



Histology Exam (Food Quality Control)

(برنامج جودة ومراقبة الأغذية)

٢٤ January 201٧

4th year 2nd Semester

Time allowed: -3 hours

Please answer the following questions and illustrate your answers with diagrams.

من فضلك دعّم جميع الإجابات بالرسم و التوضيحية

Total Marks (50)

1. Describe the histological structure of the Uterus of cow.

*The uterus can be subdivided into the fundus, corpus (body), and cervix. Functionally, as well as structurally, the fundus and corpus are similar; the cervix differs both structurally and functionally.

* The layers of the uterus are given special names:

The mucosa and submucosa are called **endometrium**;

The muscularis is the **myometrium**;

The serosa is the **perimetrium**.

* During the reproductive years the endometrium in the corpus and fundus undergoes cyclical changes. This menstrual cycle can be divided into four phases: menstrual, proliferative, secretory, and premenstrual. These stages can be recognized by the histological changes in the endometrium.

* The endometrium is divided into two layers. Near the lumen, the stroma of the endometrium appears lighter, this is the functional layer

The deeper layer is darker in color because the nuclei of the stroma are closer together. This is the basal layer. Note that the glands are relative straight and project through the length of the endometrium with some even penetrating into the myometrium. The surface epithelium contains mostly ciliated cells but some non-ciliated secretory cells are also present. In contrast, the glands are lined primarily by secretory cells.

(1) Endometrium:

The uterine mucosa consists of:

1) Lamina epithelialis: it is formed of secretory simple columnar cells with some few ciliated cells in *mare and bitch*. Patches of pseudostratified columnar epithelium are found in *sow and cow*. In *camel* the cells showed tall ciliated, nonciliated, basal cells and rod shape cells.

2) Lamina propria: it divided into: an inner stratum compactum (dense cellular C.T. rich with many capillaries. The cells are mainly fibroblasts, mast cells, eosinophils, and lymphocytes. Chromatophores are present in the endometrium of *sheep*, and an outer much broader stratum spongiosum.

Uterine glands:

The uterine glands in early secretory phase are more tortuous and the spiral arteries extend almost to the epithelial layer. Many cells will have basally located clear areas. These are areas that were rich in glycogen but were extracted during tissue processing. The stroma and bases of the glands in this region undergo little change during the menstrual cycle. They are maintained during menstruation and regenerate another stratum functionalis after menstruation.

They are simple branched tubular glands

They show changes characteristic of the different phases of the estrous cycle.

In *carnivores* show the least branching and coiling glands. The number of uterine glands decreases toward the cervix. **Caruncles** The mucosa of *ruminants* bears non-glandular projections, the **caruncles**. They are dome-shape in *cow* and cup-shape in *ewe*. The caruncles form the maternal part of the placentome, a structural component of the placenta. The caruncles are small prominences in non-pregnant animals but develop into large complex structure in pregnant animals. The caruncles consist of highly cellular connective tissue with great potentialities for proliferation and involution. They are rich by fibroblasts. Their deeper portions are usually rich in blood vessels. The uterine glands lying deep to the caruncles open on the intercaruncular mucosa close to the caruncular base.

(2) Myometrium: Consists of a thick inner circular layer and a thinner outer longitudinal one. In between the two muscle layers there is a **stratum vasculare** which is a connective tissue very rich in blood vessels and nerves; the **stratum vasculare** is distinct in *cow* but not in *women and sow*.

(3) Perimetrium:

It is a typical serosa, continued from the peritoneum of the broad ligament; the stratum vasculare and the outer longitudinal muscle layer are continuous with the broad ligament.

2. Explain the histological functional structural relationship of the testis.

The testes have, like the ovaries, two functions: they produce the male gametes or spermatozoa, and they produce male sexual hormone, testosterone, which stimulates the accessory male sexual organs and causes the development of the masculine extragenital sex characteristics.

Each testis is suspended in an out pouching of the peritoneal cavity. This cavity, like the rest of the peritoneum, is lined by a serosa consisting of mesothelial cells supported by a fibrous connective tissue.

The testes were enveloped by visceral layer of the tunica vaginalis (peritoneal covering the testes and epididymis).

Both of these tunics consist of fibrous connective tissue with a thin surface of mesothelium.

The thickened posterior portion of the tunica albuginea, called the mediastinum, receives the blood vessels, lymphatics, nerves, and ducts which serve the testis.

Fibrous septa extend from the mediastinum into the body of the testis, these septa has the same structure as that of the tunica albuginea.

The testis consists of numerous lobules, each one contain numerous seminiferous tubules.

(I) Stroma:-

It is the background of the testis; it consists of connective tissue capsule or tunica albuginea (thin layer of dense irregular C.T) with occasional smooth muscle cells are present in the capsule (*Stallion*).

