The anatomical – morphometrical and histological study of larynx in sheep and goats

S.E.J. ALSadi
Coll. of Vet. Med./Univ. of Mosul

Abstract

The larynx is a valve separating the respiratory system from the upper digestive tract. Which lies between the root of the tongue and trachea. The larynx is an irregular tube suspended by the hyoid apparatus and is partly contained within the intermandibular space. The larynx is the upper expanded portion of the wind pipe which is specially modified for the production of voice. The larynx in sheep is longer, wider and thicker than in goats. The larynx has ten muscles in sheep and goats. As well as in both animals have five cartilage two cavities and eight ligaments. The laryngeal glands in sheep were more than in goats. Histologically thickness of the layers in sheep were larger than in goats. In addition the collagen fibers and mast cells in larynx were more in sheep and in goats.

Introduction

The larynx is complicated structure consists of four basic anatomical components. It is an apparatus made up of cartilages, ligaments, muscles and mucous membrane, which guards the entrance to the lower respiratory passages (trachea, bronchi and lungs). It is the house of the vocal cords (1,2,3), the major cartilaginous and ligamentous structures which make up helps the larynx during the swallowing and it is necessary for an effective cough as well as allowing air to pass in and out of mouth (4). The larynx is a short cartilaginous tube that act as a valve via the action in spiration of foreign bodies. It provides a passage way for air conduction as some filtration analogous to the iris of the eye (5,6,7). The available literature (8,9,10,11,12,13,14,15) studied only the anatomy and the relations of these cartilages muscles, ligament to each other on the other hand, recent interest in the condition of subglottic stenosis and post in tubational stenosis of the lower respiratory tract led to a search through the literature and to determine the measurements of the larynx. However morphometric studies on the larynx in domestic animals are scarce. The present investigation aimed to provide the basic information for anatomy and histology of the larynx which is necessary to physiology, pathology and surgery.

Materials & Methods

The materials for the present study consisted of sixteen larynges of adult healthy sheep and goat obtained from Mosul slaughter house. The age of these animals ranged from (1-3) years, half of these specimens were of male animals and the rest of female ones of both sheep and goat. The total body length and age of each animal were listed before slaughtering. The specimens were refrigerated, then dissected the cartilages, muscles, cavities and ligament were separated very carefully from each other and cleaned then the specimens were studied anatomically. Various measurements were taken from the inner surface with help of a divider and give the measurements by vernier using the were taken(fig:1-A) and two diameter, transvers and dorsoventral (16,17). For the histological study, the larynx were removed (10-15) minutes after slaughtering. The larynx content was first placed by normal saline. Small pieces, represent epiglottis, thyroid, cricoid, arytenoid and corniculate regions of the larynx were placed in (10%) neutral buffered formalin. Embedded in paraffin, cut at six microne. The sections collected were stained by H&E and Masson trichrom
stain. Ten serial sections were selected for each region and measurement by vasopan with factor (8) lins (10). The mean and standard error were calculated for each region. The data were statistically analyzed by unpaired students (t-test). (17,18,19).

**Results**

**Gross observation of larynx**

The larynx in both animals were situated in the inter mandibular space where extent to the third, fourth and fifth cervical vertebra. It forms the lower part of the anterior wall of the pharax and the base of the skull. The structures of the larynx are supported by the hyoid apparatus, a series of many small bones that articulate with the temporal bone of the skull. The chief arteries of the larynx are cranial and caudal laryngeal branch derived from the cranial thyroid artery which supplied all region of the larynx. The lymphatic vessels consist of cranial cervical deep lymphnode, some of lymph nodes pass to the crico thyroid ligament and the front of the cranial part of trachea. The nerves are derived from the cranial and caudal recurrent laryngeal nerves. The cranial laryngeal nerves pass on the lateral wall of the larynx through the thyroid foramen of the larynx then divided into two branches lateral which innervate crico thyroideus muscles, others branch innervate mucous membrane and vocal cord. The caudal recurrent laryngeal nerves enter the larynx of the medial aspect of the thyroid lamina to supply all intrinsic and extrinsic muscles except the crico thyroideus muscles. The wall of the larynx consist of cartilages, ligaments, membranes and muscles.

