

Uterine tube–ovary relationship and fimbrial development during the fetal period

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ABSTRACT

Objective: We aimed to evaluate the position, localization and development of the uterine tubes and their relationships to the ovaries.

Methods: One hundred and fifty-four uterine tubes and ovaries taken from 77 human fetuses aged between 9-40 weeks of gestation have been included in this study. The study was performed in Department of Anatomy of Suleyman Demirel University Faculty of Medicine, Isparta, Turkey in 2004. The position and localization of the uterine tubes have been determined. Consequently, uterine tube - ovary relationship and fimbrial development has been investigated.

Results: It has been observed that the uterine tubes are transversely and obliquely positioned. The most commonly observed position was transverse position.

When the relationship between the uterine tubes and ovaries was explored, it was observed that the ovaries were localized in the superior, anterior or posterior aspect of the uterine tubes. In addition, when relationship between the obliquely positioned uterine tubes and ovaries was assessed, we found that the ovaries are located at the middle, anterior, lateral or posterior of uterine tubes. Furthermore, it indicates that the fimbrial development begins only after the 20th week and the quantity of fimbriae increased by gestational age.

Conclusion: We conclude that the uterine tubes are not positioned as in adults during the fetal period, some variants can be seen in the uterine tube - ovary relationship and fimbrial development begins after the 20th week of gestational age and continued after birth.

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The uterus and the uterine tubes develop from the paramesonephric duct during the 6th week of gestation. Caudal part of this duct fuses in the midline to form the uterus, cervix and the upper half of the vagina. The uterine tubes develop from the unfused cranial portion of the paramesonephric duct.^{1,2} The free ends of the duct open into what will later be the peritoneal cavity. The uterine tubes have 2 ostia; one opening into the peritoneal, the other into the uterine cavity and are comprised of 3 anatomical segments, namely infundibulum,

ampulla and the isthmus. The lateral edge of the infundibulum has finger-like processes known as fimbriae draped over the ovary. These processes catch the ovum. Ampulla is approximately 7-8 cm in length and this is where the sperms usually fertilize the ovum. Isthmus, on the other hand, is the narrowest segment of the tubes.³ The main function of the uterine tubes is to convey the oocytes or the fertilized ovum to the uterus.⁴ Ovaries are the female reproductive glands that lie adjacent to the

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tubes on both sides of the uterus, close to the lateral pelvic walls. Ovaries synthesize estrogen and progesterone as well as produce and protect the oocytes.⁵

An insult to an organ during its development and growth in intrauterine period may result in loss of function of that organ later in life.⁶ Therefore, it is important to know the morphology and the localization of the uterine tubes in the fetal period and identify their relationships with the ovaries in order to understand malformations and anomalies in adulthood. Previous studies have reported difficulties encountered during evaluation with ultrasound of the morphology and localization of the tubes in intrauterine period.⁷ Meanwhile, a literature search on the relationship between the tubes and the ovaries in the fetus or the development of the fimbriae did not reveal any studies.

In this study we carried out anatomical dissections to gather detailed information on the position and localization of the tubes, their relationships with the ovaries and the development of the fimbriae in the fetus.

Methods. This study was carried out on 154 uterine tubes and ovaries, collected from 77 fetuses aged between 9-40 weeks of gestation. Fetuses died due to prenatal asphyxia or prematurity but did not have any external pathology or anomaly were obtained from Isparta Maternity and Children's Hospital, Isparta, Turkey between 1996 and 2002. Consents were obtained from the families. Ethics Committee of Suleyman Demirel University Faculty of Medicine had approved the study prior to the commencement of the study.

The ages of the fetuses were determined according to the Crown Rump Length (CRL) until 12th week and to the biparietal diameter, head

