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Original Article

COMPARATIVE MORPHOLOGICAL AND ANATOMICAL STUDY ON THYMUS GLAND OF HUMAN AND PRIMATE

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ABSTRACT

Context: The comparative morphological and anatomical study on thymus was carried out in human and primate. The prenatal stage of *Macaca radiata* was selected for the present study.
Study Design: Cross sectional analytical type of study.
Place and Period of study: Department of Anatomy, Dr. A.L.M. PG Institute of Basic Medical Sciences, Chennai from July 1999 to June 2000.
Materials: The comparative morphology and anatomy of thymus of human embryonic, 10 weeks, 15 weeks and prenatal foetuses, and monkey foetus was carried out.
Methods: Comparative micro-anatomical study was done by paraffin processing method. The sections were stained as per the method published by Culling (1974).
Results: In monkey foetus, the thymus gland is slightly elongated, whereas in human foetuses it is not elongated and oval in shape. The size of the thymus is larger in human foetuses than monkey foetus. In both cases cells are parenchymal in nature. Due to spatial organization in human foetuses, the lymphocytes aggregation is more in cortex than in medulla. In monkey foetus the lymphocyte aggregation is simpler in arrangement through spatial organization is much less.
KEYWORDS: human foetus, *Macaca radiata*, monkey foetus, thymus gland

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INTRODUCTION

Thymus gland is found in all the vertebrates except in the cyclostomes and derives its name from the resemblance of its lobes in human beings to a leaf of the thyme plant [1.2]. Reptiles and birds have a series of large nodes in the neck. In neonatal and young mammals, the thymus is a bi-lobed mass in the thoracic cavity. The thymus gland is regarded immunologically as a primary or central lymphoid organ. Its presence is essential for the development of peripheral lymphoid tissues and their associated adaptive immune functions [3].

In human thymus is almost fully developed at birth [4]. It has been found to undergo many changes as the age advances [5]. These changes have been reported to start between 11-15 years [6]. There is reduction in the parenchyma of the gland and by middle age most of it has been replaced by fat although functional thymic tissue is found until 6th decade of life [7]. In the adult monkey, i.e., in primates, the thymus is not

traceable and is much made of connective tissue without the parenchyma. It is a much attenuated organ, but during foetal stage it is a well-developed and functional organ.

Though elaborate work has been done on the thymus gland, information available regarding the comparative knowledge on the foetal thymuses of primate and man is arguably less. These lacunae prodded to take up this study with the objectives of studying the comparative anatomy of the thymus gland between human and primate.

In view of its anatomical importance the present investigations were undertaken in *Macaca radiata.* The Bonnet macaque (*Macaca radiata*) is a macaque endemic to southern India. Its distribution is limited by the Indian Ocean on three sides and the Godavari and Tapti Rivers along with a related competing species of Rhesus macaque in the north.

MATERIALS AND METHODS

The prenatal stage of *Macaca radiata* was selected for present study. The use of this primate has been permitted through the ethical committee. The comparative morphology of thymus of human embryonic, 10 weeks, 15 weeks and prenatal foetuses, and monkey foetus was carried out. Comparative micro-anatomical study was done by paraffin processing method. The sections were stained with Toluidine blue, Haematoxylin and eosin as per the method published by Culling (1974) [8]. An ocular micrometer is used for measuring the size or diameter of Hassall's corpuscles of thymus in both monkey and human foetuses.

