

Age Related Changes of Morphology, Length And Luminal Diameter of Human Fallopian Tube

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Abstract:

Introduction And Objectives: Fallopian tubes are the important part of female reproductive tract with long flexuous structures, beginning with the ovarian end each tube is divisible into four segments viz. infundibulum, ampulla, isthmus and intramural. Due to increasing rate of tubal block and infertility, fallopian tubes are gaining importance and have become a subject of research in present days. The aim of the study is to ascertain any differences of morphology, length and luminal diameter of the fallopian tube in different age groups and the research work could be utilized for investigation and treatment of diseases and infertility.

Material and methods: Ten specimens of each group i.e., prereproductive, reproductive & postmenopausal were collected from fresh unembalmed human cadavers received in the department of Anatomy and Forensic Medicine FAA Medical College, Barpeta, Assam, after completing all legal formalities. Length of the fallopian tubes were measured by standard method as well graphical method before histological processing. The slides were prepared using standard laboratory procedure (H&E stain). Under low power objective, luminal diameters were measured by using micrometry slides.

Results: Study revealed that fallopian tubes of the prereproductive group shows less numbers of convolution than the other two groups. Among the groups average length of left and right fallopian tube were recorded shortest (7.4 cm and 7.2 cm) in prereproductive group than the reproductive (10.1 cm and 10.0 cm) and postmenopausal (10.0 cm and 9.9 cm) group. Luminal diameter of both the tubes among the groups, narrowest diameter were recorded in the isthmus and widest in the ampullary segment. Study showed regarding luminal diameter of both the tubes in the same segment, narrowest in the reproductive group (isthmus-0.24 mm) and widest in postmenopausal group (isthmus 0.27 mm).

Conclusion: From the study it can be concluded that: 1. Among the three groups average length of the fallopian tube is shortest in prereproductive group. 2. In all the groups the luminal diameter was recorded narrowest in the isthmus. 3. In intergroup comparison of luminal diameter of intramural and isthmus segment of both the tubes, narrowest diameter recorded in reproductive group. 4. In ampullary segment highest luminal diameter recorded in reproductive group.

Keywords: Prereproductive, reproductive, postmenopausal, luminal diameter, infertility

I. Introduction

Fallopian tubes (oviducts or uterine tubes) are long paired flexuous reproductive organ extending bilaterally from the uterus in the upper margin of the broad ligament of the uterus. The tube transports ova, spermatozoa, zygotes, the pre-implantation morulae and blastocyst to the uterus. It has major role during reproductive period, but it remains as if vestigial organ before puberty and after menopause. Each tube is divisible into four segments from lateral to medial viz. infundibulum, ampulla, isthmus and intramural or interstitial [1]. The infundibulum is funnel shaped and is formed of a number of processes, the fimbriae. Next to the infundibulum, ampulla is the long expanded part which is the normal site of fertilization [2,3] and terminates in a relatively short firm segment, the isthmus. The intramural part or pars uterine is the medial most part of the uterine tube which is embedded in the wall of the uterus.

In third century B.C., Based on the anatomical observations of Herophilus, the Alexandrian anatomist, Rufus the Greek anatomist and physician first described the human oviduct as “antennae or octopus like arms extending as prolongation from each side of the uterus”[4]. But till sixteenth century the existence and anatomical relations of the oviducts were not clear. Gabriele Fallopius in his publication of “Observationes Anatomicae”[5] illustrated the oviducts in a better way, and the term ‘fallopian’ derived from his name. By the mid-nineteenth century, knowledge of the oviduct was relatively complete but contemporary knowledge of the oviduct derives in great part from twentieth century due to advances in technology and application regarding morphological and histological findings. The reproduction is directly correlated to the functioning of the different parts of the reproductive system in co-ordination with the other systems of the body. In the present era

due to the increasing rate of infertility, the reproductive organs and their functions gaining importance and have become the subject of research. Studies on biometry of fallopian tube in respect to different age groups have been reported by different workers [3,6,7].

The Present study was carried out to observe any differences of morphology, length, and luminal diameter of human fallopian tube and their interrelationship with respect to different age groups and the research work could be utilized for investigation and management of infertility and postmenopausal diseases.

II. Materials And Methods

Specimens were collected from fresh unembalmed human cadavers received within six hours of death in the department of Anatomy and Forensic Medicine, FAA Medical College, Barpeta, Assam, following all legal formalities and excluding obvious pathological changes. Each specimen is complete with uterus and both the fallopian tubes(Fig. 2). The specimens of the fallopian tubes were divided into three groups according to the different ages as shown below:

Groups	Ages (Years)	Number of specimens
Group-I (Prereproductive)	0 to 13	10
Group-II (Reproductive)	14 to 49	10
Group-III (Postmenopausal)	50 & above	10

Ten specimens (20 tubes) were collected from each group and each tube was complete with intramural, isthmus, ampulla and infundibulum segment. Morphological measurements were taken before fixing the specimens. To measure the length of the tube first a flexible soft cotton thread was placed along the curve of the tube starting from the fimbriated end to the morphological uterotubal junction (Fig.2). Then the length of the thread was measured in centimeters (Fig. 4). Another graphical method [8] was employed in which the tube was placed on a graph paper (Fig.1) and a point was marked where fimbriated end lies and other point was taken at morphological uterotubal junction. The total number of squares (1small square = 0.1cm) crossed by the tube were counted and the length was calculated. But the intramural part lies inside the uterine tissue and it was difficult to measure its length by previous two methods. According to several workers [7,9] the average length of the intramural part is 1.0cm. Thus this 1.0 cm. was added to the measured length of each fallopian tube to calculate the complete length. The number of convolutions of fallopian tubes were also recorded. For histological studies four segments of the tubes were identified and from each segment approximately 3 to 5mm pieces were made and fixed in 10% formol saline and labeled separately. The fixed tissues were processed for embedding in paraffin and sectioned at 5µm thickness. Sections were stained with routine Haematoxylin and Eosin method [10].

