Benha University
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Histology and Cytology Department

Histology Exam (Food Quality Control) **(برنامج جودة ومراقبة الأغذية)**

2 Jan 2017 **Commentary (6200)** Time Allowed: - **3** hours Total Marks **50**

Please **answer the following questions and illustrate your answers with diagrams.**
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A- Describe fully the histological structure of the following:-

1. Skin of fish. (5 Marks)

Both the epidermis and dermis of the anadromous coho salmon, *Oncorhynchus kisutch*, have a full complement of the protective structures found in fish. The living epidermal surface is protected by mucous secretions which are prevented from ablation by the intricately patterned microridges of the surface keratinocytes, as seen by scanning electron microscopy. Bundles of filaments are dispersed throughout the keratinocytes but not to the extent that ribosomes, endoplasmic reticulum, and Golgi apparatus are excluded. In the yearling salmon, the straight basal lamina of the embryo has changed to a convoluted border invaded by dermal reticular fibers. The complex dermis has an upper region of loosely organized collagen fibers, which is interspersed with fibroblasts and pigment cells, and a deeper, highly ordered zone of orthogonally arranged collagen. Coho salmon also have overlapping calcified scales that extend at an angle from the upper dermis to the epidermis and push an enclosing sheath of epidermal tissue with them to the skin's surface. The other major component of fish skin, the chromatophores, are discussed in an adjacent paper.

2. Esophagus of tilapia Nilotica. (5 Marks)

Esophagus
Epithelium→ st.sq.epith. it may be ciliated columnar or cuboidal in some spp.
L.Propria→ loose CT
T. Submucosa→ fibroelastic CT
T.Muscularis→ *outer circular and inner longitudinal and oblique skeletal muscles* then this muscle orientation change caudally and become *smooth muscles*
T. Serosa→ loose CT lined by mesothelial cells.

3. Gills of marine water fishes. (10 Marks)

There are six or seven pairs of gills in cartilaginous fishes while four pairs in bony fishes due to the loss of spiracle Gill slits of bony fishes are covered by operculum while operculum is absent in cartilaginous fishes. In sharks gill slits are laterally situated while in rays they are ventrally placed. A pair of spiracle is present in Elasmobranchii anterior to first gill which corresponds to a vestigeal primitive first gill slit.
Although spiracle is absent in bony fishes, in Actinopterygii it is replaced by a pseudo-branch which is free in some fishes but skin covered in others.

Pseudo Branch:

In carp and rainbow trout the pseudo branch is embedded in submucosal connective tissue of pharyngeal wall and shows a glandular appearance due to complete conglutination of branchial filaments.
In some species, a pseudo branch with hemibranchs structure is located inside the operculum. However, in eel the pseudo branch is not present, it is also absent in cat fishes (Siluroidae) and feather back (Notopteridae).

Gill Raker:

It occurs in two rows on the inner margin of each gill arch. Each gill arch is short stumpy structure supported by bony elements. The gill arch projects across the pharyngeal opening. They are modified in relation to food and feeding habits.
The mucous cells of the epithelium help to remove sediments from the covering epithelium in order to enable the taste buds to function effectively and to sense the chemical nature of food passing through the gill sieve.

Gill Filaments (Primary Gill Lmellae):

Each hemi-branch consists of both primary and secondary lamellae
The primary gill filaments remain separated from the branchial septum at their distal end making two hemi-branch in opposition which direct the water flow between the gill filaments. Amongst dual breathers the heterogeneity in the gill system is more pronounced particularly in the swamp eel, Monopterus, Amphipnous cuchia and climbing perch, Anabas testudineus.

In Monopterus, gill filaments are stumpy and are present only in second pair of gill and lack gill lamellae.
The gill filaments are also lined by epithelium referred to as primary epithelium. The epithelium has glandular and non-glandular part.

Lamellae (Secondary Lamella):

The each gill filament is made up of secondary gill lamellae which are actual seat of exchange of gases. They are generally semicircular and lined up along both sides of the gill filaments. The lamellae frequency is directly proportional to the dimension and resistance of the gill sieve.
The secondary lamellae are having two sheets of epithelium which are separated by space and through these spaces blood circulates. The epithelial sheets are separated by a series of pillar cells. Each cell consists of central body and is provided with extensions at each end

Branchial Glands:

These are specialized cells of the epithelium. They are glandular in nature and perform different functions in normal and experimental conditions. The most common specialized branchial glands are the mucous glands and acidophilic granular cells (chloride cells).