The testicular artery and vein give arise numerous branches which forming tunica vasculosa, *present superficially in dog and ram.*

The T. albuginea gives (septulae testis) the connective tissue septa which extend toward the centrally mediastinum testis and dividing the testis into a varying number of lobules (lobuli testis).

Mediastinum testis is strand of C.T. which passes within the testis parallel to its longitudinal axis, and consists of dense C.T supporting the tubules of the rete testis.

In Horse a compact mediastinum and rete testis are restricted to the cranial pole.

(II) Parenchyma:-

It is the cellular element of the testis.

Seminiferous Tubules

The bulk of each testis consists of seminiferous tubules embedded in relatively sparse interstitial tissue. And consider as the structural units of the testis. Each begins blindly under the T. albuginea and goes convoluted then become straightened toward mediastinum testis and opening into tubules of the rete testis.

Sperm cells are produced by the tubules, while hormones are produced by endocrine cells (***Leydig cells***) within the interstitium.

A few hundred tubules comprise one testis. Thin connective tissue septa, arising in the mediastinum, separate tubules into lobules.

The tubules are lined by a complex stratified epithelium which is most easily understood as consisting of two very different cell populations:-

Sertoli cells (supporting cells):-

1-they are large and supportive cells. Simple columnar, triangular or rectangular shape epithelium cells.

2-Each Sertoli cell rests on the basement membrane and extends to the lumen.

3-The Sertoli cells create the environment in which germ cells carry out the fundamental reproductive function of gamete production.

4-The simple columnar nature of the Sertoli epithelium is most evident prior to puberty, before the germ cells begin producing sperm.

2- Germ (Spermatogenic) cells:-

Sperm Cell Formation

Male germ cells comprise a unique cell population which continually produces new male gametes, or spermatozoa, in the process called spermatogenesis. Germ cells at all stages of meiosis are found embedded within the epithelium of the seminiferous tubules.

Spermatogonia

* They are the stem cells of the germ cell population.

- * They divide mitotically to produce primary spermatocytes as well as more spermatogonia.
- * They are found at the base of the tubular epithelium.
- * They have relatively large round nuclei and lie adjacent to the basement membrane of the tubular epithelium.
- * Spermatogonia are the first cells of (*A- spermatogenesis, it is the phase which the spermatogonia change into primary spermatocytes*). They originate in the 4th week of foetal development in the endodermal walls of the yolk sac and migrate to the primordium of the testis, where they differentiate into spermatogonia. Spermatogonia remain dormant until puberty. They are always in contact with the basal lamina of the tubule. The spermatogonia have diploid number of chromosomes.

* Two types of spermatogonia can be distinguished in the human seminiferous epithelium:

Type A spermatogonia have a rounded nucleus with very fine chromatin grains and one or two nucleoli. They are stem cells which divide to form new generations of both type A and type B spermatogonia. Type B spermatogonia have rounded nuclei with chromatin granules of variable size, which often attach to the nuclear membrane, and one nucleolus. Although type B spermatogonia may divide repeatedly, they do not function as stem cells and their final mitosis always results in the formation of

Primary spermatocytes

- * They are cells in the first stage in meiosis, during which DNA replicates twice.
 - * It results from the mitotic division of type B spermatogonia.
- These cells are the largest cells in the seminiferous tubules; they are situated towards the center. Their nuclei are large, spherical and deeply stained.
- * Divide to produce secondary spermatocytes.
 - * They are found at mid-levels within the tubular epithelium.

Leydig cells which secrete testosterone.

- * Testosterone-secreting Leydig cells occur in clusters within the interstitial tissue (stroma) of the testis.
- * Leydig cells may be recognized not only by their location within the testicular interstitium but also by their round nuclei and extensive acidophilic cytoplasm.
- * Leydig cells have an appearance typical of steroid-secreting cells.
- * With electron microscopy they can be seen to contain abundant smooth endoplasmic reticulum and mitochondria with tubular cristae.
- * Leydig cells may contain small eosinophilic cytoplasmic inclusions called Reinke's crystalloids. With age, Leydig cells may accumulate lipofuscin (brown "wear-and-tear" pigment).
- * Leydig cells are numerous in the testis of the camel more than any other animals.

Lipid inclusions are found in all species and varying amount of glycogen are present in case of *stallion, bull and cat*.

Myoid Cells

Each seminiferous tubule is surrounded by a thin layer of contractile myoid cells, which produce waves of contraction to move immature (and not yet motile) spermatozoa out of the testis.

Rete Testis and Efferent Ductules

All of the seminiferous tubules converge onto a network of interconnecting channels, the rete testis, which are lined by a variable (often very low) cuboidal epithelium.

The rete testis in turn leads through numerous small efferent ductules from the mediastinum into the epididymis.

