Medical School Histology Basics
Female Reproductive System

VIBS 289 lab

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OBJECTIVE

To learn the structure of the ovary, fallopian tube, uterus, cervix, and vagina

To learn how these organs contribute to the many functions of the female reproductive system

To learn how hormones regulate and/or orchestrate the female reproductive processes
Outline

General structure of the ovary
Follicular development

Fallopian tube
Uterus/Cervix/Vagina

Hormonal orchestration
Fertilization/ Pregnancy
Lactation
FEMALE REPRODUCTIVE SYSTEM
Function

The ovaries cyclically secrete steroid hormones and periodically release ova, the female gametes.

Ova production

Ova and sperm transportation

Microenvironments for fertilization

Implantation and fetal-placental growth

Nourishment and support of offspring

Postnatal repetition
OVARY

GENERAL STRUCTURE
- GERMINAL EPITHELIUM
- TUNICA ALBUGINEA
- MEDULLA
- CORTEX

FUNCTIONAL OVERVIEW

ORIGIN OF GERM CELLS
Ovary, monkey

- Cortex
- Medulla
- Tunica albuginea
- Germinal epithelium
- Primordial and primary follicles
Ovary

- Primordial and Primary follicles
- Oocyte
- Follicular cells
- Germinal epithelium
- Tunica albunginea
- Cortex
- Theca folliculi.

Granulosa cells of thestratum granulosum

Secondary follicle
FOLLICLE MATURATION

PRIMORDIAL FOLLICLES

• OOCYTE
• FOLLICULAR (GRANULOSA) CELLS

Primordial follicle

Oocyte
Stromal cell
Follicular cell
FOLLICLE MATURATION

PRIMARY FOLLICLE

- ZONA PELLUCIDA
- STRATUM GRANULOSUM
- THECAL FOLLICULI
- CALL-EXNER BODIES
FOLLICLE MATURATION

SECONDARY (ANTRAL) FOLLICLE

FOLLICULAR FLUID
MEMBRANA
GRANULOSA
CUMULUS OOPHORUS
CORONA RADIATA
THECA INTERNA
THECA EXTERNA

Granulosa cells

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FOLLICLES
Graafian follicles.

FOLLICLE MATURATION
GRAAFIAN FOLLICLE

Membrane granulosa

Graafian (mature) follicle

Theca externa
Theca interna
Liquor folliculi
Membrana granulosa
Corona radiata
Cumulus oophorus
Cells of the corpus luteum are lutein cells and most of them are formed from the granulosa (follicular) cells that remain after ovulation. The theca interna cells also form some of the lutein cells (they form the smaller lutein cells, called theca lutein cells).
Ovary

Oocytes, follicular cells, and surrounding connective tissue
EM 25: early primary follicle

1. Cytoplasm of primary oocyte
2. Zona pellucida
3. Follicular cell
Death of the oocyte and collapse of the zona pellucida. (not shown)
Separation and pyknosis of granulosa cells
“Glassy membranes”
OVULATION
After OVULATION, the CORPUS LUTEUM DEVELOPS FROM REMAINS OF FOLLICULAR WALL AFTER OVULATION
Granulosa lutein cells, secrete progesterone, the predominant postovulatory steroid.
Corpus luteum of ovary
Corpus luteum and corpus albicans of ovary
Ovary - corpus albican
HORMONES ORCHESTRATE THE PROCESS

Figure 23–9. Diagram showing the relationships of the hypothalamus, hypophysis, and ovaries. This feedback mechanism regulates the secretion of hormones produced in the ovaries.
OOGENESIS - FORMATION AND DEVELOPMENT OF OVA

MITOSIS (OOCYTOGENESIS) – OOGONIA
- PRENATAL DEVELOPMENT (RUMINANTS, RODENT, SWINE, HUMAN)
- POSTNATAL DEVELOPMENT (CARNIVORES)
OOGENESIS - FORMATION AND DEVELOPMENT OF OVA

MEIOSIS – OO CYTES
EARLY DEVELOPMENT
MATURATION ARREST (DICTYATE STEP OF MEIOTIC PROPHASE)
LATER DEVELOPMENT SYNCHRONIZED WITH DEVELOPMENT AND MATURATION OF FOLLICLES

