Haryana Vet. **46** (December, 2007), pp 62-64

Research Article

HISTOMORPHOLOGICAL STUDIES ON DISTAL RESPIRATORY AIRWAYS DURING POSTNATAL DEVELOPMENT OF LUNGS IN GOAT (CAPRA HIRCUS)

SUMAN, A. N. GUPTA[1] and R. K. JAIN
Department of Anatomy and Histology, College of Veterinary Sciences
CCS Haryana Agricultural University, Hisar -125 004

ABSTRACT

Twenty goats of either sex from newly born to twelve months of age were used during the present study on distal respiratory airways. The alveolar ducts were closely beset with thin walled alveolar outpocketings in which numerous alveoli opened side by side and were lined by simple squamous or low cuboidal epithelial cells in goats of all age groups. Both alveolar sacs and alveoli were lined with type-1 squamous and type-II cuboidal pneumocyte cells in which the former formed the major population of alveolar cells. The average diameter and epithelial height in all respiratory segments exhibited an abrupt increase in goats of two to three months over newly born and became static with further advancement of age.

Key words: Histomorphology, respiratory airways, postnatal development, lungs, goat

The improved managemental practices used on organized farm sectors have lowered the incidence of various goat diseases however, heavy mortality is still reported due to respiratory tract disorders especially developmental deformities of distal airways of lungs in particular which are of clinical importance in gaseous exchange mechanism. Literature on histomorphology of distal respiratory airways of lungs of goat during postnatal development is very scanty and sparse. The present communication presents detailed histoarchitecture of alveolar ducts, alveolar sacs and alveoli during postnatal development of lungs in goat from birth to one year of age.

MATERIALS AND METHODS

Twenty goats of either sex used in the present study were divided into four groups having five animals in each i.e. newly born to 3 months, 4 to 6 months, 7 to 9 months and 10 to 12 months of age. The tissues of distal airways were collected from each goat and fixed in ten per cent neutral buffered formalin and Zenker's solutions. The fixed tissues were processed for paraffin sectioning and the sections were stained with routine Harris haematoxylin and eosin stain, Gomori's silver stain for reticulum, Weigert's stain for elastic fibers, Van Giesson's stain for collagen fibers, Unna' method for mast cells (Luna, 1968) and modified Mallory's triple stain for connective tissue and muscle fibers (Crossman, 1937).

RESULTS AND DISCUSSION

The respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli constituted the respiratory airways during postnatal development of lungs. The alveolar duct were long tortuous tubes with highly discontinuous wall, which in turn further branched. The alveolar ducts were beset with thin walled alveolar outpocketings and alveolar sacs (Fig 1). These findings simulated to those in domestic animals (Banks, 1983) where, the alveolar ducts divided and expanded peripherally into saccules or sacs, which were completely studded with alveoli (Banks, 1983). The squamous cells were flat with homogenously distributed eosinophilic cytoplasm. The nuclei were oval or flat, basophilic with dense chromatin material and were placed in the centre of the cells, whereas, the cuboidal cells were with lightly

[1]Corresponding author

stained eosinophilic cytoplasm and centrally placed rounded nucleus. Few cuboidal cells showed cilia on their apical/free surface protruding into the lumen of the duct, which may be called Clara cells. The basement membrane lining the alveolar ducts in goats of all age groups was indiscernible and the cells were supported by smooth muscles (Fig 2) and strands of collagen, reticular and a few elastic fibres. The alveolar ducts gave rose to both single alveoli as well as alveolar sacs comprising of two to four or even more alveoli.

The alveolar sacs called sacculi-alveolares, or vestibules were large sac like structures into which the surroundings alveoli opened. The atrium was formed between the ends of alveolar ducts and alveolar sacs making common opening of the saccules (Fig 1). These findings closely correlated to those reported in domestic animals (Banks, 1983). The alveoli were thin walled irregular polyhedral sacs opening on one side. The alveolar wall had a dense network of anastomosing capillaries and closely woven reticular and elastic fibers forming the tenuous supporting frame work for thin walled air sacs. The thick capillaries related to the rest of alveolar wall bugling into alveoli (Fig 3) and their greater surface portion was exposed to the alveolar air. The densely arranged reticular and elastic fibers were located centrally in the interalveolar septa with the anastomosing capillaries in the lungs of goats below one month of age. These formed a thick fibrous central stroma, which thinned out to stretch the alveolar walls with the advancement of age.

Small openings called alveolar pores were found in the alveolar wall separating adjacement alveoli in lungs of goats of all age groups. These pores probably play a role to distribute gases equally to keep uniform pressure among the alveoli. They may also serve for the interalveolar transmission of fluids, particulate matter, bacteria and alveolar macrophages etc. They might provide a collateral air circulation that tends to prevent atelectasis when secondary bronchi became obstructed, but might have the disadvantage also of providing pathways for spread of bacteria from one alveolus to its neighbours during pneumonia. Winkler and Cheville (1984) did not see pores in immature pig lungs but infrequently observed these in 60 days old animals.

