

JOURNEY OF OVARIES DURING THE SECOND TRIMESTER OF GESTATION: A FETAL AUTOPSY STUDY

Parneet Sandhu¹, Kanchan Kapoor², Mahesh K Sharma³

¹PG Resident, Department of Anatomy Government Medical College & Hospital, Chandigarh, India

²Professor, Department of Anatomy, Government Medical College & Hospital, Chandigarh, India

³Professor & Head, Department of Anatomy, Government Medical College & Hospital, Chandigarh, India

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Corresponding Author:
Dr. Parneet Sandhu,
Email: parneet27@gmail.com

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Abstract

Background: The ovaries are paired reproductive organ in females located anterior to the rectum. The ovary has two main purposes. It first produces the hormones that regulate the reproductive system in women. The second is the process of ovarian folliculogenesis, which creates, matures, and releases a mature oocyte suitable for fertilization. The ovaries undergo various morphological changes during fetal life. **Materials and Methods:** Fetal autopsy was conducted on 51 aborted fetuses in the Department of Anatomy, GMCH, Chandigarh after written informed consent from the parents. Morphological features were noted after dividing the fetuses into five age groups. The morphological features such as length, width, thickness etc. were recorded with the help of a digital vernier calliper. **Result:** It was observed that the weight, length, breadth and thickness increased with the increasing gestational age group and position of the ovaries also changes in different groups. The current study correlated with various studies in the literature. **Conclusion:** Morphometrical details of fetal ovaries is particularly important because it can serve an important parameter in understanding the various pathologies related to female reproduction. There is limited data available on morphometry of fetal ovaries in the literature.

INTRODUCTION

The ovaries are located anterior to the rectum, posterior to the broad ligament, and along the lateral pelvic wall on either side of the uterus¹. The ovary has two main purposes. It first produces the hormones that regulate the reproductive system in women. The second is the process of ovarian folliculogenesis, which creates, matures, and releases a mature oocyte suitable for fertilization.^[1] Due to the rise in ovarian diseases and abnormalities in recent years, research on the intrauterine development of the ovaries has become more important.

The ovaries undergo substantial changes in shape and function during childhood, adulthood, and after menopause.^[2] The ovaries are situated above the true pelvis and are tan in color, elongated, and flattened in neonates.^[2,3]

It weighs under 0.3g² and has dimensions of approximately 1.3cm×0.5cm×0.3cm. The oval-shaped adult ovaries weigh roughly 5-8g² and have dimensions of 3.0-5 cm×1.5-3 cm×0.6-1.5cm. Following menopause, the size of the ovaries decreases to about half of their reproductive age.^[2]

The fetal ovary is much smaller than an adult's (30 times lighter than at puberty).^[3] Throughout the fetal

stage, the ovaries assume a variety of positions before moving to their final location between the external and internal iliac arteries.^[2,3] Ovaries are oriented obliquely at level of linea terminalis throughout the first trimester. Ovaries are often located close to the common iliac artery and in front of the uterus during intrauterine life.^[2] The linea terminalis is the point of reference. However, in 12th week of pregnancy, ovaries begin to move past the linea terminalis and enter pelvis minor.

According to various studies, ovaries can be rod, bean, almond or S- shaped. However, almond shape is most common.^[2] The morphometric parameters such as length, width and thickness of prenatal ovaries changes with increasing gestational age.

The pathogenesis of various ovarian diseases such as PCOS is poorly understood, however, abnormal folliculogenesis has been indicated in PCOS. Other diseases such as premature ovarian failure, a rare embryologic abnormality called ectopic ovaries, ovarian cysts etc., can be reviewed in detail by studying the fetal ovary.

Further fetal ovarian morphology study can help in understanding any correlation between the fetal ovary and the increasing rate of infertility in females, if any.

MATERIALS AND METHODS

The present study was carried out on 51 aborted human fetuses in the Department of Anatomy, Government Medical College and Hospital, Chandigarh within one and a half years from September 2022 to December 2023. The 51 aborted human fetal specimens from the 12th to 28th weeks of gestational age were obtained from the Department of Obstetrics and Gynaecology and routinely sent for the purpose of autopsy and evaluation. Informed written consent in English and local languages was obtained from the parents to perform an autopsy and carry out any additional research.

