Female Accessory Reproductive Organs

Ovarian Cycle: Oocytes & Oogenesis

- **Oogonia** (Germ cells) in ovaries go through mitosis producing oogonia & primary oocytes (2N)
  - Mitosis of germ cells until ~ 5 months after conception
  - All oogonia will develop into primary oocytes
  - Ovaries of a newborn have 2 - 4 million primary oocytes (eggs) (2N).
  - These primary oocytes begin meiosis
  - By puberty, there are about about 400,000 oocytes (and follicles).
  - Only ~ 400 oocytes will be ovulated in a lifetime.

Ovarian Cycle: Oogenesis

- Primary oocytes are contained within primary follicles.
  - FSH, stimulates some primary follicles to grow producing many layers of *granulosa cells*.
  - Some follicles (Secondary follicles) develop fluid-filled vesicles.
- **Mature Graffian follicle**: when fluid filled vesicles fuse to form an *Antrum*
- Some granulosa cells become *corona radiata*
- FSH also stimulates granulosa cells to secrete estrogens

Review of Oogenesis

- During fetal development meiosis I begins.
- After puberty, primary oocytes complete meiosis I, which produces a secondary oocyte and a first polar body that may or may not divide again.
- The secondary oocyte begins meiosis II.
- A secondary oocyte (and first polar body) is ovulated.
- After fertilization, meiosis II resumes. The oocyte splits into an ovum and a second polar body.
- The nucleus of the sperm cell and the ovum unite, forming a *zygote* (2N) egg.

Ovarian Cycle: Follicles

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- **Mature Graffian follicle**: when fluid filled vesicles fuse to form an *Antrum*
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Ovarian Cycle Summary

Granulosa cells of Graafian follicle release Mullerian Inhibiting hormone that keeps other Primary follicles from maturing.

The Cycles

- Gametes produces in monthly cycles of ~28 days
  - Menstrual cycle: So named for 3-7 days of menstruation (menses)

- Menstrual cycle can be described by:
  - following changes in the follicles that occur during ovarian cycle
  - following changes in endometrial lining of uterus during (Uterine cycle)

- Follicular changes in the ovarian cycle can be broken into three phases:
  - Follicular phase
  - Ovulation
  - Luteal phase

Ovarian Cycle: Follicular Phase

- FSH stimulates a number of follicles to mature
  
  As follicles grow:
  - granulosa cells release MHH
  - theca cells release estrogens

  - Increased estrogen levels:
    - Stimulate granulosa cells to secrete estrogens
    - Exerts negative feedback on Hypothalamus and Pituitary
    - Endometrium starts to grow
    - Mucous glands of cervix to produce watery mucous

Ovarian Cycle: Ovulation phase

- Follicle ruptured & egg is released into fallopian tube
- Follicle thecal & granulosa cells transform into luteal cells and the follicle becomes the Corpus luteum

Ovarian Cycle: Follicular Phase

- As follicular phase nears its end only one follicle is developing
  - Estrogen secretion peaks

- Granulosa cells secrete Inhibin and Progesterone
  - Inhibin: Creates Negative feedback on Pituitary (FSH)
  - Progesterone (and high estrogen) have positive feedback on hypothalamus (LH surge)

- High Progesterone and Estrogens promote continued buildup of endometrium

- LH surge causes Ovulation (Ovulation Phase)
Ovarian cycle: Luteal Phase

- Corpus luteum secretes Progesterone & some estrogen:
  - Exerts negative feedback on hypothalamus and pituitary gland (Inhibin also inhibits FSH)
  - Endometrium continues to prepare for implantation
  - Progesterone causes cervical plug (to keep out sperm & bacteria)
- Corpus luteum lasts ~12 days
  - If no pregnancy it undergoes apoptosis (corpus albicans)
  - No estrogen and progesterone
    - Endometrial Blood Vessels contract and O2 starved cells die (menstrus)
- Low levels of Estrogen an progesterone initiate new cycle
  - i.e, Negative feedback removed Hupothalamus secretes GnRH

Menstrual and Ovarian Cycles

Implantation

- 6 days after fertilization, trophoblast cells secrete enzyme that allows blastocyst to "eat" into the endometrium.

Blastocyst Development

- Trophoblast secretes enzymes that eat into endometrium and endometrial cells grow outward and around the blastocyst
- Some Trophoblast cell enzymes digest into endometrium forming blood-filled cavities
  - Other trophoblast cells form chorionic villi that invade the cavities
  - i.e., chorionic villi (Chorion frondulosum ) are surrounded by maternal blood
- Other trophoblast cells form the chorion – an extraembryonic membrane that will surround the embryo and form the placenta
- The inner cells

Phases of Female Reproductive Cycle
Development of extraembryonic membranes

- From day 7 to day 12 (cont.)
  
  The inner cells mass (embryoblast) also develops:
  - Endoderm: will become the gut organs
  - Ectoderm: will become skin and nervous system
    (Mesoderm develops later and gives rise to muscle and connective tissues)
  - 3 other extra-embryonic membranes:
    - Yolk Sack
    - Amnion
    - Allantois

Extraembryonic membranes

- Chorion: Becomes part of placenta (also fetal nutrition, waste removal)
- Amnion: Surrounds embryo, filled with fluid
- Yolk sac: contributes to formation of digestive tract, first blood cells
- Allantois: becomes caudal end of gut, forms foundation of umbilical cord

Placenta and exchange

- Maternal and fetal blood do not mix.
- Molecules diffuse (some are transported) across tissues of placenta
  - Oxygen and nutrients diffuse from maternal blood to fetal blood
  - CO\(_2\) and wastes diffuse from fetal blood to maternal blood

Endocrine Functions of the Placenta

- Placenta secretes hormones:
  - Chorionic gonadotropin Hormone: acts like LH (maintains corpus luteum)
  - Chorionic somatomammotropin (along with GH): promotes lipolysis to increase blood fatty acid levels so mom’s cells get energy while keeping glucose levels high so Jr. can get energy.

Development

- Maternal tissue in contact with chorionic frondosum = decidua basalis (together = placenta)
Labor and Parturition

• What initiates labor isn’t completely clear
  – Is the signal for Jr? Mom? Or Placenta?
  – All are involved in Parturition

• We do know some of the things that occur

DHEAS = dehydroepiandrosterone