Urogenital System

Objectives - see handout or website
Urogenital System
shared ducts due to evolutionary legacy and development

**Urinary or Excretory System**
- blood filtration and excretion of salts and nitrogenous wastes
- osmoregulation
- hormonally mediated influence on blood pressure

**Reproductive System**
- procreation (and recreation)
- hormonally mediated influence on other organ systems and behavior
Organs of the Excretory or Urinary System

- Kidneys
- Ureters
- Urinary bladder
- Urethra
- External Genitalia
Kidneys

**Perirenal Fascia** – contains kidney and adrenal gland
**Perirenal Fat** – cushions kidney within location
  retroperitoneal on superior posterior abdominal wall
both kidneys
  “capped” superiorly by suprarenal (= adrenal) gland
  anterior to quadratus lumborum muscle and lowermost ribs

Right Kidney
  Superior margin – 11\textsuperscript{th} intercostal space
  Superior and anterior – suprarenal gland and liver
  Anterior inferiorly – colon
  Medial – duodenum

Left Kidney
  Superior margin – 11\textsuperscript{th} rib
  Superior – suprarenal gland and respiratory diaphragm
  Anterior – stomach (superior to hilum), pancreas (at hilum), jejunum
  (inferior to hilum)
  Anterior/left – spleen
Kidneys
Renal Capsule
Hilum
  medial surface
  entrance of renal artery, exit of renal vein and ureter, from which the
  kidney is more or less suspended
Cortex – granular appearance
Medulla – striped appearance
  Renal Pyramids
Renal Pelvis
Nephron

microscopic functional unit of the kidney

**Cardiovascular component** – ultrafiltration

Afferent Arteriole (most in cortex)

Glomerulus (most in cortex)

Efferent Arteriole (most in cortex)

Peritubular Capillaries or Vasa Rectae (in medulla)

**Collecting duct component** – countercurrent multiplier

(continued)
Collecting Duct Components of the Nephron

- Glomerular or Bowman’s Capsule (cortex)
  - envelops glomerulus
- Proximal Convoluted Tubule (most in cortex)
- Loop of Henle (in medulla)
- Distal Convoluted Tubule (most in cortex)

Collecting system uniting multiple Nephrons

- Collecting Tubule
- Renal Papilla
- Minor Calyx (pl. calyces)
- Major Calyx (pl. calyces)
- Renal Pelvis
  - most proximal part of ureter
Juxtaglomerular Apparatus
self-regulation of kidney
compares blood pressure in Afferent and Efferent Arterioles
measures osmolarity of Distal Convoluted Tubules
Renin
stimulates conversion of angiotensinogen→Angiotensin I
(angiotensinogen secreted by liver into blood)
Angiotensin I→Angiotensin II (= Vasopressin or Antidiuretic Hormone) in lungs
increases blood pressure by vasoconstriction
increases water and salt resorption by kidney
antidiuretic
Ureters

conduct urine from kidneys to urinary bladder
thin walled
smooth muscle
retroperitoneal on posterior abdominal wall
enter urinary bladder posterolaterally
open within trigone of urinary bladder on posterior wall
Urinary Bladder
storage organ
Diuresis = Micturition = Urination = Voiding

location
posterior to pubic symphysis in pelvic cavity
Females – anterior to vagina, inferior to uterus (posteriorly)
Males – anterior to rectum, superior to prostate gland

Rectovesical pouch - males
Vesicouterine pouch - females
Urinary Bladder

layers
- transitional epithelium
- smooth muscle – **detrussor muscle**
- adventitia and peritoneum

parts and surfaces:
- Roof
- Inferolateral walls
- Base
- Apex

**Urachus** – extends from apex within median umbilical ligament
- occluded vestige of **allantois** ending at umbilicus

**Urachal Fistula** (pathology)

**Trigone**
- triangular area of smooth epithelium of inferior base
- located between openings of ureters and urethra
Urethra
expels urine
passes through urogenital diaphragm

Divisions:
<table>
<thead>
<tr>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostatic</td>
<td>within Prostate Gland</td>
</tr>
<tr>
<td>Membranous</td>
<td>Membranous</td>
</tr>
<tr>
<td></td>
<td>passes through Urogenital Diaphragm</td>
</tr>
<tr>
<td></td>
<td>within Corpus Spongiosum</td>
</tr>
<tr>
<td></td>
<td>of penis</td>
</tr>
</tbody>
</table>
External Genitalia

Male

Penis
  Glans
  Prepuce
  Body
Scrotum

Female

Labia Majora (s. Labium Majus)
Labia Minora (s. Labium Minus)
Clitoris
Vestibule of the Vagina
### Fetal Differentiation of the External Genitalia

