

Histoarchitecture of Cervical Part of Oesophagus in Sheep of Tirunelveli Region

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Abstract

The oesophagus is the musculo-membranous organ of the digestive system connecting the pharynx with the stomach. It consisted of the cervical, thoracic and small abdominal part of oesophagus in all ruminants. The cervical part of oesophagus in three regions (anterior, middle and posterior) of the neck was collected from 12 apparently healthy adult male sheep. The wall of the cranial part of the oesophagus in sheep of the Tirunelveli region contained four layers from inside to outside, namely tunica mucosa, tunica submucosa, tunica muscularis and tunica adventitia. Tunica mucosa contained lining epithelium, lamina propria and muscularis mucosa. The stratified squamous epithelium contained five layers, namely stratum basale, stratum germinativum, stratum granulosum, stratum lucidum and stratum corneum. Lamina propria consisted of thin layer of collagen and connective tissue cells and fibres. The muscularis mucosa layer was found as a single layer of longitudinal arrangement of smooth muscles. Tunica submucosa appeared as a thick layer with meagre connective tissue fibres, lymphocytes and was found with abundant isolated and circularly arranged smooth muscle fibres and blood vessels. Tunica muscularis was made up of two distinct layer namely the outer longitudinal layer and the inner circular layer of striated muscle. Tunica adventitia was the outermost layer with connective tissue fibres and cells.

Keywords: Histoarchitecture, Oesophagus, Sheep, Tirunelveli Region.

Introduction

The oesophagus is the musculo-membranous organ of digestive system connecting pharynx with the stomach. It consisted of cervical, thoracic and small abdominal part of oesophagus in all ruminants. The histoarchitecture of the oesophagus of goat varies in different species based on the composition of food and digestive physiology. The oesophagus histologically contained four tunics from inside to outside namely tunica mucosa, submucosa, muscularis and serosa in the cranial part of the oesophagus. The mucosa intum was divided into an innermost lining epithelium, lamina propria and muscularis mucosa (Dellmann, 1993). The lining epithelium of mammalian oesophagus was mostly stratified squamous epithelium (Malik *et al*, 2018). Striated muscles were found in the wall of mammalian oesophagus (Dellmann, 1993). The histology of oesophagus in pig (Sharanya *et al*, 2023), goat (Kumar *et al*, 2009), beavers (Martyniuk *et al*, 2023) and sheep (Malik *et al*, 2018) were studied. Due to the paucity of literature regarding the histoarchitecture of oesophagus of sheep of Tirunelveli region, the current work was conducted with the aim to explore the histoarchitectural details of the cranial part of oesophagus in sheep of Tirunelveli region.

Materials and Methods

The cervical part of oesophagus in three regions (anterior, middle and posterior) of neck were collected from 12 apparently healthy adult male sheep (average body weight 21 kgs) of Tirunelveli region from the nearby mutton shops in and around Tirunelveli region. The oesophagus was cut into small pieces and fixed in 10% neutral buffered formalin and Bouin's solution for 48 hours. Then the tissues were dehydrated in ascending grades of alcohol, cleared in xylene, paraffin infiltrated and embedded with paraffin wax. The paraffin blocks were cut into 3-5 µm thickness sections and stained with haematoxylin and eosin stain and Masson's trichrome stain (Luna, 1968). The slide was examined under microscope and photographed using Lynx Trinocular microscope with imaging system software.

