

ORIGINAL RESEARCH

Morphological and Morphometric features of Fetal Thymus at different gestational age: A Cross - Sectional Study

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ABSTRACT

Introduction: A cross sectional study was conducted to study the morphology and morphometry of fetal thymus at different gestational age. This study is useful in determining intrauterine growth retardation as well as different immune system related diseases with relation to decrease fetal size. **Material & Methods:** The study was carried on medically aborted & stillborn fetuses (N=90) after taking ethical clearance. Thymus was dissected, viewed in-situ and then taken out to make different measurements. **Results:** All the thymus werelocated in superior mediastinum. They were greyish pink to greyish brown in colour. Some were bilobed, triangular, H shaped or irregular in shape with different extensions. Accessory thymus above thyroid cartilage was also noted. **Conclusion:** Thymic parameters and morphology in relation to gestational age can be used as a reference value in imaging studies for determining IUGR and immune deficiency diseases. The variations in shape should also be kept in mind during thymectomy.

Key Words: Fetal thymus, morphology, morphometry, gestational age

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INTRODUCTION

The Thymus is one of the two primary lymphoid organs, the other being bone marrow, which is responsible for the provision of thymus processed lymphocytes (T- Lymphocytes) to the whole body. (1) As an endocrine gland, it is more active during puberty and reduction in its function results in greater susceptibility to tumors, rheumatic diseases, growth disorders and geriatric conditions.(2) The differentiation of the thymus from other mediastinal structures, such as lymph nodes or the superior sinus of the pericardium, may be difficult. Therefore, it is important to be familiar with morphology of thymus gland for determining the effect of clinical and physiological conditions. (3) Thymus gland is soft and spongy in consistency and situated in both superior and anterior part of inferior mediastinum. It develops from 3rd pharyngeal pouch along with inferior parathyroid gland and variations like ectopic thymus , accessory nodules, cervical extensions and thymus behind left brachiocephalic vein are very common (4,5). It extends from the neck superiorly to 4th or 5th costal cartilages inferiorly. The shape of the thymus is

highly variable. Different authors have mentioned it as H, Triangular or Pyramidal in shape, which is moulded by adjacent structures. Even ultrasound and radiographic studies proposed triangular, tear drop, oval and sickle shape. The colour of thymus also changes with the age. It is pink grey to brown in prenatal, becomes gray during infancy and finally to yellow in adulthood (6).

The upper pole of each lobe of this bilobed structure remains in the neck deep to the sternothyroid which is encapsulated by a fibrous tissue superficial to the pretracheal layer and this facilitates transcervical thymectomy.(7) Regarding the blood supply, the arteries supplying it are by multiple small branches of internal thoracic artery and also from inferior thyroid artery that give no trouble at surgery, whereas the venous drainage though corresponds to the arterial input, an additional short wide vein passes directly backward from the gland into left brachiocephalic vein.(7,8) Though several studies on internal structures are available in both animals and humans, but studies on foetal morphology of thymus are limited. Thus, the present study on foetal thymus is undertaken to throw

a light on the work done by previous authors and to compare the past and present results that may add to our insight.

MATERIALS AND METHOD

A total of 90 aborted fetuses of 10 weeks to 36 weeks gestational age of both the sexes with relevant obstetric records were considered for the study. This has got the approval of institutional ethical committee. The fetuses were labelled accordingly and were grouped as group A(10-18 weeks), Group B(19-27 weeks) and Group C(28-36 weeks). The fetuses with gross developmental anomaly as well as with any abnormality in the neck such as any scar or any swelling were excluded from the study. The thymus gland was exposed according to the incision as given in ROMANES J(Reprinted 2016) (9) and certain findings like the level of gland, Accessory lobes, thymus behind innominate vein, its level of extension and its relations were noted in situ (Fig: 3).For taking

different morphometric measurements, the gland was taken out and after preserving in 10% formalin, was studied in detail. Morphometric parameters like length, width, thickness, weight and percentage of thymic weight to foetal weight were measured using digital Vernier Calliper, Mitutoyo (least count 0.01 mm) and were recorded in cm. The weight in grams was measured with an electronic balance. After filling all those parameters in a preformed proforma, the results obtained were evaluated, tabulated and analysed. For statistical analysis, SPSS version 20.0 was used along with ANOVA.

