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VASCULATURE OF THE LARYNX IN DOG,
GOAT AND DONKEY
(With 15 Fig.)

By

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**المدد الدموى للحنجره فى
الكلاب ، الماعز ، الحمير**

يسريه عبده الغنى

أجرى هذا البحث لدراسة أصل وتوزيع الاوعية الدمويه الاساسيه التى تغذى الحنجره . وقد
أوضحت الدراسه أن الحنجره تستمد مددها الدموى من الشريان الحنجري الامامى ، الفرع الحنجري
الخلفى ، الفرع الحلقى الدرقي وكذلك من الفرع قبل اللامى فى الثلاث حيوانات ، بالاضافه إلى
الشريان البلومى الصاعد وكذلك الفرع الدرقي اللامى فى حالة الحمار . وقد وجد أن هذه الشرايين
والأفرع التى تغذى الحنجره تتفمم مع بعضها فى الحيوانات موضع الدراسه وكذلك نجد أن نهايتهم
تكون شبكة فى بعض أجزاء الحنجره .

SUMMARY

This investigation was carried out on 36 larynges of adult male and female dogs (12) goats (12) and donkeys (12). The heads were injected with Gum milk "latex" or with 1:1 solution of indian ink and bovine serum. The present study revealed that the larynx receives its main arterial blood supply from *A. laryngea cranialis*, *R. laryngeus caudalis*, *R. cricothyroideus* and *R. perihyoideus*, in addition to the *A. pharyngea ascendens* and the *R. thyrohyoideus* in the donkey. The origin, course, mode of branching and anastomosis of the laryngeal arteries were studied. The present investigation showed that all the arteries supplying the larynges in the examined species are anastomosed with each other forming unique network.

INTRODUCTION

In spite of the importance of the larynx in respiration and phonation, a brief general description was given on the arterial blood supply of domesticated animals (SISSON and GROSSMAN, 1969; AHMED, 1973; PRASAD *et al*, 1974; EL-AYAT, 1977; WILKENS and MUENSTER, 1981; METWALLY, 1982; DYCE *et al*, 1987; BERG, 1988). However, in man MARKOWSKI (1973) described in details the arterial blood supply of this organ.

The present investigation was carried out to get a detailed and sufficient description of the main blood supply of the larynx in dog, goat and donkey.

MATERIAL and METHODS

This study was carried out on 36 larynges of adult dogs (12), goats (12) and donkeys (12) of both sexes. The arterial system of the specimens was injected through the common carotid artery by Gum milk "Latex" coloured red with Vulcanosocarmine (B.A.S.F.) using the technique adopted by NEUMEYER (1932). Two heads of each species were injected with 1:1 serum - indian ink solution and then preserved in 10% formalin. Different parts of the injected larynges were excised, dehydrated in alcohol and cleared in methyl benzoate. The cleared specimens were then examined and photographed.

The nomenclature given in this study was adopted by N.A.V. (1983).

RESULTS

The arterial blood supply to the larynx of the dog, goat and donkey is carried out by four vessels namely: A. laryngea cranialis, R. laryngeus caudalis, R. cricothyroideus and R. perihyoideus, in addition to the A. pharyngea ascendens and the R. thyrohyoideus only in the latter animal.

A. laryngea cranialis :

In dog and goat the cranial laryngeal artery (Fig. 1, 3, 5, /10) arises from the A. carotis communis at its termination. Only in one case it arose from the external carotid artery.

In the donkey, the cranial laryngeal artery (Fig. 9, 12-14/10) originates from the A. thyroidea cranialis (2) nearly at the cranial pole of the thyroid gland in 10 out of the 12 dissected animals. In the rest of specimens it originated directly from the common carotid artery.

From its origin, the cranial laryngeal artery proceeds rostroventrally on the lateral aspect of the pharynx where it gives off the R. pharyngeus (11) and continues as R. laryngeus (12).

In goat, the R. laryngeus (Fig. 5 - 8/12) detaches a branch (13) before entering the larynx. The latter divides into two twigs. One of them (13) passes rostroventrally to reach the rostral thyroid notch, perforates the thyrohyoid membrane and vascularizes the Mm. hyoepiglotticus, thyroarytenoideus, the epiglottic cartilages, the ventral part of the laryngeal vestibule and the glottis then anastomoses with R. laryngeus. The other twig (13) is directed caudoventrally and ends either in the Mm. thyrohyoideus, thyropharyngeus and cricopharyngeus (Fig. 5) or by joining twigs of the R. cricothyroideus in the form of an arterial vascular ring (Fig. 8/arrow).

