Some Anatomical Studies on The Laryngeal Cartilages in Balady Rabbit

M. El-Shaieb, M. Attia and A. Abo Ahmed
Department of Anatomy and Embryology, Faculty of Veterinary Medicine, Benha University, Egypt.

Summary

Recently, attention was paid to rabbit as a fur and meat producing animal. Owing to the lack of the literature concerning the morphological structures of the rabbit specially the respiratory system, this work is a trial to throw a light on the anatomical aspects of the laryngeal cartilages of Balady rabbit. The present study was carried out on twenty healthy adult Balady rabbits of different sexes. Fifteen rabbits were used for gross anatomical studies of the laryngeal cartilages and the others were used for the histological study. The cartilaginous framework of the larynx consisted of three single cartilages; the cricoid, thyroid and epiglottic and three paired cartilages; the arytenoid, corniculate and cuneiform cartilages. The thyroid cartilage was U-shaped composed of two laminae united ventrally to form the body of thyroid cartilage. The lateral surface of the thyroid lamina was divided into dorsal and lateral parts by longitudinal ridge. There was no caudal thyroid notch. The cricoid cartilage was signet-ring shaped composed of a dorsal quadrilateral lamina and a ventrolateral arch. Epiglottis had leaf or flap shape with rounded and slightly forked or notched apex. The arytenoid cartilages were small irregular quadrilateral in shape. The corniculate processes were bilateral thin flat elastic nearly quadrilateral cartilaginous pieces. The cuneiform processes were two very small bar like cartilaginous processes. The cricoid, the main part of the arytenoid and thyroid cartilages were hyaline, while the epiglottis with its cuneiform process and the corniculate and vocal processes of the arytenoid cartilages were elastic cartilages.

Introduction

The rabbits are used for a variety of purposes, including meat and fur production. The meat of rabbit contains high amount of protein and water and low amount of fat than that of other mammalian meat. In addition, the rabbit is used as an ideal laboratory animal because of its high fertility, short generation span, small size and low cost so, it is used in various researches and in the production of antibodies (**13**). Owing to the lack of the literature

concerning the structures of the larynx, this work is a trial to throw a light on the laryngeal cartilages of Balady rabbit.

Material and Methods

Materials:

The present study was carried out on twenty healthy adult Balady rabbits of different sexes. Fifteen rabbits were used for gross anatomical studies of the laryngeal cartilages. Other five adult rabbits were used for the histological study. Magnifying lens, caliber and stereomicroscope were used for demonstration of the cartilages of the larynx and a digital camera was used for preparation of photographs.

Methods of study:

A) Gross anatomical study:

Deep inhalation anesthesia was carried out using chloroform by wet cotton until the desired anesthetic effect was obtained; the rabbits were bled by severing the common carotid arteries. The larynx was isolated and the muscles and mucous membranes were removed to clear the cartilages of the larynx then they preserved in jars filled with formalin then they were described and named according to (**12**).

B) Microscopic study:

The five specimens for the histological study were taken immediately after slaughtering of the rabbits. Small pieces of the cartilages were taken and fixed in 10% neutral buffered formalin, dehydrated in ascending grades of alcohol, cleared in xylene and embedded in paraffin wax. Sections of 5-7 um in thickness were obtained and stained with:

1-Harris's alum Haematoxyline and aqueous solution of Eosin 1% was used as counter stain for general histological examination.

2-Orcein technique for elastic fibers.

The staining methods were used as outlined by (**2**).

Several photographs were prepared. The nomenclature used in this study was adopted by (**12**).

Results

(A) Anatomical Findings:

The cartilaginous framework of the larynx in the Balady rabbit (Fig.1) consisted of three single cartilages; the cricoid (Fig.1/A), thyroid (Fig.1/B) and epiglottic (Fig.1/C) in addition to three paired cartilages; the arytenoid (Fig.1/E), corniculate (Fig.1/F) and cuneiform (Fig.1/D).

