HISTOMORPHOLOGY OF THE PULMONARY ACINUS IN SAMBAR DEER (CERVUS UNICOLOR)


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ABSTRACT

Histomorphological studies were conducted on the pulmonary acinus of a female adult Sambar deer collected from the Zoo, Trichur. The lung acinus which formed the functional unit of the gas exchange area consisted of all the air spaces distal to one terminal bronchiole and comprised respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli. The respiratory bronchioles were distinctly wide and longer and showed the distended alveoli on their walls. The lining epithelium of the respiratory bronchioles was simple cuboidal except in the areas where they formed the alveoli. The smooth muscle reduced progressively during the transition from terminal bronchiole to respiratory bronchiule. More number of alveoli were recorded per field when compared to the lung tissue of domestic animals. Alveoli were composed of two types of cells, namely type-I pneumocytes and type-II pneumocytes with a few dust cells. The average alveolar diameter was found to be 40.44 ± 2.39 mm.

Key words: Histomorphology, Pulmonary acinus, Sambar deer.

INTRODUCTION

The primary function of the respiratory system is to provide the exchange of respiratory gases between the organism and the environment. It may be divided into conducting airways and gas exchange area or the respiratory portion. The functional unit of the gas exchange area is called the lung acinus (Dellman and Eurell, 2006). Hence its detailed histological knowledge is indispensable for better understanding of their physiology, biochemistry and pathology. Review of literature reveals that studies on the histological aspects of respiratory organs of Sambar deer are very scanty as compared to those of domestic animals. Being a fast running animal, some anatomical peculiarities might be there for meeting the high oxygen demand. Keeping these facts in view, the present study was undertaken.

MATERIALS AND METHODS

The lungs of adult healthy female Sambar deer collected from the Zoo, Trichur were utilized for the present study. The tissue was fixed using 10 percent neutral buffered formalin. Small tissue pieces were collected from representative areas of various lung lobes. Standard procedures were adapted for histologic examination. The sections were stained using Haematoxylin and Eosin (H & E) and van Gieson’s method (Luna, 1968). Micrometry was done with the help of calibrated ocular micrometer.

RESULTS AND DISCUSSION

The lung was encapsulated by visceral or pulmonary pleura made up of connective tissue and mesothelial covering (Fig.1). The functional unit of gas exchange area consisted of all the air spaces distal to one terminal bronchiole, namely the respiratory bronchioles branching from one terminal bronchiole, alveolar ducts, alveolar sacs and alveoli (Fig.2). Similar descriptions were given by Banks (1993) and Dellman and Eurell (2006) in domestic animals. Terminal bronchioles were lined by simple, low columnar to cuboidal cells (Fig.3). Beneath the folded mucosa was the thin continuous layer of smooth muscle fibre bundles (Fig.4). According to Banks (1993) these smooth muscles effectively controlled the resistance to air flow in the lungs. The adventitia blended with the connective tissue of

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surrounding structures. The wall of the respiratory bronchioles possessed small outpouchings of gas exchange tissue called the alveoli (Fig.5). The bronchioles were accompanied by blood vessels (Fig.6). The respiratory bronchioles were distinctly wide and longer. They were lined by simple cuboidal epithelium except in areas where they showed the distended alveoli on their walls. Well developed and long respiratory bronchioles might be a species adaptation for fast running in this species of animals. Presence of long respiratory bronchioles was reported in the lungs of mithun (*Bos frontalis*) by Kalita and Bordoloi (1998) as against shorter respiratory bronchioles with more interalveolar cells in zebu cattle (*Bos indicus*). Dellman and Eurell (2006) reported that respiratory brochioles are short or absent in some rodents and many domesticated animals, including the horse, cow, sheep and pig. They also found that this transition zone was well developed in the lungs of dogs and cats and was the focus of most lung disorders. Kahwa and Purton (1996) noticed that respiratory bronchioles were prominent and well developed in the lungs of goat. But according to Raji (2006) the respiratory bronchioles were absent in the lungs of camel. The smooth muscle reduced progressively during the transition from terminal bronchiole to respiratory bronchiole.