In the donkey before entering the larynx the R. laryngeus (Fig. 9, 11, 12-14/12) detaches 2-3 branches (14), which form a vascular network with the opposite twigs of the R. cricothyroideus to vascularize the M. cricothyroideus. The more rostral branch passes ventralwards and terminates in the M. thyrohyoideus after joining a twig of the R. thyrohyoideus (Fig. 9, 10) at the caudal border of the thyroid lamina.

The R. laryngeus of the cranial laryngeal artery enters the larynx in company with the internal branch of the cranial laryngeal nerve through the thyrohyoid membrane in dog or the thyroid foramen in goat. In donkey, the R. laryngeus of the cranial laryngeal artery enters the larynx between the cricoid cartilage and the caudal border of the thyroid lamina. The R.

laryngeus ends by dividing into a dorsally and a ventrally directed twig in goat and donkey or a rostral and a caudal twig in dog.

In the dog, the rostral branch (Fig. 1/15) runs along the rostral border of the thyroid cartilage to supply the M. vocalis as well as the laryngeal vestibule, ventral part of the glottis and the laryngeal ventricle and ends by joining a twig of the R. cricothyroideus (8). The caudal branch of the R. laryngeus (Fig. 1/16) joins the dorsal twig of the R. laryngeus caudalis (5) and runs medial to the thyroid cartilage to terminate in the M. vocalis. During its course, the caudal branch of the R. laryngeus vascularizes Mm. ventricularis and arytenoideus transversus, as well as the corniculate cartilage and the dorsal part of the glottis through a twig (16) which passes in the space between the arytenoid and cricoid cartilages and joins the homonymous twig of the other side.

In the goat, the dorsal branch of the R. laryngeus (Fig. 6, 7/16) runs firstly rostradorsally, then caudally. It supplies the Mm. thyroarytenoideus, cricoarytenoideus lateralis and arytenoideus transversus as well as the corniculate and epiglottic cartilages and gives off a twig (16) which passes in the space between the arytenoid and cricoid cartilages to supply the dorsal part of the glottis as in case of dog. The ventral branch of the R. laryngeus (Fig. 6, 7/15) redivides and runs caudalwards to be distributed on Mm. thyroarytenoideus and cricoarytenoideus lateralis in addition to the ventral part of the glottis. It gives also off a twig which anastomoses with the ventral branch of the R. laryngeus caudalis (6) forming an arterial vascular ring (Fig. 6, 7/arrowhead) on the M. cricoarytenoideus lateralis and ends by joining another twig of the R. laryngeus caudalis at the infraglottic cavity.

In the donkey, the dorsal branch (Fig. 12, -14/16) of the R. laryngeus passes upwards and terminates at the corniculate cartilage. During its course, it forms rostrally a vascular network with twigs of the ventral one (15) which supplies the Mm. vocalis and ventricularis, dorsal part of the laryngeal vestibule as well as the laryngeal ventricle. A twig arising from this vascular network anastomoses with another one of the R. perihyoideus (Fig. 13). At the apex of the laryngeal ventricle the dorsal branch of the R. laryngeus joins the R. thyrohyoideus (18). Caudally, the dorsal branch of the R. laryngeus supplies the M. cricoarytenoideus lateralis and joins the dorsal branch of the R. laryngeus caudalis (5). It forms also with the ascending pharyngeal artery an arterial vascular ring (Fig. 15/stare) supplying the M. arytenoideus transversus.

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The ventral branch of the R. laryngeus (Fig. 12 - 14/15) in donkey passes rostralwards on the lateral aspect of the M. vocalis and sinks between its fibers to vascularize the M. cricoarytenoideus lateralis as well as the ventral part of the laryngeal vestibule and the glottis. It shares rostrally as mentioned above with twigs of the dorsal branch in the formation of the vascular network. Moreover, the ventral branch gives off a twig (17) which pierces the cricothyroid ligament and divides into a rostrally and a caudally directed branch. The rostrally directed one joins the homonymous twig of the other side forming an arterial vascular arch which vascularizes the cricothyroid ligament and thyroid cartilage as well as the M. thyrohyoideus by several small branches. The caudal twig anastomoses with the R. cricothyroideus (7).

