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A study of gross and histological structure of thymus gland in fetuses and adolescent

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ABSTRACT

Background: The thymus is the lymphoid organ of greatest importance. It is a structurally separated lobules through the tissue of the connective septa. That lobule has a cortex and a medulla in it. Many studies of this organ related to the histology of early fetuses are focused on animals. The present study focuses on certain features relating to the histogenesis of the thymus and adolescent fetuses.

Materials and methods: Thirty human foetuses (19 males and 11 females) of different age groups ranging from 9th to 38th gestational week were procured from the Department of Anatomy of Chirayu Medical College & Hospital for the research work with due permission of the Medical Superintendent of the mentioned hospital and respective parents.

Result: The histometric analysis of parenchyma (cortex and medulla) and connective tissue indicates that there was no significant variation in their ratio. These corpuscles were frequently seen in thymuses of the early gestational period which were called as Solid Hassall Corpuscle (SHC) and were located at the periphery of the medulla within the age group of the present study. Their size ranged from 25-35 μm with a mean of 31.166 μm. This epithelial capsule was separated from the central mass by a subcapsular space that gave a cyst like an appearance hence named primary cystic Hassall's corpuscle (CHC I). Their size varied from 35-70 μm with a mean of 52.177 μm thickness Externally the whole structure was surrounded by an epithelial capsule as found in CHC I, hence named as secondary cystic corpuscles (CHC II). They were mainly observed in the central core of the medulla. Their size ranged from 50-100 μm with a mean of 74.185 μm thickness late stages were noticed.

Conclusion: Thymus is responsible for the provision of the T-lymphocytes to the whole body in newborns and children until puberty. For this reason it is important to know the histology of the gland at different ages.

Keywords: Thymus, Histology, Lymphocytes.

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INTRODUCTION

The thymus is a powerful lymphoid organ number one, and a main immune system regulator, and is responsible for the body's mobile immunity. The bilobed shape, divided into lobules via the septa connective tissue. Every lobule is composed of cortex and medulla. [1] This occurs due to accelerated circulating stage of sex hormones. [2]

Intrauterine infection or stress, results in steroid mediated immune response and this involutes the fetuses thymus gland. Intraamniotic infection throughout pregnancy isn't always clinically obvious and calls for invasive assessments of amniotic fluid, but the easy measurement of fetuses thymic size to the gestational age can help in assessing the pathology. [3] Also in respiratory misery syndrome, the gland involutes in size in reaction to higher circulating glucocorticoid and as a consequence can function an important indicator of the disease. [4]

The size of thymus depends on genetics and youth nutrition, especially the zinc stage and can turn out to be an oblique predictor of nutritional reputation of the developing fetuses. [5] The measurement of fetuses thymus permits early prognosis of chorioamnionitis and this is beneficial in diagnosing premature rupture of membrane. [6] The size of thymus gland in adults and in babies had been examined the use of computed tomography and ultra sonography images. [7]

However, the present observe specializes indirect visualization of the gland through fetuses autopsy. However, a fifteen years thymus gland in adolescents specializes in direct visualization of the gland by way of fetuses autopsy. Therefore, the simple morphological details and microscopic anatomy of fetuses thymus which predicts its adulthood can function an critical adjunct in diagnosing many diseases.

MATERIALS AND METHODS

Thirty human foetuses (19 males and 11 females) of different age groups ranging from 9th to 38th gestational week were procured from the Department of Anatomy of Chirayu Medical College & Hospital for the research work with due permission of the Medical Superintendent of the mentioned hospital and respective parents. They looked fresh without any gross abnormality. Only the foetuses free from detectable abnormality belonging to the mother with normal obstetrical history were taken into consideration for the study.

The foetuses so obtained were examined for their respective crown-rump lengths, gestational ages and body weights. Thereafter, all these 30 (seventy) foetuses were fixed in 10% formalin for 10 days. Then the foetuses were subjected to dissection. The sternoclavicular joints were disarticulated and costal cartilages were cut. Thus the entire thoracic cavity was opened and lower part of the neck was also dissected for complete exposure of the thymus gland in its natural location for proper recording.

