URINARY SYSTEM - composition

1  kidneys (1)
2  ureters (2)
3  urinary bladder (3)
4  urethra (4)

Major functions of kidneys:

1) Maintenance of homeostasis – regulate the fluid and electrolyte balance, acid-base balance, extracellular fluid volume, total body water

2) Elimination of a various metabolic waste products (creatinine, urea, uric acid), drugs and toxic substances

3) Endocrine activity
   - renin – regulation of blood pressure
   - erythropoietin – stimulates the production of erythrocytes
   - activation of D-vitamin
- **compound tubular gland**
- **embedded in white adipose tissue** - adipose capsule and covered by fibrous capsule made from dense connective tissue
- **concave** medial border – the hilum – enter and exit nerves, vessels
- **convex** lateral surface
- the parenchyma is divided into:
  1. dark red **cortex**
  2. lighter striated **medulla**

  - **medullary pyramid** + associated cortical tissue = lobe of kidney (renal lobe)

  - **central medullary ray** + associated cortical tissue = lobules of kidney (renal lobule)

The basic functional unit of kidney is the uriniferous tubule, which is composed from the secretory **nephron** & **collecting duct** !!!
Nephron – is the structural and functional unit of the kidney

- nephron → histological composition:
  1. Renal corpuscle
     - Bowman’s capsule
  2. Proximal tubule
     - Convoluted part
     - Straight part
  3. Henle’s loop
     - Descending limb
     - Rising limb
     - Thin & thick segments
  4. Distal tubule
     - Macula densa
     - Convoluted part

* total length: 30-38 mm
* kidney contains > 1 million

Renal corpuscle – histological structure
Visceral (inner) layer of Bowman's capsule

- modified epithelial cells – podocytes (P) have:
  a) several primary processes = trabecules;
  b) numerous secondary foot processes = pedicles which form coat around the capillaries of the glomerulus

SEM: 700 - 6.000x

Filtration barrier apparatus

- renal corpuscle contains the filtration apparatus of kidney

Histological composition:

1. Endothelium of glomerular blood capillaries without diaphragm
   * permeable to H₂O, Na⁺, urea, glucose and small proteins

2. Glomerular basement membrane = product of endothelial cells and podocytes
   * physical barrier and ion-selective filter
   Ultrastructure:
   a) lamina rara externa → fibronectin
   b) lamina densa → type IV collagen + laminin 11 + nidogen/entactin
   c) lamina rara interna → heparan sulfate + podocalyxin

3. Filtration slit diaphragm = space between adjacent podocyte pedicles connected by diaphragm

Blood

endothelium

podocyte

Primary urine/
blood plasma ultrafiltrate
The **urinary passages** consists of:

1.) **Intrarenal portions:**
   (a) Minor and major calyces
   (b) Renal pelvis

2.) **Extrarenal portions:**
   (a) Ureters
   (b) Urinary Bladder
   (c) Urethra

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**Tunica mucosa** of urinary passages

- the mucosa (*tunica mucosa*) composition:
  - transitional epithelium and lamina propria mucosae
  - epithelium (*lamina epithelialis mucosae*) – transitional epithelium –
  - UROTHELIUM
    a. Pseudostratified epithelium !
    b. Epithelium change the shape according the level of fullness
    c. Superficial epithelial cells – umbrella-shaped cells responsible for the osmotic barrier between the urine and tissue fluids
    d. Luminal membrane contain thick plates separated by thin membrane
    e. Thick plates are stored in vesicels when organ is empty- contain special phospholipids – cerebrosides

- LPM-(*lamina propria mucosae*) – loose connective tissue rich in elastic fibers