Exclusion Criteria:

1. Fetus with gross anatomical abnormality.
2. Macerated fetus.
3. Maternal history of infections such as rubella, hepatitis, CMV, HIV.

Method: The general external features such as Crown Rump Length (CRL), Crown Heel Length (CHL), head, abdomen and chest circumference and other morphometric measurements were taken.

The gestational ages were correlated with the ultrasonographic age estimation and Crown Rump Length.

The fetuses were examined according to the predesigned proforma which include morphometric examination.



Figure 1: Image showing the fetal ovaries.

RESULTS

Morphometry

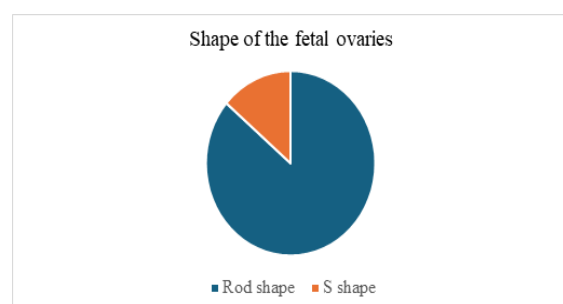
The study was done with 51 preserved specimens of fetal ovaries. These were divided into 5 different groups based on their gestational age.

Table 1: Distribution of female fetuses according to their gestational age.

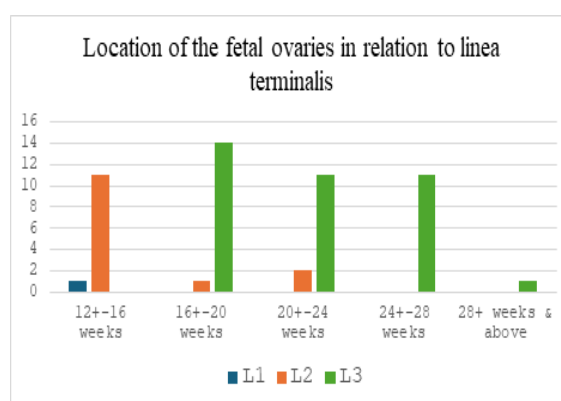
Gestational age	Groups	Number of cases
12+-16 weeks	A	12
16+-20 weeks	B	14
20+-24 weeks	C	13
24+-28 weeks	D	11
28+ weeks & above	E	1
Total		51

Morphometric features: Prior to autopsy, morphometric parameters such as fetal weight, Crown Rump Length (CRL), Crown Heel Length (CHL), Abdominal Circumference (AC) and Chest Circumference (CC) were measured with the help of a digital vernier calliper.

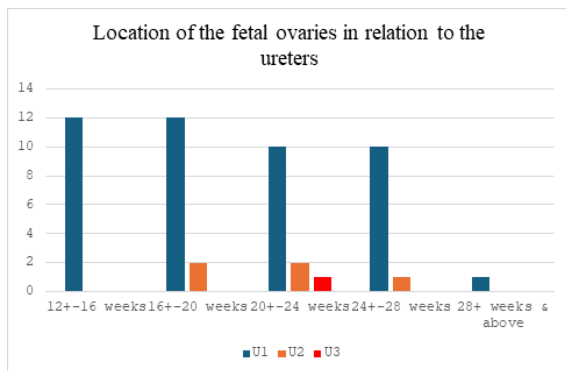
It was observed that rod-shaped ovaries were most commonly seen in female fetuses of 2nd trimester. Approximately 86% of the fetuses in this study had rod-shaped ovaries. The next common shape observed in this study was S-shaped ovaries (14%). Almond-shaped ovaries were not seen because this shape is more common in full-term fetuses. In all the specimens under this study, ovaries were located in the left and right lower quadrants and had an oblique orientation.



In the present study, 36 specimens (70%) had ovaries below the level of linea terminalis, followed by 14 specimens (27%) with ovaries at the level of linea terminalis and 1 specimen (3%) with ovaries above the level of linea terminalis. It was observed that with the advancing gestational age the ovaries cross the linea terminalis.

