Histology of larynx in the pigs

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Abstract
The present study was carried as a part of PhD programme in Department of Veterinary Anatomy, Veterinary college, Bengaluru, Karnataka. The histological studies was conducted on larynx of 10 adult healthy pigs. The larynx of the pig consisted of three unpaired and one paired cartilages namely epiglottis, thyroid, cricoid and paired arytenoids. The laryngeal cavity was divided into three different regions namely, anteriorly vestibule, middle glottis and caudal infraglottic cavity. The epithelial lining of the vestibule, glottis and initial portion of infraglottis was lined by stratified squamous non-keratinized epithelium. Rest of the infraglottis was lined by pseudostratified non-ciliated columnar epithelium. Laryngeal recesses was well developed in the glottis region. Mucus, serous and seromucous glands were seen in the propria submucosa. Subepithelial lymphatic aggregates and venous caverns were also noted.

Keywords: nasal cavity, nasal turbinates, vestibular, respiratory, olfactory, Pig

Introduction
The larynx of the pig appears superficially similar to the human organ. Previously piglets had been used successfully to study surgical interventions in the larynx, and Large White pigs are currently being used to investigate transplantation of the trachea (Hiller et al., 1998) [4]. Various phenotypes and strains of pig are available, making studies of transplantation across various swine leukocyte antigen barriers possible. Finally, the pig has been used for much of the research surrounding xenotransplantation, and this has led to "spin-off" advances in porcine immunology (Macchiariini et al., 1994) [11]. We hypothesize that the pig is an ideal candidate for a preclinical experimental model for laryngeal and tracheal transplantation. By analogy with work on the human larynx, we further hypothesized that the porcine larynx is not an inert conduit, but rather a highly immunologically active organ in its own right (Bach et al., 1995) [5]. So the present study was undertaken to study the detailed histological features of larynx in pigs.

Materials and Method
The present study was carried out in Department of Anatomy, Veterinary College, Bengaluru, Karnataka. The present study was conducted on 10 adult local cross bred pigs of either sex. The larynx of pigs were separated from the respiratory tract immediately after slaughter from local slaughter house and fixed in 10% neutral buffered formalin solution for one week. Once the tissues were fixed and tissue samples of interest from epiglottis, thyroid, cricoid and different parts of arytenoid were collected. Then these tissues processed as per the routine paraffin technique for histological study (Luna, 1968) [10]. The paraffin sections of 5-6 μ were cut and stained by routine Harris’ hematoxylin and eosin method and special stains (Luna, 1968) [10].

Review of literature
The histological features of larynx was previously studied in cattle by Adams (1986) [1], in goats by Kahwa and Purton (1996) [3]. And Ranjit et al. (2015) [13]. In one humped camel by Saber (1983) [18], in Mithun by Kalita and Kalita (2003) [7], in young cattle by Casteleyn et al. (2008) [3], in horses by Kumar and Timoney (2001) [9], in sheep by Kumar and Singh (2014) [8], in Mizo local pigs by Kalita (2014) [6] and in young pigs by Parkash et al. (2016) [12].

Results
In the present study, the larynx of the pig consisted of three unpaired and one paired cartilages namely epiglottis, thyroid, cricoid and paired arytenoids. The laryngeal cavity was divided into
three different regions namely, anteriorly vestibule, middle glottis and caudal infraglottic cavity. The epithelial lining of the vestibule, glottis and initial portion of infraglottis was lined by stratified squamous no keratinized epithelium (Fig.1). Caudal portion of the infraglottis was lined by pseudo stratified non-ciliated columnar epithelium (Fig. 2). Epithelium lining the terminal portion of cricoid and initial part of trachea was pseudostartified columnar with well-developed cilia.

In the initial part of mucosa lining the epiglottis, taste buds were found (Fig. 4). Epithelium lining the inner surface of epiglottis was thicker than the outer surface (Fig. 5), however the thickness of epithelia was varying throughout the larynx. The propria-submucosa of cranial part of larynx was denser when compared to the caudal part. Mucous, serous and mixed glands supported with different connective tissue fibres were present in the propria-submucosa (Fig. 6). The cartilage supporting the larynx was predominantly hyaline in nature (fig. 7). However, the corniculate, muscular and vocal process of arytenoids and the epiglottis (fig 8) mainly consisted of elastic cartilage. The arytenoid cartilages of either side were interconnected by well-developed inter arytenoid cartilage.

A typical transitional type of epithelium was found lining the vocal cords (fig.3) and this modification and it helps in stretching of vocal cords during voice production.

Fig 3: A typical transitional type of epithelium was found lining the vocal cords (Arrow) (Masson’s trichrome)

Fig 4: Taste buds in epiglottis ((Arrow) (H &E)

Fig 5: Epithelium lining the inner surface of epiglottis was thicker than the outer surface (Arrow) C-Cartilage

Fig 6: Mucous, serous and mixed glands supported with different connective tissue fibres were present in the propria-submucosa V-vocal cord, G-mixed glands
The laryngeal recesses were found on both the sides in the glottis area and were line by stratified squamous non-keratinized epithelium (Fig.9). Near the vocal fold region dense arrangement of the elastic fibers (Fig.10) was noticed in the propria-submucosa along with few smooth muscle fibers. Well-developed Sub epithelial lymphatic aggregates were found in mainly in epiglottis (Fig.8) and arytenoid region. In the propria-submucosa of larynx, few venous caverns were also noticed (Fig.7) which helps in conditioning of incoming air.

Fig 7: Venous caverns (Arrow) in the larynx. HC-hyaline Cartilage

Fig 8: Elastic cartilage of epiglottis (EC) and lymphatic aggregates (Arrow) (Van Geisons stain)

Fig 9: The laryngeal recesses (LR) on both the sides in the glottis area and were line by stratified squamous non-keratinized epithelium (Arrow) (H &E)

Fig 10: Elastic fibres in vocal ligament (Verhoff’s stain)

Discussion
In the present study, larynx of pig in its skeleton consisted of four different cartilages namely epiglottis, paired arytenoid, thyroid and cricoid. The mucosa lining the vestibule, glottis and initial portion of infraglottis was lined by stratified squamous non-keratinized epithelium. This finding is in accordance with Kumar and Timoney (2001) [9]. In horse, Kumar and Singh (2014) [8], In sheep, Kalita (2014) [6] in Mizo pigs and Parkash et al. (2016) [12] in young pigs. However, a typical transitional like epithelium was seen lining the vocal folds in the process of transition between stratified squamous non-keratinized to respiratory epithelium. This peculiarity was not recorded before. However, a zone of non-ciliated pseudo stratified epithelium was witnessed before complete transformation into pseudo stratified ciliated epithelium. In the initial part of mucosa lining the epiglottis taste buds were found. This finding was recorded by Kalitha and Timoney (2001) [7] in Mithun.

The paired arytenoid cartilages were interconnected by well-developed inter arytenoid cartilage which was not seen in cattle (Adams, 1986) [1], Kumar and Singh (2014) [8] in sheep. Well-developed laryngeal recesses were found on either side in the glottis area and lined by stratified squamous non-keratinized epithelium. Similar observations were made by Kumar and Timoney (2001) [9] in horse. Near the vocal cord region dense arrangement of the elastic fibers were noticed in propria sub-mucosa, few smooth muscle fibers were also seen. Well-developed Sub epithelial lymphatic aggregates were found in mainly in epiglottis and arytenoid region. Similar observations were made by Ranjit et al. (2015) [13] in goat, Parkash et al. (2016) [12] in young pigs, Kumar and Timoney (2001) [9] in horse, Kumar and Singh (2014) [8] in sheep.

References