



A study of correlation between transverse diameter of fetal thymic lobes and gestational age

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Abstract:

Background: Determination of the foetal age at the time of death is one of the major concerns of the department of forensic medicine. In complicated cases like mutilated specimens, where only a few fetal remains are available, forensic specialists might face difficulties in age estimation. Due to its favourable position and superficial location, the thymus can be used for fetal age estimation. **Objectives:** To find out the mean transverse diameters of the right and left lobes of the fetal thymus in different gestational age groups and establish a correlation of these diameters with the gestational age.

Materials and methods: 40 human formalin fixed fetuses of gestational age ranging from 9th to 38th weeks were used. The fetal thymuses were dissected out and transverse diameters of the right and left lobes were measured. Mean transverse diameters were calculated and correlation was made between the transverse diameter of each lobe and the gestational age.

Results: The transverse diameters of the right and left lobes increased with an increase in the gestational age. A positive correlation was found between the transverse diameters of the two lobes and gestational age. **Conclusion:** The findings may help in rough estimation of the fetal gestational age at the time of death especially in mutilated specimens where only few fetal remains are available.

Key words: Fetal thymus, gestational age estimation, tranverse diameter

Introduction

Estimation of the gestational age of a dead or aborted fetus is a specialized task in forensic medicine. The whole skeletal length, biparietal diameter, long bone length (femur length) using foetal ultrasonography have been used routinely for age estimation. The growth of fetal long bones is

affected by several conditions that might lead to growth retardation of the fetus in the womb. Moreover, these methods prove to be helpful when a complete fetus is available for examination. In more complicated cases like mutilated specimens, where only a few fetal remains are available, forensic specialists might face difficulties in age estimation.

In such circumstances, examination of individual available organs and correlation between various morphological parameters of the organ and gestational age becomes important [1].

Various studies have given the correlation of craniofacial dimensions [2], fetal foot length [3] abdominal circumference [4] and fetal weight [5] with gestational age. A few studies have correlated the thymic transverse diameter with the gestational age using ultrasonography [6, 7].

The thymus is a lymphoepithelial organ and the key regulator of the immune system. It is responsible for cellular immunity of the body [8]. The size of the thymus is largest during embryonic life. It develops as two separate primordia, one on each side of the midline. The thymus is divided into a number of macroscopic lobules, varying from 0.5 to 2 mm in diameter. The lobules are separated from one another by connective tissue septas and are divided into a darkly staining, peripheral (cortical) area and a lighter staining, inner (medullary) portion [9].

The location of the thymus in the anterior mediastinum behind the shield of the sternum during most of the foetal life not only saves the thymus from destruction even in grossly mutilated specimens, but also makes it an accessible organ which can be easily dissected out due to its superficial location. These features suggest that the thymus can serve as an important organ for forensic examination in the determination of fetal gestational age.

Material and Methods

The study was conducted in the Department of Anatomy, Himalayan Institute of Medical Sciences, HIHT University, Dehradun. 40 human fetuses of gestational age ranging from 9th to 38th weeks were obtained from the department of Obstetrics and Gynaecology of the same institute after taking approval from the Institutional Ethics Committee and written informed consent from the concerned families. The fetuses were either products of pregnancy terminated under Medical Termination of Pregnancy Act of India, 1971 or were stillbirths. Only those fetuses which were apparently free from any gross anatomical or congenital abnormality were selected.

The fetuses were fixed in 10% neutral buffered formalin for two weeks. Age estimation for all fetuses was done from the Crown Rump Length (CRL) and from the available history. CRL was measured with the help of Vernier Calipers from the vertex of the skull to the midpoint between the apices

of the buttocks. All fetuses were arranged into five groups depending on their gestational ages as shown in Table 1.

Table 1: Distribution of Fetuses in different groups according to gestational age

| Group | Gestational Age (weeks) | Number of fetuses |
|-------|-------------------------|-------------------|
| I | 9-14 | 10 |
| II | 15-20 | 9 |
| III | 21-26 | 6 |
| IV | 27-32 | 7 |
| V | 33-38 | 8 |

A vertical midline incision was given in the neck of each fetus, extending it into the upper thoracic region as shown in figure 1. The location of the thymus was identified, followed by its removal for morphometric study. The transverse diameters (in mm) of the right and left lobes were measured as the distance between the two farthest points on each lobe with the help of Vernier Callipers. The mean transverse diameter was calculated for each group. Correlation of the transverse diameters of the right and left lobes of the thymus with the gestational age was established. A p value of <0.05 was considered to be statistically significant.

Figure 1: Dissection of the thymus after giving a midline incision in the neck and thorax of a 16th week fetus of group 1



Results

During dissection, the thymus was found to be located in the neck till the 14th week of gestation and in the anterior mediastinum from 15th week onwards. All thymuses were found to be bilobed.

The transverse diameters (in mm) of right and left lobes for each foetus are shown in Table 2.

