Benha University
Faculty of Veterinary Medicine
Histology and Cytology Department

Complementary Histology Exam

(*F*ood *Q*uality *C*ontrol)

(برنامج جودة ومراقبة الأغذية)

Incomplete Exam

11 February 2019 Time allowed: - **3** hours

***Please* answer the following questions and illustrate your answers with diagrams.**
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I- Discuss The structure function relationship of the following:-

1. Testis.

(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 straighted 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:-

1-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.

5-In an adult testis, Sertoli cell nuclei are often inconspicuous among the much more numerous nuclei of germ cells

6-The nuclei of Sertoli cell can be readily recognized as those typical
of columnar epithelium, oval, euchromatic, nuclei, usually with prominent nucleoli.

7-The cytoplasm of Sertoli cells assumes an elaborate shape, enveloping germ cells at various stages in meiosis.

Functions

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
- Elongation of the spermatid takes place.
- Two, rings, one small and dense and the other large and less dense arise around the distal centriole.
- The distal centriole becomes a funnel shaped basal body while the large ring disappears during further maturation.
- The small ring moves distally and makes the distal end of the middle piece of the mature spermatozoon. The mitochondria form a helix in the periphery of the middle piece.
- The connecting piece forms nine longitudinally arranged columns around the centrioles, connected distally to nine longitudinal fibers peripheral to the nine double fibrils of the flagellum.
- Finally semicircular ribs form the fibrous sheath around the tail fibers in the principal piece of the spermatozoon.

Spermatozoa
* They are highly specialized, motile cells, each with a single large flagellum.
* They form by maturation (i.e., without further cell division) from spermatides.
* They have very small, highly condensed, oval to conical nuclei. (The shape of entire sperm cells, with long flagella, is not evident in tissue sections.)
* They are found near the lumen of the tubule.
Leydig Cells
*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.

Ducts of the Testis
- Spermatozoa pass via the tubuli recti (low columnar epithelium) and the rete testis (flattened or cuboidal epithelium) into numerous ductuli efferentes, which are lined by a columnar epithelium, which consists of both

absorptive and ciliated cells. The height of the two cells types which form the epithelium of the ductuli efferentes is variable which gives the lumen a characteristic wavy outline.

- The ductuli efferentes leave the testis and open into a common duct, the ductus epididymidis (about 6 m long).
- It is lined by a very tall pseudostratified columnar epithelium. Most cells of the epithelium, also called principal cells, have long Sterocilia.
- Sterocilia are non-motile structures, which in the EM resemble large microvilli. Towards the basal lamina we see a number of small nuclei, which belong to the basal cells of the ductus epididymidis. These cells regenerate the epithelium.
- Peristaltic contractions of smooth muscle cells surrounding the ductus epididymidis move the spermatozoa towards the middle segment of the duct, which is the site of final functional maturation of the spermatozoa - now they are motile.
- The terminal segment of the ductus epididymidis is the site of storage of the mature spermatozoa.
- Smooth muscle fibers of the terminal part of the ductus epididymidis do not contract spontaneously. They contract during sexual stimulation concurrently with the contraction of the musculature of the duct into which it opens the vas deferens.

2. Uterus.

* 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.

3. Smooth muscles.

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
in the tunica media of the blood vessels
* The smooth muscle has involuntary action except in the muscle of urinary bladder and ciliary muscle of eye.
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.

II- Compare between the following:

1- Ureter in different species.

The ureter leaves the kidney at the hilus and enters the urinary bladder, coursing obliquely through the wall of urinary bladder. There is a valve like mucosal flap, which closes off the urethral opening as the bladder The structure of ureter:- (1) Tunica mucosa, (2) Tunica muscularis and (3) either an adventitia or a serosa. (1) Tunica mucosa: is lined with transitional epithelial cells. The thickness varies with the species. The epithelium rests on a loose connective tissue stroma. (2) The tunica muscularis has three ill-defined layers: inner and outer longitudinal layers and a middle circular layer. Loose connective tissue often separates the smooth muscle bundles, particularly in the longitudinal layers. The inner longitudinal muscle layer is absent in the cat ureter, except for a scant amount in the proximal portion. (3) An adventitia or a serosa is composed of loose collagen and elastic fibers with varying amounts of adipose tissue around the periphery.	Ureters of the horse, donkey and have simple branched tubuloalvoelar mucous glands in the propria-submucosa they extend from the renal pelvis through the upper one third (10-cm) of the ureter. - Their secretory products give the urine of these species the characteristic stringy, mucous consistency.

