ZOO 366-Comparative Vertebrate Anatomy

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THE ALIMENTARY SYSTEM

INTRODUCTION

The alimentary canal is a tube beginning at the mouth and passing through the body to the anus. The greater part of the tube is lined by endoderm, forming a glandular epithelial lining of a variable nature termed the mucosa, but at the anterior and posterior ends ectoderm has been invaginated to form a stomodeum and proctodeum respectively. The wall of the alimentary canal is completed by tissue of mesodermal (splanchnic) origin and consisits mainly of muscle and connective tissue together with the blood vessels and nerves. Outwardly the tube is invested by the peritoneum (coelomic epithelium), which also covers the mesenteries by which it is suspended in the body.

Primarily, the alimentary canal is for the reception of food, but in all vertebrates part of the anterior region plays a part in respiration. It originates in the embryo as a simple straight tube, but in the adult it is differentiated into regions which differ according to the particular work carried out therein. The tube is usually much longer than the body, so that since the two ends fixed, it is thrown into coils.

The main regions of the alimentary canal are the buccal cavity, pharynx, esophagus, stomach and intestine.

The Buccal Cavity- This is derived from the stomodeum and consequently is lined by ectoderm and the mouth aperture opens directly into it. As derivatives of the skin covering the jaws, teeth are present, the from and functions of which differ in different vertebrates. In the higher craninates a variable shaped, movable, muscular tongue is found on the floor of the buccal cavity. In many instances, even in the lower vertebrates, there is no clear line of demarcation between the buccal cavity and the next region, the pharynx, but developmentally the former is lined with ectoderm and the latter by endoderm. The two regions can be called the bucco-pharyngeal region.

The Pharynx- It is this region that, in the embryo, the visceral clefts make their appearance. In the fishes they persist in the adult as branchial clefts, but in the higher vertebrates for the most part they close up and disappear. It is from the

hinder end of this region that the lungs, the respiratory organs found in air-breathing vertebrates, originate. The lungs may arise directly from a layngcal chamber or when a neck is present, as in the mammals, they are situated at the end of a tubular trachea. In those vertebrates where the majority of the visceral clefts have been lost, the pharyngeal part of the first cleft is retained as part of the auditory apparatus to form Eustachian tube and tympanic chamber.

The Oesphagus, Following the pharynx is the oesophagus in which, either by the flattening of the tube or the folding of its lining, the lumen is considerably reduced. The oesophagus forms a connecting channel between the pharynx and the next region, the stomach.

The Stomach: In this region the tube is dialated to form a receptacle in which the food can accumulate during feeding and also where some digestive processes can take place. The form of the stomach varies in different animals, according to their type of food and mode of life, but usually regurgitation is prevented by a valvular arrangement, the cardia, where the oesophagus enters the stomach. The premature escape of the food from the stomack into the intestine is guarded against by the development in the wall of the distal (pyloric) end of the stomach of a ring of muscle termed a sphincter, the pyloric sphincter, which closes the aperture and only opens under certain conditions. The position of this sphincter is usually marked externally by a constriction, the pyloric constriction. In the wall of the stomach numerous simple glands, the peptic or gastric glands, are present which secrete the gastric juice.

The Intestine, - Following the stomach comes the longest part of the alimentary canal, the intestine. In most vertebrates the intestine can be divided into regions distinguishable by morphological and historogical leatures. Into the first part, which immediately follows the stomach, open the ducts of the two important accessory glands, the liver and pancreas, and this region is called the duodenum. The next part of the intestine is the region where a great part of digestion and most of the aborption of the digested food takes place. And is appropriately modified in different vertebrates. The lining epithelium provides numerous glands, the products of which are poured out on to the food. The form of this region varies considerably in different vertebrates as also does its terminology, any details must be left to the description of individual examples. The terminal portion of the intestinal region is the rectum, which includes the proctodeum and terminates at the anus.
The passage of the food through the alimentary tube is caused by waves of muscular contraction of a rhymical character which pass along the length of the

tube, pushing the food in front of the constricted region. This rhythmical contraction is termed peristalsis.