R. laryngeus caudalis.

The caudal laryngeal branch (Fig. 1, 5, 6, 12-15/4) arises either from the cranial thyroid artery in dog and goat or from the ascending pharyngeal artery in donkey. From its origin at the caudal border of the cricoid cartilage the caudal laryngeal branch enters the larynx between the cricoid cartilage and the thyroid lamina in company with the caudal laryngeal nerve. It detaches firstly a twig (4) which passes rostroventrally in dog and goat or caudoventrally in the donkey. This twig penetrates the cricotracheal ligament and vascularizes the mucous membrane of the infraglottic cavity. Only in donkey another twig is detached dorsally, joins the homonymous twig of the other side and supplies the M. cricoarytenoideus dorsalis. After a variable distance the caudal laryngeal branch ends by dividing into a dorsal and a ventral twig.

The dorsal twig (5) passes rostralwards to supply the M. cricoarytenoideus dorsalis, Mm. arytenoideus transversus and ventricularis only in dog. In the donkey, the dorsal twig joins the dorsal branch of the R. laryngeus or the caudal branch of the same artery in dog.

The ventral twig of the R. laryngeus caudalis (6) passes also rostralwards on the lateral aspect of the M. cricoarytenoideus lateralis which it supplies. In dog it supplies the M. vocalis, while in goat it joins the ventral branch of the R. laryngeus as mentioned above. In two dissected donkeys the ventral branch of the R. laryngeus caudalis formed an arterial vascular ring on the M. cricoarytenoideus lateralis or on the arch of the cricoid cartilage.

R. cricothyroideus

In all examined animals the cricothyroid branch (Fig. 1-5, 8, 9, 12-14/7) arises from the A. thyroidea cranialis.

In dog, it passes rostroventrally on the M. cricothyroideus then it divides into three branches (Fig. 1-3) in 50% of cases. The first branch ($\bar{7}$) vascularizes the Mm. cricothyroideus, thyrohyoideus and thyroid cartilage. The second branch of the R. cricothyroideus ($\bar{7}$) detaches a twig (8) after supplying the M. cricothyroideus and continues its course on the lamina of the thyroid cartilage and between the latter and basihyoid joining a twig of the R. perihyoideus. The latter twig (8) divides into two branches ($\bar{8}$ & $\bar{8}$). The first branch ($\bar{8}$) pierces the cricothyroid ligament and passes along the origin of the M. vocalis to join the rostral branch of the R. laryngeus. While, the second one ($\bar{8}$) is directed medially to join the homonymous twig of the other side forming an arterial vascular arch (ventral) (9) on the cricothyroid ligament and the thyroid lamina. The third branch of the R. cricothyroideus (7) terminates shortly in the M. cricothyroideus.

In the rest of specimens the R. cricothyroideus (Fig. 4) has nearly the same course as the second branch (Fig. 1-3/ $\bar{7}$).

Along its course, the R. cricothyroideus in goat (Fig. 5, 8/7) forms a curve rostroventrally on the lateral aspect of the M. cricothyroideus where it distributes.

In donkey, the R. cricothyroideus (Fig. 9, 12-14/7) runs along the caudoventral border of the M. cricothyroideus and detaches several twigs joining the others of the R. laryngeus as mentioned above.

R. perihyoideus :

In dog and goat the R. perihyoideus (Fig. 2/21) arises from the lingual artery (20) rostral to the ceratohyoideum. It courses medially to end by joining the ipsilateral branch of the other side forming an arterial vascular arch (Rostral) (22) rostral to the basihyoid. From this arch a considerable number of twigs (23) are detached vascularizing the M. hyoepiglotticus as well as the epiglottic cartilage and the base of the tongue. Further, the arch in dog gives off a twig which passes caudally to anastomose with the R. cricothyroideus as mentioned above.

In donkey, the R. perihyoideus is represented by two, a caudal and a rostral branch. The rostral branch (Fig. 9/21) has the same course and distribution as in dog and goat. The caudal branch (Fig. 9, 13/21) runs medialwards along the M. hyoepiglotticus supplying it and the epiglottic cartilage (Fig.

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11). It gives also off a twig which anastomoses with another one of the R. laryngeus of the cranial laryngeal artery (Fig. 13) as mentioned above.