Mucous Glands:

These gland cells are unicellular. They may be oval or pear shaped with a neck through which they open outside the epithelium. The nucleus lies at the bottom of the cells. They are typical goblet cells. They are present throughout the epithelium, i.e., gill arch, gill filament and secondary lamellae.
They secrete mucus which is glycoprotein, both acidic and neutral.

B- Explain the histological structure function relationships of the following:

1- Nerve cell structure and classification. (10 Marks)

Neuron has only one axon.
Start from body soma in pyramidal region called axon hillock.
Long cylindrical & varies in length & diameter.
It has the same structure as body soma except pigment granules & Nissle's granules & endoplasmic reticulum is smooth.
The axon cytoplasm "axoplasma" & Axon membrane (Axolema) covered by myelin sheath (dendrites not cover).
The axon gives collateral branch.
Function → carry impulse away of the perikaryon
Classification of the neuron
1- According to the number of the process:-
1- Unipolar 2- pseudounipolar 3- bipolar 4- multipolar
2- According to length of the process:-
2-Golgi type I. 1- Golgi type II.
3- According to shape of perikaryon:-
Ovoid – spherical - fusifrom , pyriform - polyhedral
4- According to size of the perikaryon:-
dwarf (4um) giant (150um)
5- According to shape of the branching dendritic tree:-
(1) Isodendritic neuron.
(2) Allodendritic neuron.
(3) Idiodendritic neuron.
6- According to function:-
(1) Sensory neuron (3) interneuron.
(2) Motor neuron.
1- According to the number of the process:-
(1) Unipolar
The neuron have only one process act as axon & dendrites. This rarely occurs except in embryonic stage.
(2) Pseudo-unipolar
2 processes get out from the perikaryon and united at base of them forming one process which is short. The one branch rebranch as T shape one act as axon & other as dendrites. This occurs in spinal and sensory ganglia.
(3) Bipolar
Process from opposite side of the perikaryon one from each side, one act as axon, other as dendrites. In retina

of eye, olfactory mucosa of nose.
(4) Multipolar
Numerous processes, one as axon, other as dendrites. In autonomic ganglia and CNS neuron.
2- According to length of the process:-
(1) Golgi type I
Has long axon that emerges from CNS. As in peripheral nerve fiber
(2) Golgi type II
- has short axon that end in the vicinity of the cell body in fine branch with out forming nerve fiber. In the cerebrum and cerebellum and retina of the eye.
3-According to shape of the branching dendritic tree:-
1-Isodendritic neuron
The dendrites branch in rectilinear direction & has limited branch.
2-Allodendritic neuron
The dendrites has irregular course of branch & has much branch than isodendrities.
3- Idiodendritic tree
The dendrites have profuse branching & more branches than the other of not inter the neuronal fiber system.
4-According to function:-
1- Sensory
Found mainly in dorsal horn of spinal cord & sensory organ
2- Motor
Ventral horn of spinal cord & motor area of cerebral cortex
3- Intermediate
between motor &sensory in gray matter &CNS

2- Liver of catfish. (5 Marks)

The liver is one of the largest, most important, and least appreciated organs in the body. The bulk of the liver consists of hepatocytes, which are epithelial cells with a unique configuration.
The liver is essentially an exocrine gland, secreting bile into the intestine. But, the liver is also significantly so an endocrine gland and a blood filter. The liver has a diversity of functions not typically associated with glands. The liver is a metabolic factory, synthesizing and breaking down a variety of substances. It's functions include all of the following:
Formation and secretion of bile.
Storage of glycogen, buffer for blood glucose.
Synthesis of urea.
Metabolism of cholesterol and fat.
Synthesis and endocrine secretion of many plasma proteins, including clotting factors.
Detoxification of many drugs and other poisons.
Cleansing of bacteria from blood.
Processing of several steroid hormones and vitamin D.
Volume reservoir for blood catabolism of hemoglobin from worn-out red blood cells.
Much of the liver's organization is conditioned by its central role in removing unwanted materials from blood and otherwise maintaining the blood's normal composition.
The liver receives a dual vascular supply.
The hepatic portal vein brings to the liver all of the blood which has previously passed through the intestine and spleen.
The hepatic artery brings fresh, oxygenated blood from the aorta.
Portal venous blood from the intestine and spleen and arterial blood from the aorta mix together in hepatic sinusoids before leaving the liver in the hepatic vein.
The liver receives over 25% of the total resting cardiac output and is responsible for over 20% of the body's resting oxygen consumption.
The liver is organized into lobules which take the shape of polygonal prisms. Each lobule is typically hexagonal in cross section and is centered on a branch of the hepatic vein. Within each lobule, hepatocytes are arranged into hepatic cords separated by adjacent sinusoids.
The fenestrated endothelium lining the sinusoids lies immediately adjacent to the cords, with no basement membrane and practically no intervening connective tissue, so that each hepatocyte is bathed on two faces by