DIVISION

• FIRST MEIOTIC DIVISION – REDUCTION DIVISION – FIRST POLAR BODY
• SECOND MEIOTIC DIVISION – EQUATIONAL DIVISION – SECOND POLAR BODY
MEIOSIS

Zygote
MEIOSIS (ONLY IN SPERMATOGENESIS AND OOGENESIS)

EXCHANGE OF GENETIC MATERIAL IN HOMOLOGOUS CHROMOSOMES (LEPTOTENE, ZYGOTENE, PACHYTENE, AND DIPLOTENE STEPS OF DEVELOPMENT)
Female

Primordial follicles

birth

OOGENESIS)

Primordial germ cells

Oogonia

Mitosis

Oocytes

Initiation of meiosis:

- Leptotene
- Zygotene
- Pachytene
- Diploptene (dictyate)

Meiotic arrest:

- On
- Off

Recombination

Fetus

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Female

Primordial

Birth

OOGENESIS

Initiation of Meiosis
- Leptotene
- Zygotene
- Pachytene
- Diplotene (dictyate)

Meiotic Arrest
- Off

Fetus
- Post partum
- Growth

Non-Growing
- Fully-grown

Resumption of Meiosis
- On

Unfertilised Eggs
- Metaphase II

MEIOSIS COMPLETE
FALLOPIAN TUBE (OVIDUCT OR UTERINE TUBE)

SEGMENTS

- INFUNDIBULUM WITH FIMBRIAE
- AMPULLA
- Isthmus
- INTRAMURAL SEGMENT
Ovary and infundibulum

The infundibular portion is open to the peritoneal cavity and has numerous finger-like fimbriae which are richly vascularized.

The fimbriae are lined with simple columnar ciliated epithelium.
Ampulla of oviduct

Labyrinthine structure of the mucosal folds of the ampulla region

Fimbriated end

Secretory cells

Ciliated cells

Muscularis

Contractions of these muscles are important for movement of the fertilized egg in the tube.
PHASES OF THE MENSTRUAL CYCLE

OVERVIEW

MENSTRUAL PHASE: DAYS 1-4

PROLIFERATIVE PHASE
- EARLY: DAYS 4-7
- LATE: DAYS 7-14

SECRETORY PHASE:
- EARLY: DAYS 15-21
- LATE: DAYS 21-28

MENSTRUATION
DECIDUAL REACTION
UTERUS

GENERAL STRUCTURE
PERIMETRIUM
MYOMETRIUM
ENDOMETRIUM
ZONA BASALIS
ZONA FUNCTIONALIS
SPIRAL ARTERIES

Figure 32-32. Photomicrograph of the uterus of a macaque in transverse section, illustrating the relative thickness of the myometrium and the late proliferative endometrium. ×9. (Courtesy of H. Mizoguchi.)
The uterus is composed of
1) a mucosa, the endometrium,
2) a large smooth muscle layer, the myometrium and
3) an outer serosa, the perimetrium.

Endometrium consists of tubular glands surrounded by stromal connective tissue.
UTERUS

1. Zona Basalis: The moderately thin zone at the bottom of the endometrium that interdigitates with the myometrium. Here the stroma is very compact and cellular and surrounds the bases of the glands. This layer does not respond to hormones and provides the structures from which the entire endometrium is regenerated every month.

2. Zona Functionalis: The large zone above the Zone Basalis to the surface. The stroma (connective tissue) surrounding the glands is more loosely arranged. This layer does respond to ovarian hormones and much of it is shed during menstruation and discharged from the vagina.
The endometrium

Diagrammatic representation of the glands and vasculature of the human endometrium.
The Menstrual Cycle:

Using a 28-day cycle, with day one representing the first day of menses (bleeding) and day 14 the time of ovulation, the phases of the cycle are as follows:

1. Menstrual phase: Occupies the first four days during which the functional zone is shed in tissue fragments.
2. Phase of repair, or early proliferative phase: Days 4-7
3. Phase of rapid growth, or late proliferated phase: Days 7-14
4. Luteal, or secretory phase: Days 15-28, often divided into roughly equivalent early and late phases.
Very Late Secretory phase