The Accessory Glands. In the higher vertebrates salivary gland are present. The salivary secretion or saliva is poured on to the food during mastication. In other instances, where salivary glands are absent, the lining epithelium of the buccal cavity and pharynx contains many muscus-sereting glands which help to lubricate the food during its passage through these regions. The liver and pancreas, already mentioned as opening by their ducts into the duodenum, arise in some animals 9e.g chick0 as outgrowths of the endoderm of the alimentary canal, but soon mesodermal derivatives become incorporated with these outgrowths to form the adult glands, the connection between the gland and the intestine being retained as the duct. The secretions of these glands, bile and pancreatic juice, play an important part in the digestive processes.

In addition to these special glands, the lining epithelium of all regions of the alimentary canal contains numerous mucous glands.

VILL. THE URINARY ORGANS

The toad's kidney is formed of a complex mass of hephric units among which lie blood vessels and capillaries. The adrenal gland lies on its ventral surface. The kindney is bathed in the lymph which is contained in the cisteria magna and its drained into the veins of the kidney. These are the renal veins and the renal portal vein. Renal arteries supply the kidney.

You ought to know the structure of the nephric unit in orer toi understand well the section of the kidney. A nephric unit consist of a long trubule which begins by a peculiar structure called the Malpighian body or corpuscle. This is formed of a thin double-walled Bowman's capsule into which pushes an affercent arteriole that branches off then leaves away the corpuscle as an efferent arteriole. The tuft of vessels thus formed insiude the corpuscle is called the glomerulus. (The efferent arteriole breaks up, outside the glomerulus, into capillaries which connect with those of the renal portal vein).

The Browman's capsule leads into a uriniferous tu bule which is much convoluted and ultimately opens into a collecting tubule. The collecting tubules pour the urine into the Wolffian duct which extends along the outer lateral border of the kidney.

Search for the above mentioned structure in the section. These are:

- The Wolffian duct is seen on thelateral edge of the organ, lined by a simple cubical epithelium and surrounded by connective tissue and unstriated muscle fibres.
- The renal portal vein lies next to the Wolffian duct. It may contain blood corpuscles and its wall consists of the usual layers characteristic of veins.

- The renal artery an renal are conspicuous on the ventral side of the kidney
- The adrenal gland lies on the ventral surface, and consists of glandular cells which are surrounded by numerous blood vessels.
- The wall of the cistern magna and the nephrostomes or peritoneal funnels are found on the ventral side of the section. Each peritoneal funnel is lined largely with ciliated cuboidal cells.
- The Malpighian bodies or corpuscles are found each of the glomerulus in the middle, and of the Bowman's capsule to the outside. The wall of the latter is built up of a simple squanmous epithelium.
- The uriniferous or convoluted tubules are lined by large granular cells and each have a narrow lumen. They are the greatest elements of the kidney in number.
- The collecting tubules appear in the section lined by cuboidal cells which contain but few granules and have a wide lumen. They are mush fewer in number that the uriniferous tubules.
- A network of blood vessels and capillaries is held by connective tissue among the tubules.

THE GENITAL GLANDS (GONADS)

The genital glands differ according to sex, thus the testis in the male produces the spermatozoa, while the ovary in the female product the ova (sing.ovum).

THE TESTIS

The testis is build up of a large number of seminiferous tubules. The spermatozoa are formed in the walls of these tubules in the mature testis. The tubules are held together by an intertubular connective tissue which contains particular interstitial cells that secrete certain hormones which are responsible for the appearance of the secondary sexual characters.

Since the spermatozoon passes through a series of phase till it reaches its final form, the wall of the seminferous tubule thus contains all that represent these phases. The process is known as spermatogenesis.

Examine and note:

- The seminiferous tubules appear rounded or oval in section, each surround by a thin basement membrane and contains in its wall several layers of cells representing (from outside inwards)

(i) The spermatogonia lie along the periphery of the tubule and appear closely packed together..

(ii) The primary spermatocytes are the largest of the cells and have large nuclei.

(iii) The secondary spermatocytes are smaller than the preceding cells, about half size, and their nuclei stain deeply.

(iv) The spermatids are still smaller than the preceding cells and their nuclei are more condense. They aggregate in clusters.