<table>
<thead>
<tr>
<th>Undifferentiated</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genital Tubercle</td>
<td>Glans Penis of the Corpus Spongiosum</td>
<td>Clitoris</td>
</tr>
<tr>
<td>Urogenital Sinus</td>
<td>lumen of the Spongy Urethra</td>
<td>Vestibule</td>
</tr>
<tr>
<td>Urogenital Folds</td>
<td>Spongy Urethra</td>
<td>Labia Minora</td>
</tr>
<tr>
<td>Labioscrotal Folds</td>
<td>Scrotum</td>
<td>Labia Majora</td>
</tr>
</tbody>
</table>
Male Reproductive System

Testes
sexual ducts
glands
erectile tissues

Penis

Scrotum
contents:
receives Spermatic Cord
Tunica Vaginalis
Testes
Epididymis
Gubernaculum
Testes

internal architecture:

- Capsule or Tunica Albuginea
- Septa
- Seminiferous tubules
  - Interstitial cells
    - Sertoli cells – supportive
    - Leydig cells – secrete testosterone
  - Spermatogonia – reproduce by mitosis throughout life

Rete Testis

Efferent Ductules or Vasa Efferentia

Spermatogenesis – two meiotic cell divisions producing gametes
  - Primary Spermatocytes → Secondary Spermatocytes → Spermatids

Spermiogenesis – morphological maturation of gametes
  - Spermatids → Spermatozoans
Male Sexual ducts

Epididymis – head, body, tail

within Tunica Vaginalis of Scrotum

Vas (or Ductus) Deferens

path:

1) begins within Tunica Vaginalis of Scrotum
2) Spermatic Cord

parts and contents:

Dartos muscle
Cremaster muscle
Pampiniform Plexus of Testicular vein
Testicular Artery and Vas Deferens

3) Inguinal Canal
4) crosses roof and base of urinary bladder medial to ureters and Seminal Vesicles

(continued)
Male Sexual ducts

Ejaculatory Ducts
  union of Vas Deferens and Seminal Vesicles

Prostatic Urethra
  Prostatic Utricle
  openings of Ejaculatory Ducts

Spongy or Penile Urethra
  Intrabulbar Fossa (more on this later)
  Navicular Fossa
Semen vs sperm

Male Sexual Glands

1) Seminal Vesicles
   paired on base of Urinary Bladder lateral to Vas Deferens
   join Vas Deferens to form Ejaculatory Ducts

2) Prostate
   unpaired
   surrounds Prostatic Urethra
   inferior to Urinary Bladder
   anterior to Rectum
   superior to Urogenital Diaphragm

(continued)
Male Sexual Glands (continued)

3) **Bulbourethral or Cowper’s Glands**
   paired
   within **Bulb of Penis**
   open to **Intrabulbar Fossa**
   homologous to **Greater Vestibular glands** of female

4) **Intrinsic Glands** of the **Spongy Urethra**
   pre-ejaculatory secretions
Male Erectile tissues

1) Corpus Spongiosum
   unpaired parts:
   Bulb of Penis, including:
   - Intrabulbar Fossa – widening of urethra
   - Bulbospongiosus muscle – responsible for ejaculation
   - Bulbourethral Glands
   - Spongy Urethra
   - Glans Penis

2) Corpora Cavernosa (sing. Corpus Cavernosum)
   paired forms Body of Penis
   - Crura – buttressed by Inferior Rami of Pubes
Female Reproductive System

Ovaries
sexual ducts
Oviducts or Fallopian Tubes
Uterus
Vagina
mesenteries
external genitalia
erectile tissues
glands
Ovaries

paired
intraperitoneal
suspended from posterolateral abdominal wall
walnut-size

internal architecture:

Stroma

Follicles

Follicular or Granulosa cells

Oocytes

1000-2000 at birth
non-replicating

Oogenesis

Oogonia reproduce mitotically before birth

Primary Oocytes: Oogenesis arrested in **Prophase** of first **meiotic** division until puberty or even *much* later in life

Secondary Oocytes: develop within maturing follicle prior to ovulation; second meiotic division arrested in **Metaphase** completion of **meiosis II** stimulated by **fertilization**
Female Sexual ducts

1) **Oviducts or Fallopian Tubes**
   - paired
   - intraperitoneal
divisions, listed from proximal to distal:
   a) **Ostium** – opening to peritoneal cavity, facing medially toward ovary
   b) **Fimbria** – finger like margins of **Ostium**
   c) **Infundibulum** – normal site of **fertilization**
      - ~ 10 days for embryo to move to and implant in **Uterus**
   d) **Ampulla** – widening
   e) **Isthmus** – narrowing proximal to **Uterus**

2) **Uterus**
3) **Vagina**
Uterus
unpaired (normally)
located in Pelvic Cavity
superior to Vagina and posterior of Urinary Bladder
anterior to Rectum
intraperitoneal
Layers of Uterus listed from luminal to superficial:

1) **Endometrium** - mucosa epithelium connective tissue, supporting: arteries
   **Spiral Glands**

2) **Myometrium** - smooth muscle stimulated by **oxytocin** (secreted by Neurohypophysis or Posterior Pituitary)

3) **Peritoneum**
Parts of Uterus
- Fundus
- Body
- Cervix
- Ostium
- External Os
- Internal Os
- Cervical Plug
Vagina

unpaired
located in Pelvic Cavity
posterior to Urinary Bladder
anterior to Rectum
inferior to Uterus
superior to Urogenital Diaphragm
opening to Vestibule posterior to Urethra
Layers of Vagina from luminal to superficial:

1) **Mucosa**
   - stratified squamous epithelium, lightly keratinized or cornified intrinsic glands?