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1. URETER
The mucosa of the ureter forms longitudinally oriented folds and the lumen has irregular shape
● the wall is composed from 3 layers:
  1. TUNICA MUCOSA – pseudostratified transitional epithelium – urothelium + lamina propria mucosae
  2. TUNICA MUSCULARIS – in upper 2/3 helical arrangement of two smooth muscle layers, as the ureteral muscle cells reach the bladder they become longitudinal
  3. TUNICA ADVENTITIA – loose connective tissue
Function:
► transport of the urine to the bladder

2. URINARY BLADDER
the organ with thin wall
● in empty bladder the mucosa forms the mucosal folds
● Histological structure:
  1. Tunica mucosa – urothelium + loose connective tissue LPM
  2. Tunica muscularis – smooth muscle cells forms 3 sublayers
    2.1. inner longitudinal layer (plexiform)
    2.2. middle circular
    2.3. outer longitudinal
  3. Adventitia or serosa
Function:
  a. Storing of the urine
  b. Excretion of the urine
Male Reproductive System

This system consists of:

(1) a pair of testis
(2) excretory genital ducts:
   a. intratesticular
   b. extratesticular
(3) accessory genital glands
(4) penis

Testicle – *lat.* testis, *gr.* orchis

- testis is a both exocrine and endocrine gland:
  - Exocrine: seminiferous tubules and seminal ducts → spermatozoa
  - Endocrine: interstitial Leydig cells → ANDROGENS = testosterone
- resemble compound tubular gland
- is covered by tunica albuginea – thick and dense connective tissue
- tunica albuginea extends into the interior of organ as:
  - (a) septa – septula testis, dividing parenchyma into parts – testicular lobules
  - (b) mediastinum testis – an axial core of C.T. housing rete testis
- testicular lobules contain:
  - 1 to 4 highly convoluted seminiferous tubules embedded in interstitial C.T.
  - interstitial loose C.T. contain blood vessels and interstitial Leydig cells
Interstitial Leydig cells

- steroid-secreting cells
- **endocrine components of testis** → produce male steroid hormone → **testosterone & neuropeptides**
- situated in interstitial loose C.T.
- single, in small groups along blood vessels
- usually large, polygonal, or irregular cells
- central nucleus and cytoplasm is distinct eosinophilic in LM !!!
- EM displays abundant smooth ER, tubular type of mitochondria, small lipid droplets, Reinke's crystals and aging pigment granules

Seminiferous Tubule

- functional and structural unit of testis, composed of:
  1. Seminiferous (germinal) epithelium
  2. Basement membrane
  3. Myoid and fibrous layers – thin layer of C.T. with fibroblasts and peritubular smooth muscle (myoid) cells

* testis has 250 – 1000 seminiferous tubules
* tubules are 150 μm in diameter and 80 cm in length
Seminiferous epithelium - specialized stratified layer consists of:

A. Sertoli (supporting) cells
B. Spermatogenic cells → precursors of spermatozoa, belonging to various generations and stages of development

Seminiferous epithelium

- late spermatid
- early spermatid
- pachytene
- primary spermatocyte
- junctional complex
- basal lamina
- peritubular (myoid) cells
- type A dark spermatogonium
- type A pale spermatogonium
- type B pale spermatogonium
- Sertoli cell
- spermatid

Tunica albuginea testis
Septulum testis
Interstitial
Seminiferous tubule

Lobulus of testis
Sertoli (supporting) cells

- elongated pyramidal (pillarlike) cells
- cells with base lying on BM and apex reaching lumen of tubule
- large, pale (euchromatic), oval or triangular nucleus with prominent nucleolus and deep invaginations of nuclear envelope
- lateral boundary of cell indefinite due to intensive ramification combined with deep recesses, housing the spermigenic cells
- cytoplasm contains fine filaments, smooth ER, some RER, a well-developed Golgi complex, numerous mitochondria and lysosomes
- postmitotic cells, more resistant against physical and chemical factors

4 main functions:
- a. support + protection + nutrition
- b. phagocytosis
- c. synthesis of androgen binding protein (ABP) + formation of testicular fluid
- d. endocrine activity = anti-Müllerian hormone (Müllerian-inhibiting hormone) + inhibin
- e. in spermiation

