COMPARATIVE DEVELOPMENT OF THYMUS AND SPLEEN IN FOETAL GOAT *

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ABSTRACT

The study was conducted on 41 caprine foetuses to elucidate the comparative developmental pattern of thymus and spleen. The primordium of thymus appeared at 22 days and became solid epithelial cords infiltrated with lymphocytes by 40 days. It got invaded by blood vessels and the parenchyma differentiated into cortex and medulla with thymic corpuscles by 60 days indicating an early developmental progress. Upto two months, the spleen was composed of haemopoetic cells and reticular cells with haemopoetic areas masking the basic structure. It showed a faster development during the second half of gestation. By 93 days, a distinct organization of red and white pulps was noticed and trabeculae were seen extended into the interior.

INTRODUCTION

Protection of the body against deleterious effects of invading foreign substances is a critical function of the lymphatic system, which necessarily involves the activity of many organs and tissues. The lymphatic organs include central (primary) and peripheral (secondary) lymphatic organs. The central organs are the thymus and bursa Fabricii in birds or the bone marrow in mammals. The peripheral lymphatic organs consist of the lymph nodes, spleen, tonsils and Peyer's patches. This study comprised of a comparative developmental study of the thymus and spleen as representatives of primary and secondary lymphatic organs in foetal goat.

MATERIALS AND METHODS

The study was conducted on 41 goat foetuses. After recording straight and curved CRL (Crown Rump Length), the age of the foetuses was calculated using the formula derived by Singh *et al.* (1979), for goat foetuses, $W^{1/3} = 0.096 (t - 30)$, where, W = Body weight of the foetus in g and t = Age of the foetus in days. Based on the age, the foetuses were divided into five groups corresponding to five months of gestation. Embryos and foetuses upto 90 days of age, were fixed as such. In still older foetuses, in addition to histology, the gross parameters like shape, colour, position, weight, length (long diameter), width (short diameter) and thickness of these organs were also noted to determine the age-related changes. The data collected were analysed statistically (Snedecor and Cochran, 1994).

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RESULTS AND DISCUSSION

Thymus: The thymic primordia appeared in embryos of 35 days (Fig 1). By 40 days they became solid epithelial cords with developing blood cells and lymphocytes. Presence of developing blood cells revealed the commencement of thymic haemopoiesis by this age of foetal life. It indicated that lymphocytic proliferation in the thymus started at an early stage, confirming the findings of Ackerman (1967) in foetal cats.

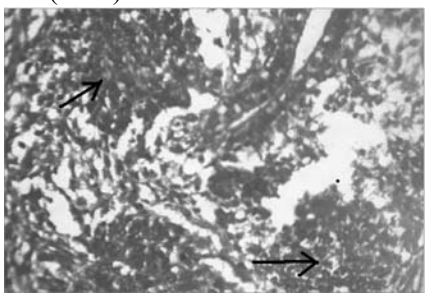

Fig..1 Thymic primordia (arrows) at 22 days. H & E x 400

Thymic epithelial reticulum became invaded by blood vessels from the surrounding mesenchyme by days Thymic tissue extended diffusely ventrolateral to the trachea from larynx to cranial thorax By this age the lymphocytes filled the spaces between epithelial cells Fig making the organ appropriate to be known as a lymphoepithelial organ

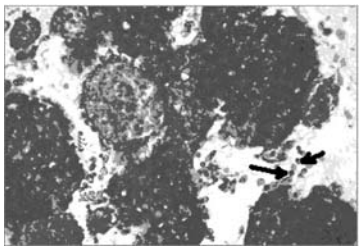

Fig. 2 Thymus showing lymphocytes (arrows) in the interstitial space at 60 days. H & E x 400

The thymus was divided into lobes and each of which was surrounded by a connective tissue capsule Thin septa extending from the capsule partially subdivided the lobes into several lobules

