HISTOCHEMISTRY OF RESPIRATORY AIRWAYS DURING POSTNATAL DEVELOPMENT OF LUNG IN GOAT (CAPRA HIRCUS)

Suman, A.N. Gupta and R.K. Jain
Department of Anatomy and Histology, College of Veterinary Science, CCS Haryana Agricultural University, Hisar - 125 004, India

ABSTRACT

Histochemical studies were conducted on various respiratory airways of lungs in goats irrespective of sex difference from birth to 12 months of age. A strong (++++) to moderate (++ ±) PAS +ve reaction was observed in the cells lining the various respiratory segments viz., respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli in goats of all age groups, which was slightly reduced on saliva treatment. The cytoplasm of these cells reacted weakly (±) with Best's Carmine but remained negative to Alcian blue. Except a weak (±) nuclear reaction for acid phosphatase, the cytoplasm of the cells failed to demonstrate any kind of fat or enzymes studied during the present investigation.

INTRODUCTION

The overall fitness of domestic animals to their environmental circumstances is conditioned by their morphological, physiological, behaviour and reproductive adaptation (French, 1970). The ruminants like buffalo, goat and sheep represent varied potentials of biological adjustment of their pulmonary system especially to the diverse ecological shifts resulting from variation in geoclimatic conditions. In order to gain complete understanding of this reason histochemical characterisation of mucosubstances in the secretory epithelium of the lungs is essential. The literature on histochemical studies of respiratory airways in domestic animals in general and goat in particular, is scanty and sparse. Hence, the present study was undertaken to elucidate the distribution pattern of carbohydrate rich components like sulphated, neutral and acid mucopolysaccharides, fats and enzymes in the respiratory airways during the postnatal development of lungs in goat.

MATERIAL AND METHODS

Twelve healthy goats from birth to one year of age of either sex were utilized in the present study. The approximate age of the animals was estimated by eruption of teeth. These animals were divided into four age groups of five animals each from birth upto 3 months, 4th upto 6 months, 7th upto 9 months and 10th upto 12 months. The lung tissues were collected from goats immediately after death in chilled absolute alcohol, chilled acetone and neutral buffered 10% formaline. These were processed for paraffin and frozen sectioning techniques. The sections were cut at 5-7 mm thickness and were stained with routine Harri’s haematoxylin and eosin (H and E) stain for normal histological studies (Luna, 1968). A variety of histochemical techniques as shown in table to localise glycogen, carbohydrate rich components like sulphated, neutral and acid mucopolysaccharides, fats, acidic and neutral lipids, alkaline and acid phosphatases in the respiratory airways were used (Gomori, 1946; Carleton, 1967; Luna, 1968).

RESULTS AND DISCUSSION

The respiratory airways in lung of goats included respiratory bronchioles, alveolar ducts, alveolar sacs and alveoli. The respiratory bronchiolo was further sub-divided into two parts viz., terminal bronchiole lined with low columnar epithelium devoid of goblet cells and true respiratory bronchiolo lined with cuboidal epithelium having some Clara cells with protruding surface as reported earlier in goats (Suman et al., 2005). Alveolar ducts were lined
by simple squamous or low cuboidal epithelium having few Clara cells with cilia on their free apical surface (Fig. 1), while both the alveolar sacs and alveoli were lined by two types of cells viz., membranous type-I pneumocytes or squamous and type-II pneumocytes or cuboidal epithelial cells (Fig. 2).

Fig. 1. Photomicrograph showing alveolar duct (C) lined with simple squamous or low cuboidal epithelium with secretory blebs (arrow) on the free surface of the epithelial cells. Out pocketing alveoli (OA) are also seen (H and E x 50).