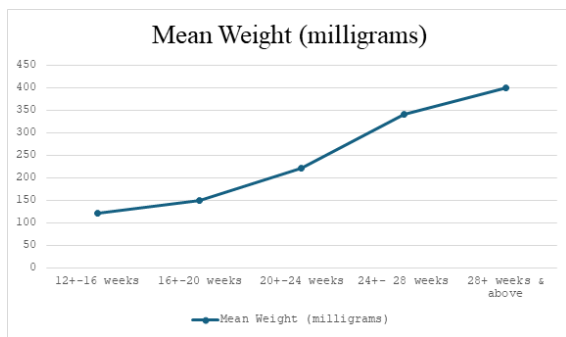


In this study, majority of the specimens (88%), had ovaries anterior to the ureters. The next common position in relation to the ureter was lateral to it in about 5 specimens (10%) and 1 specimen (2%) had ovaries medial to the ureter.



U1: Anterior to the ureter, U2: Lateral to the ureter, U3: Medial to the ureter

A constant increase in weight of the fetal ovaries was seen with the increasing gestational age. Maximum increase was seen between the group C and E. however, minimum increase was seen between group A and B.



DISCUSSION

With the help of ultrasound imaging, female fetus can be identified around the 11th week of gestation. The literature available for the morphometric observations of the fetal ovary is scanty because it is difficult to determine the precise morphometry & location in utero using ultrasonography. However, anatomical dissections can readily provide detailed information. The histogenesis of fetal ovaries has been the subject of several articles.

In this present study, detailed morphological and histological observations were made after anatomical dissection.

In the present study, rod shaped ovaries were observed in most of the specimens (86%), followed by S shaped ovaries (14%). The ovaries that were observed during the fetal phase were shaped like rods, beans, S-shaped, and almonds, based on data that was previously accessible. Almond shaped ovaries are more common in term fetuses and postnatal ovaries.

Morphometry: In the present study, the length of each ovary was measured from its upper pole to its lower pole. The mean length of the left ovaries was 5.11 and 5.14 of the right ovaries in group A, 6.80 of the left ovaries and 5.69 of the right ovaries in group B, 7.95 of the left ovaries and 8.30 in group C. The width of each ovary was measured at the midpoint in

a horizontal plane with the help of a digital vernier calliper. Similarly, the thickness of each ovary was measured anteroposteriorly.

There was a significant growth rate increase in the total length of the ovaries from the 12th week till 28th week of gestation. Similar observation was made in case of the width of the ovaries measured at its midpoint in a horizontal plane as well as thickness measured anteroposteriorly. No discernible differences between parameters on left & right sides of the comparison.

Sulak et al concluded that there was a significant difference in the morphometric measurements in between first, second, third trimester fetuses.^[2] However, there was no distinction between fetuses at full term and those in the third trimester.

In their research, Rani et al. came to the conclusion that the average breadth and thickness dropped between weeks 13 and 28 of pregnancy. This observation hadn't been previously documented. They proposed that the expansion of vital organs like the kidney, liver, or intestines could account for the decrease in volume or the rise in the number of degenerating follicles in the abdominal cavity.^[5]

With respect to the orientation of the ovaries, in the present study, all the specimens had oblique orientation. This finding was similar to other studies in the past. Accordingly, a study found that during the embryonic period, ovaries positioned transversely or obliquely convert to a vertical orientation. The association between genital eminence, from which ovaries originate, and Mullerian duct, which creates uterus and Fallopian tubes, may account for variations in ovaries' location and orientation during fetal life. Another possibility is that nearby structures will be compressed during development.^[6,7]

The linea terminalis is crossed by the ovaries approximately 12 weeks of gestation, according to traditional textbooks. According to Lin et al., the ovaries enter the real pelvis next to the kidneys.^[8] According to Sulak et al., The linea terminalis was at the level of the majority of the right ovaries during the first trimester of fetal life, whereas 50% of the left ovaries were at the same level and the remaining 50% were below it.^[2] This shows that half of the left ovaries have passed the linea terminalis during the first trimester, whilst the right ovaries have not yet reached the pelvic cavity. Most cases occurred in the second and third trimesters, with ovaries located below the linea terminalis. Both ovaries in the full-term group were usually at the level of the linea terminalis, while 37% of left ovaries and 25% of right ovaries were below it.