circumference and foot length between 13-40th weeks.¹ Cases were divided into 4 groups: Group 1 comprised of fetuses aged up to 12 weeks of gestation (1st trimester). Group 2 (2nd trimester) were fetuses aged 13-25 weeks of gestation; Group 3 (3rd trimester) with fetuses of 26-37 weeks of gestation and Group 4 (term) with fetuses of 38-40 weeks of gestation. Firstly, anterior abdominal walls of the fetuses were dissected to access the uterine tubes and the ovaries and their orientations were noted. The uterine tubes demonstrated 2 different orientations: Type A: Uterine tubes with transverse orientation. Type B: Uterine tubes with oblique orientation (**Figure 1**). In the 2nd stage, the positions of the ovaries with respect to the tubes were noted. Three distinct types were observed regarding the relationships between the ovaries and the uterine tubes with transverse orientation (**Figure 2**): Type pt1: The ovaries lie above the level of the tubes with transverse orientation, Type pt2: The ovaries lie anterior to the tubes with transverse orientation. Type pt3: The ovaries lie posterior to the tubes with transverse orientation. Similarly, 4 types were observed regarding the relationships between the ovaries and the uterine tubes with oblique orientation (**Figure 3**): Type Po1: The ovaries were on the medial side of the tubes with oblique orientation. Type Po2: The ovaries lie anterior to the tubes with oblique orientation. Type Po3: The ovaries lie posterior to the tubes with oblique orientation. Type Po4: The ovaries were on the lateral side of the tubes with oblique orientation.

Finally, the number of the fimbriae throughout the gestational life was determined (**Figure 4**). The means of all parameters with respect to the gestational age were computed using the Statistical Package for Social Sciences. The $p < 0.05$ is considered statistically significant. Measurements are expressed as mean or mean \pm standard deviation,

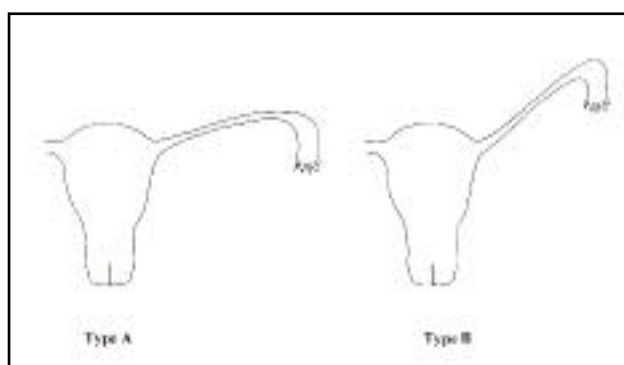


Figure 1 - Types of uterine tube. Type A: transverse orientation, Type B: oblique orientation.

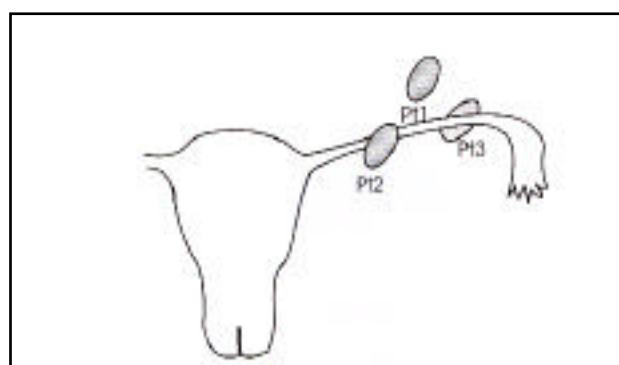


Figure 2 - The relationship between the ovaries and the transverse oriented uterine tubes. Pt1: The ovaries lie superior to the tubes; Pt2: The ovaries lie anterior to the tubes; Pt3: The ovaries lie posterior to the tubes.

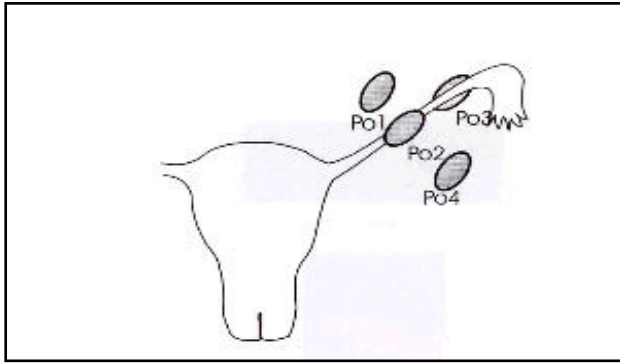


Figure 3 - The relationship between the ovaries and the oblique oriented uterine tubes. Po1: The ovaries lie medial to the tubes, Po2: The ovaries lie anterior to the tubes, Po3: The ovaries lie posterior to the tubes, Po4: The ovaries lie lateral to the tubes.