Spermigenic cells

1. SPERMATOGONIA
   - a. Type A dark spermatogonia (stem cells)
   - b. Type A pale spermatogonia
   - c. Type B spermatogonia (progenitor cells)
- least numerous and least differentiated type of spermigenic cells
- stem/progenitor cells, undergoing mitosis
- represent several generations differencing in cell size, shape and nuclear structure

2. SPERMATOCYTES
- 2 generations, primary and secondary spermatocytes, undergoing meiosis
- Primary spermatocytes = regularly encountered in middle zone and recognized by their large size and nuclear morphology (presence of chromosomes)
- Secondary spermatocytes = smaller haploid cells with only 23 chromosomes

3. SPERMATIDS
- smallest and most numerous spermigenic cells, forming the thickest innermost zone, nuclei with areas of condensed chromatin
- they don't divide, but undergo metamorphosis, a slow transformation from round cell into flagellated spermatozoa (mature sperm cell)
Spermatogenesis

1. phase – SPERMATOCYTOGENESIS
2. phase – SPERMATOHISTOGENESIS

Zone of Mitosis
Zone of Meiosis
Zone of Metamorphosis

the duration of spermatogenesis = 64 ± 4.5 days

Different stages of spermatogenesis

Spermatohistogenesis (Spermiogenesis)

- it can be subdivided into 3 main phases:

(1) **Golgi phase** = acrosomal vesicles formation + migration of 2 centrioles

(2) **Acrosomal phase** = acrosome formation + nucleus transformation + middle piece formation

(3) **Maturation phase** = formation and phagocytosis of residual bodies + spermiation
GENITAL DUCTS

Intratesticular
(1) Tubuli recti - simple cuboidal epithelium
(2) Rete testis - simple cuboidal epithelium

Extratesticular
(3) Ductuli efferentes testis – 10 -20
   head part of epididymis – caput epididymis
   • simple epithelium – 2 types of cells:
     - tall columnar ciliated
     - nonciliated cuboidal cells
(4) Ductus epididymidis
   • a single highly coiled tube about 4-6 m in length forms:
     the body and tail of the epididymis
     - lumen is very regular – reservoir for the spermatozoa
     - lined by pseudostratified columnar epithelium with stereocilia (uptake and
digestion of residual bodies, secretion of GPs for inhibition of capacitation
(5) Ductus (vas) deferens
   • part of spermatic cord, straight tube empties into the prostatic urethra
     wall is composed of 3 layers: mucose, muscular layer – thick – 3 sublayers,
     adventitia

Ductuli efferentes testis
• irregular star-shaped lumen:
  simple epithelium:
  1. a tall columnar ciliated cells (transport of spermatozoa)
  2. nonciliated cuboidal cells (absorption of testicular fluid) - thin layer of circularly
     oriented smooth muscle cells in loose CT outside the BM

Ductus epididymidis
Caput epididymis- formed by 10-20 convoluted tubules ductuli efferentes - they
gradually fuse to form the ductus epididymidis- highly coiled tube about 4-6m in
length and form corpus et cauda epididymis

Histological structure:
1. **pseudostratified columnar epithelium**
   A rounded basal cells - undifferentiated
   B columnar cells with stereocilia

2. **thin layer of loose connective tissue**

3. **tunica fibromuscularis** – 2-3 layers of circulary oriented smooth muscle cells

**Function:**
- secretion of glycerofosfocholin
- inhibition of early maturation of the sperm
- uptake and digestion of residual bodies that are eliminated during spermatogenesis

**Ductus deferens**
- straight tube with a thick muscular wall, long 40cm
- narrow lumen
- part of the spermatic cord, funiculus spermaticus which includes testicular artery, the pampiniform plexus and nerves
- emptais into pars prostatica urthtrae
- dilatation before it enters the prostate – ampulla – the seminal vesicles join the duct

