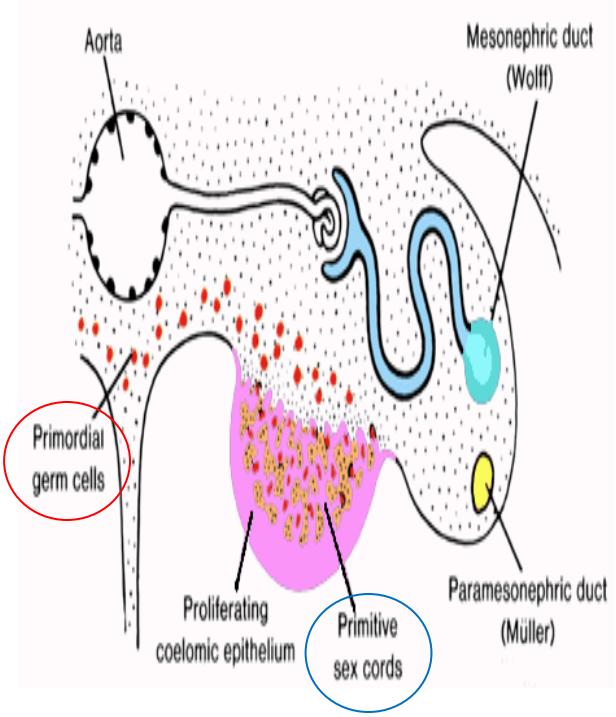


	Cortex	Medulla
XX (Female)	differentiates into Ovary	Regresses
XY (Male)	Regresses	differentiates into Testis

Development of the Ovary

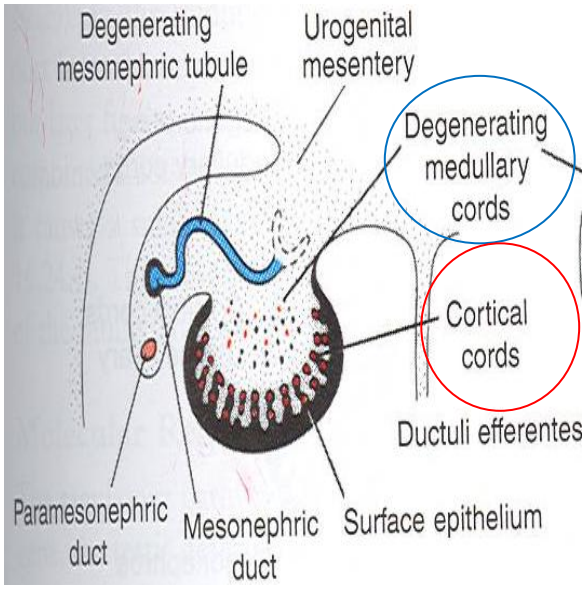
Primitive (Primary) Sex Cords

- Finger-like epithelial cords (primary sex cords) grow from cortex of the indifferent gonad and extend into the medulla.
- The Primary sex cords dissociate into (Rete ovarii).
- Both the primary sex cords and rete ovarii degenerate and disappear.
- The ovary is identifiable histologically at the 10th week.



Cortical (Secondary) Sex Cords

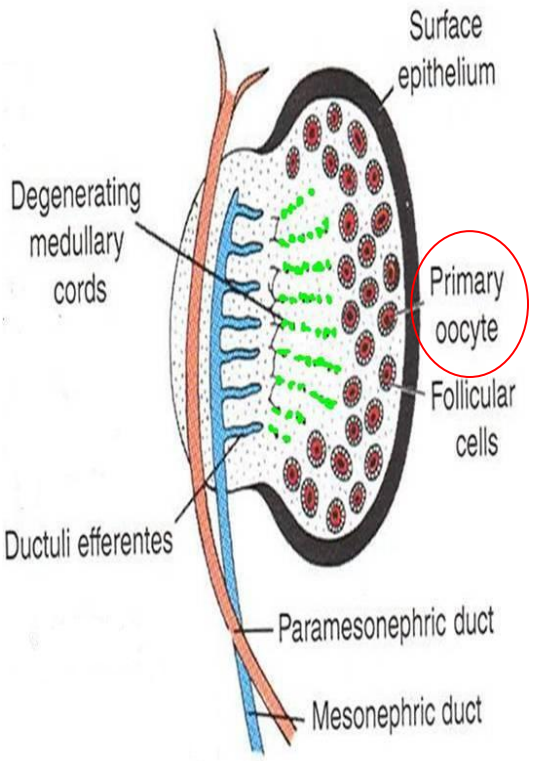
- The secondary sex cords extend from the surface epithelium into the underlying mesenchyme to replace the primary cords.
- The primordial germ cells are incorporated into them (I.e. each cord has the migrated primordial germ cells).
- At the 16th week, the sex cords break up into isolated cell clusters, Primordial Follicles (Primary Oocyte)