A. pharyngea ascendens

Only in donkey the A. pharyngea ascendens (Fig. 9, 13-15/3) arises from the A. thyroidea cranialis dorsally at the caudal border of the cricoid cartilage in 8 cases or directly from the common carotid artery in the rest of specimens. It ascends rostralwards for a short distance between the M. cricopharyngeus and cricoarytenoideus dorsalis. Above the cricothyroid joint it detaches the R. laryngeus caudalis and continues its course on the latter muscle where it ends by joining a twig from the R. laryngeus forming an arterial vascular ring (stare) as mentioned before. During its course, it supplies the M. cricopharyngeus and the initial part of the esophagus. At the level of the M. cricoarytenoideus dorsalis 2-3 twigs are detached: one of them is directed caudomedially to anastomose with the homonymous of the other side forming an arch. The others branches divide in a diastomic manner (Fig. 15) vascularizing the M. cricoarytenoideus dorsalis. The ascending pharyngeal artery gives also off another twig (3) which enters the space between the arytenoid and cricoid cartilage, joining the homonymous of the other side and supply the dorsal part of the glottis.

R. thyrohyoideus :

This artery (Fig. 9, 10, 13/18) is observed only in donkey originating inconstantly either from the external carotid artery or directly from the common carotid artery. It passes rostroventrally above the retropharyngeal lymph node. It gains the larynx through the thyroid foramen in company with the internal branch of the cranial laryngeal nerve where it terminates by joining the dorsal twig of the R. laryngeus of the cranial laryngeal artery. During its course, and before entering the larynx the thyrohyoid branch gives off 3-4 twigs to the retropharyngeal lymph node. It detaches in addition a twig (19) near the thyroid foramen which redivide into 2 branches: one of them (19) terminates in the M. thyrohyoideus and the other (19) joins a twig of R. cricothyroideus. In some cases the R. thyrohyoideus arose directly from the R. laryneus of the cranial laryngeal artery then emerges through the thyroid foramen (Fig. 10) to redivide into 2 branches as already described.

DISCUSSION

The present study revealed that the main blood vessels supplying the larynx come from the A. laryngea cranialis, R. laryngeus caudalis, R. cricothyroideus and R. perihyoideus in the three dissected species; and also from A. pharyngea ascendens and R. thyrohyoideus in the donkey. Similar results were given in other domestic animals (GHOSHAL, 1975; SIMOENS *et al.*, 1979; WILKENS and MUENSTER, 1981; METWALLY, 1982).

The A. laryngea cranialis originates from the common carotid artery in dog and goat simulates that described in sheep (HEESCHEN, 1958), goat (SCHWARZ, 1959) and dog (SISSON and GROSSMAN, 1969). However, MILLER *et al.* (1964), TELESER (1971) and GHOSHAL (1975) in dog recorded that this artery originates from the A. carotis externa.

In donkey, the A. laryngea cranialis arises from the cranial thyroid artery resembles that of camel (AHMED, 1973), horse (HARE, 1975; WILKENS and MUENSTER, 1981) and mule (METWALLY, 1982).

As revealed from the present study the R. laryngeus of the cranial laryngeal artery enters the larynx through the thyroid membrane in dog as recorded in the same animal by MILLER *et al.* (1964). In the goat the R. laryngeus of the cranial laryngeal artery gains the larynx through the thyroid foramen similar to that described in sheep (HEESCHEN, 1958), horse (GHOSHAL, 1975), buffalo (EL-AYAT, 1977) and small ruminants (SIMOENS *et al.*, 1979).

However, in donkey it passes between the cricoid and the caudal border of the thyroid cartilage as in ox (RAGHAVAN and KACHROO, 1964), camel (AHMED, 1973), ox and horse (SIMOENS *et al.*, 1979) and horse (WILKENS and MUENSTER, 1981).

In this investigation, the R. laryngeus of the cranial laryngeal artery supplies all the intrinsic laryngeal muscles except M. cricoarytenoideus dorsalis in donkey and M. cricoarytenoideus lateralis in dog and goat. Also, it supplies the mucosa of the laryngeal vestibule and the glottis as well as the laryngeal ventricle in dog and the donkey. However, in sheep (HEESCHEN, 1958), dog (MILLER *et al.*, 1964) and domestic animals (GHOSHAL, 1975; SIMOENS *et al.*, 1979) the R. laryngeus supplies the laryngeal mucosa and the intrinsic muscles. On the other hand, MAY (1970) in sheep reported that the R. laryngeus supplies the laryngeal mucosa and M. thyroarytenoideus only. While, EL-AYAT (1977) in buffalo stated that this Ramus supplies the mucosa of the laryngeal vestibule.