I-Single cartilages:

1- Cartilago thyroidea:

It was the largest of the laryngeal cartilages and it was situated rostral to the cricoid cartilage. It had a wide U-shaped or gutter shaped form (Fig.2). It was composed of two quadrilateral laminae (Fig.2/8) which united ventrally in the midline to form the body of the thyroid cartilage (Fig.2 and 3/1) which was long and had no laryngeal prominence. The dorsal border of the thyroid lamina (Fig.2/6) was slightly concave. The rostral border of the thyroid lamina (Fig.2/9) was slightly straight but it was concave above the origin of the rostral cornu while the caudal border (Fig.2/10) was slightly straight along its length.

The lateral surface of the thyroid lamina was divided into two parts; dorsal and lateral by a longitudinal ridge (Fig.2 and 3/4) which extended from behind the rostral cornu, increased in its lateral projection caudally then subsided suddenly before reaching the caudal border of the thyroid lamina. Also, another faint transverse ridge (Fig.2 and 3/5) was also found on the lateral surface of the thyroid laminae extended ventrally and slightly caudally from the caudal end of the longitudinal ridge. These ridges gave origin to the thyrohyoid muscle and insertion to the sternothyroid muscle.

At the junction between the dorsal and lateral parts of the thyroid lamina, the rostral border projected rostrally for about 0.4-0.5 cm to form the rostral cornu (Fig.2 and 3/3) which formed the rostral thyroid notch with the rostral border of the thyroid lamina. The caudodorsal angle of the thyroid laminae was pointed caudally to form the caudal cornu (Fig.2 and 3/2) which had a small oval facet medially for articulation with the thyroid articular facet of the cricoid cartilage.

The thyroid lamina was pierced by the thyroid foramen (Fig.2/7) just dorsal to the rostral end of the longitudinal ridge. There was no caudal thyroid notch.

2- Cartilago cricoidea:

The cricoid cartilage in the Balady rabbit (Fig.4 and 5) was signet-ring shaped composed of a dorsal quadrilateral lamina and a ventrolateral arch. The dorsal surface of the cricoid lamina had the median muscular crest (Crista mediana) (Fig.4/1), on either side of which there was a smooth shallow depression (Fig.4/2) from which the dorsal cricoarytenoid muscle arised.

The rostral margin of the cricoid lamina (Fig.4/3) was strongly convex, while the caudal margin (Fig.4/6) was slightly straight. The lateral margins of the cricoid lamina were concave at their middle.

Bilaterally, at the junction between the lamina and the arch and near the caudal border, there was a facet for articulation with the thyroid cartilage (Facies articularis thyroidea) (Fig.4 and 5/5). Rostral to the before mentioned facet, there was another facet for articulation with the arytenoid cartilage (Facies articularis arytenoidea) (Fig.4and5/4) which occurred at the junction between the rostral margin of both the cricoid lamina and the arch.

The cricoid arch (Fig.4/7) was obliquely situated and was narrow ventrally than laterally. The rostral margin of the cricoid arch (Fig.5/1) was slightly straight but its direction was oblique caudo-ventrally, the caudal margin (Fig.5/3) was concavo-convex from above downward. The ventral part of the cricoid arch was notched caudally by the cricoid notch. The lateral surface of the cricoid arch had a shallow longitudinal groove (Fig.5/2) from which the cricothyroid muscle originated.

3- Epiglottis:

The epiglottic cartilage was the most rostral of the laryngeal cartilages situated immediately caudal to the root of the tongue. It measured about 0.6 - 0.7 cm from the apex to the base. It had leaf or flap shape (Fig.6).It presented an apex, base, two surfaces (lingual and laryngeal) and two lateral borders. The apex (Fig.6, 7 and 8/1) was slightly forked or

notched while the base (Fig.6and8/3) was thickened and situated dorsal to the rostral end of the body of the thyroid cartilage. The petiolus was absent.

The two lateral borders of the epiglottic cartilage (Fig.6 and 7/2) were convex. The lingual surface of the epiglottic cartilage (Figt.6/4 and 8/2) was concave from the apex to the base and convex from side to side. The laryngeal surface of the epiglottic cartilage (Fig.7/3) was convex from the apex to the base and concave from side to side.