**The cartilages of the larynx**

The skeleton of the larynx composed of three large and two small cartilages into both aniamles (fig1-B&C):

1. **Epiglottis cartilage**: Is the rostral cartilage which projects over larynx close and open the larynx during swallowing. The epiglottis is leaf-shaped like but a cordate leaf in goat and an abovate leaf in sheep. It consist of two surfaces (lingual and laryngeal), two lateral borders, abase and apex. The apex in sheep are rounded but in goat are pointed. It was related dorsally to the caudal part of the soft palate.

2. **Thyroid cartilage**: Is the largest cartilage of the larynx that forms the most lateral and ventral portion of the cartilaginous laryngeal skeleton. The thyroid cartilage consist of two right and left quadria laminae, which were united ventrally forming the body an acute angle in middle line of body consist of subcutaneous projection laryngeal prominence (Adam’s apple) Dorsally, the thyroid laminae are expanded to form rostral and caudal cornua, the caudal cornua is long and narrow in sheep but short and broad in goat. Thyroid fissure separates the rostral cornua from the rostral border of the cartilage, leaving a small foramen at the depth of the fissure.

3. **Cricoid cartilage**: The most caudal cartilage of larynx form a complete ring or signet ring. The cricoid cartilage is wide dorsally and narrow ventrally. It consist of a dorsal plate called lamina and narrow ventro lateral part called the arch. The lamina has median sagittal crest, the cartilage has two surfaces (dorsal, ventral) and two borders (cranial, caudal). The arch of the cricoid cartilage was more concave in sheep and goat.

4. **Arytenoid cartilage**: Pyramid in shape, two in number consist of three surface (dorsal medial and lateral) and three borders (ventral, medial and lateral) meet with each other by three process (muscular, vocal and articular) with apex and base, at the base of the cartilage the ventral border forms the vocal process. The muscular process in the medial dorsal border, the articular process in the lateral dorsal border was pointed in sheep and goat. The apex of the
arytenoid cartilage in sheep are more curved.

5. Corniculate cartilage: Small cartilage on each side of the arytenoid cartilage. They were like horn process more curved in goat than in sheep. Consist of two surfaces (dorsal and ventral) two borders (cranial and caudal) apex and base.

The Ligaments and Membranes of the larynx:
The ligaments of the larynx are extrinsic which connect the larynx with hyoid bone and the trachea. The intrinsic ligaments which connect the several cartilages of the larynx to each other (fig1-D).

Extrinsic ligament:
1. Thyrohyoid membrane: In goat the ventral part of this membrane may be thickened in which case it is termed the thyrohyoid ligament but in sheep it is considered as a sheet of connective tissue extending from the rostral bordors of the lamina and the body of the thyroid cartilage to the caudal borders of basi hyoids bone.
2. Hyoepiglottis ligament: Which extended from the lingual surface of the epiglottis to the body of the hyoid bone. It was small ligament and like band shape.
3. Crico Trachcal ligament: This ligament connect the caudal border of the cricoid cartilgem with the cranial border of the first ring of trachea. This is broad ligament in two animals.

Intrinsic ligament:
4. Thryo epiglottic ligament: Was a long ligament in sheep but short in goat, it extended from the base of epiglottic to the body of the thyroid.
5. Cricothyroid ligament: Consist of two ligament in sheep but one broad ligament in goat. It is extended from the rostral border of the cricoid cartilage to the body of the thyroid cartilage.
6. Cricoarytenoid ligament: It connect the cranial and ventral parts of the lamina of the cricoid to the medial surface of the aryteroid cartilage.
7. Transvers arytenoids ligament: It was extended between two angles (medial and dorsal) of the two arytenoids cartilages and it is similar in sheep and goat.
8. The focal ligament which presents on either side and extends from the vocal process of the arytenoids cartilage to the dorsal surface of the body of thyroid cartilage.

Cavity of the larynx:
The cavity of the larynx extended from the laryngeal inlet to the caudal border of the cricoid cartilage. It is the space enclosed by the laryngeal cartilages, muscles and ligaments. It is divided into two part by the projection of the vocal folds (two flaps of tissue in side the larynx which contain the muscular vocal cord and a small median ventricle is present in both animals) (fig1-E&F).
1. Vestibule: It is wide and triangular in shape. The part of the cavity is located between the laryngeal inlet and the level of the vocal folds. The boundaries of vestibule are dorsally the epiglottis and the body of thyroid cartilage, latrally the medial surface of the arytenoid cartilage ventrally, the arytenoideus transversus muscles (fig1-E&F).
2. Infra glottic cavity: It is elliptical form extended between the vocal fold and the caudal border of the cricoid cartilage, and is bounded by the cricothyroid ligament and the inner surface of the cricoid cartilage (fig:1-E&F).