2- Thyroid and parathyroid glands.

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	Parathyroid Glands * Two pair of parathyroid. The pair from pharyngeal pouch III is the inferior pair with the superior pair derived from pharyngeal pouch IV. * The glands are small about 6mm by 3mm and found on the posterior aspect of each lateral lobe of the thyroid. The parathyroid glands develop from the mesoderm of the pharyngeal pouches, the cranial parathyroids from

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 syntehesizes, 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.

the 4th pouch, and the caudal parathyroids from the 3red pouch.

* Delicate C.T. partially divides the gland into poorly defined lobules with still finer septa separating the epithelial cells into anastomosing cords and groups.

Parenchyma is composed of two cell types:

Principal (or chief cells)

Polyhedral in shape, round nuclei with a. loosely arranged chromatin giving a vesicular appearance. It may classify as light and dark chief cells.

Large Golgi apparatus, small secretory granules and some rough endoplasmic reticulum

It secretes PARATHORMONE which elevates blood calcium levels

Oxyphil cells

Larger than chief cells. Smaller darker staining nuclei. Cytoplasm stains well with eosin contains fine granules. The number of the cell is fewer than that of the chief cells

*Abundant mitochondria, not present until about 10 years of age and only

* Abundant after puberty. May represent a state in the life cycle of the chief cells

* Small colloid follicles may be present but are not functionally related to thyroid.

A transitional cell (Syncytial cells) type with structural characteristics intermediate between those of principal and oxyphil cells, i.e., with many mitochondria, relatively abundant rER, Golgi complex, and secretory granules, is likewise present.

In goats and sheep, the periphery of the gland is occupied by light principal cells, and the dark princi¬pal cells are in the center. In all other domestic mammals, the dark and light principal cells are dis¬tributed randomly with one or the other form pre¬vailing, depending on the functional phase of the glands. Colloidal cysts with ciliated lining cells are frequent.

In dogs and sometimes in horses, the parenchymal cells form a simple pericapillary epithelial layer with oc-casional rosette like formations.

3- Esophagus and crop.

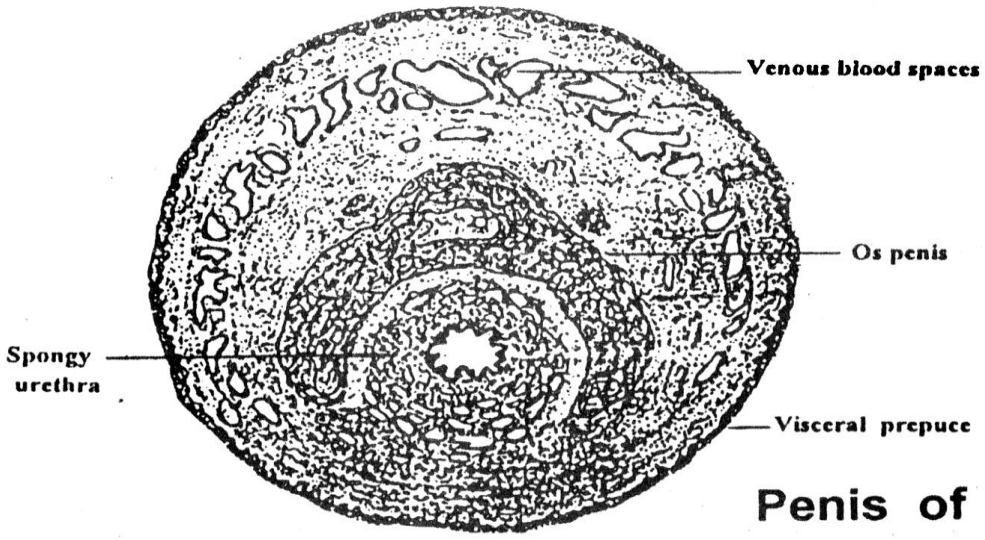
It connects the mouth region to the crop in close association with the trachea. The crop is a large dilation of the esophagus located just prior to where the esophagus enters the thoracic cavity. The crop provides the capacity to hold food for some time before further digestion commences. This capacity enables the bird to take its food as “meals” at time intervals but permits continuous digestion. Inside the thoracic cavity, the esophagus enters or becomes the proventriculus which is a very glandular part of the digestive tract (often