(v) The spermatozoa lei in the cavity of the tubule. They are always grouped in clusters and some appear connected with peculiar large cells which lie at the periphery of the tubule. These are cells of Sertoli.

A spermatozoon (or sperm) has an elongated head and a long delicate tail. Its nucleus lies in the head which is pointed at the acrosome.

Identify all the above mentioned stages in the seminiferous tubule with the help of the H.P. and proceed studying other structures of the testis:

-The intertubular tissue is formed of connective tissue which holds the tubules together and contains blood vessels. It also contains cells of endocrine secretion, the interstitial cells.

-The tunica albuginea is built up of fibrous connective tissue and surrounds the testis. The intertubular tissue extends to the periphery of the testis where it is connected with this sheath.

-The peritoneal epithelium is the outermost covering of the testis.

3 THE OVARY

The ovary is concerned with the formation of eggs. The process of formation of the eggs, or oogenesis, closely resembles the process of formation of the spermatozoa. However, the ova (eggs) are very much larger in size than the sperms, since the ova represent the non-motile and food storing gametes. The sperms, on the other hand, ought to be very small because they are motile. They are also formed in much greater numbers than the ova.

I.T.S of the ovary of the toad

Here the ovary consist of a number of hallow lobules in which the ova are formed. Each lobule is surrounded externally by the theca externa, which corresponds to the peritoneal epithelium of the testis.

Thousands of sacs of various sizes are connected to the theca externa, depending on the size of the ovum that each sac contains. Each sac is surrounded by the theca interna, an envelope which contains unstriated muscle fibres, blood vessels and nerves. The theca interna, however,is incomplete where the sac is connected to the outer wall of the ovary. It is this place at which the ovum, when fully mature, bursts out to fall into the body cavity.

The ovum is also surrounded by a number of cells form the ovarian stroma which is responsible for the secretion of the ovarian hormones.

The ovum passes through a number of phases following the oogonium stage. First is the primary oocyte which increases in size gradually.
Its nucleus also undergoes certain changes and shows several nucleoli.
Finally a vitelline membrance is formed around the primary oocyte, which separates it from the follicular cells.

The first reduction division usually occurs when the ovum reaches the oviduct, thus becoming the secondary oocyte. The second maturation division occurs on fertilization, that is, externally in water.87

The Mammalian Circulation

Basically the muscular heart pumps the blood into the system of arteries, which split up within the tissues into capillaries. Here exchange of materials between blood and cells takes place. From the capillaries blood is collected up into a series of veins by which it is returned to the heart. The heart is divided into four chambers: right and left atria (auricles), and right and left ventricles. Blood returning to the heart enters the right atrium, whence it passes into the right ventricle, and then via the pulmonary artery to the lungs. This is deoxygenated blood, oxygen having been removed from it and carbon dioxide added to it during its passage through the tissues. As the blood flows through the capillaries in the lungs it shed its carbon dioxide and take up oxygen. The oxygenated blood now returns via the pulmonary veins to the heart, entering the left atrium. From this chamber it passes into the left ventricle, and thence to the dorsal aorta, the main artery of the body. From this numerous arteries, some median and paired, convey

blood to the capillary systems in the organs and tissues, where gaseous exchange takes place. Corresponding veins convey the deoxygenated blood to the venae cavae (great veins) by which it is returned to the right atrium. The walls of the arteries and veins are elastic, and the heart and the veins are equipped with valves which prevent blood flowing in the wrong direction. At one time it was thought that blood was pumped from the heart and subsequently drawn back into it in the same vessels, a sort of ebb-and-flow system. It is interesting to note that this kind of thing does happen in certain primitive animals, but not vertebrates. That the blood circulates was first discovered by the seventeenth century physician, William Harvey. By meticulous dissection and ingenious experiments, Harvey showed beyond all reasonable doubt that blood flows away from the heart in certain vessels (arteries) and returns to it in different vessels (veins).

From a functional point of view the two most important parts of the circulatory system are the heart and capillaries. As the organ responsible for pumping the blood, the heart is of the utmost importance in maintaining the tissues in a state of health and efficiency. The capillaries represent the place where exchange of materials takes place, and as such provide the raison d'etre
for the circulatory system. We shall deal with these two parts of the circulatory in turn.