Primary Oocyte

Consists of:

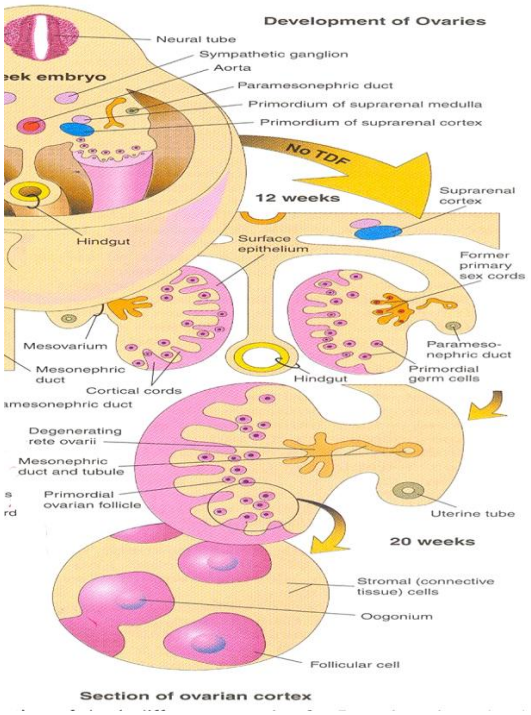
- Oogonium derived from the Primitive Germ Cell.
- Surrounded by a single layer of flattened Follicular Cells derived from the surface epithelium (Sex Cord).
- Active Mitosis of Oogonia occurs during fetal period producing thousands of primordial follicles
- (No new Oogonia are formed postnatally).
- About 2 millions oogonia enlarge to become Primary Oocytes Before Birth.



Changes of the Ovary After Birth (postnatal)

1. Surface Epithelium: (between the cortex & follicles)
Flattened into a single layer and separated from follicles in the cortex by a thin tunica albuginea.

2. The ovaries descend from the posterior abdominal wall (near the kidneys) into the pelvis; just inferior to the pelvic brim.

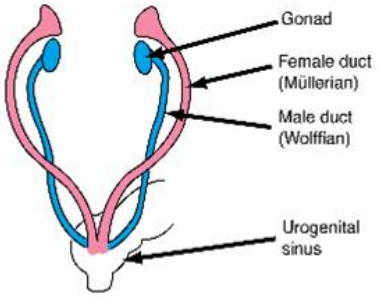


(Remember that in males, the characteristic feature of the testicular development is the development of a **thick tunica albuginea**)

Development of the Female Duct System

(Fallopian Tube – Uterus – Vagina)

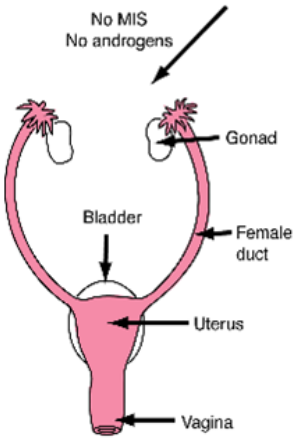
- In female embryo the mesonephric (Wolffian) ducts **regress** due to absence of the testosterone hormone.
- The paramesonephric ducts **develop** due to absence of MIS (Müllerian Inhibiting Substance).
- The female sexual development does not depend on the presence of Ovaries or Hormones



In the indifferent stage, 2 ducts appear:
1) Mesonephric (Wolffian):
Develops only in males, and it'll give the vas deference.