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Evaluated specimens were preserved in freshly prepared solution of 10% Formal Saline fixatives for 7 days. After proper fixation, the tissue was subjected to the standard paraffin block making procedure. Thereafter 10 micrometers thick serial sections were prepared and alternate sections were stained with Haematoxylin and Eosin, Masson's Trichrome and Leishman's stains. The stained sections were examined under light trinocular research microscope.

RESULTS

Table 1 Gestational age based on CRL

Gestational age (weeks)	Crown-Rump Length (mm)	Number of Fetuses
15-18	**61-100 mm**	3
19-22	**101-150 mm**	4
23-26	**151-200 mm**	8
27-30	**201-260 mm**	5
31-34	**261-320 mm**	6
35-39	**321-390 mm**	4

Table 2 Grouping of fetuses

Phase	Group	Gestational Age (Weeks)	Number of Fetuses
Early	**I**	**17-24**	9
	II	**25-30**	5
Late	**III**	**31-35**	9
	IV	**36-40**	7

Table 3 Analysis of weight and volume in fetal thymus

Group	Gestational Age (weeks)	Weight (Grams)	Volume (mm3)
		Mean ± SD	**Mean ± SD**
I	**17-24**	1.71 ± 1.25	1330 ± 805.55
II	**25-30**	4.75 ± 1.80	2910 ± 993.35
III	**31-35**	8.60 ± 1.85	5310 ± 773.45
IV	**36-40**	15.130 ± 4.45	11370 ± 539.03
Kruskal-Wallis Test		20.355	20.472
p-value		0.001	0.001

Table 4 the weight of thymus and fetus was correlated during intrauterine life

S.no	Weight of the fetus (in grams)	Weight of the thymus (in grams)
1	200	0.41
2	250	0.24

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3	450	0.99
4	600	4.89
5	650	0.73
6	500	4.99
7	900	1.81
8	550	5.91
9	300	4.23
10	700	5.24
11	1000	1.84
12	1750	7.71
13	1700	6.59
14	1600	8.81
15	1200	7.99
16	900	8.99
17	2500	9.41
18	2900	12.15
19	2400	17.03
20	2600	16.99

Table 5 Ratio of cortex and medulla

Group	**Gestational Age (weeks)**	**Cortex (mm3)**	**Medulla (mm3**	**Cortex/Medulla Ratio**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**
I	**17-24**	1.584 ± 1.71	1.487 ± 1.33	6.655 ± 2.79
II	**25-30**	1.594 ± 1.95	1.550 ± 1.33	7.018 ± 4.29
III	**31-35**	1.585 ± 1.210	1.455 ± 1.08	7.899 ±6.55
IV	**36-40**	1.585 ±1.033	1.496 ± 1.050	7.789 ± 1.825
Kruskal-Wallis Test		1.340	7.401	1.633
p-value		1.840	1.315	1.999

Table 6 Ratio of parenchyma and connective tissue

Group	**Gestational Age (weeks)**	**Connective Tissue (mm3)**	**Parenchyma (Cortex+Medulla)/ Connective Tissue**
		Mean ± SD	**Mean ± SD**
I	**17-24**	1.265 ± 1.053	9.790 ± 5.855
II	**25-30**	1.240 ± 1.043	10.463 ± 5.590
III	**31-35**	1.263 ± 1.099	11.555 ± 5.299
IV	**36-40**	1.260 ± 1.023	9.868 ± 4.545
Kruskal-Wallis Test		1.220	1.253
p-value		1.989	1.740

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The histometric analysis of parenchyma (cortex and medulla) and connective tissue indicates that there was no significant variation in their ratio.