Throughout the current investigation, majority of specimens (36 ovaries) has been found below linea terminalis, with one pair of ovaries, gestation age of 12-16 weeks, placed above the linea terminalis and fourteen pairs at level of linea terminalis. As a result, current study found that the ovaries shifted below the linea terminalis as gestation period increased.

Blaustein et al. concluded that the ovaries first form in the false pelvis and only move into the true pelvis later in the growth phase.^[9]

The length and width of the ovary were both observed to increase linearly with age.^[10]

According to evidence from earlier research, adults' ovaries are located in the pelvis, ahead of their ureters^{2,8}. Regarding the interactions between ureters, ovaries, and iliac arteries during fetal stage, there are no references in the literature. The ovaries may be positioned medially, laterally, or anteriorly to the ureters, according to research by Sulak et al. Additionally, they concluded that ovaries moved their relative location to the ureters later in postnatal life, taking up their position in front of ureters.^[2] Ovaries' relationship to the ureters and iliac arteries was examined in the current investigation. Eighty-eight percent of the ovaries were found to be anterior to the ureters, ten percent to be lateral, and two percent to be medial. It was observed that, in reference to the iliac arteries, 35% of the specimens were anterior to the external iliac arteries and 65% of the specimens were anterior to the common iliac arteries. There was no association found between growing gestational age in the second trimester and the position of the ovaries with respect to the ureters and iliac arteries. Ovaries prior to the common iliac artery, however, reduced with increasing fetal age, and they tended to be anterior to the internal or external iliac arteries, or between them, according to Sulak et al.^[2]

In the present study, the morphometric measurements (length, width and thickness) were noted in situ and ex situ. The total mean width, length, & left ovary's thickness, in situ was 7.853, 2.780, and 2.057. The total mean width, length & right ovary's thickness was 7.631, 2.749, and 2.088 respectively. The total mean, width, length & left ovary's thickness, ex situ, was 7.576, 2.663, and 2.018. The total mean, width, length & of right ovary's thickness, ex situ was 7.196, 2.533, and 1.939. The difference in measurements in situ and ex situ might be due to the neighboring structures in situ.

In the current study, the weight of the ovaries ranged between 0.155g to 0.410g. The ovarian weight & size increased with the increasing gestational age.

According to a study conducted by Rani et al, there was a remarkable relationship in between gestational age & weight of prenatal “(r = 0.56; P < 0.05) and postnatal (r = 0.696; P < 0.001)” ovaries and their gestational age⁴. Prior research on the relationship between ovarian weight and age did not exist, with the exception of the study by Sulak et al².

CONCLUSION

The aim of this work was to explore the morphometric development of the ovaries in different gestational ages. With advanced imaging techniques, the congenital anomalies and other reproductive disorders can be diagnosed early with greater precision, and morbidity can be reduced remarkably. 51 normal fetuses in the age group of 12 to 28+ weeks of gestation obtained from the department of Obstetrics and Gynaecology, GMCH Chandigarh for routine fetal autopsy were taken for the study. The morphometric measurements made in situ and ex situ included location, shape, and orientation of the ovaries. The correlation of the parameters was made with gestational age and the fetal weight.

Morphometry: The ovaries showed a constant location in the lower left and right quadrant throughout the gestation from 12 weeks of age. The dynamics of the morphometrical parameters had a significant increase between different gestational age groups. Major growth phase was seen between group B and group C (16+-20 weeks and 20+-24 weeks). The length, width, and thickness of the ovaries increased with the increasing age groups. Statistically, the growth rate was significant as p<0.0001. With regard to the shape and orientation of the ovaries, rod-shaped ovaries were most common with oblique orientation in this study. Maximum number of specimens were located below linea terminalis level, anterior to ureters as well as common iliac arteries. For concluding, embryonic development of the ovaries can be described as stable with very few congenital variations. Discrepancies of morphometric parameters could be due to in situ and ex situ measurements.

Table 2: Average of total length, width, and thickness of fetal ovaries in different gestational age groups.

Gestational age	Average length (mm)	Average width (mm)	Average thickness (mm)
12+-16 weeks	5.83	4.33	0.79
16+-20 weeks	7.50	6.00	1.12
20+-24 weeks	10.99	9.16	1.16
24+-28 weeks	13.75	10.5	1.25
28+ weeks & above	11.66	10.66	1.49

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