RESULTS

Out of 90 cases studied, 29 (33%) belongs to gestational age between 10 to 18 weeks (Group I), 39 (44%) were between 19-27 weeks (Group II) and 22 (23%) belong to 28 - 36 weeks (Group III). In relation to fetal weight, the largest number of cases i.e., 70 (77%) were below 10 gms.

Table 1: Different morphological variations of Thymus

Types of variations			Number of cases
Shape		Triangular	69
		Pyramidal	8
		H Shaped	9
		Others	4
Lobes		Single	23
		Double	45
		Tri Lobed	13
		Others	9
Extension	Above	Upto Cricoid Cartilage	39
		Upto Thyroid Cartilage	43
		Any other	NIL
	Below	Upto Pericardium	8
		Upto Diaphragm	NIL
		Any other	NIL
Accessory Thymus		Site	1 (Above thyroid Cartilage)
Thymus behind innominate vein			79
Fibrous connection to thyroid gland		NIL	None
Any other		NIL	None

Thymus gland is situated in superior and anterior inferior mediastinum in all the specimens observed in the present study. The gland presented two lateral borders, two surfaces and two poles. The convex sterno-costal surface is related to sternum and costal

cartilages. The concave or flat posterior surface is related to brachiocephalic vein in 79(90 %) specimens and in 11(10 %) specimens the brachiocephalic vein is anterior to the gland. There was no fibrous connection to thyroid gland. About 82 (91.1%) of glands

presented cervical extensions or superior pole extensions up to thyroid gland. Inferior pole extensions were observed in 8 (8 %) specimens, but not extended up to diaphragm. Most of the thymus were symmetric i.e 80%. 31 % presented right predominance and 13% presented left predominance. The glands are greyish pink to greyishbrown in colour. About 45 (50%) thymus glands were

bilobed, 23 (25%) were trilobed, and 13(14%) was single lobed. In trilobed thymus the third lobe is observed inbetween two main lobes of gland. Out of 90 specimens, 9 (10 %) were ‘H’- shaped, 8 (9 %) were pyramidal, 4 (4.4%) were irregular and remaining 69(76.6 %) were triangular in shape. (Fig: 1)



Figure 1: Showing different shapes of thymus.

Table 2 : Mean dimensions of Fetal Thymus (in cms)

Gestational ages in weeks	Mean Length Cms	Mean Breadth Cms	Mean Thickness Cms	Mean Weight (Gms)
Group A(10-18)	0.99+-0.45	3.56+-1.75	0.6	0.43+-0.30
Group B(19-27)	1.57+-0.30	8.75+-4.5	0.	1.65+-0.50
Group C(28-36)	4.01+-0.72	11.23+-7.5	1.66	7.98+-3.81

Among 90 fetuses 29 were in Group A (10 to 18 weeks) with a mean age of 14 weeks. The weight of fetuses in this group ranges from 0.39 to 0.451 grams with mean weight of 0.43grams. The ‘mean’ length, width and thickness of the thymus gland in group I were 0.99, 3.56 and 0.6 respectively. The mean length was lower than mean width of thymus gland in this group. Out of 90 fetuses, 39 were in group II (19 - 27 weeks) with a mean age of 23 weeks. Their weights varied from 0.280 to 1.80grams with a mean of 1.65 grams. The ‘mean’ length, weight and thickness of

thymus glands were 1.57, 8.75 and 0.95 cms respectively in which the ‘mean length’ is less than ‘mean width’ of thymus for this group. The ‘mean weight’ of thymus in this group is 1.65 grams with a range of 0.22 to 5.12 grams and mean of ‘percentage of thymic weight to fetal weight’ is 0.21% with a range of 0.05 to 0.39%. Out of 90 fetuses we obtained, 22 were in this group (>36 weeks) with gestational age from 36 to 40 weeks. Weight of fetuses ranges from 1.400 to 25. 00 grams with mean weight of 7.98 grams. (Fig:2)



Figure 2: Showing weight of thymus.

