HISTOCHEMICAL STUDIES ON THE DEVELOPING ADRENAL GLAND IN CROSSBRED GOAT FOETUSES (Capra hircus)*

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ABSTRACT

The study was conducted on the adrenal gland of embryos/foetuses collected from 55 crossbred goats of varying gestational ages to trace the histochemical contents of carbohydrates, acid mucopolysaccharides and glycogen and also to study the intensities of acid and alkaline phosphatases at different stages of development. Capsule, trabeculae and the parenchyma were all PAS positive with an increased intensity with the advancement of foetal age. Acid mucopolysaccharides and glycogen were also detected in the cortex. The acid mucopolysaccharides increased from 73 day of foetal age till term whereas, glycogen content showed a decreasing trend with the advancement of pregnancy. A strong alkaline phosphatase activity was noticed in the developing cortical cells up to 84 days of foetal age, thereafter a moderate activity up to 122 days which further intensified towards term. Acid phosphatase activity also showed an increasing trend in the cortical cells after 122 days of foetal age. Medullary cells showed strong acid phosphatase activity throughout foetal life.

Key Words: adrenal, histochemistry, development, foetus, goat

INTRODUCTION

Biochemical and histochemical studies indicate that the foetal adrenals produce steroids even before the evidence of cortical zonation (Black, 1972). Reports indicating the role of foetal adrenal cortex in the initiation of parturition in sheep are plenty (Reperant and Durand, 1997) and is evidenced by an increased corticosteroid secretion by the foetal adrenals and elevated foetal plasma corticosteroid concentrations towards the end of gestation (Basset and Thorburn, 1969). Moreover hyperactivity of the foetal adrenal cortex in crossbred goats towards the end of pregnancy have been reported (Ashok et al., 2000) which is manifested by a rapid growth of cortical zones and an increase in the adrenal weight in this period. Secretory activity of any glandular cells is directly linked with the histochemical reactions. Therefore the present study is envisaged to relate the secretory activity of the foetal adrenal gland with certain histochemical parameters at different foetal ages in cross bred goats.

MATERIALS AND METHODS

A histochemical study was conducted on 55 crossbred goat foetuses comprising of 17 sexually indifferent and 38 males collected from the local farms and hospitals. Immediately after collection, body weight and the crown-rump length of the foetuses were recorded. Approximate age of the foetuses was calculated from the formula $W^{1/3} = 0.096 (t - 30)$ derived by Singh et al. (1979) for goat foetuses where, $W =$ body weight of the foetus in g and $t =$ approximate age of the foetus in days.

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The adrenals acquired a harvestable size around 59 days of gestation. The embryos up to 43 days were fixed in toto. From foetuses of 59 days to term, both the right and left adrenals were excised after recording the gross anatomical relations. The specimens were cut into small pieces and fixed in chilled acetone (4°C) and 90 percent alcohol. After fixation, the tissues were processed in low melting paraffin (MP- 40 - 42°C) and 6 µm thick sections were cut. Frozen sections of 20 µm thickness were also taken.

Following histochemical methods were employed:

1. Periodic Acid Schiff's (PAS) reaction for carbohydrates (Bancroft and Stevens, 1977)
2. Alcian blue method (pH 2.5) for acid mucopolysaccharides (Luna, 1968)
3. Best's carmine method for glycogen (Bancroft and Stevens, 1977)
4. Modified Gomori's method for alkaline phosphatase (Pearse, 1977)
5. Naphthol AS-B1 phosphate method for acid phosphatase (Barka, 1960)

RESULTS DISCUSSION

The adrenal anlagen were first identified in 33 days of embryos. The area of adrenal development was characterized by whorls of cells anterior to the developing metanephros on the ventrolateral aspect of dorsal aorta. The adrenal capsule and parenchyma were PAS positive from 42 days of foetal life (fig.1). The intensity of the reaction increased with foetal age. The differentiating cells of zona glomerulosa and the medullary cells were weakly positive. Bielanska-Osuchowska (1989a, 1989b) also has reported PAS positive material in the cortical cells of foetal pig. In full term foetuses, capsule, trabeculae and zona reticularis were strongly PAS positive. Zona glomerulosa showed a weak reaction while a moderate reaction was seen in the zona fasciculata and medulla. The reaction for acid mucopolysaccharide in 73 days old foetuses was moderate in the capsule and weak in the cortical cells (fig.2). However earlier to this no positive reaction for acid mucopolysaccharides was noticed. As the foetal age advanced, acid mucopolysaccharide content also increased in the cortical cells and showed a strong reaction after 122 days of foetal age. Medullary cells showed a moderate reaction. No literature is available for a similar comparison in other domestic animals.

Even though the cortical and medullary cells showed a positive reaction for glycogen in young foetuses, the intensity of the same slightly decreased in the cortical cells as pregnancy advanced. Albano et al. (1976) reported large accumulation of glycogen in the future cortical cells of rabbit foetuses from day 16 onwards. Idelman (1970) noticed glycogen granules in proximity to the liposomes in the cortical cells in rat embryo. All these suggest that they are concerned with the elaboration and regeneration of lipid resources of the gland.

The developing cortical cells showed strong alkaline phosphatase activity up to 84 days of foetal age (fig.3). Thereafter a moderate activity up to 122 days was observed which further intensified towards term. Wintour et al. (1975) proved that between 60 and 90 days of gestation, ACTH was a potent stimulus for aldosterone and cortisol production in foetal sheep. Between 90 and 120 days the effect of ACTH was reported to decline and hence both the glucocorticoid and the mineralocorticoid levels were lowered during this period compared to the other periods of gestation. The reduced activity of alkaline phosphate between 84 and 122 days of foetal life observed in the present study could be due to the reduced activity of the cortical zones during this period, as observed in sheep. A weak activity in the sub capsular zone and total absence in the migratory cells observed in this study concurs with the findings of Bielanska-Osuchowska (1989a, 1989b) in the foetal pig.
A moderate activity of acid phosphatase was recorded in the cortical cells just below the capsule in foetuses from 58 days to term. Medullary cells showed strong enzyme activity throughout foetal life. In other cortical cells, the enzyme activity was very weak or even absent in foetuses up to 122 days of age. Thereafter a moderate activity was recorded in these cells also till term. In general the acid phosphatase activity was stronger in the medullary cells compared to the cortical cells. These observations are in agreement with the findings of Bielanska-Osuchowska (1989a) in foetal pigs.

REFERENCES


Fig.1: Photomicrograph of adrenal (42 days foetus) showing moderate PAS positive reaction in the cortical cells. Note strong PAS reaction (arrows) in the developing metanephric tubules

CV - Central vein  M - Metanephric tubule  PAS method X 200

Fig.2: Photomicrograph of adrenal (73 days foetus) showing moderate reaction for acid mucopolysaccharides in the capsule and weak reaction in the cortical cells

CA - Capsule  CC - Cortical cells  Alcian blue method X 200
Fig. 3: Photomicrograph of adrenal (73 days foetus) showing strong alkaline phosphatase activity in the cortical cells

CA - Capsule  C - cortex  M - Medulla  Modified Gomori's method X 200