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The present investigation revealed that the R. laryngeus caudalis originates from the cranial thyroid artery in dog and goat similar to that described by MAY (1970) in sheep, EL-AYAT (1977) in buffalo, ABDEL-MOATY (1980) in donkey, SIMOENS et al. (1979) and WILKENS and MUENSTER (1981) in domestic animals. In the donkey the caudal laryngeal branch is given off the A. pharyngea ascendens as stated by METWALLY (1982) in mule.

The R. laryngeus caudalis enters the larynx between the cricoid and thyroid cartilages simulates that recorded by HARE (1975) and SIMOENS et al. (1979) in domestic animals.

The R. laryngeus caudalis supplies the laryngeal mucosa of the infraglottic cavity, the Mm. cricoarytenoideus dorsalis and lateralis. HARE (1975) mentioned that in domestic animals this branch supplies the intrinsic muscles and the mucous membrane caudal to the laryngeal vestibule. However, EL-AYAT (1977) in buffalo observed that it supplies the laryngeal mucosa, transverse arytenoid and the dorsal cricoarytenoid muscles. On the other hand, ABDEL-MOATY (1980) reported that the arterial vasculature of the larynx in donkey comes from the caudal laryngeal artery.

The present work proved that the R. cricothyroideus originates from the cranial thyroid artery in all studied species similar to that described in dog (MILLER et al., 1964), buffalo (EL-AYAT, 1977), horse (WILKENS and MUENSTER, 1981), mule (METWALLY, 1982) and domestic animals (SIMOENS et al., 1979).

The R. cricothyroideus supplies the M. cricothyroideus in examined animals. MILLER et al. (1964) in dog added that this branch supplies the mucosa of the caudal compartment.

The present investigation revealed that the Rr. perihyoidei were represented by one vessel in dog and goat as given by SCHMIDT (1910) in cattle, HUERLIMANN (1912) in cat and SCHWARZ (1959) in goat. While in donkey the Rr. perihyoidei were represented by two vessels as described by METWALLY (1982) in mule.

The Rr. perihyoidei supply the M. hyoepiglotticus and epiglottic cartilage as stated by the beforementioned authors as well as WILKENS and MUENSTER (1981) in all domestic animals.

Similar to that stated by SIMOENS et al. (1979) in horse the R. thyrohyoideus in donkey originates from the external carotid artery. However, it was found that it may arise from the common carotid artery or the R. laryngeus.

The present findings revealed that the A. pharyngea ascendens in donkey originates from the cranial thyroid artery and supplies M. cricoarytenoideus dorsalis and the dorsal part

of the glottis. Its origin simulates that of horse (BRADLEY and GRAHAME, 1947; SISSON and GROSSMAN, 1969); donkey (ABDEL-MOATY, 1980) and mule (METWALLY, 1982).

In domestic animals CHAUVEAU and ARLOING (1891) mentioned that the terminal ramification of the laryngeal arteries form a plexus on the surface of certain parts of the larynx.

The present investigation showed that the laryngeal arteries anastomose with each other. These anastomoses are between the R. laryngeus, R. laryngeus caudalis, R. perihyoideus, R. cricothyroideus and also with these of other side in the 3 dissected species. In addition, in donkey there are anastomoses between R. laryngeus, A. pharyngea ascendens and R. thyrohyoideus. MILLER *et al.* (1964) in dog; EL-AYAT (1977) in buffalo and METWALLY (1982) in mule mentioned that there are anastomoses between some laryngeal arteries.

Accordingly these anastomoses may be serve as collateral circulation in case of occlusion or ligation of one of the laryngeal arteries as stated by MAY (1967) in sheep.

LEGEND TO FIGURES 1 - 15

- Fig. 1,2: Diagrams showing the distribution of the laryngeal arteries in the dog.
(1- Deep view. 2- Ventral view).
- Fig. 3,4: Photographic pictures of the larynx in the dog injected with serum indian ink (Ventrolateral view).
- Fig. 5,6: Diagrams showing the distribution of the laryngeal arteries in the goat.
(5- Superficial view 6- Deep view).
- Fig. 7,8: Photographic pictures of the larynx in the goat injected with serum indian ink.
(7- Deep view 8- Superficial view).
- Fig. 9, : A diagram showing the distribution of the laryngeal arteries in the donkey (superficial view).
- Fig. 10-12: Photographic pictures of the larynx in the donkey injected with serum indian ink.
(10- Superficial view 11- Epiglottis. 12- Deep view).
- Fig. 13: A diagram showing the distribution of the laryngeal arteries in the donkey (Deep. view).
- Fig. 14, 15: Photographic pictures of the larynx in the donkey injected with serum indian ink.
(14- Deep view. 15- Dorsolateral view).