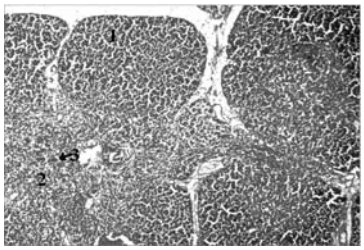

Fig. 3 Thymus at 99 days. H & E x 100

1.Cortex 2. Medulla 3. Thymic corpuscles

Differentiation of the thymic parenchyma into cortex and medulla was obvious by days of gestation The cortex comprised of an epithelial reticulum with lymphocytes At this age thymic (Hassall's) corpuscles appeared in the future medullary region the number of which increased as the gestational age advanced. The appearance of thymic corpuscles also indicated an early maturation of this primary lymphatic organ.

Lymphoblasts and medium sized lymphocytes predominated in the meshes of the peripheral epithelial reticulum where mitotic divisions occurred producing small lymphocytes that differentiated in the deep cortex The cortex stained much darker than the medulla due to a denser population of lymphocytes In the medulla a few epithelial reticular cells had the same structure as those in the cortex however majority of them were much larger in size

Spleen: During initial stages of gestation, the mesenchymal primordium of spleen presented irregular vascular network with reticular fibres and cells. It appeared in the dorsal mesogastrium close to the stomach (Fig. 4). By third month the organ presented haemopoetic cells and reticular cells. The latter were with irregular cytoplasmic processes. The cellular haemopoetic areas masked the basic structure of the spleen in which the red and white pulps were indistinguishable. The number and size of these haemopoietic foci gradually reduced towards the terminal stages of gestation. The undifferentiated capsule presented only a single layer of cells by third month of age.

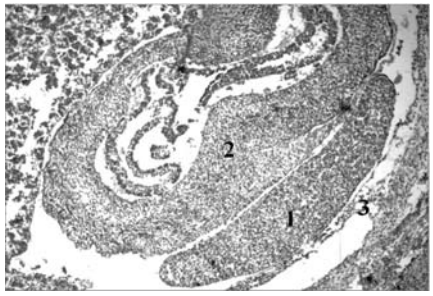

Fig. 4 Cross section of coelomic cavity at 48 days. H & E x 100

1. Spleen 2. Stomach 3.Dorsal mesogastrium

By 81 days, the differentiation of splenic parenchyma into red pulp and white pulp was not evident. A thin capsule was noticed surrounding the organ, however, no trabeculae was seen extending into the parenchyma. The peritoneal covering seen on the external surface of the capsule presented one to two layers of cells. Clumps of haemopoetic areas and non-nucleated RBCs were also seen in the parenchyma.

By 93 days of age, the splenic parenchyma resembled that of mature animals with distinct red and white pulps (Fig . Trabeculae extended from the capsule into the interior of the organ. The capsule and trabeculae were made up of connective tissue, smooth muscle fibres, blood vessels and nerves and had a thickness of 32μm.

The size of the lymphocytes reduced from 5 to 4μm as age advanced.

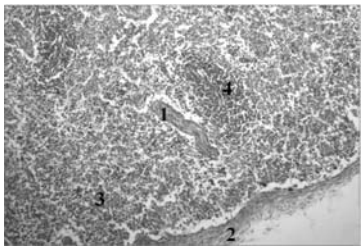

Fig. 5 Spleen at 93 days. H & E x 100

1.Trabeculae 2. Capsule 3. Red pulp 4. White pulp

The mean values for length, width, thickness and weight increased with advancing age, confirming the observations of Baishya *et al*. (2001) in pigs. But the contribution of the weight of the foetal spleen to the body weight decreased as the age advanced. It was 0.96 per cent by third month, which got reduced through 0.41 per cent by fourth month to 0.17 per cent by fifth month.

It was obvious that in the absence of antigenic stimuli, the spleen, which is a secondary lymphatic organ, developed very slowly and its final maturation was to take place only in the postnatal period. This was in contrary to an early progress in the development of thymus, a primary lymphatic organ, which was needed to develop immunity even before birth. This primary immunity will be sustained with utmost importance in the early postnatal period also, after which regression of the organ occurs.

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