Histogenesis of Endodermal Component of Human Fetal Thymus

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Research Article

Abstract: The present study is conducted to observe the early cellular events and histological maturity endodermal component of thymus. After ethical approval from institutional ethics committee 53 human fetuses were obtained from department of Obstetrics and Gynaecology with permission of head of department and written informed consent from respective parents. The gestational age was determined by menstrual history and Crown Rump length (CRL). The specimen were dissected through parasternal incision and processed in paraffin. The sections were taken by rotary microtome. The slides were stained by Haematoxylin and eosin and Periodic acid-Schiff (PAS) stains. Endoderm of thymus differentiate into epithelial cells which from cytoreticulum and Hassall's corpuscles in medulla. Epithelial cells are first observed at 10th week. Hassall's corpuscles appeared PAS positive. They are first observed at 12th week and increased in size and number with increase in gestational age.

Keywords: Thymus, Epithelial cells, Cytoreticulum, Hassall's corpuscles,

Introduction

The differentiation implies to increase in the structural complexities. Tissue differentiation culminates in the assumption of coordinated functional activities. The total process by which cells differentiate into distinctive kinds and assume specific tissue characters is known as histogenesis[1]. The endoderm in thymus differentiates to form epithelial tubes that proliferate and give rise to side branches which become the core of a lobule. Some epithelial cells spread apart but retain connection with each other to form the epithelial reticulum while other gets arranged around a central point to form the Hassal's corpuscles [2]. Although during the ensuing decades, the myriad complexities of the thymus and the thymocytes development have been intensively investigated, it is often true that the more one knows about a topic, the more one realizes that how much is still to be learnt. The details of microscopic development of the thymus are not studied to great extent in the human fetuses and most of our knowledge regarding early fetal histology of this organ is based on the studies in different animals. Secondly, the histological details of the different cellular components of the gland in the early developmental stages can be observed to a better advantage than in the adults, due to less crowding of the lymphocytes and no infiltration of fat. The epithelial character of the cells of cytoreticulum and concentric Hassal's corpuscles is more obvious in fetal life [3]. The present study, therefore, has been undertaken to observe the early cellular events in the different stages of human fetal period, and an attempt has been made to note the degree of histological and functional maturity attained by this important gland of immune system.

Materials and Methods

The study was conducted in department of anatomy, Government medical college, Aurangabad during 2006 to 2009. After ethical approval from institutional ethics committee, 53 human fetuses (24 male and 29 female) of different age groups ranging from 9th to 40th weeks of gestation were procured from the department of Obstetrics and Gynecology of Government medical college and hospital, Aurangabad for research work with due permission from the Professor and Head of the Department and consent from respective parents. Only fetuses free from detectable abnormality belonging to the mother with normal obstetrical history were taken into the study. These specimens included the spontaneous abortuses, still born and terminated fetuses under the Medical Termination of Pregnancy Act of India 1971. Twins and fetuses with gross anomalies were omitted.

Fetuses were obtained within 4-5 hrs of birth to avoid post-mortem changes and immediately fixed in 10% formalin. Gestational age of fetus was calculated from first day of last menstrual period (LMP). Fertilization age was obtained by subtracting two weeks from gestational age. Fertilization age was also determined from Crown Rump Length of fetus and using table in the Moore and Persaud[2]. The sternoclavicular joints were disarticulated and costal cartilages were cut. Thus the entire thoracic cavity was open and lower part of neck

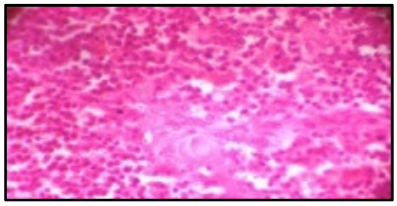
was also dissected for complete exposure of thymus in its natural location. The tissue sample was fixed in Bouins's fluid, processed to prepare paraffin embedded blocks and 4-5 micron thick sections were cut. The slides were stained with Haematoxylin & Eosin (H &E) and Periodic acid Schiff (PAS) stains and were studied under light microscope.

Results

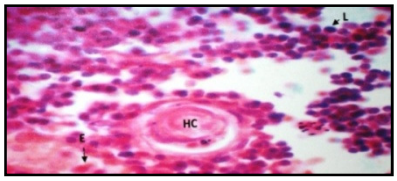
Epithelial cells are visible at 10th week. They are irregular in shape with many processes which extend among the lymphocytes. They are much larger and possess abundance of the cytoplasm as compared to lymphocytes. Their cytoplasmic processes are joined by processes of neighbouring cells to form cytoreticulum.

At 12th week Hassal's corpuscles are visible in the medulla as concentrically arranged epithelial cells with central eosinophilic mass. They maximum growth is observed between 18th to 24th weeks. They gradually increased in number and size with increase in the gestational age.

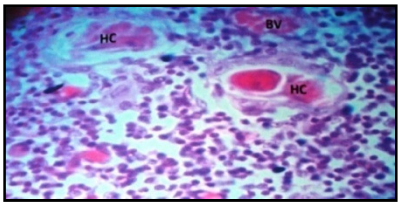
They give PAS positive reaction with Periodic Shiff's stain.