The muscles of the larynx:
The laryngeal muscles cover the laryngeal cartilages, they were divided into extrinsic and intrinsic muscles.

The extrinsic muscles:
1. Sterno thyroid muscles: Arise with sternohyoid muscles laterally originated from the sternum and insert on the thyroid cartilage. These are long muscle strap shape in sheep and goat.
2. Thyrohyoid muscles: This is strap muscles connect between the lingual
process of hyoid bone and thyroid lamina (fig 2-D).

3. Hyoepiglottic muscle: This small muscle like band shaped originated from the body of the hyoid bone and inserted in the lingual surface of the epiglottic muscle (fig 2-A).

4. Crico pharangeal muscles: It lies on the dorsal surface of the cricoid cartilage. It is originated from larynx and inserted from the pharange. The muscles has strap shape in sheep and goat.

5. Thyro pharangeal: It lied on the lateral surface of the laminae of thyroid cartilage and originated from thyroid cartilage. It is broad muscles inserted in the pharange (fig 2-A&B).

The intrinsic muscles:

6. Arytenoides transverses muscles: It arises from the muscular process of the arytenoids cartilage it ends together with its from the other side on amedin rapha.

7. Cricoarytenoid dorsalis muscles: Originated from the cricoid lamina lateral to the median crest and passes rostrolaterally to the muscular process of the arytenoids cartilage.

8. Cricoarytenoid lateral muscles: Originated from lateral part of the lamina and arch of the cricoid cartilage and inserted to the vocal process of arytenoids cartilage (fig 2-C).

9. Thyro arytenoid muscles: This is small muscles originate from dorsal surface of the lamina of the thyroid ligament and insert in the muscular process of arytenoids cartilage.

10. Cricothyroid muscles: Originated from the ventral part of arch from cricoid cartilage and insert in the caudal border from the lamina of the thyroid cartilage (fig 2-E&F). The length, diameter and thickness are more in larynx of sheep than in goat (table 1,2).

Histological observations:

The orval portion of the organ, it is lined with stratified squamous epithelium, the respiratory part it was lined with psedostratified columnar epithelium (fig 3-A) & (fig 4-A&B). The lamina propria contain a number of laryngeal cartilages. The large cartilages (thryoid,cricoid, and arytenoids) are hyaline type. The smaller cartilages (epiglottis,cuniform) are elastic cartilage. In addition the epiglottis cartilage extends in to the pharynx covered with stratified squamous epithelium toward the base of the epiglottis the epithelium under goes to ciliated pseudostratified columnar epithelium. Mixed mucous and serous glands were lied beneath the epithelium. Below the epiglottis the mucosa form two vocal fold which covered by stratified squamous epithelium. Laryngeal glands in the sheep were more than in goats. Laryngeal muscles are skeletal muscles (fig 4-C&D) in to both animale. Adventitia it has loss connective tissue in both animals. The thickness of larynx in sheep was more than the thickness in goat (table 3,4).