2) **Muscularis**
   - smooth muscle
   - voluntary **Bulbospongiosus muscle** inferiorly

3) **Adventitia**
Mesenteries of the Female Reproductive system

Suspensory ligament – of Ovaries

Broad ligament – of Uterus

Mesovarium – between Epööphoron and Ovary

Mesosalpinx – between Epööphoron and Oviduct

female homologs of the Gubernaculum (continued)
Female homologs of the Gubernaculum

**Ovarian Ligament**
- homolog of proximal Gubernaculum location
  - from Ovary to Uterus
  - within Broad Ligament

**Round ligament** or **Ligamentum Teres**
- homolog of distal Gubernaculum, i.e., distal to Uterus
- Location:
  - within Broad Ligament in peritoneal cavity
  - passes through Inguinal Canal
  - terminates in Labium Majus
Erectile tissues and glands of the Female Reproductive System

Lesser Vestibular (= Skene’s or Paraurethral) Glands
- located in anterior **Vestibule** lateral to **urethral orifice**

Greater Vestibular or Bartholin’s glands
- located in posterior **Vestibule** posterolateral to vagina

Clitoris
- **Glans Clitoris** – anterior to **Vestibule**
- **Crura** – paired, buttressed by **Inferior Ramus of Pubes** lateral to **Vestibule**
Menstrual Cycle
Follicle Stimulating Hormone (FSH)
gonadotropin secreted by Adenohypophysis
stimulates maturation of follicle
Primordial Follicle → Secondary Follicle → Mature (= Graafian) Follicle
Secondary Follicle, includes:
  Antrum
  Cumulus Oophorus vs Parietal Follicular cells
Estrogen – Follicular Fluid of Antrum produced by Follicular cells
  stimulates Proliferative Phase
  hypertrophy of Endometrium, its arteries and spiral glands

(continued)
Menstrual Cycle

Luteinizing Hormone (LH)

gonadotropin secreted by Adenohypophysis
pulse together with FSH stimulates Ovulation
rupture of oocyte with Corona Radiata (Cumulus Oophorus) from ovary into Peritoneal cavity
Parietal Follicular cells → Corpus Luteum
secrete Progesterone
stimulates Secretory Phase
maintenance of hypertrophied endometrium for implantation
cessation of progesterone production results in:
Ischemic Phase – atrophy of endometrium, followed by:
Menstrual Phase – sloughing of endometrium
Corpus Luteum → Corpus Albicans – scar tissue

Chorionic Gonadotropin
produced by embryo, if present
maintains Corpus Luteum (hence, Progesterone and Secretory Phase)
Embryonic and Fetal Development – Key Terms

**Extraembryonic Membranes** – membranes that are derived from the zygote and surround and support the developing embryo but are not part of the embryo

1) **Amnion** – membrane that encloses developing embryo in amniotic cavity and fluid
2) **Chorion** – membrane that encloses extraembryonic coelom; interacts with endometrium of uterus to form embryonic contribution of placenta
3) **Chorioamniotic membrane** – fusion of the two above in later development

**Connecting Stalk** – tissue uniting developing embryo with extraembryonic membranes and maternal tissue; as embryo enlarges as fetus the connecting stalk will be recognized as the **umbilical cord**

**Yolk Sac** – a cavity, continuous with primitive gut; contained within connecting stalk

**Allantois** – a cavity, outgrowth of primitive gut; grows into connecting stalk carrying with it umbilical arteries and vein; unites with chorion to form embryonic contribution of placenta
(a) Hormonal regulation of changes in the ovary and uterus

(b) Changes in concentration of anterior pituitary and ovarian hormones
Fetal Development – More Key Terms

**Decidua Basalis** – portion of endometrium that lines the uterine wall and that interacts with chorion basalis to form maternal contribution of placenta

**Decidua Parietalis** – portion of endometrium that lines the uterine wall and does not contribute to the placenta

**Decidua Capsularis** – portion of endometrium that overlies the chorion but does not contribute to the placenta

**Chorion Frondosum** – portion of the chorion that interacts with the decidua basalis to form the embryonic contribution of the placenta

**Chorion Laeve** – portion of the chorion that does not contribute to the placenta
Abdominal Hernias
Inguinal
Direct – most common form in men
Indirect – congenital birth defect
Femoral – most common form in women