3. Compare from histological view between:

1- **Esophagus and Gizzard.**

The gizzard is a flattened sphere surrounded by powerful muscles that generate high pressures within. Muscular contractions can physically break up very dense food particles such as whole cereal grains. Particles of grit are retained in the gizzard and they provide an abrasive surface that helps in grinding the food. The submucosa of the gizzard secretes a protein— polysaccharide substance called koilin. The koilin solidifies into short rods when it reaches the acid conditions in the gizzard and the rods cross-link to form a mesh around the gizzard wall. This protects the wall from damage and provides an abrasive surface for the grinding process.

The luminal surface is lined with secretory product of the mucosal glands, which solidifies at the surface to form a hard cuticle of koilin.

Lamina Epith.

It is formed from one layer of simple columnar epithelium secretory types

Lamina propria:

It consists of layer of loose connective tissue containing branched and unbranched tubular glands which lined by cuboidal to low columnar cells (chief cells and basal cells)

partl

also have low amount of endocrine cells but not open into the luminal of the gland but face to the blood capillary.

Lamina muscularis mucosa:

IT IS ABSENT IN GIZZARD.

Tunica submucosa:

It is loose connective tissue fused with lamina propria.

Tunica muscularis **mucosae**:

It formed the main bulk of the gizzard. It is smooth muscle form three layer in different direction which ranged from oblique to circular and longitudinal, these itire layer were connected by collagen fiber in between.

Tunica serosa

It is subserosal layer which is fibrous connective tissue and covered by mesothelium. The gizzard covered externally by tendinous layer.

The wall of the esophagus is composed of four layers (inner to outer): mucosa, submucosa, muscularis propria and adventitia, reflecting the general structural organization of the entire gastrointestinal tract. The mucosa is composed of three components (inner to outer): a non-keratinizing stratified squamous epithelium, a lamina propria and the muscularis mucosa. The submucosa is composed of loose connective tissue, blood vessels, lymphatics, lymphoid follicles, the meissner plexus of nerves and submucosal glands. The submucosal glands secrete mucus which functions to lubricate the esophagus and protect the epithelial layers from the harsh environment to which it is exposed, e.g., food and gastric acid. The muscularis propria consists of an inner circular muscle layer and an outer longitudinal muscle layer with an intervening myenteric (auerbach) plexus. Contraction of the circular muscle layer causes an increase in luminal pressure, while contraction of the longitudinal muscle layer causes shortening of the esophagus. The muscularis propria of the esophagus is unique in that the proximal 1/3 is composed of skeletal muscle, the middle 1/3 is composed of both smooth and skeletal muscle and the distal 1/3 is composed of only smooth muscle. The adventitia is the connective tissue fascia layer that surrounds the esophagus (1).

The crop has the same structure but no glands.

2- Smooth and cardiac muscle.

Long spindle like cell (30 – 200 u)

Centrally located nucleus & elongated.

At side pole of elongated nucleus there numerous mitochondria, R.E.R & large Golgi body

The cytoplasm appear unstructured under E.M, it consists of arrays & myofilaments. Acidophilic, homogenous cytoplasm.

The fine structure of the smooth muscle consists of actin, myosin and desmin filaments. It also contains caveolae, (pockets) in its cell membrane but no T tubules.

It has autonomic innervation.

Mesenchymal in origin.

Site of smooth muscle

Dispersed in C.T of some organs (prostate and seminal vesicle)

Small muscle bundle → erector pill muscle of skin

Constitute large bulk in the myometrium of the uterus

present in capsule of some gland

CARDIAC MUSCLE

It only present in heart and characterized by branching.

Cardiac muscle exhibit cross striated banding pattern identical to that of the skeletal muscle but less than it.

Cardiac muscle cell possess only one or 2 centrally located, oval nucleus (may be called multinucleated)

A delicate sheath of endomyseal C.T which contain rich capillary network surround the column of muscle Cardiac muscle characterized by dark stained transverse line that cross the muscle into irregular interval (Intercalated disc) which represent junctional complex

- (1) Fascia adherens
- (2) Macula adherens (desmosomes)
- (3) Jap junction

Cardiac muscle cell are elongated branching cell, less regular, 15um in diameter and 100um long. No regeneration occur in the cardiac muscle because no centrosome which is responsible for dividing.

- Cardiac muscle is richly vascularized.

- T tubules are larger and numerous than that of the skeletal muscle. It located at Z line.

The sarcoplasmic reticulum is not regularly arranged as skeletal muscle and usually located at one side of the T tubules forming a diad.

There are two contractile cells, atrial and ventricular

Atrial cells are smaller and have fewer T tubules than ventricular

The atrial cells (especially right atrial cells) contain granules than that of the ventricular cells. These granules called (*natriuretic factor*), a hormone that cause loss of the sodium and water from the kidney.