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- A) Trachea. B) Cartilago cricoidea
 C) Cartilago thyroidea D) Epiglottis
 E) Processus corniculatus F) Processus cuneiformis.
 G) Apparatus hyoideus H) Plica aryepiglottica.
 I) Ventriculus laryngis. K) Lig. cricothyroideum.
 L) Gl. thyroidea.
 M) Ln. retropharyngeus.
 a. M. cricopharyngeus. b. M. thyropharyngeus.
 c. M. sternothyroideus d. M. thyrohyoideus.
 e. M. ceratohyoideus. f. M. hyoepiglotticus.
 g. M. cricothyroideus. h. M. cricoarytenoideus dorsalis.
 i. M. arytenoideus transversus.
 k. M. cricoarytenoideus lateralis.
 l. M. thyroarytenoideus l. M. ventricularis.
 =1. M. vocalis. 2. A. thyroidea cranialis.
 1- A. carotis communis. 3- A. pharyngea ascendens.
 -3- R. of 3. 4- R. laryngeus caudalis. -4- R. of 4.
 5- R. dorsalis of caudal laryngeal nerve.
 6- R. ventralis of caudal laryngeal nerve.
 7- R. cricothyroideus.
 -7, =7, =7 - Branches of the R. cricothyroideus.
 8- R. of the 7 of the R. cricothyroideus.
 -8- R. anastomoticus to the R. laryngeus.
 *8- R. of 8 share in formation of arterial arch.
 9- An arterial vascular arch (ventral).
 10- A. laryngea cranialis.
 11- R. pharyngeus of cranial laryngeal artery.
 12- R. laryngeus. 13- R. of laryngeal branch.
 -13- Rostral branch of 13. =13- Caudal branch of 13.
 14- Rr. musculares of 12.
 15- R. rostralis (dog); R. ventralis (goat & donkey) of 12.
 16- R. caudalis (dog). R. dorsalis (goat & donkey) of 12.
 -16- R. of 16.
 17- R. of ventral branch of 12. 18- R. thyrohyoideus
 19- R. of 18 -19, =19- Branches of 19.
 20- A. lingualis. 21, -21- Rr. perihyoidea.
 22- An arterial vascular arch (rostral).
 23- Rr. of arterial vascular arch.
 Arrow- Arterial vascular ring at the M. cricothyroideus.
 Arrowhead - Arterial vascular ring on the M. crico-
 arytenoideus lateralis.
 Stare- Arterial vascular ring on the M. arytenoideus
 transversus.