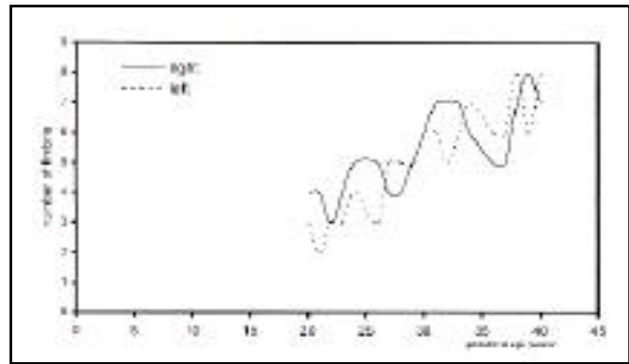


Figure 4 - The number of the fimbriae on both sides during the fetal period.

Table 1 - The number of cases and their percentages of orientations of the uterine tubes.

Group	n	Right uterine tube		Left uterine tube		Total (R + L)	
		Type A	Type B	Type A	Type B	Type A	Type B
1st trimester	12	8 (66)	4 (34)	9 (75)	3 (25)	17 (70)	7 (30)
2nd trimester	39	29 (74)	10 (26)	28 (72)	11 (28)	57 (73)	21 (27)
3rd trimester	18	13 (72)	5 (28)	11 (61)	7 (39)	24 (66)	12 (34)
Term	8	5 (62)	3 (38)	5 (62)	3 (38)	10 (62)	6 (38)
Total	77	55 (71)	22 (29)	53 (69)	24 (31)	108 (75)	46 (25)

R - right, L - left

where appropriate. Non-parametric tests were used to compare groups due to limited number of cases. Following the analysis of variance with Kruskal Wallis, groups were compared pair-wise with Mann Whitney U test. The levels of significance were assessed with Bonferroni method. The correlations between the parameters were tested with Pearson's test.

Results. The tubes were classified into 2 groups, namely, transverse or oblique according to their orientations (**Figure 1, Table 1**). Type A (transverse orientation) was the most common on both sides. When all cases were taken into account, there were no significant differences among the groups with respect to the incidences of Type A and Type B (**Table 1, p>0.05**).

When the relationship between the transverse oriented tubes and the ovaries were assessed, the most commonly observed type was Type Pt1 (ovaries lay superior to the tubes), followed by Type Pt3 (ovaries lay anterior to the tubes) and Type Pt2 (ovaries lay posterior to the tubes) (**Figure**

2). There were significant differences between the incidences of Type Pt1, Pt2 and Pt3 among groups ($p<0.001$, χ^2 : 48.508). Type Pt1 was the most common in all trimesters. Type Pt3 was observed in the 1st, 2nd and 3rd trimesters but not in term fetuses. Type Pt2 was the least common type; nevertheless, it was observed in all trimesters (**Table 4**).

When the relationship between the oblique oriented tubes and the ovaries were assessed, the most commonly observed type was Type Po1 (ovaries lay medial to the tubes), followed by Type Po2 (ovaries lay anterior to the tubes), Type Po4 (ovaries lay lateral to the tubes), Type Po3 (ovaries lay posterior to the tubes) (**Figure 3**). There were significant differences between the incidences of Type Po1, Po2, Po3 and Po4 among the groups ($p<0.001$, χ^2 : 87.635). Type Po1 was most common in term fetuses, Type Po4 was most common in the 3rd trimester, Type Po2 and Type Po3 were most commonly seen in the 1st trimester (**Table 4**).

In the final stage of the study, the development of the fimbriae throughout the fetal period was

Table 2 - The number of fimbriae in fetus with respect to the gestational age.

Gestational age (weeks)	The number of fimbriae (Right)	The number of fimbriae (Left)
20	4	3
21	4	2
22	3	3
23	4	3
24	5	4
26	5	3
27	4	5
28	4	5
29	5	5
30	6	6
31	7	6
32	7	5
33	7	6
34	6	7
36	5	6
37	5	6
38	7	8
39	8	6
40	7	8

Table 3 - Mean number of fimbriae (standard deviation) in the fetal period for each group.