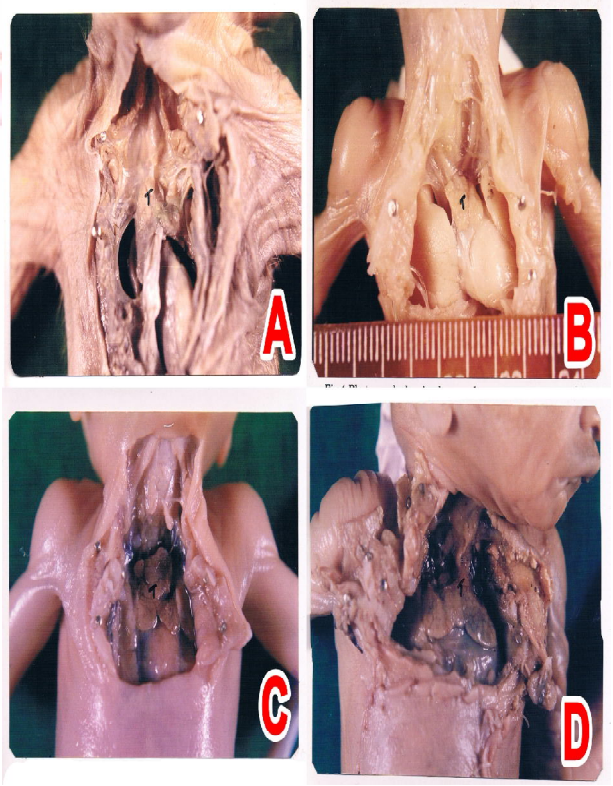
RESULTS AND DISCUSSION

Morphology

The thymus of prenatal stage of monkey is elongated in shape. It is measured about 5 mm in length and 5 mm in breadth. It has four lobes. The lobes are surrounded by a capsule. It is located in thoracic region (Fig. 1A). In early embryonic stage human foetuses appears as a single mass and appears as 2 lobes below the sternum. After 10 weeks it is very small and measured about 6mm in length and 7mm in breadth. They are bilobed. Both likes in the superior mediastinum. The right and left lobes covered by connective tissue capsule (Fig. 1B). After 15 weeks thymus become larger and bilobed structure. It is measured about 1.3cm in length and 1.4 cm in breadth. It is found in superior and anterior part of inferior mediastinum. In prenatal foetus it is very larger in size. It is measured about 2.7 cm in length and 2.9 cm in breadth. The lower lobes become broader. The upper lobes become slightly enlarged and small. It is covered by capsule (Fig. 1C & 1D).

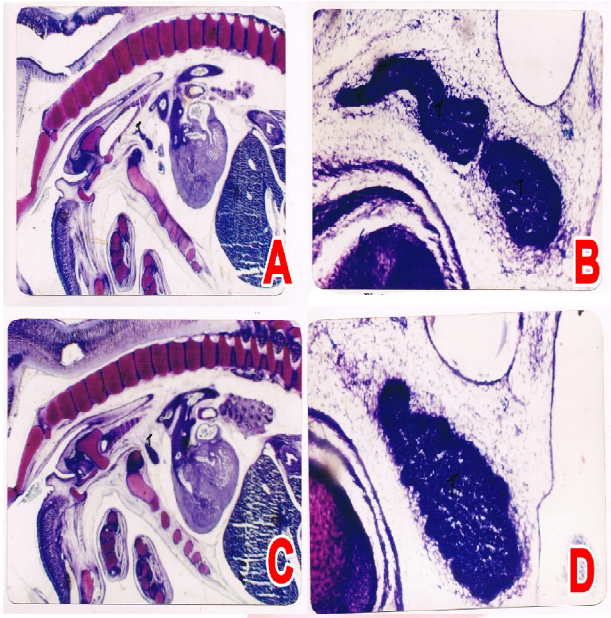
Morgen and Griesson (1990) stated that in monkey and human fetuses the thymus is composed of various tissues. Therefore, it is primordial organ for lymphocytes and enter the thymus especially, the T-Lymphocyte, which are primarily concerned with cell mediated immunity or response [9]. Mariappa (1958) explained that in Indian Elephant foetus the thymus us situated in the anterior mediastinum where as in monkey it is located in thoracic region, and human fetuses it is situated in the superior and anterior part of inferior Mediastinum [10].

Fig. 1: Morphological characters.



A. Thymus of monkey foetus in situ
B. Human Thymus – 10 Weeks
C. Human Thymus – 15 Weeks
D. Human Thymus – Prenatal

Fig. 2: Showing Human Embryonic Thymus 17mm CR Length 3X.



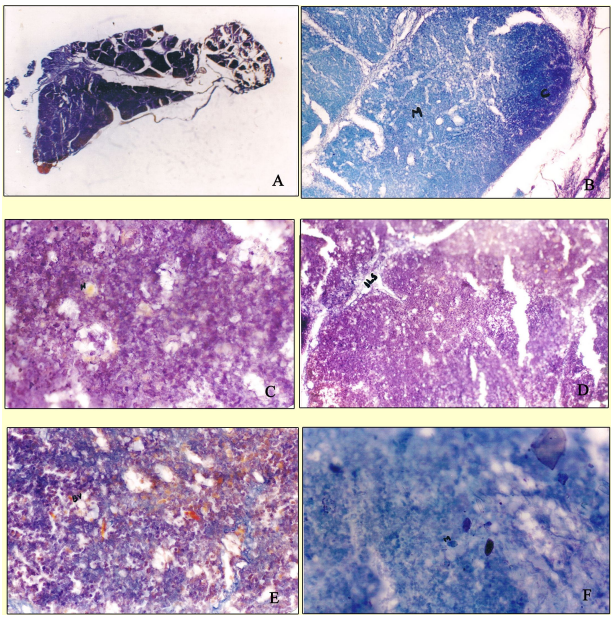
Microscopic observations

In Monkey Foetus the cells are parenchymal in nature. The lymphocytes are densely packed in the cortex of thymic lobule stem cells formed in the bone marrow migrate to the thymus. Here they come to lie in the superficial part of cortex and divide repeatedly to form small lymphocytes. The medulla of each lobule also contains lymphocytes, but these are less densely packed than in the cortex (Fig. 3A). The cortex is darkly stained and medulla is lightly stained (Fig. 3B). There are scatted Hassall's corpuscles seen in the medulla (Fig. 3C). The gland is surrounded by capsule. The capsule extends into the interior of gland and forms interlobular connective tissue (Fig: 3D). The interlobular septa do not extend into the medulla (Fig. 3E). Mast cells are seen but less in number (Fig. 3F). The size of the Hassall's corpuscle is varying from 5µ to 20µ.

