Male Reproductive System

• Functions
  • Sperm (and other semen components) production and delivery
    • Scrotum, testes, epididymis, vas deferens, urethra, prostate gland, seminal vesicle, bulbourethral gland, penis
  • Testosterone production
    • Testes (primary sex organ)
Male Reproductive System

Scrotum
- Storage sac for testes
- Cremaster muscle: extension of external oblique
  - Contracts to draw scrotum in towards body or relaxes to allow scrotum to drop away from body
- Ideal temperature for sperm production and longevity: 34°C

Male Reproductive System

Penis
- special erectile tissue (corpora cavernosa) that elongates and stiffens when filled with blood

Urethra
- tube through penis that carries both ejaculated semen and excreted urine
  - longer in males than females, acidic urine through urethra lessens risk of bladder infections in male
Male Reproductive System

- Circumcision: removal of prepuce (foreskin)
  - Usually done without anesthesia on babies
  - Most evidence finds it medically unnecessary, although often important for religious rituals
  - Multiple lines of evidence suggest that circumcision can reduce HIV transmission risk for men (most studies showed at least 40% reduction in risk), and reduce the risk for other sexually transmitted infections

Male Reproductive System

- Accessory glands for semen production
  - Seminal vesicles
  - Prostate gland
  - Bulbourethral gland
Male Reproductive System

- Seminal vesicles
  - adds majority of semen ejaculated (60%)
  - increases pH of vagina
- Prostate gland
  - 30% of semen, also increases pH
- Bulbourethral gland
  - 5% of semen
  - also pre-ejaculatory fluid, lubricant (mucous)
  - flushes urethra of urine residue

Sperm Production

- Testes: both sperm production and testosterone production
  - sperm is made in seminiferous tubule, supported by Sertoli Cells
Sperm Production

- Sperm develop through both mitotic and meiotic divisions

- Sperm then mature in the epididymis, where they remain for 10-14 days

- From the epididymis, sperm are then stored in the vas deferens (ductus deferens) for up to about a month

- Degenerate there if not ejaculated
Mature Sperm

- Minimally complicated – equipped for rapid movement and egg penetration
- Sperm head has enzyme coating (acrosome) to aid in penetrating egg
- Head contains DNA to contribute in fertilization
- Midpiece contains mitochondria
- Tail contains microtubules for locomotion

Vasectomy

- cutting the vas deferens so that sperm cannot leave testicle and be ejaculated
  - no loss of virility (libido, maleness) because testosterone is still produced by Leydig Cells and carried into blood stream
  - no loss of sexual response (due to hormones and nervous system reflex
  - no loss of ejaculate volume, which is primarily determined by seminal vesicles
  - 99+% effective
Testosterone Production

- Testosterone and FSH are necessary for spermatogenesis
- LH is necessary for testosterone production
- Testosterone level is regulated by negative feedback control
Female Reproductive System

- Functions
  - Ovum production and fertilization
    - Ovaries, uterine tubes, uterus, cervix, vagina, and external genitalia
  - Pregnancy
    - Ovaries, uterus, vagina
  - Hormone production
    - Ovaries (primary sex organs)
Ovarian Cycle

- each month, several primordial follicles begin to develop
  - FSH from the anterior pituitary stimulates the development
- only one, though, becomes the “dominant” primary (preantral) follicle
  - the developing follicle secretes estrogens until ovulation
- it ultimately develops into a mature Graafian follicle just prior to ovulation
**Ovarian Cycle**

- at ovulation, the Graafian follicle ruptures, releasing the secondary oocyte out of the ovary
- the ruptured follicle (corpus hemorrhagicum) then becomes the corpus luteum (yellow body)
  - secretes lots of progesterone and some estrogen
- if pregnancy does not occur, the corpus luteum ultimately degenerates into a corpus albicans (white body)
- if the oocyte is fertilized, the corpus luteum is maintained for 3-4 months