II-Paired cartilages:

1-Cartilago arytenoidea:

The arytenoid cartilages (Fig.9/A) were small irregular quadrilateral in shape. They were bilaterally situated rostral to the lamina of the cricoid cartilage and flanked laterally by the dorsal parts of the laminae of the thyroid cartilage. It had two surfaces (lateral and medial), four borders (dorsal, ventral, rostral and caudal); and four angles (rostrodorsal, caudodorsal, rostroventral and caudoventral). The rostrodorsal angle was found between the dorsal and rostral borders. The caudodorsal angle was found between the dorsal and caudal borders. It constituted the base of the arytenoid cartilage (Fig.9/A5) which had a facet for articulation with the arytenoid articular facet of the cricoid cartilage. The rostroventral angle was found between the rostral and ventral borders. The caudoventral angle was found between the ventral and caudal borders and formed the vocal process (Fig.9/A6) to which the vocal ligament was attached.

The dorsal border of the arytenoid cartilage (Fig.9/A3) was thick and slightly concave and extended from the apex rostrally to the base caudally. The ventral border (Fig.9/A1) connected between the apex rostrally and the vocal process caudally. The caudal border (Fig.9/A2) extended from the base dorsally to the vocal process ventrally. The rostral border (Fig.9/A4) fused with the base of the corniculate process (Fig.9/arrow head).

2-Processus corniculatus:

The corniculate process (Fig.9/B) was quadrilateral cartilaginous piece reached about 0.2-0.3cm in length. It had lateral and medial surfaces, base and apex. The base of each cartilage (Fig.9 / arrow head) was fused

with the apex of the arytenoid cartilage. The apex of each cartilage (Fig.9/B1) was relatively broad which approached each other dorsally in the midline.

3-Processus cuneiformis:

The cuneiform process (Fig.6, 7and8/B) was very small bar reached about 0.1 cm in length. It was attached to either side of the base of the epiglottic cartilage.

(B) Histological Findings:

The cricoid, the main part of the arytenoid (Fig.10) and thyroid cartilages (Fig.13) were hyaline, while the epiglottis with its cuneiform process (Fig.11) and the corniculate (Fig.12) and vocal processes of the arytenoid cartilages were elastic cartilages.

Discussion

The present work revealed that the cricoid cartilage surrounded the first tracheal cartilaginous ring; this was accepted by (**18**) in the same animal. In agreement with (**18**) in the rabbit, the rostral margin of the cricoid lamina was convex, while its caudal margin was slightly straight, also the thyroid articular facet of the cricoid cartilage was found near to the caudal border at the junction between the lamina and arch. The latter author added that in the cat, both margins of the cricoid lamina were convex and the thyroid articular facet was found near the mid-line of the cricoid arch. The ventral part of the cricoid arch was notched caudally similar to that described by (**5**) in the cat and (**18**) in the rabbit and cat.

The absence of the ventral laryngeal prominence in the present study confirmed the findings of (**3**); (**8**) and (**5**) in the cat and (**18**) in the rabbit and the cat.

The transverse and longitudinal ridges noticed on the thyroid lamina confirmed the findings of (**18**) in the rabbit but could not be traced by (**15**) or (**9**) in the same animal. The division of the lateral surface of the thyroid lamina into dorsal and lateral parts by the longitudinal ridge was not

achieved by (15) and (18) in the rabbit. However, a less prominent transverse ridge was observed on the thyroid lamina in the cat (8) and (18) and in the dog (5) and (11).

The presence of the rostral thyroid cornu in this work was not met with in the available literature concerning the rabbit.

The absence of the caudal thyroid notch was in agreement with that reported by (18) in the same animal and (11) in the pig. The thyroid foramen which observed in the present investigation was not recorded by (18) in the rabbit. However, (3), (8), (5) and (18) decided the absence of the thyroid foramen in the cat.

The epiglottis had flap shape with rounded and slightly notched or forked apex similar to that recorded by (18) in the same animal. The absence of the petiolus from the base of the epiglottis in the present study was in agreement with that given by (15) and (18) in the rabbit and (8), (5) and (18) in the cat.

The arytenoid cartilage was represented by a small quadrilateral plate situated rostral to the cricoid cartilage similar to that traced by (17) and (18) in the same animal.