Table 2: Transverse diameters of the right and left lobes of thymus at different gestational ages

| Fetus No. | Gestational age (wks) | Transverse diameter (mm) | | Fetus No. | Gestational age (wks) | Transverse diameter (mm) | |
|-----------|-----------------------|--------------------------|-----------|-----------|-----------------------|--------------------------|-----------|
| | | Right lobe | Left Lobe | | | Right lobe | Left Lobe |
| 1. | 9 | 2.4 | 1.2 | 21 | 22 | 9 | 12.3 |
| 2. | 10 | 2.4 | 1.3 | 22 | 23 | 10.1 | 12 |
| 3. | 10 | 2.7 | 1.3 | 23 | 23 | 10 | 11 |
| 4. | 11 | 2.2 | 1.1 | 24 | 24 | 10 | 12.1 |
| 5. | 11 | 2.4 | 1.2 | 25 | 25 | 16.3 | 22 |
| 6. | 12 | 6.3 | 4.5 | 26 | 27 | 16 | 22 |
| 7. | 12 | 6.1 | 4.1 | 27 | 28 | 15.5 | 20 |
| 8. | 13 | 5.5 | 4.2 | 28 | 28 | 14.8 | 21 |
| 9. | 13 | 6.2 | 4.3 | 29 | 30 | 15 | 21 |
| 10. | 14 | 6.1 | 3.7 | 30 | 30 | 17 | 20.6 |
| 11. | 15 | 7.2 | 6.2 | 31 | 31 | 16.6 | 21 |
| 12. | 15 | 7.3 | 6.6 | 32 | 32 | 15.9 | 22 |
| 13. | 15 | 7.1 | 5.9 | 33 | 33 | 14.8 | 21.6 |
| 14. | 16 | 6.3 | 6.7 | 34 | 33 | 15 | 21.4 |
| 15. | 16 | 6.3 | 6 | 35 | 34 | 15.2 | 21 |
| 16. | 17 | 7 | 6 | 36 | 34 | 16 | 20 |
| 17. | 18 | 10.4 | 11 | 37 | 35 | 16.2 | 20.7 |
| 18. | 18 | 10 | 11.5 | 38 | 36 | 16 | 21 |
| 19. | 19 | 9.3 | 12.2 | 39 | 36 | 17 | 21.6 |
| 20. | 21 | 10 | 11 | 40 | 38 | 17 | 22 |

The mean transverse diameters of the two lobes in each group are shown in Table 3.

Table 3: Mean transverse diameters of right and left lobe in different groups

| Group | Gestational age groups (wks) | Mean values±SD (in mm) | |
|-------|------------------------------|--------------------------------|-------------------------------|
| | | Transverse diameter right lobe | Transverse diameter left lobe |
| I | 9-14 | 4.23 ±1.923 | 2.69±1.563 |
| II | 15-20 | 7.87±1.583 | 8.01±2.697 |
| III | 21-26 | 10.9±2.677 | 13.40±4.251 |
| IV | 27-32 | 15.82±0.801 | 21.08±0.720 |
| V | 33-38 | 15.9±0.848 | 21.16±0.628 |

The transverse diameters of the right and left lobes increased as the gestational age increased. The left lobe was found to be broader than the right lobe. A highly significant positive correlation of the transverse diameters of the right and left lobes with gestational age was found, the values of the correlation coefficients being 0.952 and 0.957 respectively and the p values being 0.0032 and 0.0052 respectively.

Discussion

Determination of the foetal age at the time of death is one of the major concerns of the department of forensic medicine. It is also important to find out whether the fetus was viable or not at the time of death, the threshold for viability being 20 weeks. Methods generally used for fetal age estimation are body weight, crown heel length, crown rump length, femur length, length of feet and ossified parts of long bones [10]. Reference tables correlated with in vivo ultrasound measurements are widely available for complete fetuses but these may not be applicable in complicated cases. The forensic specialist would also need methods for estimating gestational age from soft tissues and organ remains. For this reason, many studies have identified the need for developing new methods to measure the gestational age apart from long bones [1].

The thymus may prove to be a useful organ for age estimation in cases where few fetal remains are available. A study was conducted by Juan D et al to determine whether the size of the thymus is different in male and female fetuses. The transverse diameter and perimeter of the thymus were measured in healthy fetuses between 24 and 37 weeks' gestation. The means of the study variables from male and female fetuses were compared by the Student t test. No differences were noted between male and female fetuses for the means of the study variables. They suggested that fetal sex does not affect the size of the thymus [11]. This further increases the effectiveness of using the thymus for age estimation as the sex of the fetus may not always be known. Few studies have measured the transverse diameter of the thymus using ultrasonography. A positive correlation has been found between the transverse diameter and the gestational age. Regression equations have been formulated [6, 7].

To the best of our knowledge, hardly any study has been done to find out this correlation in dissected gross specimens. The present study is an effort in this direction. In the present study, left lobe

of the developing thymus was found to be broader than the right lobe. Ivan V et al found that the left thymic lobe was longer and broader than the right lobe [12]. The transverse diameters of the right and left lobes increased with increasing gestational age. A positive correlation was found between the transverse diameters of the two lobes and gestational age. The mean transverse diameters for each group may help in rough estimation of the gestational age when combined with other methods.

Conclusion

The transverse diameters of the right and left lobes increased with an increase in the gestational age, showing a positive correlation. The findings may help in rough estimation of the fetal gestational age at the time of death especially in mutilated specimens where only few fetal remains are available.

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