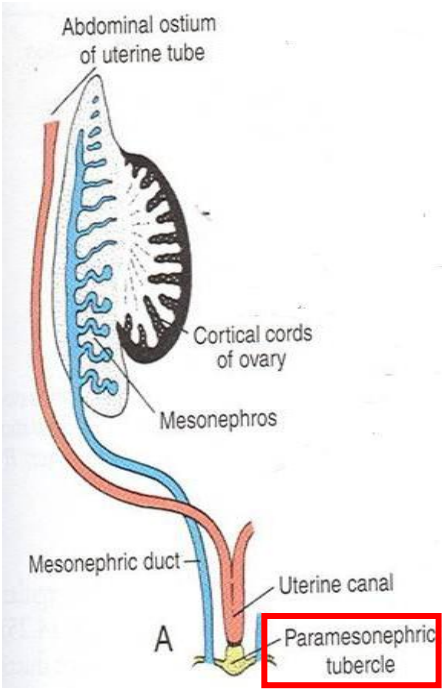
2) paramesonephric (Müllerian): Lateral to the 1st duct
Develops only in females.

*MIS, which is found only in MALES, regresses the development of the paramesonephric ducts.



The Paramesonephric Ducts

- They form most of the female genital tract.
- They develop lateral to the gonads and mesonephric ducts.
- Their funnel-shaped cranial ends open into the peritoneal cavity.
- They pass (descend) caudally parallel to mesonephric ducts to reach the future pelvic region.
- They cross ventral to the mesonephric ducts & approach each other in the median plane and fuse to form the Y shaped Uterovaginal Primordial.
- Which opens into the dorsal wall of the urogenital sinus and produces Paramesonephric (müllerian) Tubercle.



Derivatives of Paramesonephric Ducts

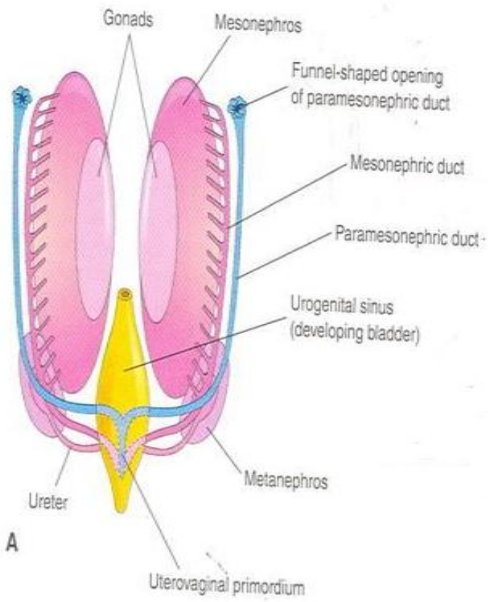
1. Uterine Tubes:

- Develop from the cranial unfused parts of the ducts.

2. Uterovaginal Primordium: It differentiates into:

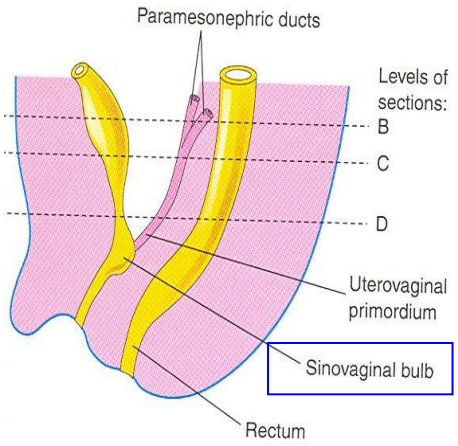
- Uterus (Body and Cervix)
- Superior Portion of the Vagina.

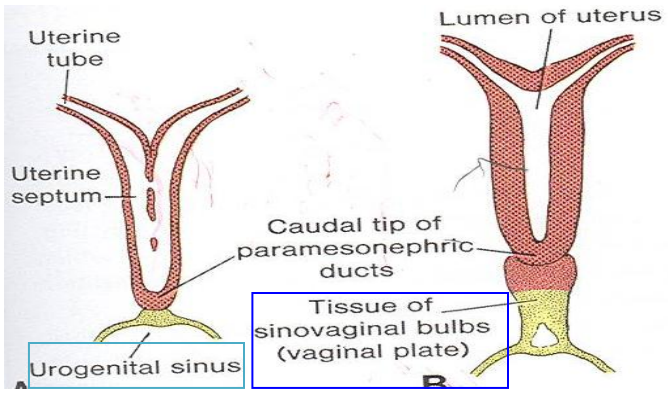
➢ The endometrial stroma and myometrium are derived from the splanchinic mesoderm.



