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Research Article

GROSS ANATOMICAL AND SCANNING ELECTRON MICROSCOPIC STUDIES IN THE LARYNX OF PIGS

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ABSTRACT

The present work was carried out on the gross anatomical and scanning electron microscopic studies in the larynx of 12 non-descript pigs of 8-12 months of age. Gross anatomically, the larynx in pig was a short tubular structure supported by unpaired epiglottis, thyroid and cricoid cartilages and paired arytenoids cartilage. Epiglottis was characterised by an orbiculate leaf like structure. Paired arytenoid cartilages were pyramidal in shape with well-developed corniculate process. The gutter shaped thyroid cartilage was consisted of a ventral body and ventrally fused two laminae, while rostral cornu, thyroid fissure, thyroid foramen and laryngeal prominence were absent. The ring shaped cricoid cartilage was characterised by a paperaceous spatula like projection on the median part of its caudal border. Under scanning electron microscopic study, epiglottis presented different types of microplicae. However, distinct microplicae system was not observed in the thyroid cartilage, while cricoid cartilage showed different angular profiles. Arytenoid cartilage was characterized by cell projections similar to corals. The mucosa of vocal cord had longitudinally oriented folds with microplicae system.

Keywords: Gross anatomy, Larynx, Pig, Scanning electron microscopy

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Larynx is a tube-shaped organ that provides connection between pharynx and trachea. The functions of the larynx are respiratory and sound production, in addition it also works to prevent the passage of foreign matters into the respiratory tract during respiration. So it can be considered as gatekeeper of the trachea. The skeleton of the larynx is combined with double-side symmetrical shaped cartilages. The larynx is more prone to various pathological conditions. Some research has been carried out on the gross anatomy of larynx in pigs (Wysocki *et al.*, 2010), gaddi sheep (Pathak and Rajput, 2020), goat and sheep (Al-Sadi, 2006), camel (Nagpal *et al.*, 1988), yak (Singh and Sharma, 1992), elephant (Rajani *et al.*, 2019), Gaddi goat (Baltoo *et al.*, 2018) and mithun, yak and zebu (Kalita and Kalita, 2003). However scanning electron microscopic studies on the larynx of pigs are meagerly available. The paucity of literature led to pursue the present study on gross anatomy and scanning electron microscopic study in the larynx of pigs.

MATERIALS AND METHODS

Gross anatomical and scanning electron microscopic study was conducted on the larynx of 12 non-descript breeds of 8-10 months old pigs, procured from local slaughter house and the tissue from six animals were fixed in 10% neutral buffered formalin solution for 48 hours and then were sectioned into mid sagittal and transverse planes to observe the topography and morphology of various cartilages present in the larynx. Fresh tissues from six animals were fixed in 2% glutaraldehyde solution for 6-8 hours after thorough washing in chilled 0.1 M phosphate buffer (pH 7.4). Then the tissues were again washed twice with 0.1 M phosphate buffer and rest of the procedure of SEM was carried out at EM Lab., AIRF, JNU, New Delhi and observed under scanning electron microscope.

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RESULTS AND DISCUSSION

Gross anatomically, the larynx was a relatively long tubular structure extended from the base of occipital bone to the level of fourth/fifth cervical vertebra. It was concealed in between angles of mandibles and greater cornu of hyoid bone. The larynx was comprised of paired arytenoid and unpaired epiglottic, thyroid and cricoid cartilages (Figs. 1a, b).

The epiglottic cartilage (Figs. 2a, b) was present rostro-dorsal to the rostral border of the body of the thyroid cartilage. It was an orbiculate leaf like structure with its border unturned and having thick base and pointed apex and its base led into short and round mass, petiolus in pig same as reported by Wysocki *et al.* (2010) and Hare (1975).The epiglottis in ox, sheep, horse, dog, cat (Hare, 1975), goat (Al-Sadi, 2006) and leopard (Rajani *et al.*, 2012) also had pointed apex whereas rounded apex was mentioned in camel (Nagpal *et al.*, 1988), yak (Singh and Sharma,1992), sheep (Al-Sadi, 2006), elephant (Rajani *et al.*, 2019) and Gaddi goat (Baltoo *et al.*, 2018). Petiolus was short and curved rostrally as in ox (Hare, 1975) whereas it was long and prominent in camel (Nagpal *et al.*, 1988), forked in dog (Nickel *et al.*, 1979) and absent in cat.

