Lectures of Human Embryology

*Genital Ducts*

*By*

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Introduction
Reproductive system in both male and female develops during the 5th week of intrauterine life, from the same embryological origins. Until the 7th week’ gestation, the genitalia of both sexes take the same appearance, although the sex is determined at time of fertilization. The genital ducts develop from two pairs of ducts; Wolffian (mesonephric) and Müllerian (paramesonephric) ducts. The fate of these ducts depends upon the genetic sex of the embryo. In XY embryos, the SRY gene (sex determining region of the Y chromosome) stimulates testicular differentiation. Then the developing testes produce androgens and anti-Müllerian hormone (AMH), causing regression of Müllerian ducts. In XX individuals, absence of the SRY gene allows the gonads to develop into ovaries whilst the subsequent lack of AMH allows the Müllerian ducts to develop into female genital ducts.

Development of Genital Ducts

In the embryo, there are 2 pairs of ducts that give rise to genital ducts in both sexes, as follows:

1. In males, the genital ducts arise from the mesonephric (Wolffian) ducts.
2. In the females, the genital ducts arise from the paramesonephric (Müllerian) ducts.

Development of Paramesonephric (Müllerian) Duct

I. Indifferent stage
- It arises at first as a longitudinal invagination (or groove) in the coelomic epithelium, lateral to the cranial end of the mesonephric duct (or urogenital ridge).
- The edges of the groove fuse together forming a duct, called paramesonephric (or Müllerian) duct.
- Cranially, the paramesonephric (or Müllerian) duct remains open to be connected with the coelomic (abdominal) cavity.
- Caudally, it grows lateral to the Wolffian duct, then it crosses ventral to the duct to pass caudally on its medial side to reach the posterior wall of urogenital sinus. In the last part of its course, it lies in contact with its corresponding duct.
At this stage, the duct is formed of 3 portions:
1. Cranial vertical portion; lateral to the mesonephric duct.
2. Middle horizontal portion; ventral to the mesonephric duct.
3. Caudal vertical portion; medial to the mesonephric duct.

- The two adjacent "caudal" portions fuse together forming the **uterovaginal canal**.
- The caudal tip of this canal extends into the posterior wall of urogenital sinus, forming a bulge called **Müllerian (paramesonephric) tubercle**. This tubercle is located between the 2 openings of mesonephric ducts.

## II. Stage of differentiation
*(Fate of Müllerian ducts in both sexes)*

### A. In males:
The paramesonephric duct on each side disappears, except the:
- Cranial end, forming the **appendix testis**.
- Caudal end, forming the **prostatic utricle**.

### B. In females:
The paramesonephric ducts persist, forming the female genital ducts, as follows:

#### a. Fallopian tube:
develops from the cranial portion of the paramesonephric duct.
- This portion descends to lie transversely (with the descent of the ovary).
- Its end remains open and dilates to form a funnel-shaped **infundibulum** that gives rise to finger-like processes, called **fimbriae**.

#### b. Uterus:
develops from the middle (transverse) portions of the paramesonephric ducts and the cranial part of utero-vaginal canal.
- The horizontal portions form the **uterine horns** (or **cornua**).
- With further growth, the angular notch between the 2 horns elevates forming the rounded upper convex part of uterus, called **fundus**.
- The lower part of uterus develops from the upper part of **utero-vaginal canal**.
- The uterus is surrounded by a layer of mesenchyme, forming its **myometrium** and peritoneal layer forming the **perimetrium**.
c. Vagina: It develops from two sources. It develops from the lower part of utero-vaginal canal (mesodermal in origin). The small lower part of vagina develops from the definitive urogenital sinus (endodermal in origin).

**Development of Vagina**

- As a result of contact of the solid tips of the 2 paramesonephric ducts with the urogenital sinus, 2 evaginations called sinovaginal bulbs appear from the posterior wall of sinus.
- These bulbs form the solid vaginal plate.
- Later, central canalization of the vaginal plate occurs, leaving the peripheral cells that form the epithelium of the vagina.
- Until late in the female's fetal life, the lumen of the vagina is separated from the cavity of the urogenital sinus (vestibule) by the hymen.
- During the perinatal period, the hymen ruptures and remains as a thin fold of mucous membrane just within the vaginal orifice. It partially closes the vagina.