The present study revealed that the corniculate cartilages were thin flat nearly quadrilateral plates fused with the apices of the corresponding arytenoid cartilages, similar to that reported by (18) in the same animal. However, (15) and (6) in the rabbit added that the apices of these processes have a small nodule called cartilage of Santorini. On the other hand, the corniculate cartilages were absent in the cat as recorded by (3); (1) and (18).

The cuneiform cartilage was a small bar like process attached to the base of the epiglottic cartilage and was directed caudodorsally, a fact which recorded by (18) in the rabbit. In contrast, (15) did not found this cartilage in the same animal. However, (17) in the same animal, described it as a small pair of bumps called the epiglottic hamuli lied at the base of the epiglottis. On the other hand, (10), (5) and (1) described the cuneiform cartilages in the dog as processes from the arytenoid cartilages.

The thyroid, cricoid and the main part of the arytenoid cartilages were hyaline, while the epiglottis with its cuneiform process and the

corniculate and vocal processes of the arytenoid cartilages were elastic cartilages similar to that mentioned by (14); (16); (3); (5) and (11) in the domestic animals and (7) in man. This fact was not traced in the available literature of the rabbit. However, (4) mentioned that the epiglottic cartilage in the camel was formed of the parenchymatous type in which there was a much greater presence of cartilage cells and very scanty matrix.

References

1. **Adams, D.R. (1986):** Canine anatomy. 1st edition. The lowa State University Press / Ames.

2. **Bancroft, J.D.; Cook, H.C.; Stirling, R.W. and Turner, D.R. (1994):** Manual of Histological Techniques and Their Diagnostic Application. 2nd Ed., Churchill, Livingstone, Edinburgh, London, Madrid, Melbourne, New York and Tokyo.

3. **El-Hagri, M.A.A. (1967):** Splanchnology of the domestic animals. 1st Edition. Cairo Univ. Press.

4. George, A.N. (1951): The respiratory system in the camel and its histology. M. V. Sc. Thesis, Faculty of Vet. Med. Cairo Univ. Egypt.

5. Hare, W.C.D. (1975): Respiratory system of equines, porcines, carnivores and ruminants. In: Getty, R.; Sisson and Grossman's. The anatomy of the domestic animals.5th Edition. W.B. Saunders, Philadelphia, London, Toronto.

6. Jordan, E.L. and Verma, P.S. (1986): Chordate zoology and elements of animal physiology. 6th Ed. S. Chand andCompany Ltd., Ram Nagar, New Delhi.

7. **Last, R.J. (1966):** Anatomy: regional and applied. 4th Edition. J. and A. Churchill Ltd, London.

8. McClure, R.C.; Dallman, M.J. and Garrett, P.D. (1973): Cat anatomy: an atlas, text and dissection guide. Lea and Febiger, Philadelphia.

9. **Mclaughlin, C.A. and Chiasson, R.B. (1990):** Laboratory anatomy of the rabbit. 3rd Edition. Wm. C. Brown Publishers, Dubuque.

10. **Miller, M.E.; Christensen, G.C. and Evans, H.E. (1964):** Anatomy of the **dog. 1st Edition. W.B. Saunders Comp., Philadelphia and London**

11. Nickel, R.; Schummer, A. and Seiferle, E. (1979): The viscera of the domestic animals.2nd revised Edition. Verlag Paul Parey.Berlin.Hamburg.

12. **Nomina Anatomica Veterinaria (2005):** 5th Edition (Electronic Edition). Published by the international committees on veterinary gross anatomical nomenclature under the financial responsibility of the world association of veterinary anatomists. Zürich and Ithaca, New York.

13. **Okerman, L. (1994):** Diseases of domestic rabbits. 2nd Edition.

14. Blackwell Scientific Publications.Oxford, London, Edinburgh Boston, Melbourne, Paris, Berlin, Vienna.

15. **Sisson, S. and Grossman, J.D. (1953):** The anatomy of the domestic animals. 4th Edition. W. B. Saunders, Philadelphia, London.

16. Thakur, R.S. and Puranik, P.G. (1984): Rabbit - a mammalian type. 2nd Edition. S. chand and Company Ltd, Ram Nagar, New Delhi.

17. **Trautmann, A. and Fiebiger, J. (1960):** Fundamentals of the histology of domestic animals. Comstock Publishing Associates. A Division of Cornell University Press. Ithaca, New York.