Purkinje fibers are the largest conducting cells (one of the impulse conducting system of the heart)

Special cardiac muscle but larger and has pale area around the nucleus

Fewer myofibrils and glycogen granules

No T tubules and poorly organized sarcoplasmic reticulum

Contraction of the cardiac muscle depends on excitation- contraction coupling.

4. What do you know about thyroid gland.

The thyroid gland consists of two lobes united by a broad band of similar tissue called isthmus.

The most part of the two lobes is located in the cervical region, in front and around the sides of the trachea just below the larynx. The isthmus lies over the 2nd and 3rd cartilaginous rings of trachea. The gland is covered by the cervical fascia. It is derived from the endoderm. It synthesizes thyroxine hormone which control the metabolic rate in body cells.

In certain species they also partly secreted calcitonin which controls the calcium level in blood.

Structure of Thyroid Gland

The thyroid gland is surrounded by a thin fibrous C.T. capsule.

Thin trabeculae extend from the capsule into the parenchyma.

They divide the gland into irregular lobules; each lobule is packed with thyroid follicles which are supported by a network of reticular fibers with extensive capillary bed. The thyroid follicle is the structural and functional unit of the gland, they are rounded, tubular or irregularly in shape.

They vary greatly in size depending on the level at which the follicles are cut and their functional activity. Each thyroid follicle is surrounded by a basement membrane and consists of a single layer of cuboidal cells surrounding a lumen filled with a structureless acidophilic material, the colloid. An active follicle tends to have walls of cuboidal to high cuboidal epithelium, while inactive follicles have flattened epithelium. The thyroid follicle contains also in addition Para follicular cells (C, clear, or light cells). These cells lie adjacent to the follicular cells but do not reach to the follicular cavity, they are larger than follicular cells and their nuclei are eccentrically. These cells produce calcitonin which controls the blood calcium level.

With EM; the follicular cells presents the characteristics of a cell which synthehesizes, secretes, reabsorbs, and digests proteins. The basal part of these cells is rich in granular ER. The nucleus is generally spherical and centrally situated. The apical pole contains Golgi apparatus and secretory granules. Abundant lysosomes are present. Mitochondria, distended cisternae of rER, and ribosomes are dispersed throughout the cytoplasm, the apical cell membrane have microvilli.

5. Discuss the histological structure of the following:-

1- Urinary bladder.

It is an expanded ureter, because most of the layers present in the ureter are present in the bladder. The major differences are:-

- (1) The relative increases in the thickness of individual layers of the bladder tunica muscularis.
- (2) The presence of a scanty lamina muscularis in bladders of some animals.

Structure of urinary bladder:

I. Tunica mucosa:-

1- *Lamina epithelialis*: - lined by transitional epithelium varies in thickness, depending on the species and degree of distention. There are lymphocytic migration from lamina propria to epithelial cell, they numerous in ruminants.

2- *Lamina propria* composed of loose connective tissue with a substantial amount of elastic fibers. The fibers become more abundant at the bladder neck, where they are arranged circularly. Lymphatic nodules in the lamina propria are a common finding in all domestic animals.

3- *Lamina muscularis mucosa*:

The presence and amount of a lamina muscularis mucosa vary with the species:-

In horse it is well developed.

In ruminant, dog and pig: it is extremely thin and sometimes only isolated cells are seen.

In cat, it is absent.

II. *Tunica submucosa* is somewhat looser and contains more elastic fibers than that of the lamina propria; large blood vessels and small ganglia are present at the bladder neck.

III. *Tunica muscularis*:

The bladder muscularis is composed of three rather ill-defined layers: an inner and outer longitudinal layer and a middle circular layer.

IV. *Tunica serosa or adventitia*:

It consists of a loose connective tissue only or with and the mesothelium

2- Trachea.

It is flexible tubular C.T organ lined with respiratory epithelium which contains Clara cells and neuroendocrine (APUD) cells.

Various hyaline cartilage interconnected through inter annular ligament.

That provide continuous opening of the lumen through the C shape cartilage.

The C shape cartilage makes the trachea flat for facilitation of the esophagus above it.

1- Mucosa:-

It appear without folds because lack of substantial submucosal C.T.

L. epith. Respiratory epith.

L. propria fibroelastic CT & lymphocytic infiltration at deep part (Dense elastic lamina).

2- Submucosa:- Loose C.T.

Seromucoid gland & their duct pierce the dense elastic lamina to empty it's content in the inner surface of the trachea.

3- Tracheal cartilage:-

C. Shape series of cartilage arranged
the free border closed with bundle of smooth muscle.

Above free border — ~~Cat~~ , Dog.

Within the free border — ~~Pig~~ Horse, Ruminant.

4- Tunica Adventitia :- layer of loose C.T rich in blood vessels and nerves.

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