Development of Lower Portion of Vagina

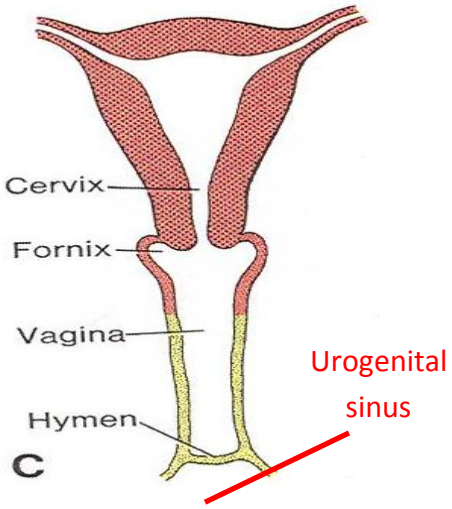
- It is derived from the Urogenital Sinus.(Endoderm)
- The contact of the uterovaginal primordium with the urogenital sinus induces formation of SinoVaginal bulbus
- The bulbs proliferate and fuse to form a solid Vaginal Plate.
- The central cells of the vaginal plate break down (canalize) to form the lumen of the vagina.





Differentiation of Vagina

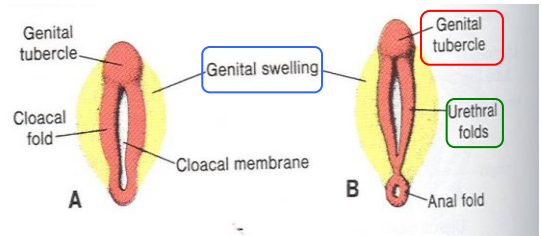
- The lining of the entire vagina is derived from the Vaginal Plate (urogenital sinus)
- The lumen of vagina is separated from the urogenital sinus by the hymen, which remains as a thin fold of mucous membrane just within the vaginal orifice.

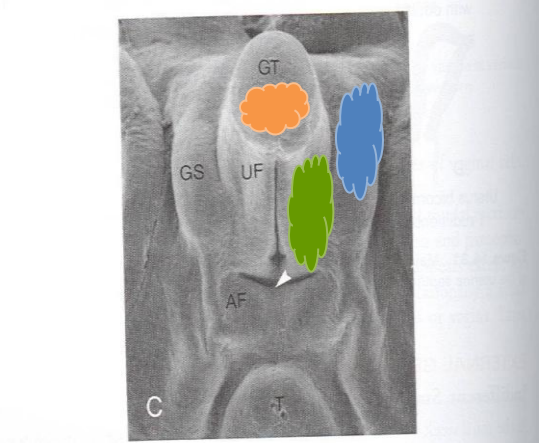


Development of Female External Genitalia

Proliferation of mesenchyme of the cloacal Membrane, forms:

- At the Cranial End:
  - The Genital Tubercle
- On the sides:
  - Inner Part:
    - Urogenital Folds (Urethral Folds)
  - Lateral Part:
    - Labioscrotal Swellings (Genital Swellings)





External Genitalia

- Similar in both sexes up to the 7th week (indifferent stage).
- Begin to differentiate in the 9th week.
- Fully differentiated by the 12th week.