Groups	Right	Left	Total
1st trimester	-	-	-
2nd trimester	3.5 ± 1.3	3 ± 0.7	3.3 ± 1.3
3rd trimester	5.5 ± 1.1	5.4 ± 1.0	5.6 ± 1.2
Term	7.3 ± 0.5	7.3 ± 1.1	8.3 ± 0.5
Total	5.4 ± 0.9	5.2 ± 0.9	5.7 ± 1

assessed. Until 20th week, the infundibulum was tubular in shape and had no processes. After the 20th week fimbriae, started to develop on both sides and the number of fimbria increased with gestational age (Figure 4, Tables 2 & 3).

Discussion. The uterine tubes are involved in catching the oocytes expelled from the ovaries, fertilization and the conveyance of the embryo.⁴ They have a close relationship while fulfilling their functions. In this study, the orientation, localization of the uterine tubes and their relationship with the ovaries in intrauterine period and the development of the fimbriae were explored. In anatomical textbooks, the uterine tubes in adults are described as extending horizontally to the lateral, forms a right angle and turns cephalad, infundibulum turns posteriorly and the fimbriae wraps around the ovaries.⁸ In our study, we found that in 75% of the cases, the tubes ran transversely (Type A) and in 25% obliquely (Type B) (Figure 1). The orientations and localizations of the tubes in the fetus do not exactly conform to the descriptions made by Waldeyer and Mayet⁸ in adults. This suggests that the tubes assume their final orientation and position later in the postpartum period.

Throughout the whole intrauterine period, the ovaries lay superior to the tubes with a transverse orientation in the majority of the cases (Table 4). On the other hand, when the tubes had an oblique orientation, the ovaries were most commonly localized on the medial side of the tubes (Table 4). Previous studies have reported difficulties in evaluating the pelvic viscera with ultrasound.⁴ Tubal anomalies in intrauterine life, albeit rare, include segmental or total agenesis, ectopic tubes such as in the retroperitoneal region, iliac fossa or around the descending colon.⁹⁻¹¹ Such anomalies are frequently asymptomatic but may result in infertility or ectopic pregnancy in the reproductive years.⁹ Therefore, it is important to define early such anomalies in order

Table 4 - The percentage distribution of the relationship between the ovaries and the transverse and oblique oriented uterine tubes for each trimester.

Groups	1st trimester		2nd trimester		3rd trimester		Term	
	Oblique	Transverse	Oblique	Transverse	Oblique	Transverse	Oblique	Transverse
Type 1	57	59	73	81	66	75	83	90
Type 2	0	6	9	8	22	8	0	10
Type 3	28	35	9	11	0	17	0	0
Type 4	15	0	9	0	22	0	17	0

to be able to diagnose and treat infertility and ectopic pregnancies. Dueck et al⁷ identified with ultrasound an abdominal cystic mass in a 37 week old fetus, repeated the ultrasound postpartum and found, in addition to the cystic mass, agenesis of the left ovary and rudimentary left uterine tube. A thorough knowledge of the development of the uterine tubes and the relationship between the tubes and the ovaries during the fetal period could be very important for antenatal diagnosis and treatment. With anatomical dissections we defined tubes-ovaries relationship in detail. This is a pioneering work defining the relationship between the uterine tubes and the ovaries that will provide the clinicians with necessary knowledge to assess uterine tube development and anomalies.

We also investigated the development of the fimbriae in this study. We found that the fimbriae did not develop until the intrauterine 20th week, namely, the infundibulum had a tubular shape until then. The fimbriae started to develop after 20th week and the number of the fimbria increased with gestational age (**Figure 4, Tables 2 & 3**). There are no publications on the intrauterine development or the number of the fimbriae. According to the anatomical textbooks the number of fimbria in adults is between 12-15.¹² The average numbers of the fimbriae (total) in the 2nd trimester was 3.3 fetuses, 3rd trimesters was 5.6 fetuses while in the term was 8.3 fetuses (**Table 3**). Therefore the number of the fimbria continues to increase after birth. It is a fact that the fimbriae pick up the ovum released from the ovaries and convey the ovum to the uterine tubes. It is worth investigating whether or not the number of the fimbria or functional capacity to pick up and deliver the ovum is critical in abdominal pregnancies.

We believe the information on the intrauterine localization, orientation of the uterine tubes, and the relationship between the tubes and the ovaries will contribute to the research in obstetrics, fetopathology, radiology and forensic medicine.

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