**Histological structure:**
1. **Tunica mucosa**
   - forms longitudinal folds
   1.a pseudostratified columnar epithelium with the stereocilia
   b. loose connective tissue – rich in elastic fibers

2. **Tunica muscularis**
   - longitudinal
   - circular
   - longitudinal

3. **Tunica adventitia**
Accessory genital glands

1. Seminal vesicles - *vesiculae seminales* → diverticula of ductus deferens
2. Prostate
3. Bulbourethral glands (Cowper’s) – *glandulae bulbourethrales*

**Function:**
- exocrine glands → secretory material of ejaculate
  - a) moisturing of genital ducts + regulation of urethra condition
  - b) yellowish viscid fluid contains spermatozoa activating substances – buffer function, energy, stimulation of sperm motility

**Seminal vesicles (vesiculae seminales)**
- paired accessory genital glands
- convoluted simple tubular glands
- the wall is composed of:
  1. *Tunica mucosa*
     - forms many branched mucosal folds, lined by **simple columnar or pseudostratified epithelium** - secretory protein-synthesizing cells: citrate, inositol, abundant fructose
     - *lamina propria* – loose connective tissue rich in elastic fibers
  2. *Tunica muscularis*
     - 2 layers of smooth muscle cells
  3. *Tunica adventitia*
     - loose Ct with vessels, nerves
Secretion:
- forms 70% ejaculum
- yellowish alcalic fluid
- contains substances activating the spermatozoa (fructose, citrate, prostaglandins, proteins, inositol)

Prostate
- biggest unpaired accessory male genital gland
- fibroelastic capsule rich in smooth muscle
- in fibromuscular stroma: 30-50 branched tubulo-alveolar glands
- prostatic glands are lined by simple cuboidal or columnar or pseudostratified epithelium
- glands produce material of neutral or slightly alkalic pH emptying into urethra (enzymes)
- between glands collagen fibers with smooth muscle
- in lumen – spherical prostatic concretions of GPs-
  - corpora amylacea (concretio prostatica)

PROSTATE – topography of glands
Female Reproductive System

Components of the female reproductive system:
1. a pair of ovaries
2. a pair of oviducts
3. a uterus
4. a vagina
5. the external genitalia

OVARY – *lat.* OVARIUM, *gr.* OOPHORON

**Functions:**
- 1. produce ova
- 2. secrete hormones – estrogens + progesterone

**Histology:**
- consists of a cortical and medullar regions (not sharply delineated)
- the surface of the ovary is covered by a simple cuboidal epithelium – the germinal epithelium
- under the germinal epithelium – *tunica albuginea* – layer of dense irregular connective tissue

**A. CORTICAL REGION (CORTEX):**
- the stroma composed from connective tissue – cells respond to hormonal stimuli
- contains numerous ovarian follicles in various stages of development
- ovarian follicle consists of an oocyte surrounded by one or more layers of follicular cells – the granulosa cells
- Development of ovarian follicles:
  1. Primordial follicles
  2. Primary follicles
     - 2.1. Unilaminar primary follicles
     - 2.2. Multilaminar primary follicles
  3. Secondary (antral) follicles
  4. Mature (Graafian) follicles

**A. MEDULLARY REGION (MEDULLA):**
- contains a rich vascular bed within a cellular loose connective tissue
1. PRIMORDIAL FOLLICLES
- at the time of birth 400,000 - 1,000,000
- only few hundred maturate
- arrested in prophase of meiosis I
- Composition:
  a. primary oocyte
  b. single layer of flat follicular cells
- surrounded by basement membrane

GROWING FOLLICLES:
- under influence of hormones at the onset of puberty – growing and maturation of ovarian follicles
- distinct changes in morphology of oocyte, follicular cells and stroma arround growing follicle