Feminization of External Genitalia

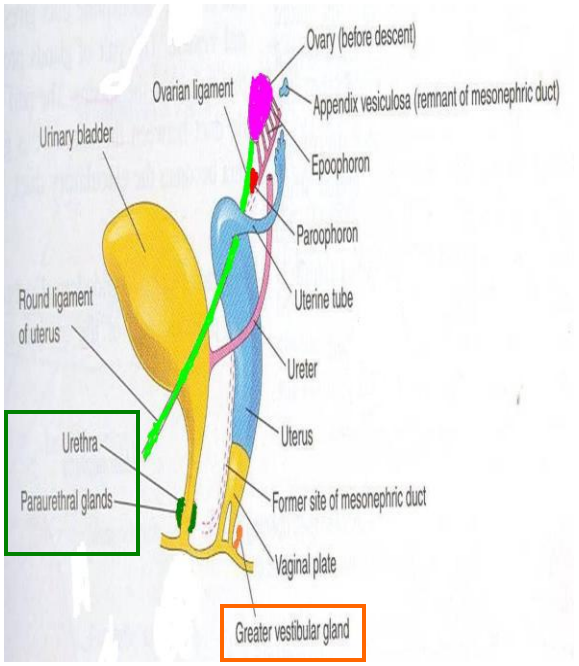
- Estrogen produced by both the placenta and the fetal ovaries has a role in feminization of the external genitalia.
- **The Genital Tubercle** proliferates to form the Primordial Phalls.
- The phalls elongates slightly to form the Clitoris.
- **The Urethral Folds** do not fuse and form the Labia Minora.
- **The Labioscrotal Folds** form the Labia Majora, they fuse to form the Posterior & the Anterior Labial Commissures.

*The clitoris is equivalent to the penis in male.

Female Sex Glands

1. Urethral & Paraurethral Glands: grow as buds from the urethra; they are corresponding to the Prostate Gland of the male.

2. Greater Vestibular Glands: outgrowths of the urogenital sinus, they are corresponding to the Bulbourethral Glands of the male.



ovary

- Mullerian ducts → Female internal genital Organs:
  - *Upper Vagina
  - *Cervix and Uterus
  - *Fallopian Tubes
- Urogenital sinus →
  - *Female external genitalia
  - *Lower vagina
  - *Absence of androgen exposure

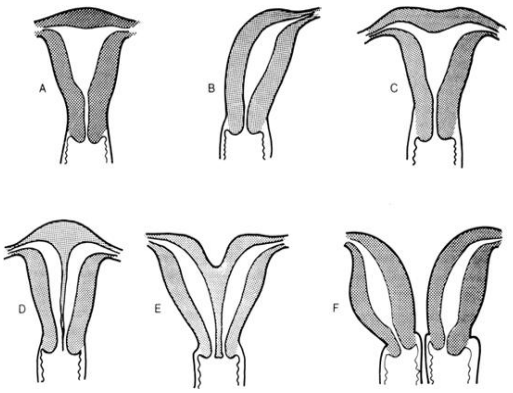
Congenital Anomalies

- Various types of anomalies can result due to:

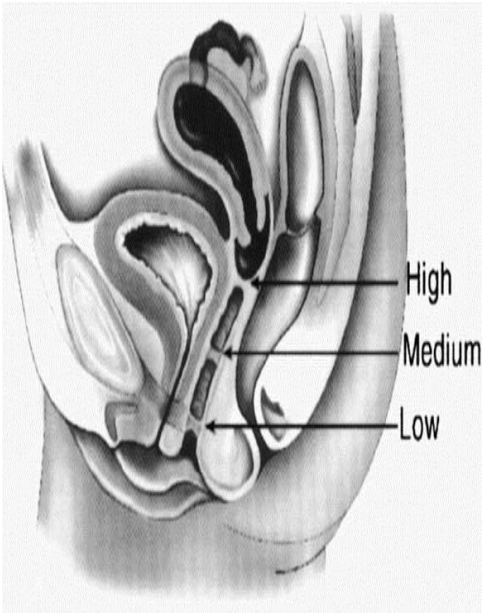
1. Arrest of development of the uterovaginal primordium during the 8th week.(Affects the uterus, cervix & superior vagina)
2. Incomplete development of the paramesonephric ducts. (Affects all the genital tract)
3. Incomplete fusion of the paramesonephric ducts.
4. Failure of parts of one or both paramesonephric ducts to develop.

Uterine Malformations

1. Double uterus (Uterus Didelphys):
   - Due to failure of fusion of inferior parts of the paramesonephric ducts.
   - May be associated with a double or single vagina.
2. Bicornuate uterus:
   - The duplication involves the superior segment.
3. Unicornuate Uterus:
   - One paramesonephric duct fails to develop.
4. Arcuate Uterus.