Discussion

According to the (9,10,11,12) the larynx of domestic mammals was located at the level of base of the cranium ventral to the laryngopharynx and the beginning of the oesophagus, but the present study revealed that the larynx was located in the intermandibular space but more caudal in the other species, the different specing of the position due to the shape of thyroid cartilage. The cartilaginous skeleton of the larynx which consist of anumber of paired and unpaired cartilage which are connected to each other to the hyoid bone and to the trachea by ligaments and muscles this is in agreement with (11,12). In addition the thyroid cartilage forms the skeleton of a large part of the lateral walls of the larynx (13,14,15). The present study show that apex of epiglottis is pointed in goat, our results are in agreement with that stated in horse and dog by the (9,11) but apex of epiglottis is rounded in sheep this is in agreement with (12) in ox and pig, this is related dorsally to the caudal part of the soft palate. In this study the cricoid cartilage is more concave in sheep and goat.
in contrast with (8,9) whom mentioned that cartilage are slightly concave. The present study show that the ventral part of the thyrohyoid membrane may be thickened in which case it is termed the thyroid ligament in sheep but it is as sheet of connective tissue in goat. Our results were in contrast with previous observation on the cavity of the larynx is divided into three compartment but result show it has two cavities because not contain lateral fold, when this fold are present the space between them is known as the rima vestibuli. The result of the present study show that the cricopharangeal and thyropharyngeal muscles consider that muscles from extrinsic muscles from the larynx because it is originated from the larynx and inserted of the pharanx. The result of the present study agreement with (21,22,23,24,25,26) the based on normal larynx(cartilage,ligament,muscles and fold). And the migration of the mast cells from connective tissue and muscular layer in different region of the larynx. The number of mast cells can not be a part of pathological tissue, but has been seen as part of the physiological tissue reaction in agreement with that mentioned (27,28,29). The histometric analysis of the present study have showed that mucosal cartilage layer larger part in sheep and goat. Results of the present study clearly demonstration the presence of a large number of laryngeal glands in sheep more than in goat.

Table (1) The length, diameter and thickness of larynx in sheep and goat male by verinear.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sheep male mean ± SD</th>
<th>Goat male mean ± SD</th>
<th>t –value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>4.25 ±0.02</td>
<td>3.76 ±0.4</td>
<td>2.899*</td>
</tr>
<tr>
<td>Transvers diameter</td>
<td>2.15 ±0.07</td>
<td>2.05 ±0.3</td>
<td>3.571*</td>
</tr>
<tr>
<td>Dorsoventral diameter</td>
<td>1.19 ±0.2</td>
<td>0.82 ±0.09</td>
<td>2.402*</td>
</tr>
<tr>
<td>Thickness of larynx</td>
<td>0.5 ±0.09</td>
<td>0.35 ±0.04</td>
<td>4.054*</td>
</tr>
</tbody>
</table>

n=8 used (t) table(2.36).

*Significantly different from the corresponding (t) value (P≥0.05)

Table(2) the length, diameter and thickness of larynx in sheep & goats female by verinear.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sheep female mean ± SD</th>
<th>Goat female mean ± SD</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>4.0 ±0.17</td>
<td>3.75 ±0.15</td>
<td>2.941*</td>
</tr>
<tr>
<td>Transvers diameter</td>
<td>2.11 ±0.05</td>
<td>2.0 ±0.03</td>
<td>4.992*</td>
</tr>
<tr>
<td>Dorsoventral diameter</td>
<td>1.17 ±0.13</td>
<td>0.87 ±0.10</td>
<td>4.918*</td>
</tr>
<tr>
<td>Thickness of larynx</td>
<td>0.45 ±0.15</td>
<td>0.25 ±0.02</td>
<td>2.631*</td>
</tr>
</tbody>
</table>

n=8 used (t) table(2.36).

*Significantly different from the corresponding (t) value (P≥0.05)
Table (3) the thickness of four layers in larynx of sheep & goat male by vasopan.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sheep male</th>
<th>Goat male</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lins(10)factor(8) Mean SD</td>
<td>lins(10)factor(8) Mean SD</td>
<td></td>
</tr>
<tr>
<td>Thikness of mucosa and submucosa</td>
<td>80× 4.7</td>
<td>376±13.10</td>
<td>7.752*</td>
</tr>
<tr>
<td>Mucosal cartilage nous tunica</td>
<td>80× 7.2</td>
<td>576±12.5</td>
<td>4.786*</td>
</tr>
<tr>
<td>Tunica adventitia</td>
<td>80× 2.5</td>
<td>200±7.9</td>
<td>4.695*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n=8 used (t) table(2.36).
*Significantly different from the corresponding (t) value (P≥0.05).

Table (4) the thickness of four layers in larynx of goats by vasopan.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sheep female</th>
<th>Goat female</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lins(10)factor(8) Mean SD</td>
<td>lins(10)factor(8) Mean SD</td>
<td></td>
</tr>
<tr>
<td>Thikness of mucosa and submucosa</td>
<td>80× 3.9</td>
<td>360±11.4</td>
<td>8.332*</td>
</tr>
<tr>
<td>Mucosal cartilage nous tunica</td>
<td>80× 6.7</td>
<td>560±8.7</td>
<td>8.547*</td>
</tr>
<tr>
<td>Tunica adventitia</td>
<td>80× 2</td>
<td>176±3.1</td>
<td>12.851*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n=8 used (t) table(2.36).
*Significantly different from the corresponding (t) value (P≥0.05).
A- Show the larynx cut in cross section to give the parameter anatomically by veriner.

