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A Comparative Study on the Tubal Tonsil in Goats and Pigs

V. R. Indu[1*], K. M. Lucy[1], K. S. Prashanth Kumar[2], N. Ashok[1] and S. Maya[1]

[1]Department of Veterinary Anatomy & Histology, College of Veterinary and Animal Sciences, Mannuthy, Kerala, India
[2]Department of Veterinary Anatomy, Veterinary College, Bangalore, Karnataka, India

**Corresponding author*

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A B S T R A C T

A comparative study was conducted on the tubal tonsil of six adult male crossbred goats and Large White Yorkshire pigs. Macroscopically the tubal tonsil were found in the nasopharynx, caudal to and around the openings of the auditory tubes as a thick raised mass of small nodules 4 to 5 cm in length in the pigs while in goats the small nodules were seen scattered. In histological sections the tubal tonsil in goats and pigs were lined by pseudostratified ciliated columnar epithelium. Surface of the tubal tonsil showed folds and invaginations which formed crypts where, the epithelium was modified into follicle-associated epithelium (FAE), also called lympho-epithelium. There was no significant difference in the height of crypt epithelium between both the groups of animals used in the present study. Propria-submucosa was filled with primary and secondary lymphoid nodules and diffuses lymphoid tissue arranged as crypto-lymphatic units (CLU) and tonsillar nodules in the superficial lamina propria. The tubal tonsil was encapsulated and well developed in pigs but in goats the tubal tonsils were not macroscopically distinguishable from the surrounding tissue and were not encapsulated. On statistical analysis significant differences ($p \leq 0.01$) were observed in the average number and diameter of the lymphoid nodules, and number of lymphocytes per nodule. The average number and diameter of the lymphoid nodules, and number of lymphocytes per nodule was more in Large White Yorkshire pigs when compared to crossbred goats, offering them better mucosal immunity by guarding the auditory openings of eustachian tube.

Introduction

The tubal tonsil is seen around the opening of the eustachian tube in the nasopharynx. It represents a part of nasal associated lymphoid tissue (NALT) and is also a component of the lymphoid tissue of Waldeyer's ring (Kumar and Kumar 2012). Thus it forms a first line of defence against foreign antigens passing through the nasopharynx and therefore plays a key role in immunity. Since documented information about the comparative study of tonsils in pigs and goats is limited, and considering the prime importance of tonsils in mucosal immunity, a study was performed in which the morphological and histological characteristics were compared in both the species.

Materials and Methods

A study was undertaken to compare the gross morphology and histology of the tubal tonsils in Large White Yorkshire pigs and crossbred goats. Tissue samples were collected from six apparently healthy adult male goats and pigs sold for slaughter from University Sheep and Goat Farm, Mannuthy and Centre for Pig Production and Research, Mannuthy respectively. The heads collected were sectioned in median plane and rinsed in tap water. One half of the head was fixed in two per cent acetic acid for 24h to visualise the morphology of the tonsils clearly. From the other half of head, tissue pieces were collected from the nasopharynx surrounding the auditory tube and fixed in 10 per cent neutral buffered formalin. The materials were processed routinely to obtain 5-6µm thick serial paraffin sections. The sections were stained by Haematoxylin and Eosin (Luna, 1968), Gomori's rapid one step trichrome method for collagen fibres (Luna, 1968), Verhoeff's method for elastic fibres (Singh and Sulochana, 1996), Gordon and Sweet's method for reticular fibres (Bancroft and Gamble, 2003) and Unna's method for mast cells (Luna, 1968).

Results and Discussion

In both pigs and goats, after fixation in acetic acid, the tubal tonsils were found, as small raised nodules caudal to and around the openings of the auditory tubes in the nasopharynx (Fig. 1 & 2). A total number of 93.33 ± 1.61 nodules could be counted in goats and 103.14 ± 1.21 in pigs. The nodules were scattered in goats while in pigs the nodules were arranged together as a raised mass 4 to 5 cm in length. Cocquyt *et al.*, (2005), Breguelmans *et al.*, (2011) and Kumar and Kumar (2012) conducted morphological studies on the tubal tonsils of adult sheep and observed 40 to 150 scattered nodules in it. According to Liu *et al.*, (2012) the tubal tonsils were the smallest among all the tonsils in pigs.

