Oogenesis

• Development of ovum (oogenesis)
• Maturation of follicle
• Fate of ovum and follicle

Fundamental reproductive unit = single ovarian follicle, composed of one germ cell (oocyte), surrounded by endocrine cells
OOGENESIS

- Maturation of Oocytes Begins Before Birth

- Once primordial germ cells have arrived in the gonad of a genetic female, they differentiate into oogonia

- These cells undergo a number of mitotic divisions and, by the end of the third month, are arranged in clusters surrounded by a layer of flat epithelial cells

- All of the oogonia in one cluster are probably derived from a single cell,

- the flat epithelial cells, known as follicular cells, originate from surface epithelium covering the ovary.
**Oogonium (44XX)**
- In fetal ovary

**Primary oocyte (44XX)**
arrest till puberty in prophase of 1st phase meiotic division

**Secondary oocyte (22X) + Polar body (22X)**
1st phase meiotic division completed at ovulation & enter in 2nd phase

**Ovum (22X) + polar body (22X)**
After fertilization
Oogenesis:
Oogonia produced by mitotic division, then at 8-9 wks of gestation, prophase of 1st meiosis starts – becomes primary oocyte.
Number of primary oocytes decreases throughout childhood from 1-2 mil to 400,000 just before puberty – surrounded by pre-granulosa cells – called primordial follicle – complete about 6 mos. after birth.
Follicular Development
Recruitment
Maturation
MATURATION OF FOLLICLE:

Primordial follicle
  - Follicular cells

Primary follicle
  - Zona pallucida
  - Granulosa cells

Secondary follicle
  Antrum developed

Ovarian / Graafian follicle
  - Theca interna & externa
  - Membrana granulosa
  - Antral cavity
  - Discus proligerus
  - Cumulus oophoricus
At birth (no further development until sexual maturity)

FSH, LH secretion at sexual maturity

Primordial follicles containing primary oocytes

Early primary follicle

Primary follicle

Secondary follicle

Graafian follicle containing secondary oocyte

First meiotic division starts

Second meiotic division starts

If no fertilisation

Corpus albicans

Corpus luteum

Ovulation
Formation of Corpus luteum
- After ovulation ovarian follicle
  Ruptured and folded

Corpus luteum
- Follicular cells/ granulosa cells
  - Cells of membrana granulosa
  - lutien pigment
- Luteal cells
- Thecal cells
Two phase of ovulation:
1. Follicular Phase
2. Luteal Phase

Hormones:
1. Progesterone
2. Estrogen
3. LH
4. FSH
Thecal cells – superficial – no aromatase – have only LH Receptors – can get cholesterol from LDL in blood
Granulosa cells – interior – have aromatase, but no 17\(^\alpha\)-hydroxylase (17,20-desmolase) – (Converts pregnenolone to 17\(^\alpha\)-hydroxyprogrenolone to DHEA)
And progesterone to 17\(^\beta\)-progesterone
– get cholesterol from de novo synthesis – have both LH and FSH receptors
If androgen levels high, preferentially forms DHT from Testosterone – and inhibits aromatase activity – decr. estradiol, inhibit synthesis LH R

Chemical mechanics of ovulation:
LH surge prostaglandin endoperoxide synthase in granulosa cells (sets up pseudoinflammatory response)
FSH (some LH) stimulates release of plasminogen activator from granulosa cells (converts plasminogen to plasmin)
Prostaglandins E and F release lysosomal enzymes that digest follicular wall – not completely understood
“Stigma” – form on surface of follicle, balloons out, forms vesicle and ruptures – oocyte expelled
Process facilitated by intrafollicular pressure and contraction of smooth muscle in theca
1. **Follicular Phase**
   - Low level of estrogen inhibits production of LH and FSH (keeping their levels low)
     - Inhibits AP to prevent ovulation

2. **Ovulation**
   - High estrogen stimulates LH and FSH production
     - More effect on LH than FSH
   - Stimulates AP to cause ovulation

3. **Luteal Phase**
   - High levels of progesterone and estrogen inhibits LH and FSH production
   - Inhibit AP and Hypothalamus
Corpus Luteum

• After ovulation, empty follicle becomes a corpus luteum.
  – Corpus Luteum secretes:-
    • Progesterone – completes the preparation of uterine lining
    • Estrogens – work with progesterone
    • Relaxin – relaxes uterine muscles and pubic symphysis
    • Inhibin – decreases secretion of FSH and LH

• Corpus albicans is a white scar tissue left after the corpus luteum dies.
Fate of follicle
• **Corpus luteum**
  - Corpus albicans
• **Corpora atretica**
  - Interstitial gland
Corpus luteum
- Provides necessary hormones for implantation of ovum and maintenance of zygote until placenta can take over 80% granulosa cells, 20% thecal cells
If no fertilization, it will regress in about 14 d
Avascular scar = corpus albicans

Ovarian cycle – follicular phase – avg 15 d (range, 9-23 days) ovulatory phase – 1-3 d – culminates with ovulation luteal phase – 13 d – less variable than follicular
Endometrial cycle – menstruation, proliferative and secretory Phase
Menstrual Cycle controlled by gonadotropin and gonadal hormone
Oocyte/Egg

Fertilization

Menstruation

Corpus luteum

- Corpus luteum of pregnancy

- Corpus luteum of menstruation

Next Lecture on Fertilization and Implantation...