The pyramidal shaped arytenoid cartilage was

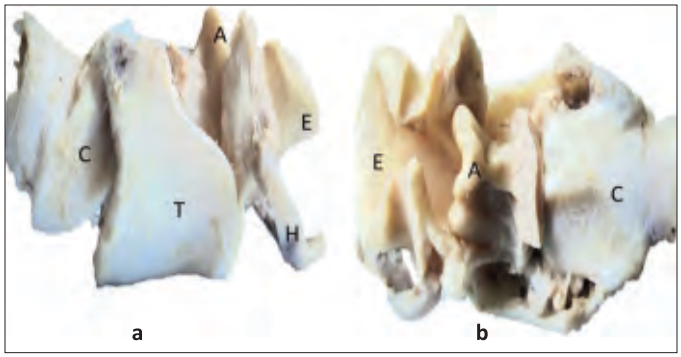

Fig.1a,b. Photograph of larynx articulation of various cartilages showing epiglottis (E), inter-arytenoid (A), hyoid bone (H), thyroid (T) and cricoid (C) cartilages- a (lateral view), b (dorsal view) (macerated).

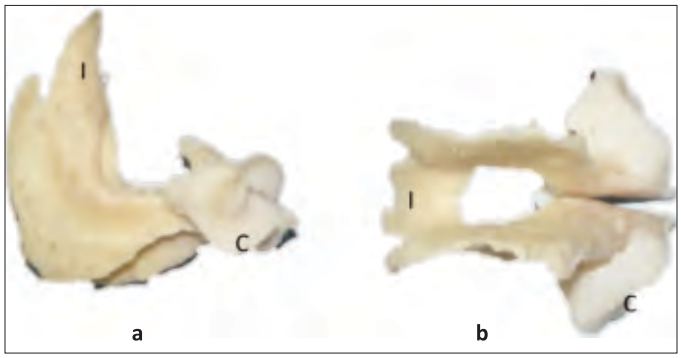

Fig. 3. Photographs of the arytenoid cartilage of the pig (b-dorsal and a-lateral views) showing inter-arytenoid cartilage (I) and articular facet for cricoid cartilage (C).

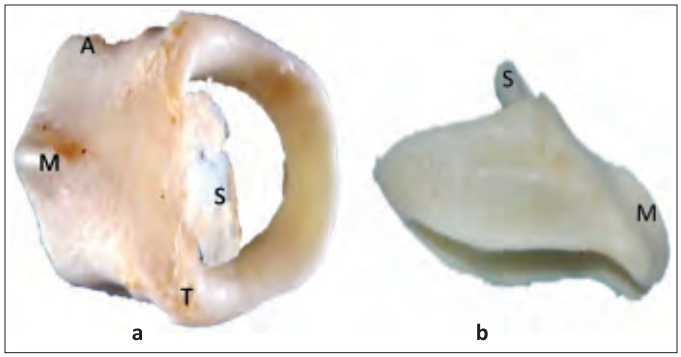

Fig. 5. Photographs of the cricoid cartilage of the pig (a-dorsal and b-lateral views) showing median crest (M), spatula (S) and articular facet for arytenoid cartilage (A) and articular facet for thyroid cartilage (T).

composed of a base, an apex, with three surfaces and three borders. It was lying in front of cricoid cartilage and was supported laterally by thyroid cartilage laminae (Figs. 3a, b). Similar findings were observed in pig (Wysocki *et al.*, 2010 and Hare, 1975), yak (Singh and Sharma, 1992) and Gaddi goat (Baltoo *et al.*, 2018). Its medial pointed angle continued into concavity of the inter-arytenoid cartilage. Apex on the interarytenoid process (processus corniculatus) was broader at origin and conical at terminal part which was projected upward and backward with its conical muscular process and pointed vocal process (Figs. 3). Similar findings were observed in pig (Wysocki *et al.*,