Table 7 Diameter in different types of Hassall's corpuscles

Gestational Age (Weeks)	Solid (SHC) µm	Cystic I (CHC I) µm	Cystic (CHC II) µm
17	31.03	59.38	74.00
19	39.78	72.00	68.00
20	38.93	74.53	73.00
22	34.00	69.00	100.00
24	32.38	50.99	84.00
26	35.16	59.81	74.00
27	36.81	42.89	69.63
28	31.81	42.89	69.00
28	36.81	74.07	99.00
29	34.93	54.81	105.90
30	31.81	51.81	80.00
31	30.00	50.41	84.00
32	29.00	44.00	73.29
32	30.00	50.55	66.00
33	26.35	56.81	77.00
34	31.35	56.81	79.00
36	26.35	53.66	73.00
37	26.35	33.25	86.00
38	38.81	41.81	62.91
39	31.65	41.81	54.81
Mean	31.166	52.177	74.185

These corpuscles were frequently seen in thymuses of the early gestational period which were called as Solid Hassall Corpuscle (SHC) and were located at the periphery of the medulla within the age group of the present study. Their size ranged from 25-35 µm with a mean of 31.166 µm. Certain corpuscles had a homogenous hyalinized eosinophilic mass in the center encircles by well defined, compactly packed concentric layers of epithelial cells which formed a capsule like structure. This epithelial capsule was separated from the central mass by a subcapsular space that gave a cyst like an appearance hence named primary cystic Hassall's corpuscle (CHC I). Their size varied from 35-70 µm with a mean of 52.177 µm thickness Externally the whole structure was surrounded by an epithelial capsule as found in CHC I, hence named as secondary cystic corpuscles (CHC II). They were mainly observed in the central core of the medulla. Their size ranged from 50-100 µm with a mean of 74.185 µm thickness late stages were noticed. They were identified especially in the central core of the medulla from late gestational age.

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DISCUSSION

Histogenesis of thymus gland in general has been studied extensively by using various techniques starting with simple histological techniques with light microscope to recent immuno histochemical and computer analysis technique by the earlier workers, to recent workers. [8-11]

The differentiation of the thymic medulla and cortex occurs in embryos of about 40 mm C.R length. The former arises in the central part of the gland and in the deep portion of the lobules by hypertrophy of the cytoreticulum accompanied by degeneration or migration, of thymocytes. Later Hassall's corpuscles appear as differentiation of the cytoreticulum. [12-15]

When sectioned, the thymus is seen to consist of an outer cortex of densely packed cells mainly of the T - lymphocyte lineage, the thymocytes, and an inner medulla rich in connective tissue but with fewer lymphoid cells. Both lobes have a loose fibrous connective tissue capsule, from which septa penetrate to the junction of cortex and medulla, to partially separate the irregular lobules each 0.5 to 2.0 µm in diameter.

Hassall's corpuscles are balls of flattened medullary epithelial cells from 30 to 100 µm in diameter. They start to form before birth and their number increases until puberty and then decreases [16-18].

Their function is not clear, although in the past it has been suggested that they are graveyards for thymic cells or regions where immunoglobulins are concentrated. [19]

The present study demonstrated that, at 18 weeks - the section showing - the cortex and medulla are well demarcated. Capsule is well defined. The diameter of lobule is 0.4 µm and diameter of H.C is 29 µm the average number of H.C per lobule is 2 to 3.

At 34 weeks, the section showed well defined capsule and cortex and medulla are well defined. The average diameter of lobule is 1.6 µm and diameter of H.C is 61 µm and the average number of H.C per lobule is 7 to 8.

At pubertal age, the section showed well defined capsule, cortex and medulla were well demarcated. Interlobular connective tissue is more with some adipose tissue. The average diameter of lobule is 2 µm and average diameter of H.C is 94 µm and average no of H.C per lobule is 8 to 9.

The diameter of lobule is ranging from 0.4 to 2 µm and diameter of H.C ranging from 29 to 94 µm and there is gradual increase in thickness of interlobular connective tissue with some adipose cells observed at puberty.

CONCLUSION

There is clear demarcation of capsule and inter lobular septa with the advancement of age of fetuses. There is clear demarcation of lobules with the advancement of age of fetuses. Blood vessels in the interlobular septa became prominent with advancement of age of fetuses. Cortex and medulla are well demarcated at age of 18 weeks. Diameter of lobules is ranging from 0.4 to 2 µm. Number of H.C is lobule increased with advancement of age. Inter lobular connective

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tissue increased with advancement of age. The diameter of H.C is ranging from 29 to 94 µm. Demarcation of cortex and medulla is very clear with advancement of the age of fetuses.

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