blood plasma.
Although the liver is an exocrine gland (with bile duct leading to the intestine), the cells of the liver are not organized into secretory acini or tubules. Instead, hepatocytes form linear cords, within which a network of bile canaliculi provides passage through intercellular channels to the nearest branches of the bile duct.
This remarkable tissue arrangement appears to optimize the liver's several roles as exocrine gland, endocrine gland, and blood filter.

Dual vascular supply.
All of the blood which passes through the intestine and spleen is delivered to the liver by the hepatic portal vein.
This portal blood carries not only nutrients but also various contaminants (drugs, toxins from food, bacteria, by products of blood-cell recycling) which have been absorbed through the intestinal mucosa or produced in the spleen.
The liver also receives arterial blood, carrying oxygen, from the hepatic artery.
Blood from both portal vein and hepatic artery mixes together in the hepatic sinusoids and then passes out of the liver through the hepatic vein.
The parenchyma of each lobule can be divided into arbitrary zones based on oxygen supply, with the central zone (closest the central vein) poorest in oxygen.
This blood flow pattern can yield visible differences in hepatocyte appearance. For example, glycogen is depleted first from the periphery during times of fasting and deposited first in the periphery during times of feasting. This leads to a pattern of glycogen which can reflect recent nutritional history.
Both the hepatic portal vein and the hepatic artery branch in parallel along the corners of hepatic lobules, in regions called portal areas.
A branch of the hepatic vein, called the central vein, runs along the central axis of each lobule.
Organization of Liver Lobules
The liver is organized into lobules (portal lobules, hepatic lobules) which take the shape of irregular polygonal prisms. Some texts refer instead to liver acini.
At the corners between adjacent lobules are the so-called portal areas (portal canals, portal triads). These are regions of connective tissue which include branches of the bile duct, the portal vein, and the hepatic artery.
Along the central axis of each lobule runs a central vein, which is a branch of the hepatic vein.
Occupying the bulk of the lobule are hepatocytes arranged into cords. separated by sinusoids.

C- Compare between the following.

1. Lymph node and peyer's patches. (7.5 Marks)

Lymph nodes are round or kidney-shaped lymphoid organs which are distributed throughout the body along lymphatic vessel system. All lymph passes through at least one node before it enters the circulatory system. Afferent lymphatic vessels enter a lymph node along the convex surface of the capsule. Efferent lymphatic vessels leave lymph node at a concave depression called the hilum (or hilus). Arteries enter and veins leave the node via the hilum as well. Each node has a dense connective tissue capsule which (like the thymus) sends connective tissue septa or trabeculae into the organ. Reticular cells and reticular fibers form a supporting meshwork which extends throughout the lymph node. In addition, a lymph node contains an inner and outer cortex and a medulla.

Cortex

Afferent lymphatics empty into the subcapsular (or cortical) sinus located immediately beneath the capsule. This sinus connects to the medullary sinuses via intermediate or paratrabecular sinuses which run alongside the trabeculae.
The outer cortex is populated primarily by B-lymphocytes along with macrophages, plasma cells, and reticular cells. Lymphoid follicles are found here.

The inner (or deep) cortex contains mostly T-lymphocytes. This area also called paracortex or paracortical zone. Few lymphoid nodules will be
found in this area. Contains specialized vessels called high endothelial venules (HEVs). They are lined with plump, cuboidal endothelial cells with large nuclei. These vessels serve as the point of entry for lymphocytes from the peripheral blood into the lymph node parenchyma.

Medulla

The medulla is composed of medullary cords of lymphatic tissue separated by medullary sinuses which

contain lymph.