Spiral arteries became increasingly tortuous

. The decidual reaction = stromal cells have become larger with more voluminous cytoplasm.
HORMONES ORCHESTRATE THE PROCESS
Figure 32-15. Diagram of the various steps leading to fertilization of the ovum. (1) Sperm head binds to zona. (2) Acrosome reaction of sperm is induced in sperm head. (3) Zona is penetrated. (4) In perivitelline space, sperm head binds to oolemma and fuses with it. (5) Sperm sinks into the ooplasm (6) Sperm nucleus decondenses in preparation for conjugation with oocyte nucleus.
Fig. 26-12. Diagram illustrating the liberation of an oocyte from the ovary (lower right), entrance into the oviduct (lower right), fertilization, passage through the oviduct, and implantation in the endometrium, presented in an anticlockwise direction. The five segments of uterine wall shown represent, from top to bottom, the following stages: early cleavage, first cleavage division, pronuclei fuse, and so keeps up supply of progesterone which maintains endometrium. LH for a time, maintains corpus luteum. FSH matures follicle. LH causes ovulation. Sperm enters egg. Second maturation division begins.
Uterus with about 10 day old fetus – only the placental membranes are shown.

Endometrium, Myometrium, Perimetrium
CERVIX

VAGINA

ENDOCERVIX
  – CERVICAL MUCUS

EXTERNAL OS

ECTOCERVIX

VAGINA

STRUCTURAL COMPONENTS

EPITHELİUM
CERVIX

Endocervix (canal of the cervix) is covered by a simple columnar epithelium of mucous-secreting cells that lines deep crypts.

Ectocervix = junction of the differing types of epithelia occurs at the external os.

Smooth muscle

Stratified squamous epithelium

Endocervix (canal of the cervix) is covered by a simple columnar epithelium of mucous-secreting cells that lines deep crypts.
VAGINA

The tubular vagina has a thick wall consisting of a multilayered epithelium, lamina propria, muscularis and serosa. The vagina has no glands and lubrication comes from serum exudate during sexual activity.
Figure 23–21. Schematic drawing of female breast showing the mammary glands with ducts that open into lactiferous sinuses. The outlines of the lobules do not exist in vivo.

Figure 23–23. Diagram illustrating changes in the mammary gland. A: In nonpregnant women, the gland has an inactive duct system. B: During pregnancy, alveoli proliferate at the ends of the ducts. C: Lactating, milk secretion and accumulation in alveolar lumen.
Uterus, late secretory
1. Decidual cells
2. Spiral arteries
EM 26; trophoblast, 20,000x
1. Nucleus
2. Microvilli
3. Tubular cristae
hemochorial placenta = human placenta
**hemochorial placenta**

A type of **placenta** having the maternal blood in direct contact with the chorionic trophoblast.
Connective tissue

Connective tissue proper

Connective tissue with special properties

Supporting connective tissues

- Mucous tissue
  - Cartilage (Chapter 7)
  - Bone (Chapter 8)
NOURISHMENT AND PROTECTION OF OFFSPRING
Nipple
Breast, pregnancy
Breast, pregnancy
Breast during pregnancy
HORMONES ORCHESTRATE THE PROCESS
In summary

**Function**

The ovaries cyclically secrete steroid hormones and periodically release ova, the female gametes.

Ova production

Ova and sperm transportation

Microenvironments for fertilization

Implantation and fetal-placental growth

Nourishment and support of offspring

Postnatal repetition
1. The female reproductive system produces ova, transports ova and sperm, provides a microenvironment for fertilization, implantation of the fetal-placenta growth, and provides nourishment and protection post-natally. To accomplish these functions in constant repetition, coordination of organs is paramount. Examples of this coordination include:
   a. ovarian hormonal orchestration of the endometrial cycle
   b. ovarian hormonal feedback to the hypothalamus
   c. ovarian and pituitary orchestration of mammary gland development and lactation
   d. a and b
   e. a, b, and c

2. Oogenesis differs from spermatogenesis in:
   a. gonadal hormones that regulate the function of accessory sex organs
   b. cyclic nature of function of the ducts attached to the gonad
   c. the temperature of gonad
   d. a and b
   e. a, b, and c

3. Features of the fallopian tube include:
   a. ciliated epithelium on its luminal surface
   b. divisions known as the infundibulum, ampulla, and isthmus
   c. lymph vessels to add rigidity to the numerous finger-like fimbriae
   d. a and b
   e. a, b, and c
Many illustrations in these VIBS Histology YouTube videos were modified from the following books and sources: Many thanks to original sources!

The end of

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