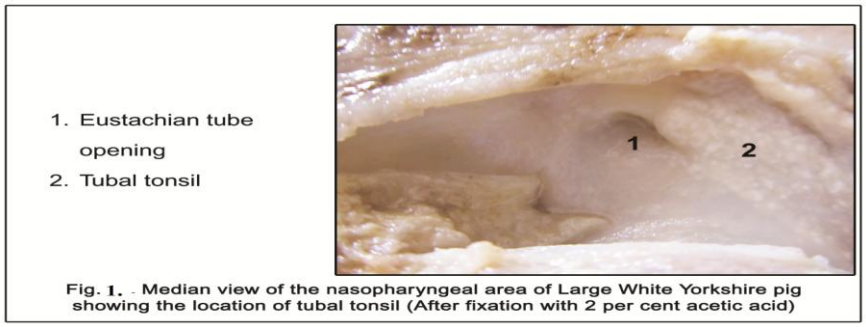

Fig. 1. Median view of the nasopharyngeal area of Large White Yorkshire pig showing the location of tubal tonsil (After fixation with 2 per cent acetic acid)

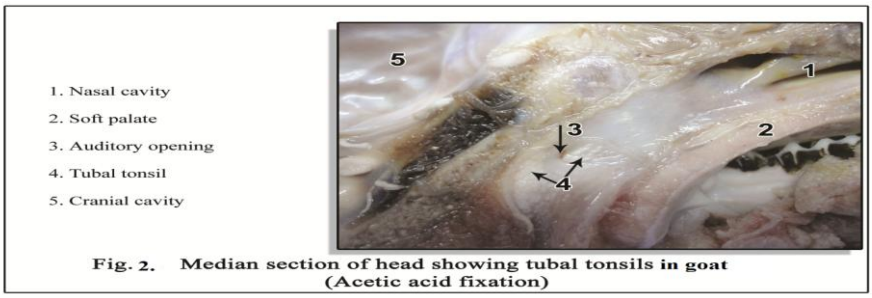

Fig. 2. Median section of head showing tubal tonsils in goat (Acetic acid fixation)

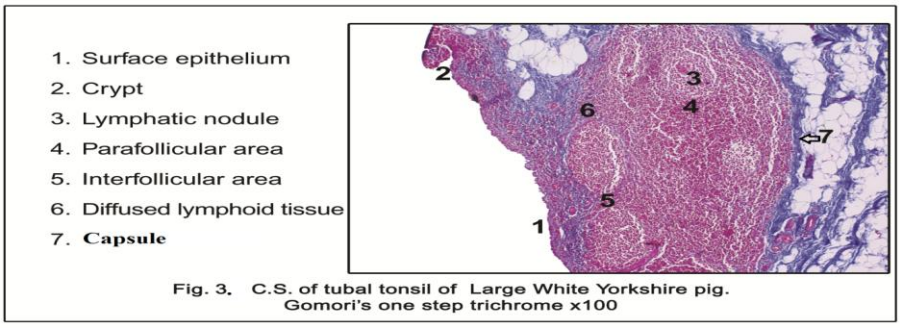

Fig. 3. C.S. of tubal tonsil of Large White Yorkshire pig. Gomori's one step trichrome x100