2. PRIMARY FOLLICLES
2.1. Unilaminar primary follicle
- follicular cells form single layer of cuboidal cells
- primary oocyte
- follicular cells proliferate by mitosis and form a *stratified follicular epithelium*, or *granulosa layer* → multilaminar primary follicle

**2.2.** Primary multilaminar follicle:

**Avascular part:**
- primary oocyte
- *granulosa layer* → stratified follicular epithelium
- a thick coat – the *zona pellucida* composed of glycoproteins, surround the oocyte

**Vascularized part:**
- stromal tissue around differentiates into two layers:
  - *Theca folliculi interna* – cellular layer
  - *Theca folliculi externa*– fibrous layer
- theca folliculi interna cells – production of steroid hormones

**3. SECONDARY FOLLICLES**
- *liquor folliculi* – fluid accumulate in the spaces between granulosa cells (plasma exudate with hormones)
4. MATURE GRAAFIAN FOLLICLE

- about 2.5 cm in diameter
- protrudes deep into cortical tissue and extends over the surface of the organ
- the granulosa cells that form the first layer around the oocyte and are in close contact with zona pellucida – become elongated and form the corona radiata
- a hillock called cumulus oophorus, carrying an oocyte – positioned off center
- antrum folliculi with follicular fluid
- oocyte prior to ovulation complete first meiotic division forming secondary oocyte
- usually only one dominant follicle undergoes ovulation
Ovulation
► the process of ovulation consists of rupture of the mature follicle and liberation of the ovum (into the oviduct)
► ovulation takes place approximately in the middle of the menstrual cycle – around the 14th day of a 28-day cycle
► the stimulus is a surge of LH – Luteinizing Hormone - secreted by the anterior pituitary gland

Maturation of oocytes
► oocytes are forming during intrauterine life
► primordial follicles contain primary oocytes in on the prophase of first meiotic division
► first meiotic division is completed before ovulation (expulsion of first polar body)
► second meiotic division stops in metaphase – completed after fertilization

ATRETIC FOLLICLE
● the most ovarian follicles undergo the process – atresia → follicular cells + oocytes die and are disposed of by phagocytic cells (MQ)
● the atresia can take place during any stages in the development of a follicle
● this process is histologically characterized by:
  a. stop of mitosis in the granulosa cells
  b. detachment of granulosa cells from the BM
  c. death of the oocyte

CORPUS LUTEUM (CL)
● after ovulation, the granulosa cells and those of theca interna that remain in the ovary form a temporary endocrine gland called the corpus luteum
● CL is localized in the cortical region of the ovary and persists 14 days after ovulation
● secretes hormones → progesteron + estrogens + relaxin
● the granulosa cells make up 80% of the parenchyma of the CL and are now called – granulosa lutein cells
● the cells of the theca interna form – theca lutein cells
OVIDUCT (FALLOPIAN TUBE) – lat. tuba uterina

Anatomy:
  a. infundibulum (with fimbriae)
  b. ampulla - most common for fertilisation
  c. isthmus
  d. intramural portion - traverses the wall of the uterus

Histology:
  → the wall is composed of 3 main layers
1) Tunica mucosa
   • forms longitudinal mucosal folds (mainly in ampulla → labyrinth)
   • lamina epithelialis – simple columnar epithelium
   1.) CILIATED CELLS – possess many cilia - transport of the ovum and embryo
   2.) SECRETORY CELLS – secrete a nutrient rich medium – nutrition of spermatozoa and preimplantation embryo
   • lamina propria – loose connective tissue (is richly vascularized!)