Medullary cords contain lymphocytes (both T and B), macrophages, and plasma cells. This is the area where plasma cells are formed, and, therefore, where antibody production takes place.

follicles

Primary follicles are nodules or aggregates of small B-lymphocytes.

When a germinal center develops in a primary follicle, it becomes a secondary follicle. The presence of germinal centers indicates the lymph node is being antigenically-stimulated. The lighter-staining germinal center contains activated B-cells which eventually give rise to antibody-forming plasma cells. The germinal center is surrounded by a cuff of small, dark B-lymphocytes called the mantle zone.

Dendritic Reticulum Cells (DRCs) are found in the germinal center. They trap antigens on their surface and present them to B-lymphocytes. They are long-lived and difficult to see by light microscopy.

The B-cells found in the germinal center are large and have vesicular nuclei. These are proliferating cells, so mitotic figures are not uncommon in this area.

Tingible body macrophages can also be found in the germinal center. These are large cells whose cytoplasm contains phagocytized debris. Because their cytoplasm is not conspicuous (unless it's filled with something), they appear as "clear areas" in the tissue.

Circulation of lymph

Afferent lymphatic vessels → subcapsular sinus → intermediate sinuses → medullary sinuses → efferent lymphatic vessels.

Lymphatic vessels contain one-way valves to assure flow of lymph in proper direction.

Peyer's patches The aggregates of lymphatic nodules occurring in the small intestine, seen grossly as elevations in the mucosa, are called Peyer's patches**.** These patches are most conspicuous in the ileum, appearing in ruminants, pigs, and carnivores as a single large. The numerous discrete small intestinal Peyer's patches and scattered aggregated or solitary nodules of the colon and rectum persist into adulthood.

2. Thymus and spleen. (7.5 Marks)

The primary function of the spleen is to remove RBCs & blood platelets from the blood circulation in process known as <u>" culling "</u>

Capsule →

Spleen is surrounded by thick C.T capsule divided into two ill distinct layers ; C.T layer and muscular layer

The thickness of the capsule varies according to the animal species, in which it thicker in horse than ruminant than pig than dog and cat

Trabecula→Irregular CT trabecula contains collagen; elastic fibers and muscle contain nerve blood vessels and lymph vessels.

Both of the trabecula and the reticular fiber support the parenchyma of the spleen.

CT capsule and trabecula contain myofibroblast which not only contractile but also give extracellular CT fiber.

Hilus → on medial aspect hold passage for splenic artery, nerve lymph vessels & vein.

Spleen hold large volume of RBCs in reverse storage

Parenchyma of the spleen:-

1-White pulp→

It is the lymphatic tissue distributed randomly through out the spleen lymph nodule and as PALS (periarterial lymphatic sheath)

The lymph nodule may or may not contain germinal center according to the functional state.

Principle cells of germinal center are lymphocyte.

T lymphocyte occupy periphery of the nodule & PALS.

The reticular cells & fibers form 3 dimension stroma contain sequestrated lymphocyte & plasma cell.

Marginal Zone → at periphery of the white pulp the reticulum form concentric layers, immediately adjacent to the last layer is the marginal Zone. Marginal zone is the location through which most blood filter before entering red pulp. Also with this area T lymphocyte has initial opportunity to interact with B lymphocyte.

- It's efficient filtering station "functionally significant part of the spleen

<u>NB</u>

- appear basophilic area due to staining of numerous nuclei of lymphocyte 'heterochromatin.

Branch of the splenic artery enter white pulp through capsule & trabecula so called central artery 'the lymphocyte PALS occupies it & replace it so appear eccentric position

Human → germinal center seen by naked eye.
Lymph nodule = splenic nodule = Malpighian corpuscle.

Red pulp

Most of the splenic pulp is red owing to high amount blood held with in reticulum.
- It consists of → splenic sinus (venous sinus).
Splenic cords between sinuses

Splenic Sinuses

Are wide vascular channel lined with elongated longitudinal arranged endothelial cells contain contractile microfilament arranged parallel to lateral cell margin which make stabilization of the endothelial cells.

- Gap or slit opening done when contraction that enables Rbcs to pass from cords sinus and pass bet cells.
- The cells rest on fenestrated basement membrane and supported by reticular fiber. Some of which encircling the sinus form hoop like structure.

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مباشـــــرة بالقســـم

GOOD LUCK
Department members