As the respiratory bronchioles branched, the alveoli forming outpocketings from their walls became progressively more frequent and closer together. Eventually the alveoli were so frequent that they were lying side by side separated only by their walls (alveolar septa). This marked the beginning of the alveolar ducts. At first, the ends of the septa facing into the lumen of the alveolar duct showed prominent knobs of smooth muscle. Figure 2. shows a low power view of an alveolar duct progressing into two alveolar sacs. The wall of the alveolar ducts consisted of open sides of alveoli and the terminations of the interalveolar septa which separated the alveoli. Collagen and elastic fibres and smooth muscle fibres could be identified in the walls of the alveolar ducts at the portions wherefrom the
alveolar sacs arose. After giving off several branches, the alveolar ducts terminated into clusters of saccules termed as the alveolar sacs. The common opening of the alveolar sacs formed the atrium (Fig. 2). The alveolar sacs were completely surrounded by alveoli. Similar observations were made by Banks (1993) and Dellman and Eurell (2006) in ox, Baba and Choudhary (2008) in goats.

The characteristic feature noticed in the lungs of Sambar deer was that the alveoli formed a rich network throughout the parenchyma. The number of alveoli seen per field was more when compared to the lung tissue of domestic animals. This arrangement of alveoli might help to meet the high demand for oxygen during fast running in this species as explained by Sarah (1994) in quick moving animals.

The alveolar wall was composed of a thin single layer of epithelium. A very thin layer of connective tissue composed of fine elastic, reticular and collagen fibres underlay the epithelium. The alveolar epithelium consisted of two types of cells namely squamous alveolar epithelial cell (Type-I...
FIG. 6: Section of lungs of Sambar deer showing blood vessels associated with bronchioles. H&E. x 100.

FIG. 7: Section of lungs of Sambar deer showing alveolar epithelium. H&E. x 400.
1. Type-I pneumocytes. 2. Type-II pneumocytes. 3. Dust cell.
pneumocytes) and granular pneumocytes (Type-II pneumocytes). Type-I pneumocytes formed the main lining epithelium of alveoli (Fig. 7). These cells were pressed against the capillary walls establishing close contact with the endothelial cells and showed centrally located nucleus with thin cytoplasm beyond the perinuclear region. These cells were stated to be mainly responsible for maintaining an interface between the air and blood to allow the gas exchange (Bloom and Fawcett, 1970 and Banks, 1993). Type-II pneumocytes were occasionally found among the Type-I cells and projected more towards the alveolar lumina and were cuboidal in shape having centrally placed nuclei (Fig. 7). According to Banks (1993), type-II cells were secretory in nature, possessing well developed cell organelles. When the secretion was liberated onto the epithelial surface, it lowered the surface tension thereby preventing the alveoli from collapsing during expiration. Kahwa and Purton (1996) reported that the alveolar epithelium of goat was of simple squamous type only, whereas Kahwa et al. (1997) demonstrated both type-I and type-II cells in the same species. Similarly both these cell types were identified in the alveoli of cattle by Iovannitti et al. (1985) and in reindeer by Saari (1995).

In the present study, the average alveolar diameter of was found to be 40.44 ± 2.39 mm. Free phagocytic cells known as alveolar macrophages were observed in the lumina of only a few alveoli (Fig. 7). They were roughly spherical. The presence of the alveolar macrophages was also reported by Banks (1993) and Dellman and Eurell (2006) in domestic animals and Baba and Choudhary (2008) in goats. Cormack (1987) opined that these cells were loosely attached to alveolar surface epithelium and were immersed in little pools of alveolar tissue fluid. The alveolar macrophages were considered to be a part of the macrophage system distributed throughout the body, having a protective role through their defensive system (Dellman and Eurell, 2006). The interalveolar septa were covered on both sides by alveolar epithelium and were internally supported by fine elastic, reticular and collagen fibres. Very extensive capillary network was also present (Fig. 7). The connective tissue fibres were continuous with the surrounding interstitial tissue.

REFERENCES