(B) Tunica muscularis
  • consists of smooth muscle cells disposed as:
    1) INNER CIRCULAR (SPIRAL) LAYER
    2) OUTER LONGITUDINAL LAYER

(C) Tunica serosa
  • composed of visceral peritoneum (mesothelium + submesothelial layer)
UTERUS

Function:
- during pregnancy – houses and support the developing embryo and fetus

Anatomy:
- a. body (corpus uteri) – major part
- b. cervix – narrow lower part
- c. fundus – upper part (entrances of the oviducts)
  * dense connective tissue of the lateral part of uterus form the broad ligament

Histology:
- the uterus is a thick-walled organ, wall consists of 3 layers:
  A – tunica mucosa – ENDOMETRIUM
  B – tunica muscularis – MYOMETRIUM
  C – tunica serosa – PERIMETRIUM
  * PARAMETRIUM – dense regular C.T. of the broad ligament

ENDOMETRIUM
- consists of lamina epithelialis and lamina propria
- epithelial lining – simple columnar epithelium containing secretory and ciliated cells
- lamina propria – loose connective tissue with many stellate fibroblasts, contains abundant amorphous ground substance → uterine glands – simple tubular glands (covered by simple columnar epithelial cells)
- Layers of endometrium:
  1. Zona functionalis
     - superficial layer
     - exhibit dramatic changes during menstrual cycle every month as a result of hormonal changes
     - shed during menstruation!
  2. Zona basalis
     - basal layer adjacent to the myometrium
     - undergoes little changes during the menstrual cycle
     - not shed during menstruation!
     - provides a new epithelium and lamina propria for the renewal of the endometrium!
ENDEOMETRIAL BLOOD SUPPLY
○ the endometrium has a unique dual blood supply
○ the uterine artery distributes blood to arcuate arteries in the middle layer of the myometrium
○ from these vessels, 2 sets of arteries arise to supply blood to the endometrium:
  (1) STRAIGHT (BASAL) ARTERIES → which supply the zona basalis
  (2) COILED (SPIRAL) ARTERIES → which bring blood to the zona functionalis and undergo pronounced changes during menstrual cycle

MYOMETRIUM
● thick muscular layer (4 poorly defined layers)
● composed of bundles of smooth muscle cells separated by connective tissue
● inner and outer layers are longitudinal, thick middle circular
● the middle layers contain the larger blood vessels (arcuate arteries)- stratum vasculare
● myometrium thickness during pregnancy because of the hypertrophy and hyperplasia of individual smooth muscle cells

PERIMETRIUM
● submesothelial connective tissue and mesothelium
MENSTRUAL CYCLE

- hormonally (estrogens & progesterone) modulated cyclic morphological changes of the endometrium
- duration → variable but averages - 28 days

1. Menstrual phase (1-5 days)
   - menstrual bleeding
   - removing of endometrial zona functionalis
2. Proliferative phase (5-15 days)
   - estrogens from the ovarian follicles
   - uterine glands and epithelium regeneration
3. Secretory phase (16-28 days)
   - starts after ovulation
   - upon progesterone - corpus luteum
   - maximal thickness of endometrium → accumulation of secretions in coiled glands
4. Ischemic phase (28 day)
   - contraction of aa.spirales caused by decrease of progesterone and estrogens
   - necrosis of lamina propria in functional zone, glands and arterial walls
VAGINA

E – lamina epithelialis
L – lamina propria
M – tunica muscularis

- no secretory glands

1) TUNICA MUCOSA
- the cells of nonkeratinized stratified squamous epithelium become filled with glycogen before desquamation
- thin-walled veins of the mucosa and muscular layers exude fluid into the epithelium.

- the lamina propria (L) extends narrow papillae into the epithelium (E)

2) TUNICA MUSCULARIS
- the muscular layer (M) has bundles of smooth muscle arranged in a circular manner near the mucosa and longitudinally near the adventitia

3) TUNICA ADVENTITIA
- a coat of dense connective tissue rich in thick elastic fibres
UMBILICAL CORD (lat. *funiculus umbilicalis*)

► is 55 cm long cord connects the foetus to the placenta

Histological features:
- at the surface → amniotic epithelium (*ectodermal lining*)
- contains 2 umbilical arteries and 1 umbilical vein
- the vessels are surrounded by *Wharton's jelly* (*mucous connective tissue*)