crop was a keratinised stratified squamous. The lamina propria was a loose connective tissue containing glands. Glands were either purely mucous or seromucous (mixed). In the rock dove, rose-ringed parakeet and collared dove, there were no glands either in the cervical part of oesophagus or in the crop. There were differences in the histochemistry of glands' secretions. The muscularis mucosa was present as a thick layer of smooth muscle fibres. The tunica submucosa was a loose connective tissue containing vessels and nerves.

called the glandular stomach). The wall of the esophagus is composed of four layers of tissue, the innermost being mucous membrane. The mucous membrane is an important barrier to the entry of microbes and the mucous it produces is a lubricant that aids the passage of the food along the alimentary canal. The structure below the crop is similar to that above except there is less lymphoid tissue below the crop. The crop structure is similar to that of the esophagus except there are no glands present in fowls. Ducks and geese have glands in the crop mucous membranes. In pigeons, the surface cells of the crop slough off during brooding to form pigeon's milk, which is used to feed the baby pigeons in the nest	The tunica muscularis consisted of smooth muscle and was surrounded by the tunica adventitia at the cervical part of the oesophagus and crop, and by the tunica serosa at the thoracic part of the oesophagus.

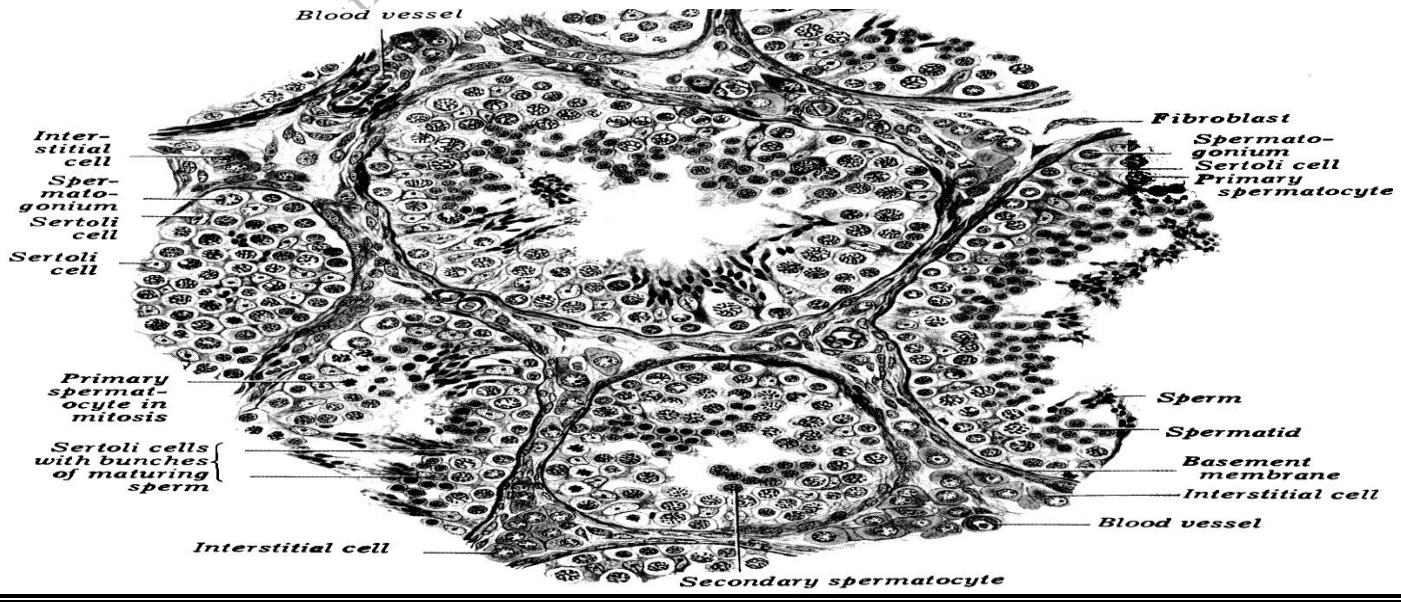
III- Draw only with complete data:

1. Penis of dog.



Penis of Dog

2. Testis of cock.



Iv- Sketch your Internet Research and **clarify** the main histological components in your way.

Anatomically, the respiratory system of fowl resembles that of mammals. The only exceptions are:
Presence of 2 larynx; one at the beginning of trachea (larynx) &
one at the end of trachea (syrnix).
Presence of air sacs which help the birds to fly.

Nose:
Formed of 2 cavities, separated by a cartilaginous septum (Septum nasi).
Each cavity is divided into 3 regions:
Vestibular region lined with stratified squamous epithelium and contains mucous glands.
Respiratory region lined with respiratory epithelium and contains mucous glands.
Olfactory region lined with sensory epithelium and contains mucous glands. (Olfactory gland)
Each nasal cavity is connected with:
Outside by anterior nasal opening (slit-like opening, covered by skin and contains a cartilaginous plate.
Pharynx by posterior nasal opening.
Mouth by chonical opening.
Lacrimal gland by Naso- lacrimal duct.

Larynx:
It acts as a respiratory passage only. It cannot produce sounds because the vocal cords are absent
Wall of larynx is formed of 4 layers:

1- T. mucosa:
L. epith.-------- respiratory epithelium except the inlet (str. Sq. epith)
L. propria------- fibroelastic C.T containing mucous glands groups of
salivary gland).
2- Laryngeal cartilage
The larynx is supported by a group of hyaline cartilage. Epiglottis is absent.
3- Laryngeal muscles 3 groups of striated muscles (Intrensic, extrensic. & dorsal). The intrinsic group lies under the epith & around the inlet.
4- T. adventitia -------fibroelastic CT

Trachea :
Long tube which connects the larynx & syrnix & then bifurcates into 2 bronchi
Wall of trachea is formed of 4 layers:
1- T. mucosa:
L. epith ---- respiratory epithelium
L. prop. ----fibro elastic C.T. containing mucous glands.
2- Tracheal cartilages:
The trachea is supported by 100-120 complete rings of hyaline cartilage.
The rings are overlapping & connected together by ligaments.
3- Tracheal muscles: ----2 thin bands of SMF
4- T. adventitia:-------- contains longitudinal bundles of striated muscles.

Syrinx :
Syrnix is the terminal part of trachea & the first part of bronchi.
The wall of syrnix is formed of 4 layers:
1- T. mucosa:
L. epith respiratory epithelium.
L. prop. fibroelastic C.T.
2- Laryngeal cartilages. 4 groups of hyaline cartilage.
Cranial group = 4 rings.
Intermediate. Group = 4 rings.
Caudal group = 3 rings.

Pessulus = wedge-shaped cartilage present at tracheal bifurcation.

3- Laryngeal muscles: 2 groups of striated muscle. (extrinsic and intrensic.).

4- T. adventitia: loose CT

* Syrnix is the organ of voice.

Voice is produced by tympanic membranes

1-Lateral tympanic membranes lie on the lateral aspects of syrnix.

2-Medial tympanic membranes lie on the medial aspects of each bronchus.

The membranes are not lined by resp. epith but by str. Sq. epith.

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GOOD LUCK

With Best wishes

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