18. Walker, W.F. (1975): Vertebrate dissection. 5th Edition. Library of Congress Cataloging in Publication Data, W. B. Saunders Company, Philadelphia, London, Toronto.
19. Yam, Z.A. (1991): Comparative morphological study on the cartilaginous skeleton of the larynx in the rabbit and cat. Beni-Suef. Vet. Med. Res. (1), 1:11-23.

Legends for Figures

Plate (1):

Fig. (1): Photograph of fresh specimen of Balady rabbit showing the cartilaginous framework of the larynx in the Balady rabbit. (Lateral view)
A) Cartilago cricoidea. B) Cartilago thyroidea. C) Cartilago epiglottica.
D) Processus cuneiformis. E) Cartilago arytenoidea. F) Processus corniculatus.

Fig. (2): Photograph of fresh specimen showing Cartilago thyroidea. (lateral view)
1) Body of the thyroid cartilage. 2) Cornu caudale.
3) Cornu rostrale. 4) Longitudinal ridge.
5) Transverse ridge.
6) Margo dorsalis of Lamina cartilaginis thyroideae.
7) Foramen thyroideum.
8) Lamina dextra of Cartilago thyroidea.
9) Margo rostralis of Lamina cartilaginis thyroideae.
10) Margo caudalis of Lamina cartilaginis thyroideae.

Fig. (3): Photograph of fresh specimen showing Cartilago thyroidea. (Ventral view)
1) Body of the thyroid cartilage. 2) Cornu caudale.
3) Cornu rostrale. 4) Longitudinal ridge.
5) Transverse ridge.

Fig. (4): Photograph of fresh specimen showing Cartilago cricoidea . (caudodorsal view)
1) Crista mediana. 2) Shallow depression.
3) Margo rostralis of Lamina cartilaginis cricoideae.
4) Facies articularis arytenoidea. 5) Facies articularis thyroidea.
6) Margo caudalis of Lamina cartilaginis cricoideae.
7) Arcus cartilaginis cricoideae.

Fig. (5): Photograph of fresh specimen showing Cartilago cricoidea. (Lateral view)
1) Margo rostralis of Arcus cartilaginis cricoideae. 2) Shallow longitudinal groove.
3) Margo caudalis of Arcus cartilaginis cricoideae. 4) Facies articularis arytenoidea.
5) Facies articularis thyroidea.

Plate (2):

Fig. (6): Photograph of fresh specimen showing Cartilago epiglottica with Processus cuneiformis. (lateral view)

A) Cartilago epiglottica
1) Apex. 2) Margo lateralis.
3) Basis. 4) Facies lingualis.
B) Processus cuneiformis.

Fig. (7): Photograph of fresh specimen showing Cartilago epiglottica with Processus cuneiformis. (dorsal view)

A) Cartilago epiglottica.
1) Apex. 2) Margo lateralis 3) Facies laryngea.
B) Processus cuneiformis.

Fig. (8): Photograph of fresh specimen showing Cartilago epiglottica with Processus cuneiformis. (ventral view)

A) Cartilago epiglottica
1) Apex. 2) Facies lingualis. 3) Basis.
B) Processus cuneiformis.

Fig. (9): Photograph of fresh specimen showing Cartilago arytenoidea sinistra with Processus corniculatus. (medial view)

A) Cartilago arytenoidea
1) Margo ventralis. 2) Margo caudalis.
3) Margo dorsalis. 4) Margo rostralis.
5) Basis cartilaginis arytenoideae has Facies articularis.
6) Processus vocalis.
B) Processus corniculatus
1) Apex. (Arrow head) Basis.

Fig. (10): Section of the larynx of the Balady rabbit showing the cricoid (CC) and the main part of the arytenoid cartilages (AC), stratified squamous non keratinized epithelium (SE) and skeletal muscles (SK). HandE (X40).

Fig. (11): Section of the larynx of the Balady rabbit showing the epiglottis (EC) and cuneiform process (CnP). Orcein (X40).

Fig. (12): Section of the larynx of the Balady rabbit showing the corniculate process (CrP). Orcein (X100).