**Development of Broad Ligament**

- As the paramesonephric ducts extend caudomedially, they take transverse folds of peritoneum medially.
- After fusion of caudal portions to form uterovaginal canal, two peritoneal folds "broad ligaments" extend from the lateral sides of the developing uterus to the lateral pelvic wall.

![Diagram of Development of Broad ligament of uterus](image-url)
Figure showing development of female genital ducts (Coronal sections)

Figure showing development of uterus and vagina (sagittal sections)

Development of Mesonephric Duct
Development of mesonephric (Wolffian) duct

1. It develops from the intermediate mesoderm.
2. At first, it is called pronephric duct that opens into the cloaca, then it becomes mesonephric duct after its joining with about 70 S-shaped tubules (called mesonephric tubules).

N.B. For more details, see the development of kidneys.

Fate of mesonephric (Wolffian) duct:

In both sexes, the mesonephric duct gives rise to ureteric bud that forms ureter and shares in formation of kidney, as well as its caudal absorbed part forms the trigone of urinary bladder.

In addition, its cranial part down to origin of ureteric bud, forms the following:

I. In males:
   - It persists to form the genital ducts; epididymis, vas (ductus) deferens and ejaculatory duct as well as seminal vesicle (that arises during 3rd month as a diverticulum from the hind part of duct).

II. In females:
   - It degenerates except some remnants e.g. duct of epoophoron, duct of paroophoron and Gartner's duct (or cyst).

Fate of mesonephric tubules:

Most of tubules disappear, but few remain to form:

I. In males:
   a. Functional tubules called efferent ductules (vasa efferentia), connecting testis to the epididymis.
   b. Non functional tubules e.g. superior and inferior aberrant ductules, appendix of epididymis and paradidymis.

II. In females:
   - They degenerate, except few ones that form non functional tubules of epoophoron and paroophoron.
Fate of mesonephric and paramesonephric ducts in both sexes

Derivatives of paramesonephric ducts and genital ridge in females
Congenital anomalies of uterus

I. **Agenesis**: Absence of uterus, associated with absence of Fallopian tubes and vagina. This is due to failure of development of paramesonephric ducts.

II. **Hypogenesis** (hypoplasia): Infantile uterus is due to incomplete development. This may lead to infertility or recurrent abortions.

III. **Anomalies caused by imperfect fusion or development of the paramesonephric (Müllerian) ducts**:
   1. **Uterus didelphys**: Double uterus, double cervix and double vagina.
   2. **Uterus bicornis bicornis**: Two uterine horns, two cervices and one vagina, separated by a narrow septum.
   3. **Uterus bicornis unicollis**: Two uterine horns, one cervix and one vagina.
   4. **Uterus unicornis unicollis**: One uterine horn and one cervix.
      It is due to failure of development of the other paramesonephric duct.
   5. **Uterus unicornis with a rudimentary horn**: One uterine horn and the other horn is rudimentary. The small horn appears as an appendage connected to the well developed side.
      It is due to atresia of paramesonephric duct on one side.
   6. **Septate uterus**: Normal uterus but with a complete septum.
   7. **Subseptate uterus**: Normal uterus but with an incomplete septum, extending from the fundus.
   8. **Arcuate uterus** (depressed fundus): The uterus shows a slight depression at the fundus.
   9. **Cervical atresia**: due to atresia of the corresponding parts of the paramesonephric ducts.

Congenital anomalies of vagina

1. **Agenesis**: Absence of vagina is due to failure of development of the sinovaginal bulbs.
2. **Atresia of vagina**: due to failure of canalization of the solid vaginal plate.
3. **Double vagina**: due to failure of fusion of the 2 sino-vaginal bulbs. It is accompanied by double uterus.

4. **Septate vagina**: Vagina with a septum is due to incomplete fusion of the 2 sino-vaginal bulbs.

5. **Imperforate vagina**: due to failure of canalization of the solid vaginal plate.

6. **Imperforate hymen**: due to failure of its partial rupture at the perinatal period. It causes to accumulation of menstrual blood inside the vagina after puberty, leading to a condition called *hematocolpos*. This case is presented clinically by primary amenorrhea and cyclic lower abdominal pain every month and pelvic mass. Blood may extend into uterus. Accumulation of blood in the uterus is called *hematometra*. It is treated by surgical hymen incision with excision of the incised edges.

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![Diagram of congenital anomalies of uterus and vagina](image)