Results and Discussion

The oesophagus was the musculo-membranous tube of digestive system connecting pharynx with the stomach. It consisted of cervical, thoracic and small abdominal part of oesophagus in all ruminants. The wall of the cranial part of the oesophagus in sheep of Tirunelveli region contained four layers from inside to outside namely tunica mucosa, tunica submucosa, tunica muscularis and tunica adventitia (Fig. 1) as in other mammals (Dellmann, 1993). Tunica mucosa in the present study was found with longitudinal folds and contained lining epithelium, lamina propria and muscularis mucosa (Fig. 2). Similar results were also reported in goat (Kumar *et al*, 2009), pig (Sharanya *et al*, 2023) and beavers (Martyniuk *et al*, 2023). The lining epithelium in the present study was found as stratified squamous epithelium with keratinized type. Similar results were also reported in sheep (Malik *et al*, 2018), goat (Kumar *et al*, 2009), pig (Sharanya *et al*, 2023) and beavers (Martyniuk *et al*, 2023). The stratified squamous epithelium contained five layers namely stratum basale, stratum germinativum, stratum granulosum, stratum lucidum and stratum corneum (Fig. 3). Similar results were observed in beavers (Martyniuk *et al*, 2023), in pigs (Sharanya *et al*, 2023) and in goats (Kumar *et al*, 2009). But in Gaddi sheep, Malik *et al* (2018) observed only four layers and stratum granulosum was not found which may be due to species differences. The epithelium was not keratinized in dogs, slightly keratinized in horse and pig and well keratinized in ruminants (Dellmann, 1993).

Stratum basale consisted of single layer of tall columnar cells with oval nucleus located at the basal part of the cells (Fig. 3). Similar observations were also reported in gaddi sheep (Malik *et al*, 2018) and in goats (Kumar *et al*, 2009) where they observed cuboidal to columnar cells but in our present study only columnar cells with basophilic nucleus were found. The rete pegs which may be the lamina propria part was seen in the epithelium at the stratum basal part as islands as stated by Malik *et al* (2018) in Gaddi sheep and by Sharanya *et al* (2023) in pigs. But Kumar *et al* (2009) in goats observed rete pegs areas deep into the stratum lucidum layer which was not observed in the present study which might be due to species differences (Fig. 4).

Above this layer was found stratum germinativum layer which was composed of multiple layers of polygonal cells with centrally located round to oval vesicular nucleus in 5-6 layers (Fig. 3). Mitotic figures in nucleus were found in the cells of this layer showed the rapid multiplication of cells of layer. Intercellular junctions in the cells of the stratum showed a spiky appearance in this layer. The cell boundaries often appeared distinct in this layer. Similar observations were also recorded by Malik *et al* (2018) in Gaddi sheep and Kumar *et al* (2009) in goats.

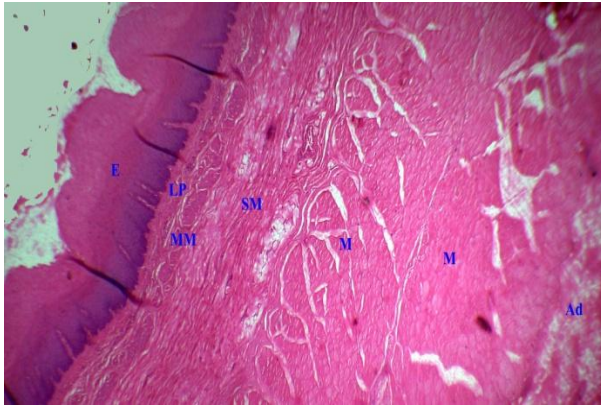


Fig. 1: Photomicrograph showing the cross section of cranial part of oesophagus of sheep showing epithelium (E), Lamina propria (LP), muscularis mucosa (MM) submucosa (SM), Muscularis (M) and Adventitia (Ad) H & E x 100

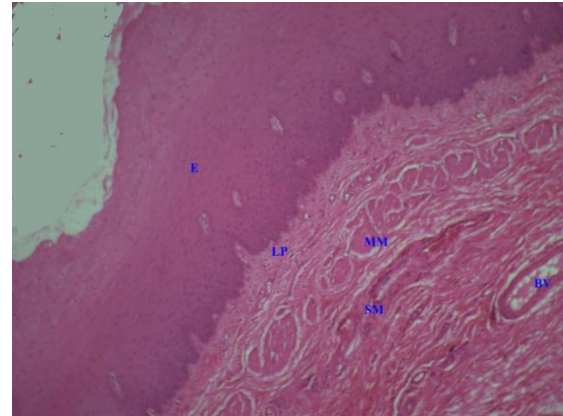


Fig. 2: Photomicrograph showing the cross section of cranial part of oesophagus of sheep showing epithelium (E), Lamina propria (LP), muscularis mucosa (MM) submucosa (SM) and Blood vessels (BV) H & E x 100