Fig. 2. Photomicrograph showing pneumocyte type-I (T), and type-II (T) cells lining the lung alveoli. Note alveolar pores (arrow) and capillary (C) (H and E x 200)
Fig. 3. Photomicrograph showing PAS +ve reaction (arrow) in the cells lining the alveolar ducts (C) and alveoli (E) (PAS x 50)

Fig. 4. Photomicrograph showing PAS +ve reaction in the cytoplasm of type-I (T1) and type-II (TII) pneumocytes lining the alveoli (A) and alveolar sac (AS). PAS +ve reaction in macrophage cell (M) is also visible (AS x 100)

Histochemically fine granular PAS +ve material was found distributed throughout the cytoplasm of the cells lining all the segments of respiratory airways including Clara cells during the development of lung in goats from birth to 12 months of age. The intensity of which was graded strong (++++) in respiratory bronchioles high to strong (+++) in alveolar
Table 1. Histochemical reactions in the cytoplasm of epithelial cells lining the various respiratory segments of goat lung at different age groups

<table>
<thead>
<tr>
<th>Histochemical techniques</th>
<th>Respiratory bronchiole</th>
<th>Alveolar duct</th>
<th>Type-I pneumocyte cell</th>
<th>Type-II pneumocyte cell</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Birth to 3 months</td>
<td>4 to 6 months</td>
<td>7 to 9 months</td>
<td>10 to 12 months</td>
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<tr>
<td>PAS without saliva</td>
<td>++++</td>
<td>++++</td>
<td>++++</td>
<td>++++</td>
</tr>
<tr>
<td>PAS with saliva</td>
<td>+++±</td>
<td>+++±</td>
<td>+++±</td>
<td>+++±</td>
</tr>
<tr>
<td>Best's Carmine</td>
<td>±</td>
<td>±</td>
<td>±</td>
<td>±</td>
</tr>
<tr>
<td>Alcian blue at 2.5 pH</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nile blue sulphate</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sudan Black-B</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Oil-Red 'O'</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Gomori's revised method</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>(a) Alkaline phosphatase</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(b) Acid phosphatase</td>
<td>±</td>
<td>±</td>
<td>±</td>
<td>±</td>
</tr>
</tbody>
</table>

- = Negative; ± = Weak; + = Mild; ++ = Moderate; +++ = High; ++++ = Strong.
ducts (Fig. 3) in goat lungs of all age groups (Table) while it was high (+++) and moderate to high (++ ±) in type-I as well as type-II pneumocyte cells lining the alveolar sacs as well as alveoli in lungs of goats from birth to 6 months and 7 months to 12 months of age, respectively (Fig. 4 and Table 1). The reaction was slightly (+) reduced on saliva treatment. The PAS +ve material also formed the secretory blebs on free surface of epithelial cells lining the first-part of respiratory bronchiole. The cytoplasmic material of almost all cells lining the respiratory airways exhibited very weak (+) reaction with Best’s Carminé, while it failed to react with alcian blue at 2.5 pH (Table 1). Similar findings have been reported in different domestic animals viz., buffalo (Gill et al., 2003); pig (Baskerville, 1970) and goat (Atwal et al., 1979; Bhattacharyya et al., 1996). Bhattacharyya et al. (1996) also reported an age associated increasing PAS +ve reaction up to 30 days of age in the basement membrane of bronchi and bronchioles in Assam local goats. On the basis of these reactions, the authors were of the opinion that the cytoplasm of the cells lining the respiratory airways contained glycogen in traces and mucopolysaccharides other than acidic and sulphated mucus substances which may be either sialomucin or neutral mucosubstances considered to be important components of pulmonary surfactant secretion, as it was established that PAS +ve reaction was outstandingly sensitive for mucopolysaccharides (Curran, 1964) which detects neutral sugars and sialic acid polymers very efficiently but its reactivity is low or absent towards polysaccharides containing uronic acid (Quintarelli, 1968). According to Curran (1964) presence of mucoid substances in the alveoli is important as an antidesicant. Therefore, there is a strong inferential reason to believe that there might be a relationship between presence of polysaccharides in the alveolar cells and adaptive ecology of goat. Except a very weak (+) nuclear reaction for acid phosphatase in respiratory bronchioles, the cytoplasm of the cells lining the other segments of respiratory airways in lungs of goats of all age groups failed to demonstrate any kind of fat and enzymes studied during the present study (Table 1).

REFERENCES

Suman et al. (2005). Haryana Vet., 44.