Female reproductive system

I. Introduction

- female reproductive system far more complex than male:

- production of sex cells
- production of sex hormones
- receive penis during sexual intercourse
- create environment for implantation
- create environment for embryo development

- sex organs: ovaries; produce eggs and sex hormones

- accessory ducts: oviducts (uterine tubes), uterus, vagina

- external sex organs: external genitalia, vulva

- mammary glands

II. Anatomy of female reproductive system

A. Ovaries

- paired, flank uterus on each side, almond-shaped

- X-section: outer layer with forming gametes at different stages of development; inner layer region has blood vessels, nerves

- in cortex see ovarian follicles: one or more layer(s) of cells surrounding an immature egg, oocyte

- surrounding cells called follicular cells
- at birth woman has many follicles each containing an oocyte
- every month at least one follicle and associated oocyte stimulated to develop
- follicle matures, oocyte "released" through ovulation
    - fertilization -- completes maturation
- "leftover" follicle -- corpus luteum -- becomes endocrine gland

B. Uterine tubes

- receive ovulated oocyte, provide site where fertilization occurs; very muscular walls

- fimbrae with cilia draw egg into tubes; peristalsis moves egg to uterus

- ectopic pregnancy -- fertilization and implantation in peritoneal cavity

C. Uterus

- hollow, thick walled organ: receives, retains, nourishes fertilized ovum

- size/shape of inverted pear; during pregnancy up to 60X original size

- layers:

- perimetrium: outermost, visceral peritoneum
- myometrium: bulky, interlacing bundles of smooth muscle
- endometrium: mucosal lining of uterine cavity, undergoes cyclical changes in response to blood levels of ovarian hormones

D. Vagina

- thin-walled tube, 8-10 cm long, extends from vestibule to cervix

- receives penis/semen during intercourse
- provides passageway for delivery during childbirth
- highly distensible wall
- very well vascularized
- acidic mucosa to prevent infection

E. External genitalia

- collectively known as vulva

- mons pubis
    - rounded area overlying pubic symphysis
- labia majora
    - two hair-covered skin folds surrounding vaginal and urethral openings
    - homologous to male scrotum

- labia minora
    - two hairless skin folds
    - enclose space called vestibule
    - homologous to ventral penis
- vestibule
    - space within labia minora that contains external openings of urethra and vagina
    - flanking vagina are vestibular glands that release mucous into vestibule
        - moisten, lubricate, facilitate intercourse
        - homologous to bulborethral glands in male
- clitoris: anterior to vestibule
    - erectile tissue, homologous to penis
    - covered by thin fold, prepuce

F. Mammary glands:

- present in both sexes only functional in female; modified sweat glands
- internally divided into 15-20 lobes by CT
- lobes divided into lobules that contain secretory units or alveoli that empty secretion into lactiferous duct system
- unite at nipple

III. Physiology of female reproduction

A. Oogenesis

- note that in male gamete production begins at puberty; in female preparation for gamete production begins in fetus

- stem cells -- oogonia
- oogonia divide mitotically (several million) enlarge, mature -- before birth
- cells become primary oocytes when they begin first meiotic division (DNA replicated)
    - division is stalled prior to birth
- primary oocyte enclosed by follicular cells

- at puberty under appropriate stimulation
    - follicle growth
    - completion of first meiotic division
        - secondary oocyte and polar body
    - ovulation
    - when fertilized second meiotic division takes place
        - ovum and polar body

- thus at birth all of women's potential eggs formed: of about 2 million follicles, at birth about 700,000 remain; by puberty about 300-400,000 left

B. Ovarian cycle

- follicular phase: period of follicular growth, d1-d14

- luteal phase: period of corpus luteum activity, d14-d28

1. follicular phase
    - starting at puberty a group of follicles stimulated to continue development every 28 days
    - follicle cells divide
        - follicle cells begin to produce estrogen
    - complete meiosis I
    - ovulation
    - meiosis II

2. luteal phase:
    a. remaining follicular cells begin producing progesterone, estrogen -- corpus luteum (CL)
    b. if fertilization occurs, the embryo produces human chorionic gonadotrophin (HCG) which maintains CL until placenta can kick in its own progesterone/estrogen production
    c. if fertilization does not occur, CL degenerates as no HCG

C. Hormonal regulation of ovarian cycle

- feedback inhibition patterns:
  - low level of estrogen inhibit FSH/LH
  - high level of estrogen stimulate LH/FSH release

D. Uterine cycle: menstrual cycle, regulated by ovarian hormones
  - d1 of cycle, est/prog very low -- shed endometrium
    - FSH level begin to increase due to lack of feedback inhibition
  - FSH stimulates follicle growth
    - follicles produce estrogen
    - uterine build up
  - as estrogen levels increase, LH/FSH spike
    - ovulation
    - estrogen levels begin to drop
    - corpus luteum develops -- secretes progesterone/some estrogen
      - builds up endometrium and prepares it for implantation
      - depending if HCG present or not, CL maintained or degenerates and likewise endometrium

E. Extra-uterine estrogen effects

- female secondary sex characteristics: increased deposits of subcutaneous fat, widening, lightening of pelvis; growth of axillary and pubic hair.

- maturation of reproductive structures

F. Female sexual response

1. excitement or arousal:
    - sexual arousal results from:
        - psychological stimuli
        - physical stimuli
            - tactile stimulation of clitoris and external genitalia
    - stimuli trigger neural reflexes
        - parasympathetic induced vasodilation of arterioles throughout vagina and external genitalia
        - swelling of labia
        - erection of clitoris - more sensitive to stimulation
        - increased flow through vaginal capillaries
            - fluid forced out of vessels into vaginal lumen
            - lubricant for intercourse
        - increased vestibular gland activity
        - breast enlarge and nipples erect as result of vasocongestion
            - nipples very sensitive -- stimualtion increases neural influences on vagina, external genitalia

2. Plateau

- changes initiated during excitement phase intensify
    - lower third of vagina swells with blood
        - tighten around penis
    - simultaneously uterus contracts upwards, lifts cervix, enlarges upper two thirds of vagina
        - space for ejaculate
    - systemic effects
        - increased BP, respiratory rate, muscle tension

3. Orgasm

- at certain level of arousal, massive, whole body neural discharge

- lower third of vaginal canal and uterus contract rhythmically
- pelvic musculature contracts rhythmically
- increased HR/BP
- endorphin/enkephalin release
- sexual intensity can diminish to plateau -- brought back to peak again
    - no refractory period
    - no ejaculate