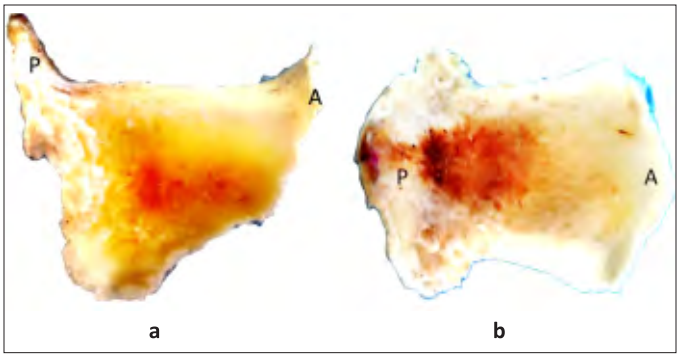

Fig. 2. Photographs of the epiglottis cartilage of the pig (b-ventral and a-lateral views) showing petiolus (P) and apex (A).

Fig. 4. Photographs of the thyroid cartilage of the pig (a-ventral and b-lateral views) showing caudal cornu with articular facet for cricoid cartilage (C) and laryngeal prominence (P).

Fig. 6. Scanning electron micrograph showing microplicae system (M) in epiglottis cartilage. × 10410

2010 and Hare, 1975), yak (Singh and Sharma, 1992) and elephant (Rajani *et al.*, 2019). Whereas well defined corniculate process was absent in Gaddi goat (Baltoo *et al.*, 2018) and leopard (Rajani *et al.*, 2012).