B- The five cartilage of larynx in (male) of sheep and goats. 1-1° thyroid cartilage .2-2° cricoids cartilage. 3-3° epiglottis cartilage 4-4° corniculate cartilage 5-5° arytenoid cartilage.

C- The five cartilage of larynx in (female) of sheep and goats. 1&6 cricoids cartilage 2&7 thyroid cartilage. 3&8 epiglottis cartilage 4&9 arytenoid cartilage 5&10 corniculate cartilage


E- Show the cavities cross section in sheep.

(Fig:1)

F- Show the cavities longitudinal section. 1. vestibule. 2. infra glottis cavity. 3. medial fold
A- Show the extrinsic muscles of larynx in sheep  
1. hyoepiglottis muscle  
2. sterno thyroid muscles  
3. thyroid pharangeal muscles  
4. crico pharangeal muscles.

B- Show the extrinsic muscles in goats.  
1. thyroid pharangeal muscles  
2. crico pharangeal muscles

C- Show the intrinsic muscles of larynx in sheep .  
1. transverse arytenoids muscles  
2. Crico arytenoid dorsalis muscles.  
3. Crico arytenoid laterals muscles.

D- Show the extrinsic muscles of larynx in sheep .  
1. thyrohyoide muscles

E- Show the intrinsic muscles of larynx in goat .  
1. Cricothyroid muscle

(Fig:2)
A- Show the four layers of arytenoids in sheep. 1. the membrane of larynx 2. the lamina propria and submucosa. 3. mucosal cartilaginous 4. the tunica adventitia. H&E x320

B- Show the mucous, serous and mixed glands of thyroid in sheep. 1. mucous gland 2. serous gland 3. mixed gland. H&E x1320

C- Show the 1. mixed glands of thyroid in Sheep. H&E x320

D- Show the 1. serous glands of cricoids in sheep. H&E x1320

E- Show the muscles cartilaginous layer. H&E x320

F- the hyaline cartilage of larynx in sheep. 1. condrocyte. H&E x320

(Fig:3)
A- Show the four layers of arytenoids in goats. 1. the membrane of larynx 2. the lamina propria and sub mucosa 3. mucosal cartilaginous 4. the tunica adventitia H&E x320

B- Show the four layers of epiglottis in goat. 1. the membrane of larynx 2. the lamina propria and sub mucosa 3. mucosal cartilaginous 4. the tunica adventitia H&E x320

C- Show the 1. serous glands of cricoids in goat. H&E x1320

D- Show the 1. mixed glands of thyroid in goats. H&E x320

E- The hyaline cartilage of larynx in goats. 1. condrocyte. H&E x1320

(Fig:4)

F- The muscles and mast cells of larynx in sheep. 1. mast cell 2. connective tissue. Masson, Trichrome x1320
References

دراسة تشريحية – قياسية ونسيجية للحنجرة في الاغنام والماعز

سمية عباسي جعفر الساعدي
كلية الطب البطري / جامعة الموصل

الخصائص

الحنجرة عبارة عن مفصل يفصل الجهاز التنفسي والجزء العلوي من القناة الغذائية. تقع مسببة جذر اللسان والرغامي وهي انبوب غير منتظم مدعمة بالرئة اللامية تنتظر جزء من مكونات فراغ مابين الفكين. والحنجرة هي الجزء العلوي المتعلق من انبويب الهواء المتطور. وتحتوي على إنتاج الصوت والحنجرة في الاغنام أطول وأعرض وألمع مما هي عليه في الماعز للحنجرة في الاغنام والماعز عشرة عضلات وليها في كلا الحيوانين خمسة غضاريف وتجويفين وثمانية أرباطا. العدد الحجري في الاغنام أكثر من الماعز وكذلك سمك اللب من نسيجيا في الاغنام أكثر مما هو عليه في الماعز. إضافة إلى أن الألباب الغزارية والخلايا البدينة كثيرة في الاغنام والماعز.