**Fertilization**

- once ovulated, the oocyte travels down the Fallopian tube (the fimbriae help guide the oocyte into the tube), moving toward the uterus
- the trip to the uterus takes about 5-6 days
  - if fertilization is going to take place, it ideally does so in the ampulla of the Fallopian tube about 24 hours after ovulation
Fertilization

• while the follicle is developing, the estrogens secreted by the follicle have been stimulating growth of the endometrial lining of the uterus
  • especially important is the development of a large number of blood vessels in the endometrium, to nourish an implanted zygote
  • the myometrium (muscular wall just outside of the endometrium) of the uterus will contract during labor when an implanted zygote is ready for delivery

28 Day Menstrual Cycle

• Changes in hormone levels drive the development of a mature ovum and the preparation of the uterine wall to receive a fertilized egg
28 Day Menstrual Cycle

- follicular development takes place in the follicular phase of the ovarian cycle (day 1-14)
  - stimulated by FSH (secreted by AP)
  - estrogens secreted by follicle stimulates the proliferation (growth) of the endometrium
    - this is called the proliferative phase of the uterine cycle (day 7-14)

- high levels of estrogens cause the anterior pituitary to switch from mostly FSH secretion to mostly LH secretion in response to GnRH
  - an LH “surge” occurs, peaking at day 13
  - the LH surge causes changes in the follicle that result in its rupture and release of the oocyte (ovulation, day 14)
28 Day Menstrual Cycle

• the development of the corpus luteum from the Graafian follicle causes a change from estrogen secretion to mostly progesterone secretion (luteal phase of ovarian cycle, day 14-28)
• the secreted progesterone is necessary to maintain the developed endometrial wall (secretory phase of uterine cycle, day 14-28)

• without pregnancy, the corpus luteum dies off, becoming the corpus albicans
  • the corpus albicans secretes no hormones, so progesterone levels drop dramatically
  • the drop in progesterone causes the blood vessels of the endometrial lining to vasoconstrict, which starves the endometrial cells (functional zone)
• the endometrium cells then die and slough off (menstruation, day 1-7 of uterine cycle)
28 Day Menstrual Cycle

- If pregnancy does occur, then the chorion of the implanted fetus quickly secretes human chorionic gonadotrophin (hCG), which maintains the corpus luteum.
- Since the corpus luteum continues to secrete progesterone, the endometrium (with the implanted fetus) is maintained.
Hormonal Contraceptives

- most are high in progesterone, low in estrogen
  - high progesterone in the follicular phase of the ovarian cycle feeds back to hypothalamus, which does not secrete much GnRH as a result
  - low GnRH secretion means low FSH
  - low FSH means follicle doesn't develop, estrogen doesn't get secreted by follicle, and LH surge does not occur
  - without LH surge, ovulation does not occur and pregnancy cannot result

Development During Pregnancy

- fertilization ideally takes place 24 hrs after ovulation in the ampulla of the Fallopian tube
Development During Pregnancy

- the zygote very quickly starts to divide
- a blastocyst with an inner cell mass that will become the fetus is present within 5 days, a day before implantation

Implantation occurs 6 days after ovulation when the blastocyst attaches to the endometrial wall and begins to produce cells that will become the chorion (the fetal portion of the placenta)

- soon thereafter (day 10), the amnion and yolk sac develop
Development During Pregnancy

• The chorion is developing chorionic villi, which are projections that reach out to almost touch maternal endometrial blood vessels.

• The chorionic villi will become filled with fetal blood vessels that connect back to the umbilical cord.
Development During Pregnancy

- the chorion and the associated portion of the endometrium are called the placenta
  - provide four main functions:
    - exchange of oxygen and carbon dioxide
    - storage of nutrient for the fetus
    - protection against certain pathogens (most bacteria, some viruses are small enough to slip through)
    - production of hCG at least through the first trimester to maintain the endometrium ultimately, the chorion itself will secrete progesterone and estrogens to maintain the endometrium through the rest of the pregnancy