In early embryonic stage of human foetus lymphocytes aggregation along with blood vessels are seen everywhere (Fig. 4A). Hassall's vessels are seen in medulla (Fig. 4B). After 10 weeks the cells were reticulo epithelial in nature. Lymphocytes are present. They migrate from bone marrow and aggregate in the thymus. There is no cortex and medulla differentiation. Hassall's corpuscles are not seen. After 15 weeks the cortex and medulla differentiation begins. Hassall's corpuscles are seen, but its size is very small. Blood vessels are more in number. The lymphocytes are present in more in cortex than in medulla. In medulla lymphocytes are scattered. Interlobular septum does not extend into medulla between lobules. In parental foetus the cortex medulla are well differentiated. The cortex darkly stained while the medulla is lightly stained (Fig. 4C). The Hassall's corpuscles are found scatted in medulla. They are more in number and of various in size (Fig. 4D). After 15 weeks the size of the Hassall's corpuscle is varying from 15µ to 25µ but 15µ to 30µ in prenatal foetus.

According to Milicevic and Milicevic (1982) normal thymic parenchyma contains numerous intracellular granules of varying size. In present observation, in human and monkey foetuses, there are intracellular granules present [11]. Duijvestijin and Hoefsmit (1981) stated that rat thymic macrophages are loaded with lymphocytes. Here also human and monkey the thymic macrophages are loaded with lymphocytes, but aggregation of lymphocytes are more in human fetuses and less in monkey foetus. In monkey foetus, the size of gland is small because the body weight is less when compared with human foetus. It is concluded that there is a significant difference in human and monkey thymus in terms of these parameters [12].

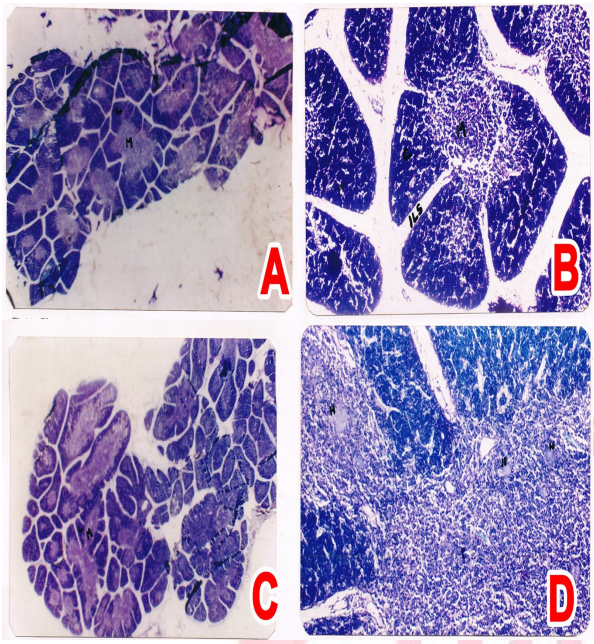
Fig. 3: Histology of Monkey Foetal Thymus.



A. Monkey foetal thymus
B. Monkey foetal thymus showing dark cortex and pale medulla 30X
C. Monkey foetal thymus showing medulla containing Hassall's corpuscles

D. Monkey foetal thymus showing interlobular septum in medulla 30X
E. Monkey foetal thymus showing blood vessels 125X
F. Monkey foetal thymus showing mast cells 125X

Fig. 4: Showing Human Foetal Thymus.



A. Human Foetal Thymus (15 Weeks) showing Cortex, Medulla, differentiation. 30X
B. Human Foetal Thymus (15 Weeks) showing differentiation of cortex, medulla and interlobular septa does not extend in the medulla between lobules. 30X
C. Human Foetal Thymus (Prenatal) showing Cortex, Medulla. 30X
D. Human Foetal Thymus (15 Weeks) showing Hassall's corpuscles in the medulla. 30X

CONCLUSION

In monkey foetus, the size of the gland is small because the body weight is less when compare with human foetus. The lymphocyte aggregation is monkey foetus appears to be less because of the smaller size of the organ.

Conflicts of Interests: None

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