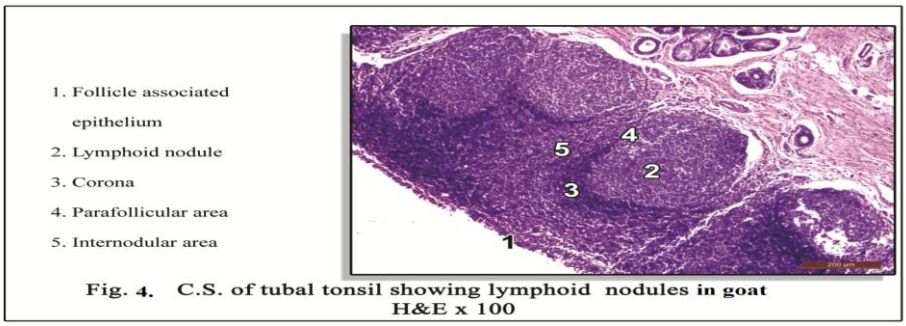

Fig. 4. C.S. of tubal tonsil showing lymphoid nodules in goat H&E x 100

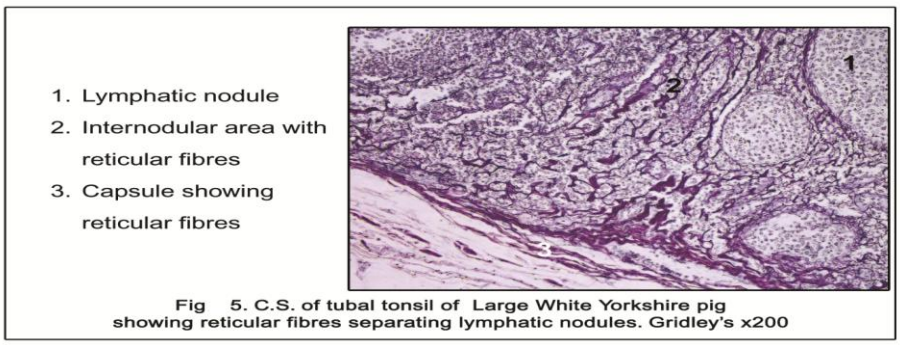

Fig 5. C.S. of tubal tonsil of Large White Yorkshire pig showing reticular fibres separating lymphatic nodules. Gridley's x200

In histological sections, similar to the observations made in sheep by Casteleyn *et al.,* (2007) and Kumar and Kumar (2012), in the present study, the tubal tonsil in goats and pigs were lined by pseudostratified ciliated columnar epithelium consisting of six to ten rows of nuclei of basal, supporting and goblet cells. Surface of the tubal tonsil showed folds and invaginations which formed crypts. In areas overlying the dome of lymphoid nodules, the epithelium was modified into follicle-associated epithelium (FAE), also called lympho-epithelium and was characterized by the absence of goblet cells, reduced number of cell layers, lack of cilia and a large amount of infiltrated lymphoid cells due to interrupted basement membrane in both pigs and goats in the present study (Fig. 3&4). These observations confirmed the reports by Kumar and Timoney (2005) in horse and Casteleyn *et al.,* (2007) and Kumar and Kumar (2012) in sheep. The epithelial cells in FAE helped in transcytosis of antigens, transportation of immunocytes and mucosal protection (Brandtzaeg and Halstensen, 1992). The height of the FAE was 34.33±0.92 µm and 35.00±3.13 µm in goats and pigs respectively**.** There was no significant difference in the height of crypt epithelium between both the groups of animals used in the present study.

The lamina propria-submucosa underneath the epithelium was filled with primary and secondary lymphoid nodules and diffuse lymphoid tissue arranged as crypto-lymphatic units (CLU) and tonsillar nodules in the superficial lamina propria similar to the observations of Mair *et al.,* (1987) in horse. The secondary lymphoid nodules consisted of a corona, parafollicular area (PFA) and internodular area (Fig. 4). In a few lymphoid nodules, the corona with dark staining dense small lymphocytes was seen towards the epithelium. The high endothelial veins (HEVs) were distributed more towards the internodular area. Large number of small, medium and large-sized lymphocytes, macrophages and plasma cells were seen within the nodules. These observations are in accordance with the reports of Cocquyt *et al.,* (2005), Casteleyn *et al.,* (2007) and Kumar and Kumar (2012) in sheep.

On statistical analysis significant differences ($p \leq 0.01$) were observed in the average number and diameter of the lymphoid nodules, and number of lymphocytes per nodule. The average number of lymphoid nodules counted per field under low power magnification was 1.17±0.17 in goats and 3.17±0.48 in pigs. The diameter of the lymphoid nodules was 566.67±11.45µm in goats and 594.89±6.75µm in pigs. The number of lymphocytes in it counted 10141.67±174.36 and 1460.83±14.32 in goats and pigs respectively.

The average number and diameter of the lymphoid nodules, and number of lymphocytes per nodule was more in Large White Yorkshire pigs when compared to crossbred goats, offering them better mucosal immunity by guarding the auditory openings of eustachian tube. Similar reports on the micrometry of lymphatic tissue in tubal tonsils of goats and pigs are not available for comparison.

Below the nodules in the deeper lamina propria, dense arrangement of collagen and elastic fibres was seen near the cartilage and in between the clusters of glandular acini in both pigs and goats. A capsule of dense collagenous connective tissue separated the lymphoid tissue from adipose tissue and acini in pigs (Fig. 3 & 5), but in goats the tubal tonsils were not macroscopically distinguishable from the surrounding tissue and were not encapsulated (Fig.4). Similar observations were made by Liu *et al.,* (2012) in pigs and Cocquyt *et al.,* (2005) and Kumar and Kumar (2012) in sheep.

It was concluded that the tubal tonsil was well developed in the nasopharynx of pigs as compared to the goats to offer better immunological protection at the auditory openings of eustachian tube against the spread of infection from the pharynx towards the inner ear.

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