The 'mean' length, width and thickness of the thymus glands in group III were 4.01 cm, 11.23 cm and 1.66 cm respectively. However the 'mean length' of thymus gland is lesser than 'mean width' of thymus gland in this group. The mean weight of thymus gland in this group is 7.98 grams with a range of 2.01 to

7.28 grams and the mean of 'percentage of thymic weight to the foetal weight is 0.22% with a range of 0.14 to 0.29%. As all the parameters significantly correlated with gestational age of fetuses, each parameter is categorized and compared according to gestational ages.



Figure 3: Showing in-situ Thymus.

Table 3: Comparison between morphometric measurements of present study with others

Dimensions		Incidence in %		
		Niurka et al 2010(n=147)	Hasini HS et al 2012(n=45)	Present Study (n=90)
Length	<4cm	78.9	97.6	22.5
	4-6 cm	19.1	2.4	27.5
	>6cm	2	0	40
Breadth	<2cm	46.9	55.5	33.5
	2-5cm	53.1	44.5	44.5
	>5cm	0	0	12
Width	0.5cm	89.1	88.8	55.5
	0.5-1cm	9.4	11.2	30.5
	>1cm	1.4	0	4
Weight	<5gm	78.9	91.2	77.5
	5-10 gm	14.3	8.88	10.5
	>10gm	6.8	0	2

DISCUSSION

The present study was carried out with an attempt to delineate the proper development of the human fetal thymus gland. Different morphometric parameters were included in the study in order to elaborate the developmental changes in the thymus gland. Differences in past and present studies along with conclusions exist on account of different authors regarding the dimensions of thymus gland. In the literature there is no clear cut description to

distinguish cases of ectopic thymus and mediastinal thymus with cervical extensions though it was mentioned cervical ectopic thymus as a common embryological anomaly that is diagnosed incidentally at autopsy [10]. K Vijayalaxmi and Vaishali Sitaram conducted the length of isthmus in three groups as 0.672, 1.667 and 3.605 respectively are more or less similar to present study. (11,12).

Mamta Rani et al [12] concluded that maximum thickness of right lobe of Thymus was (0.40+0.14),

(0.87+0.29) and (3.34+0.70) in group I,II and III respectively. Whereas present study shows that average thickness of right lobe of thymus at 12th week is 0.60 cm, 0.9 cm and 1.66cm respectively. Yekeler et al[13] concluded that maximum transverse diameter of thymus was found to be of mean value 29.3+3.3 mm in foetuses of 31-40 weeks whereas in our study the mean value is 11.23 +-7.5. The average values of gland weight given by K.Vijaya Lakshmi[11] were 0.40, 2.21, 6.76 gms in group I,II and III whereas it was 0.43, 1.65 and 7.98 gms in three groups of present study. These findings are more or less similar to the findings of the present study with slight difference in the means of individual group. Waszak and Cieslik (2003) studied the weight of thymus in 20-42 weeks of 3389 fetus. They found the weight of thymus about 9.38 gms in male fetuses and 8.16 gms in female fetuses [15]. In present study, thymus was observed at 12th week of gestation weighing about 0.1 gm. Some studies depicted cervical extension of thymus gland in preterm and post term fetuses, and found the cervical extension, from level above thyroid cartilage till suprasternal notch. They found extension of thymus till diaphragm [13,14]. No such observation was found in present study. Accessory thymus was found in 1 case (1.1%) in cervical region as found by Joshi SD in 9.03%. (16).

CONCLUSION

Thymic morphometric parameters in relation to gestational age can be used as reference values in imaging studies in the prenatal stage and in initial perinatal stage along with thymectomy with respect to shape variabilities. The morphometric measurements of thymus are useful in calculating size, as IUGR and cellular immune deficiency of infant is associated with a significant decrease in fetal thymic size. A basic knowledge about thymic embryology and morphology is also important for diagnosis of ectopic thymic mass and pathological conditions like thymic epithelial tumors. HIV infection which causes severe loss of T- lymphocytes for which it has become important to understand the role of human fetal thymus as to reactivate cellular immunity.

LIMITATIONS

Greater sample size would have given a better statistical result and more precision in morphometry.

CONFLICT OF INTEREST

None

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