![Funiculus Umbilicalis](image)

A – *arteria umbilicalis*, V – *vena umbilicalis*, VJ – *Wharton's jelly*

PLACENTA

- temporary organ
- composed of *cells derived from 2 distinct individuals*
- it consists of: A) *Fetal part (chorion)*
  - B) *Maternal part (decidua basalis)*
- discoid shaped organ 15-20 cm in diameter, weights 400-600g
- hemochorial – maternal blood comes in direct contact with the chorion
- Function:
  1) diffusion of oxygen, carbon dioxide, nutrients
  2) excretion of waste products
  3) hormonal production (*steroid hormons*: progesteron, estrogen – maintenance of pregnancy; *peptid hormons*: human chorionic gonadotropin, human placentar lactogen, relaxin, leptin, growth factors)

- formed as the endometrium of the uterus is invaded by the developing embryo and as the trophoblast forms villous chorion
1- Fetal Part

Embryo arriving as a blastocyst about 5 days after fertilization - uterus is in the late secretory phase.

**blastocyst** - trophoblast + embryoblast

1) **Implantation** - blastocyst settles into the endometrium (days 6-10)

2) Invading trophoblast differentiate:
   - **cycriotrophoblast** - mitotic active inner cells
   - **syncytiotrophoblast** - erosive outer multinucleated cytoplasmic mass

   - Embryo becomes enclosed within stroma
   - Implanted embryo absorbs nutrients and oxygen from the local endometrial tissue and lacunae of blood

3) **Villous chorion formation** goes through three stages:
   - End of the second week - first appearance of chorionic villi
   - Layer of the placenta from which the villi project - chorionic plate.

   a) **Primary chorionic villi** - central core of cells derived by cytotrophoblast (11-13 day)

   b) **Secondary villi** - about day 16
      - Primary villi invaded by mesenchymal cores

   c) **Tertiary villi** (end of 3. week) - mesenchymal cells within the villi differentiate into blood capillaries

   1. Connective tissue
   2. Placental membrane
   3. Syncytiotrophoblast
   4. Cytotrophoblast
   5. Endothelium
   6. Fetal blood vessels
4) **end of week 4** - vascularised tertiary villi become connected with the embryonic heart via vessels that differentiate in the mesenchyme of the chorion and in the connecting stalk.  
8) cells of trofoblast invade walls of aa. spirales in endometrium - the blood of mother gets to the intervillous space

9) **week 20** – fully formed placenta - it consists of:  
A.) Fetal part (chorion)  
B.) Maternal part (decidua basalis)

**A- Fetal Part**  
- chorion plate - the chorionic villi arise  
- chorionic villi - connective tissue core surrounded by the syncytiotrophoblast and the cytotrophoblast developed from chorion frondosum

**Placenta**

A.) Fetal part → chorion  
B.) Maternal part → decidua basalis
B- Maternal Part

- endometrium is called the **decidua**, with three regions:
  
  - decidua basalis
  - capsularis
  - parietalis.

- the **decidua basalis** – maternal part of the placenta supplies arterial blood to and receives venous blood from the lacunae (intervillous spaces) between the chorionic villi
Decidual reaction:
- changes of endometrium in days following implantation
  1) cells from the connective tissue stroma – fibroblasts (lamina propria) of the decidua basalis form the **decidual cells**
  - large, vacuolised - lipid droplets, glycogen
  - exhibit the characteristics of protein-synthesizing cells (prolactin)
  2) capillaries of decidua form wide irregular sinusoids
  3) active glandular secretion

- extraembryonic blood vessels become closely associated with areas of thin trophoblast for **maximal diffusion of material between the two pools of blood**
- transplacental barrier:
  1. fetal endothelium+BM
  2. embryonic CT
  3. cytotrophoblast
  4. syncytiotrophoblast