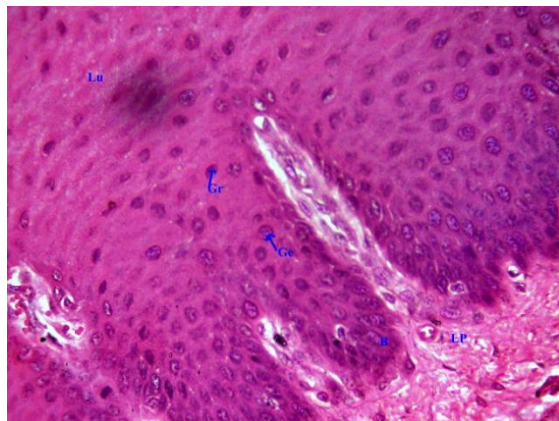


Fig. 3: Photomicrograph showing the cross section of cranial part of oesophagus of sheep showing layers of epithelium namely Stratum Basale (B), Stratum Germinativum (Ge), Stratum Granulosum (Gr), Stratum lucidum (Lu) and Lamina propria (LP) H & E x 400

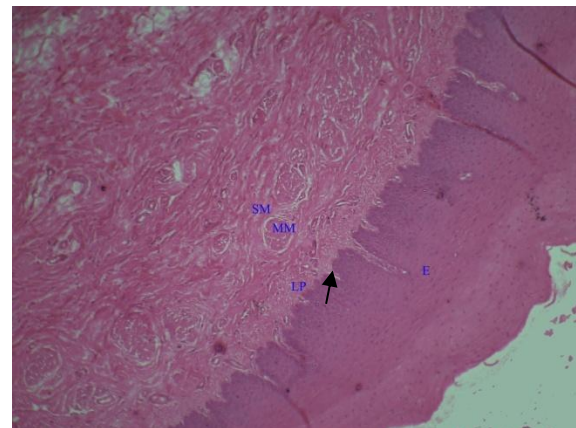


Fig. 4: Photomicrograph showing the cross section of cranial part of oesophagus of sheep showing epithelium (E), Lamina propria (LP), muscularis mucosa (MM) and submucosa (SM) Arrow – rete pegs H & E x 100

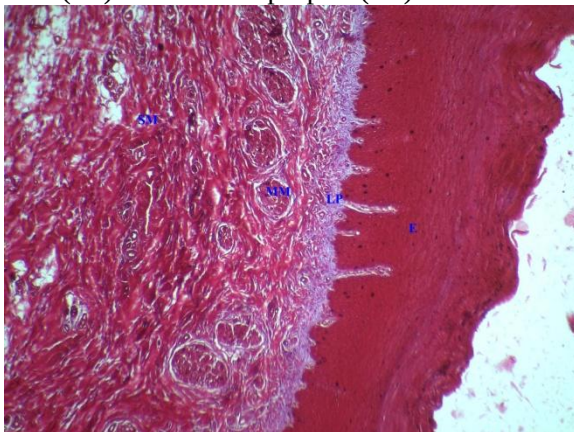


Fig. 5: Photomicrograph showing the cross section of cranial part of oesophagus of sheep showing epithelium (E), Lamina propria (LP), muscularis mucosa (MM) submucosa (SM) Masson's Trichrome x 100

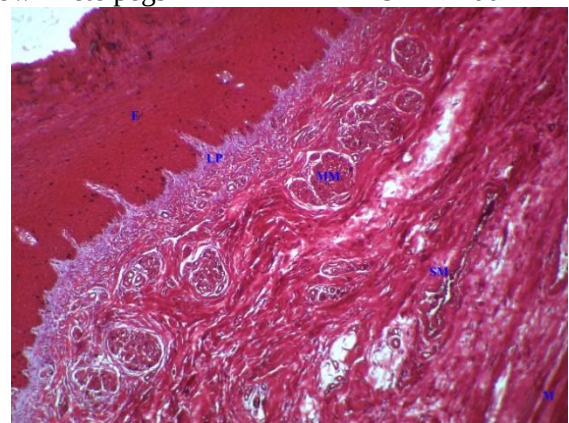


Fig. 6: Photomicrograph showing the cross section of cranial part of oesophagus of sheep showing epithelium (E), Lamina propria (LP), muscularis mucosa (MM) submucosa (SM) and Muscularis (M) Masson's Trichrome x 100