Fig. (13): Section of the larynx of the Balady rabbit showing cuneiform process (CnP), intrinsic muscle (IM), thyroid cartilage (TC) and thin tunica adventitia (TA). HandE (X100).

Plate 1

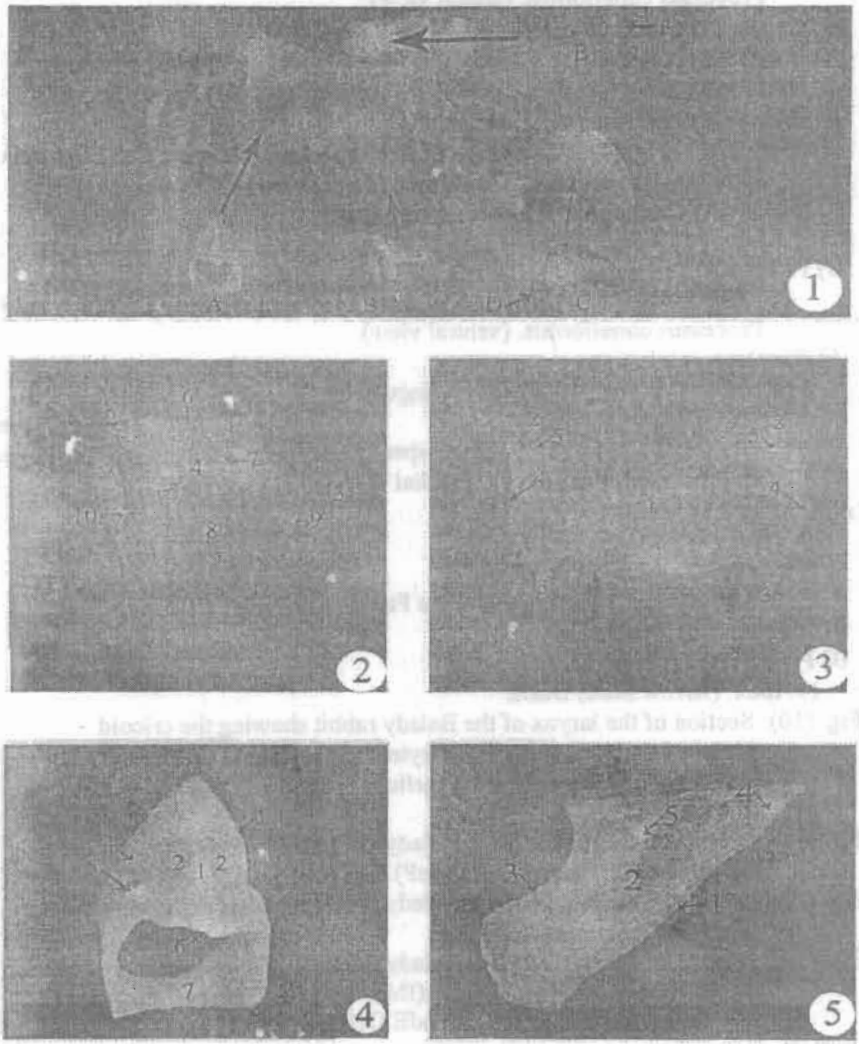
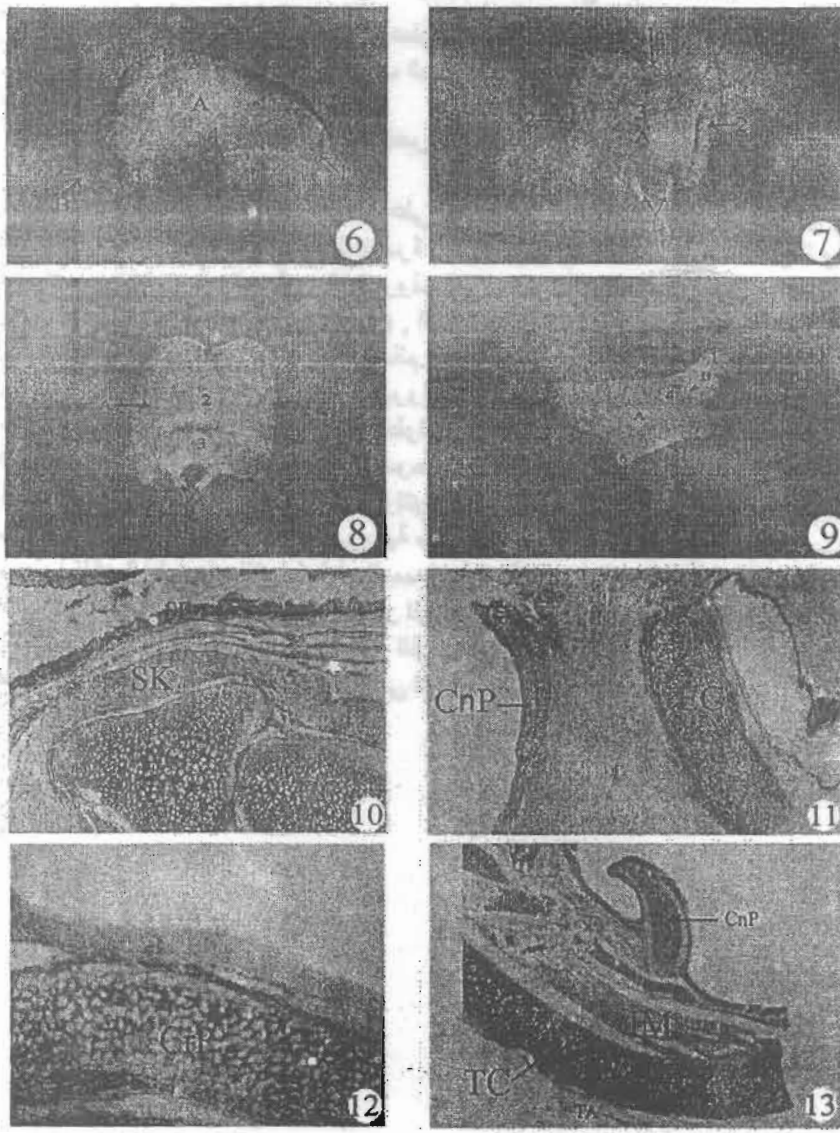