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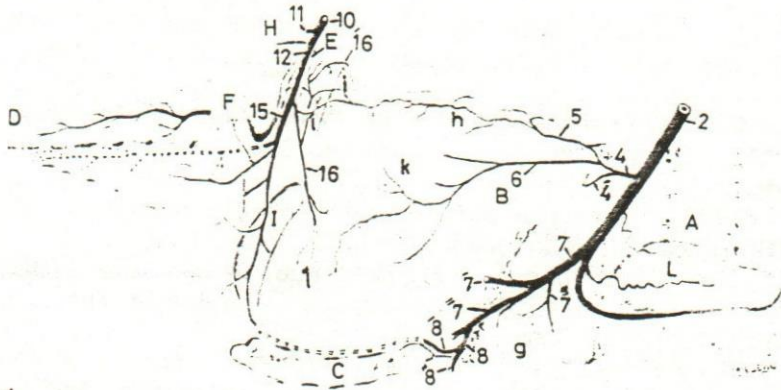
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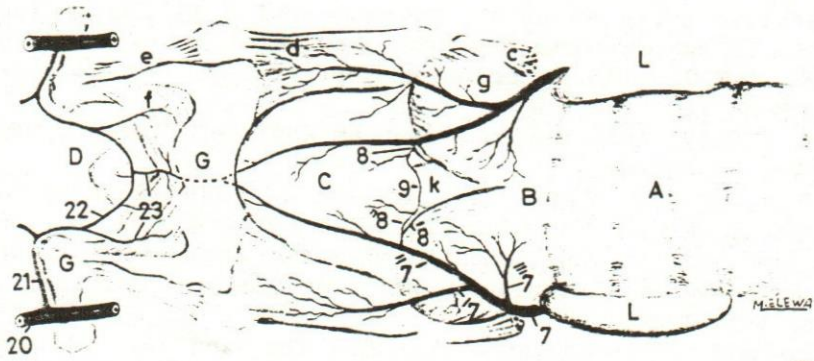
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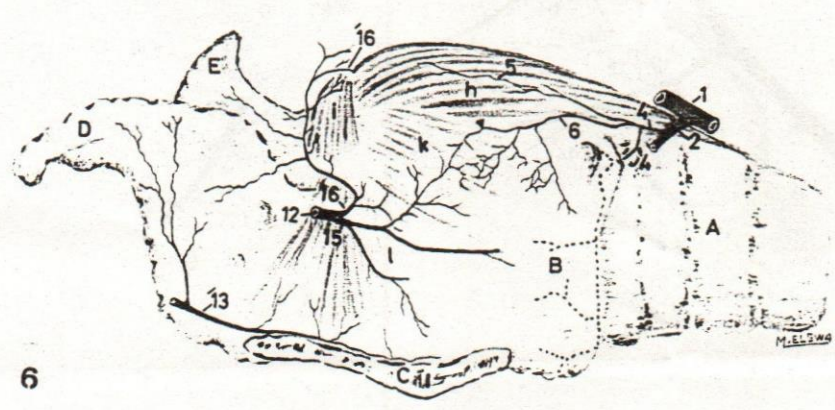
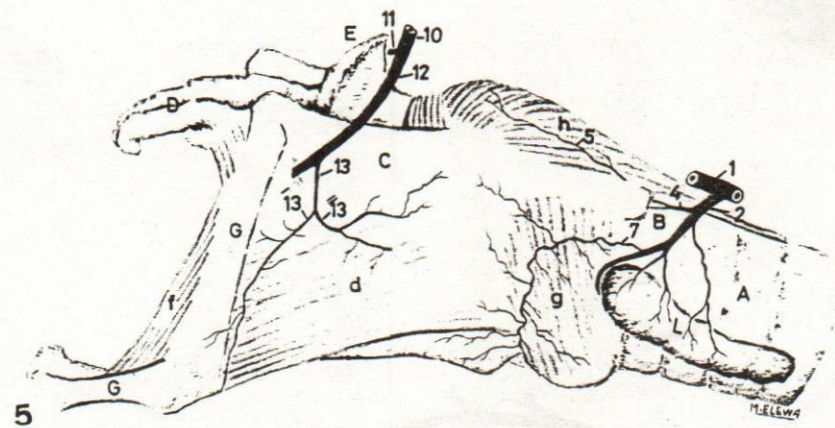


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3

VASCULATURE OF THE LARYNX IN DOG, GOAT & DONKEY

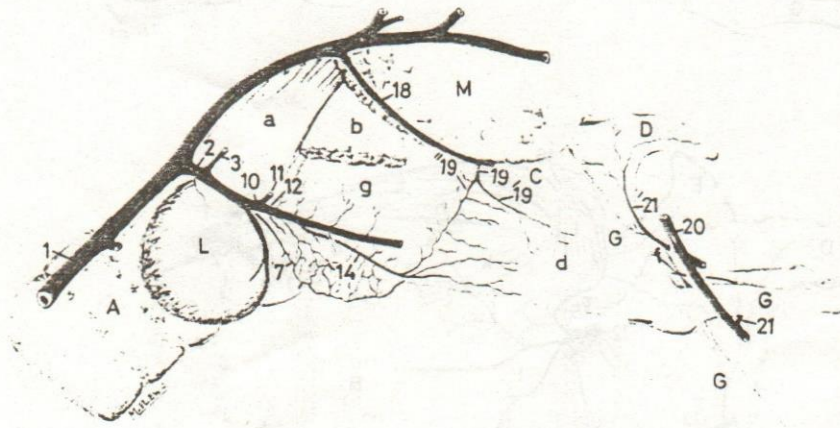




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VASCULATURE OF THE LARYNX IN DOG, GOAT & DONKEY



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