Above this layer found stratum granulosum which consisted of rhomboid cells in 4-5 layers (Fig. 3). Malik *et al* (2018) in Gaddi sheep found flattened spindle shaped cells which may be due to species differences. The

keratohyaline granules were observed in the cytoplasm of the rhomboid cells which were responsible for dark purple colouration by H & E staining. The nucleus was elongated and oval in transverse or oblique manner.

Above this layer was stratum lucidum with 3-4 layers of squamous cells with flat to oval nucleus in most of the cells but some cells were not nucleated (Fig. 3). The outer most layers towards to lumen were stratum corneum with cornified cells without any details of cytoplasm and nucleus. Keratinization of the epithelium in the above layer played an important role in the mechanical stability of the epithelium owing to different food habits of ruminants (Meyer and Schnapper, 2014).

Lamina propria was found below the epithelial layer and consisted of thin layer of collagen and connective tissue cells and fibres (Fig 5). Blood vessels, capillaries and lymphocytes were also found in this layer as stated by Malik *et al* (2018) in Gaddi Sheep, Kumar *et al* (2009) in goats and Martyniuk *et al*, (2023) in beavers. The connective tissue of this layer was found as rete pegs within the basal part of epithelial layer. Thin layer of connective tissue was found in this layer which was contrast to the observation of Malik *et al* (2018) in Gaddi sheep who found denser layer of connective tissue and the connective tissue thinness may be related to feeding pattern.

Muscularis mucosa layer was found as a single layer of longitudinal arrangement of smooth muscles (Fig. 6). Similar observations were stated by Malik *et al* (2018) in Gaddi sheep, Kumar *et al* (2009) in goats and Martyniuk *et al*, (2023) in beavers. But Eurell and Frappier (2006) found thick and two layers of muscularis mucosa namely inner circular and outer longitudinal layer in pig and were not present in the current study. Muscularis mucosa was absent in the cranial part of the oesophagus in pigs (Sharanya *et al*, 2023).

Tunica submucosa was found below the tunica mucosa layer and appeared as thick layer with less to meager connective tissue fibres, lymphocytes and found with abundant isolated and circularly arranged smooth muscle fibre and blood vessels (Fig. 2, 6). Submucosal glands were not observed in the present study. Similar results were observed by Malik *et al* (2018) in Gaddi sheep, Kumar *et al* (2009) in goats and Martyniuk *et al*, (2023) in beavers. But Naghani and Andi (2012), Islam *et al* (2008) and Sharanya *et al* (2023) observed submucosal glands in camel, Black Bengal goat and pig oesophagus. The oesophageal glands were absent in species which had high thickness of epithelial layer or lamina propria layer (Goetsch, 1910). The submucosa was found with more blood vessels. Collagen fibres were found only in meager amount in the present study by staining with Masson's Trichrome stain. Less amount of connective tissue and more muscle in this layer denoted that the wall of the oesophagus in the cranial part was dominated by muscular layer which was more important for swallowing and propulsion of food to the thoracic part of oesophagus.

Tunica muscularis was made up of two distinct layer namely outer longitudinal layer and inner circular layer of striated muscle. Less amount of collagen and connective tissue fibres were found separating the muscle fibres (Fig. 1, 6). Similar results were also found by Malik *et al* (2018) in Gaddi sheep and Sharanya *et al* (2023) in pigs. But Nickel *et al* (1979) and Kumar *et al* (2009) in goats reported oblique, interlocking and spiral orientation of muscle fibres which were not observed in the present study.

Tunica adventitia was the outermost layer with connective tissue fibres and cells which also had blood vessels (Fig. 1) as reported by Malik *et al* (2018) in Gaddi sheep and Gupta and Sharma (1991) in buffalo calves.

Contribution by Authors

All the authors contributed equally to writing the manuscript. The final manuscript was read by all authors and consented to publication.

Conflict of Interests

There is no conflict of interest.

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