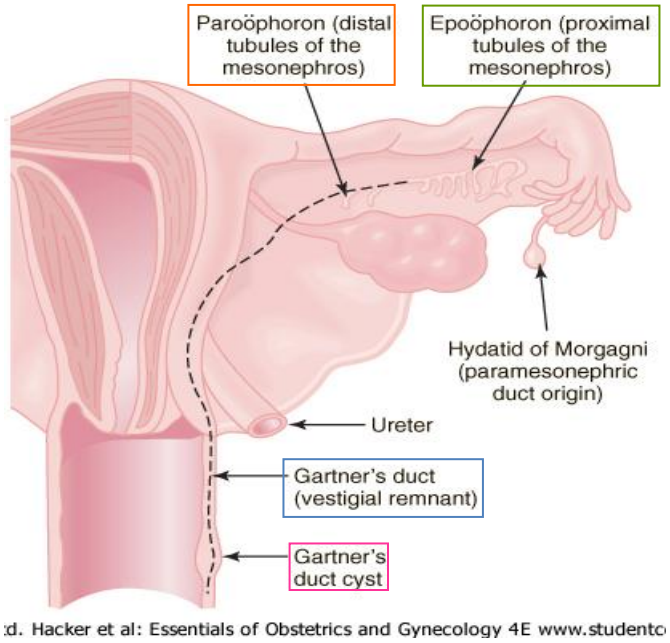


- Cervical Atresia:
  - This may be combined with incomplete development of the upper vagina or lower uterus.
- Vaginal Anomalies:
  - Atresia (Partial or complete).
  - Double vagina.
  - Transversely septate vagina: Results from faulty canalization of the fused müllerian ducts.



Remnants of the mesonephric (wolffian) ducts may persist in the anterolateral wall of vagina or adjacent to the uterus within the broad ligament or mesosalpinx:

1. Paroophoron: persistent of the distal tubules.
2. Epoophoron: persistent of the proximal tubules.
3. Gartner's duct: vestigial remnants, wall of the vagina.
4. Gartner's cyst: wall of the vagina



:d. Hacker et al: Essentials of Obstetrics and Gynecology 4E www.studento

Time Table

4th Week	The Primordial germ cells appear (among the Endodermal cells in the wall of the yolk sac near origin of the allantois)
5th Week	Genital (Gonadal) Ridge appears
6th Week	The Primordial germ cells migrate to the Gonadal Ridges
7th Week	*The gonad acquires the Female or Male morphological characteristics *External Genitalia are similar in both sexes up to the 7th week (indifferent stage).
8th Week	Arrest of development of the uterovaginal primordium during the 8th week. (It can cause a congenital anomaly)
9th Week	External genitalia begin to differentiate
10th Week	The ovary is identifiable histologically
12th Week	External genitalia become fully differentiated
16th Week	The secondary sex cords break up into isolated cell clusters, Primordial Follicles (Primary Oocyte)
Before birth	About 2 million oogonia enlarge to become Primary Oocytes

Questions:

1) What influence on the differentiation and development of the gonad into ovary or testis?

A. The migration of the primordial germ cells.

B. Hormones.

C. Absence of Y chromosome

D. Proliferation of mesenchymal cells.

2) The uterine malformation that happens as a result of failure of fusion of inferior parts of the paramesonephric ducts is:

A.Bicornuate uterus.

B.Arcuate Uterus.

C. Uterus Didelphys.

D.Unicornuate Uterus.

3) The genital tubercle develops from:

A. The caudal end of the cloacal membrane.

B. The inner part of the side of the cloacal membrane.

C. The lateral part of the side of the cloacal membrane.

D. The cranial end of the cloacal membrane.

4) The labia minora is formed from:

A. The fused urethral folds.

B. The unfused urethral folds.

C. The primordial phalls.

D. The labiosacral folds.

5) We can know the gender of the baby by the week:

A. 10.

B. 11.

C. 12.

D. 13.

Answers: 1) A 2) C 3) D 4) B 5) C