Plate 2



بعض الدراسات التشريحية على غضاريف الحنجرة فى الأرنب البلدى

محمد الشايب ، محمد عطية ، أحمد ابو أحمد
قسم التشريح والاجنة ، كلية الطب البيطرى ، جامعة بنها ، مصر

الملخص

تم إجراء هذا البحث بغرض دراسة تشريحية على غضاريف الحنجرة فى الأرنب البلدى ولقد أوضحت الدراسة أن الهيكل الغضروفى للحنجرة يتكون من ثلاث غضاريف منفردة وهى الغضروف الحلقى , الغضروف الدرقى والغضروف المزمارى بالإضافة إلى ثلاث غضاريف مزدوجة وهى الغضروف الطرجهالى(القمعى) , الغضروف القرنى والغضروف الإسفينى أو المسمارى. يأخذ الغضروف الحلقى شكل حلقة الخاتم. بينما الغضروف الدرقى هو أكبر الغضاريف الحنجرية ويأخذ شكل المزراب، لوحظ غياب البروز الحنجرى والثلمة الدرقية الخلفية. يحتوى السطح الوحشى للصفيحة الدرقية على الحيدين الطولى و المستعرض. يأخذ الغضروف المزمارى شكل الورقة بقمة دانرية بها ثلمة خفيفة و لوحظ غياب العنق أو العود . تأخذ الغضاريف الطرجهالية (القمعية) شكل رباعى غير منتظم وتتواجد هذه الغضاريف أمام الصفيحة الحلقية. تأخذ الغضاريف القرنية شكل قطعة غضروفية مفلطحة ومرنة تلتحم مع قمة الغضروف الطرجهالى. بينما تأخذ الغضاريف الإسفينية أو المسمارية شكل نتوء غضروفى صغير جدا يشبه المرود. الغضروف الحلقى والدرقى والجزء الأكبر للغضروف الطرجهالى هى غضاريف زجاجية بينما لسان المزمار ونتوئه الإسفينى والنتوءات القرنية والصوتية للغضاريف الطرجهالية هى غضاريف مرنة النوع عند دراسة التركيب النسيجى لها.