In addition, interstitial cells like fibroblasts, macrophages, plasma cells, lymphocytes and occasional mast cells were found in the inter-

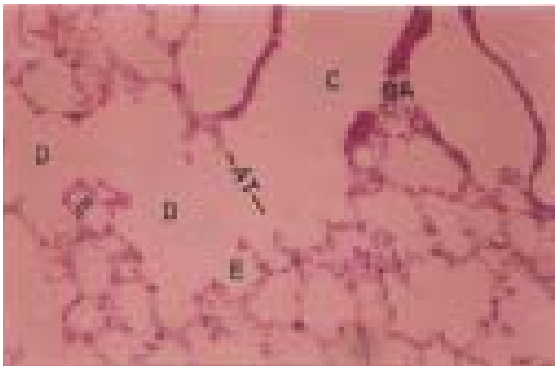

Fig 1. Photomicrograph of goat lung (2-3 months age) showing alveolar ducts (C), alveolar sacs (D), alveolus (E) and atrium (AT). Outpocketing alveoli (OA) can also be seen. (H. & E. x 50)

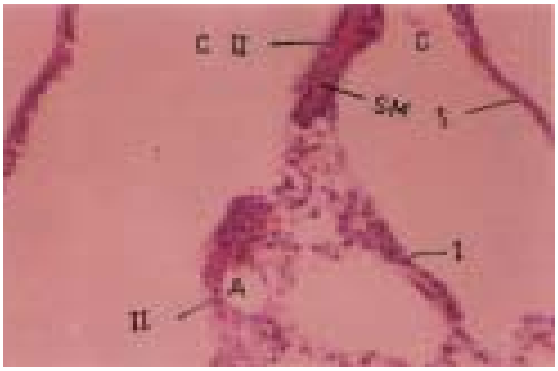

Fig 2. Photomicrograph of goat lung (2-3 months age) showing squamous cells (I) and cuboidal cells (II) lining the alveolar ducts (C). Arteriole (A) and smooth muscle fibers (SM) can also be seen.
(H. & E. x 100).

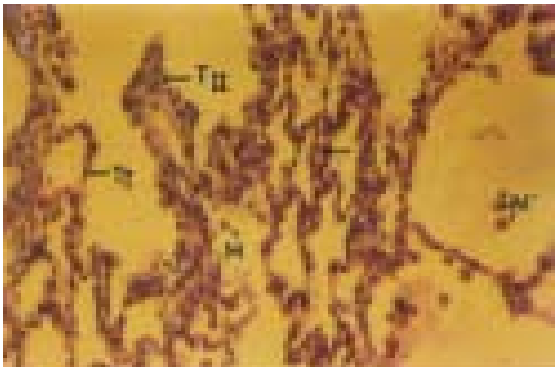

Fig 3. Photomicrograph of goat lung (below one month age) showing pneumocyte type-I (T_I) and type-II (T_{II}) cells lining the alveoli and thick capillaries (arrow). Macrophage cells (M) can also be seen in the alveoli.
(H. & E. x 100).

alveolar spaces. The presence of these cells in the interalveolar connective tissue of lungs has also been recorded in pigs (Winkler and Cheville, 1984). Both the alveolar sacs and alveoli were lined with type-I pneumocyte (squamous) and type-II pneumocyte (cuboidal) epithelial cells (Fig 3). Their alveolar diameter as well as epithelial height showed a significant increase in lungs from goats below one month of age to two to three months age and became static with further advancement of age. Bhattacharya and Baishya (1995) noticed rapid histomorphological changes in the lung parenchyma in goat fetuses. Neonatal lungs at birth demonstrated well developed and distinct alveoli. The formation of new alveoli was the main characteristic feature from birth to 30 days of age. The neonatal lungs of 30-days-old kid almost resembled to that of adult. The type-I or squamous epithelial cells formed the major population of alveolar epithelial cells. The type-II pneumocytes were found interspersed between the former cells and produced pulmonary surfactant, which lowers the alveolar surface tension and prevents the alveolus from collapsing, particularly at low lung volumes thus aiding in expiration. In addition to the squamous pulmonary epithelial cells (small alveolar cells or pneumocytes type-I), there were numerous rounded or cuboidal cells in the lining called septal cells or alveolar cells (great alveolar cells).

A third cell type known as alveolar macrophage or dust cell resembling more or less to the structure of alveolar epithelial cells was noticed in the lumen of lung alveoli in goats (Fig 3) of all age groups as reported earlier in goat (Bhattacharya and Baishya, 1995) and pigs (Winkler and Cheville, 1984).

REFERENCES

Banks, W.J. (1983). Applied Veterinary Histology. Williams and Wilkins, Baltimare, USA.

Bhattacharya, R. and Baishya, G. (1995). Histomorphological development of lung in peinatal goat. *Indian J. Anim. Sci*. **65**: 1296-1300.

Crossman, G.A. (1937). A modification of Mallory's connective tissue stain with a discussion of principles involved. *Anat. Rec*. **69**: 33-38.

Luna, L.G. (1968). Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology. (3rd edn.) McGraw-Hill Co., New York.

Winkler, G.C. and Cheville, N.F. (1984). The neonatal porcine lung: ultrastructural morphology and postnatal development of the airways and alveolar region. *Anat. Rec*. **210**: 303-313.