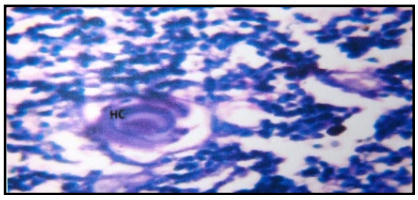
Photograph 1: Thymus (16 weeks) Stained by Haematoxylin and Eosin Stain showing Hassall's Corpuscle



Photograph 2: Thymus (18 weeks) Stained by Haematoxylin and Eosin Stain showing Hassall's Corpuscle (HC), Epithelial cell (E) and Lymphocyte (L).



Photograph 3: Thymus (24 weeks) Stained by Haematoxylin and Eosin Stain showing Hassall's Corpuscle (HC) and Blood Vessel (BV).



Photograph 4: Thymus (24 weeks) Stained by Periodic acid Schiff Stain showing Hassall's Corpuscle (HC)

Discussions

The endoderm in thymus differentiates to form epithelial cells which spread apart but retain connection with each other to form the epithelial reticulum while other get arranged around a central point to form the Hassal's corpuscles[1].

1) Epithelial cells

The epithelial reticular cells, together with the lymphocytes constitute the thymic parenchyma. They are derived from endoderm of the third pair of pharyngeal pouches. These are stellate in shape bearing many digitiform processes which extend among the lymphocytes. Their cell bodies are irregular and much larger in size than the lymphocytes. The predominance of euchromatin gives the nuclei a vesicular appearance under the light microscope. The epithelial cells possess abundance of cytoplasm as compared to the lymphocytes. They are arranged to form an extensive, tridimensional cellular reticulum (cytoreticulum). Although more compact in the medullary region, this network of epithelial cells is distributed throughout the thymic lobule[4].

In the present study, the epithelial cells are observed at 10th week.

Standring S *et al*. (2008)[3]and Hamilton and Mossman (1976)[5] mentioned the presence of epithelial cells at 8th week.

Ajita *et al*. (2006) observed the epithelial cells at 9th week[6].

Hayward (1972)[7] and Arey (1956)[1] reported that the epithelial component of the thymus was recognized at 10th week.

Von Gaudecker and Muller-Hermelink *et al*. (1980) stated that at 8th week, the primordium of the thymus contained almost exclusively of undifferentiated epithelial cells. At 10th week, the epithelial cells in the central part were spindle shaped[8].

2) Hassal's corpuscles:

The medulla contains Hassal's corpuscles which are concentrically arranged nests of epitheloid cells varying in size from 25-75 micron. The central cells show granular degeneration. The concentric corpuscles of Hassal are first formed in the fetal life and are then continuously formed throughout the life of the thymus.

They increase in the size and number during the periods of intense lympholysis[3].

a) Time of appearance:

In the present study the Hassal's corpuscle is first observed at 12th week of gestation.

There are different reports on the time of appearance of the Hassal's corpuscles.

-As early as 8th week by Fawcett (1994)[9],
-at 9th week by Gilhus *et al*. (1985)[10],
-at 10th week by Standring S *et al*. (2008)[3] and Arey (1956)[1],
-at 11th week by Ghali *et al*. (1980)[11],
-at 12th week by Sawant (2003)[12],
-at the end of 3rd month by Baxter JS (1953)[13],
-at 15th week by Ajita *et al*. (2006)[6],
-between 15th and 16th week by Lobach and Haynes (1987)[14]

b) Growth:

In the present study, size and number of Hassal's corpuscle is increased in 18th to 24th weeks.

Bodey and Kaiser (1997) reported that the development of the first Hassal's corpuscle occured during the second part of the third intrauterine lunar month in human fetuses but the greatest development of Hassal's corpuscles was observed between 6th and 10th lunar months[15].

Liberti *et al*. (1994) mentioned that the mean area of Hassal's corpuscle was increased with the fetal age, with greatest difference observed between 16th-19th week and 20th-23rd week[16].

Ajita *et al*. (2006) observed that Hassal's corpuscle increased in number and size during 17th to 24th week[6].

c) Periodic acid-Schiff (PAS) positivity:

In the present study, Hassal's corpuscles appear to be PAS positive

Bodey B *et al*. (1987) reported diffuse PAS positivity of Hassal's corpuscles[17]

Bodey and Kaiser (1997) detected histochemically a rich content of basic non histone protein and PAS positive substances (Glycogen and acid mucopolysaccharides) within the corpuscles[15]

Conclusion

The endoderm in thymus differentiates to form epithelial cells which spread apart but retain connection with each other to form the epithelial reticulum while other get arranged around a central point to form the Hassal's corpuscles. Epithelial cells, in the present study, are observed at 10th week. Hassall's corpuscles appeared PAS positive. They are first visible at 12th week. Maximum growth is observed between 18th to 24th weeks, thereafter they increase in size and number with increase in gestational age. The findings of the present study are comparable with the findings of standard text books and previous workers.

Conflict of Interest

Conflict of interest declared none.

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