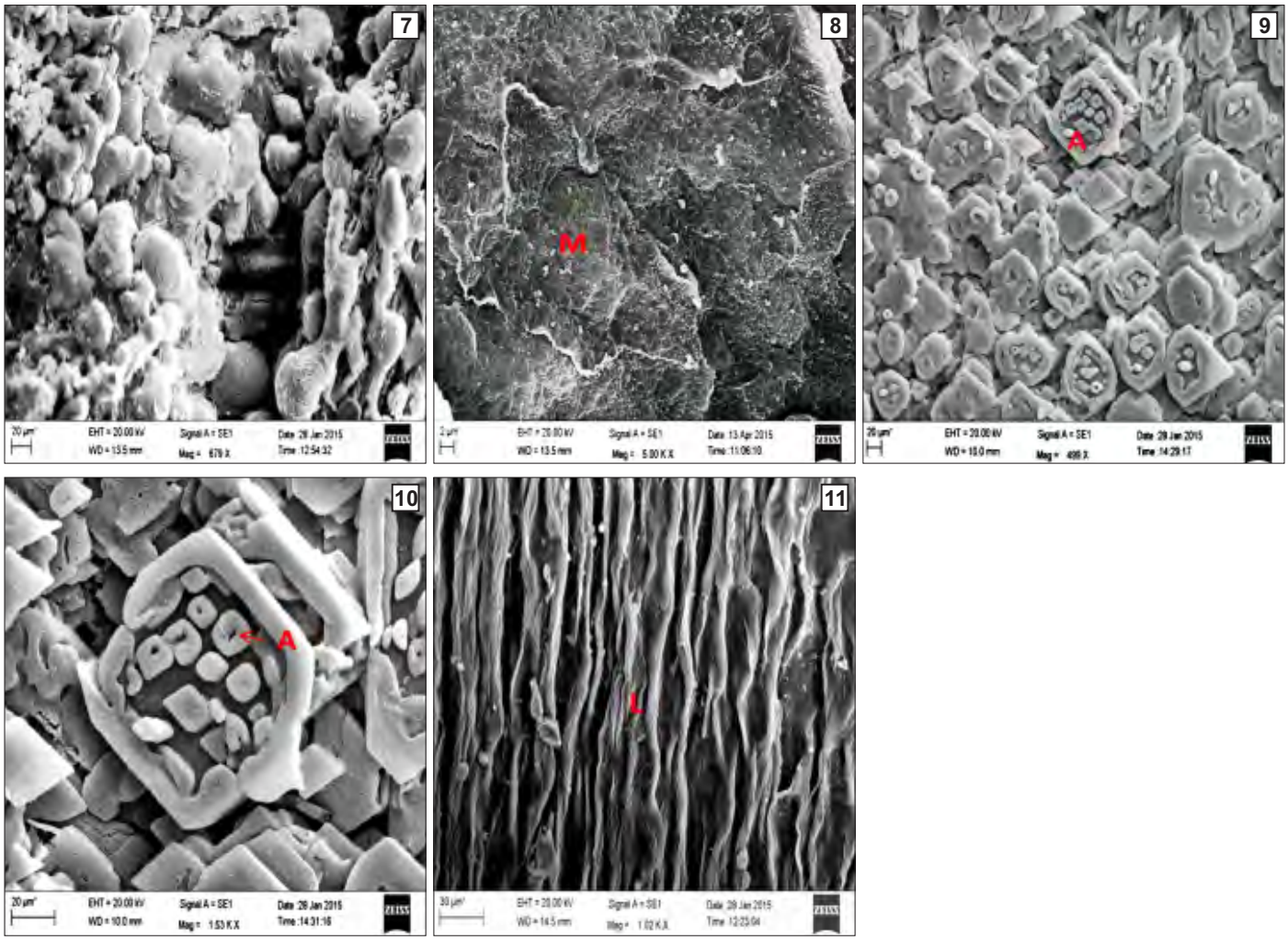

Fig.7-11. (7) Scanning electron micrograph showing cell projections in arytenoid cartilage. × 679; **(8)** Scanning electron micrograph at higher magnification showing microplicae system (M) in the thyroid cartilage. × 5000; **(9)** Scanning electron micrograph showing different sized cells with angular profiles (A) in the cricoid cartilage. × 499; **(10)** Scanning electron micrograph at higher magnification showing angular profiles (A) of cell in the cricoid cartilage presented hole in centre. × 1530; **(11)** Scanning electron micrograph showing longitudinally oriented folds (L) of microplicae system in vocal cord. × 1020

The gutter shaped was the largest cartilage of larynx (Figs. 4a, b) in pig. The cartilage was comprised of a very long ventral body and two quadrilateral laminae, these laminae were fused ventrally at an acute angle. Similar findings have been reported in pig (Wysocki *et al.*, 2010 and Kalita, 2014) and giraffe (Erdogan and Perez, 2013). The rostral cornu, thyroid fissure, thyroid foramen and laryngeal prominence were absent in the thyroid cartilage of pig. Whereas, well developed rostral cornu was found in Gaddi goat (Baltoo *et al.*, 2018) and sheep and goat (Al-Sadi, 2006). The caudal cornua were very short and articulated with cricoid cartilage. The laminae formed the lateral laryngeal wall and body formed the floor of the larynx (Figs. 4a, b). Similar findings were reported in pig (Kalita, 2014) and elephant (Rajani *et al.*, 2019). Whereas well developed caudal cornu was observed in leopard (Rajani *et al.*, 2012). In yak, the caudal thyroid notch was absent and laryngeal prominence was distinct (Singh and Sharma, 1992).

Cricoid cartilage was ring like most caudal cartilage in pig having broad dorsal surface with median crest and long lamina with narrow arches pointing caudo-ventrally which were ventrally fused (Figs. 5a, b). The arches were narrow and sloped caudally so that they were obliquely oriented to the long axis of the larynx same as reported earlier in sheep and goat (Al-Sadi, 2006), Gaddi goat (Baltoo *et al.*, 2018) and elephant (Rajani *et al.*, 2019). Similar to the finding of Wysocki *et al.* (2010), caudally a spatula like structure was present on the dorsal surface in pig.

Scanning electron microscopically, the epiglottis was lined by stratified squamous epithelial cells and presented microplicae of different arrangements (Fig. 6). Similar findings were reported in goat (Kahwa, 1992) and rats (Lewis and Prentice, 1980). Arytenoid cartilage was characterized by cell projections similar to corals (Fig. 7). These spiraly arranged cells presented small spicules like pattern which were separated from each other by small

depressions. This whole pattern led to a corrugated appearance. Thyroid cartilage presented irregular plaques of various dimensions and did not show distinct microplicae even at higher magnification (Fig. 8). Cricoid cartilage presented different sized cells having angular profiles (Fig. 9). Some of these cells were smooth surfaced whereas others had peripherally placed border and centrally placed angular profiles of smaller dimensions. The centre of the some of the angular profiles were filled whereas some others presented hole in centre (Fig. 10). The mucosa of vocal cord had longitudinally oriented folds which presented pitted appearance and microplicae system (Fig. 11) same as reported in goat (Kahwa, 1992).

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