Stained slides were studied under low power objectives, luminal diameters were measured with the help of an "Spencer ocular" lens and objective micrometer scale.

Calculation of micrometry scale:

15 divisions of ocular micrometer = 5 divisions of objective micrometer.

Therefore, 1 division of ocular scale = 5/15 divisions of objective micrometer.

As 1 division of objective micrometer = 0.01mm

Hence, 5/15 divisions = 5/15 × 0.01mm = 0.003mm = 3.33µm (10⁻³ = 1micron)

Therefore, 1 division of ocular micrometer scale = 3.33µm

Statistical Analysis:

The length and luminal diameters were analyzed by standard statistical methods [11]. The data were analyzed to calculate the Mean ± SE and 't' test was applied to find out the statistical differences between the mean values.

III. Results And Observations

In present study the results and observations were grouped in three headings as follows: 1.Morphology, 2. Length and 3. Luminal diameter.

Morphology:

As fallopian tube is a flexuous organ it shows some convolutions. The number of convolutions were more in prereproductive and reproductive ages (Fig.1,2) while it was observed less in postmenopausal cases (Fig.3). In all the groups different segments of the fallopian tubes were easily identified by their relative

diameters. In all the tubes infundibulum was funnel shaped and prominent fimbriae surrounded its opening. Uterine tubes were enclosed in a peritoneal fold derived from broad ligament and mesosalpinx were present in all the three groups, (Fig.1,2,3).

Length:

The average length of left and right fallopian tubes were recorded as in Group I-7.4 cm and 7.2 cm, Group II- 10.1 cm and 10.0 cm and Group III-10.0 cm and 9.9 cm, respectively (Table 1,2,3). In all the groups it was recorded that left tube was little longer than the right tube but statistically they were at par (Table 4).

Intergroup variation of the length of the left and right fallopian tube of prereproductive, reproductive and postmenopausal groups has been shown with the help of bar diagram (Table 5,6, Fig. 7,8). Bar diagram showed that the length of the both left and right fallopian tubes of prereproductive group was shortest (7.4 cm and 7.2cm) than the reproductive (10.1 cm and 10.0 cm) and postmenopausal groups (10.0 cm and 9.9 cm). However, there was little difference between the length of the tubes in Group II and Group III but non-significant (Table 4,5,6).

Luminal Diameter:

In all the groups, the luminal diameter of the fallopian tubes were recorded at three different segments starting from medial to lateral, intramural or interstitial (D₁), isthmus (D₂) and ampulla (D₃).

Prereproductive group exhibited average luminal diameter of left and right uterine tube at D₁, D₂ and D₃ as 1.0 mm and 0.9 mm, 0.34 mm and 0.28 mm and 5.9 mm and 5.89 mm respectively (Table 1). In reproductive group, average luminal diameter of left and right oviduct was recorded at D₁, D₂ and D₃ as 0.61 mm 0.26 mm and 6.5 mm, and 0.57 mm, 0.24 mm and 6.4 mm respectively (Table 2). Average luminal diameter of left and right uterine tube was recorded at D₁, D₂ and D₃ as 1.87 mm, 0.33 mm and 6.30 mm and 1.84 mm, 0.27 mm and 6.2 mm respectively in postmenopausal group (Table 3).

In all the groups it was noted that the luminal diameter of both the tubes were narrowest in the isthmus segment and widest in the ampullary segment (Table 4,5,6) and also represented by bar diagram (Fig. 7,8). Intergroup comparison showed that luminal diameter of both the tubes in the same segment found to be narrowest in Group II (reproductive) and widest in Group III (postmenopausal) which has been represented by bar diagram (Table 5,6, Fig. 7,8).

Table 1: Length (cm) and luminal diameter (mm) of fallopian tube in prereproductive age (Group I)

Number of Specimen	Length (cm)		Luminal diameter (mm)					
			Intramural		Isthmus		Ampulla	
	Left	Right	Left	Right	Left	Right	Left	Right
1	7.3	7.1	1.0	0.9	0.3	0.3	5.7	5.7
2	7.0	6.8	0.9	0.8	0.3	0.2	6.0	6.0
3	8.2	8.0	0.9	0.8	0.3	0.3	5.8	5.8
4	8.4	8.2	1.1	1.0	0.4	0.4	5.7	5.7
5	7.0	6.8	1.2	1.1	0.3	0.3	6.0	6.0
6	6.8	6.6	1.0	0.9	0.4	0.2	6.2	6.2
7	7.1	6.9	0.9	0.8	0.3	0.3	5.9	5.9
8	7.2	7.0	1.0	0.9	0.4	0.2	5.8	5.8
9	8.0	7.8	1.1	1.0	0.4	0.3	6.0	6.0
10	7.0	6.8	0.9	0.8	0.3	0.3	5.9	5.8
Average	7.4	7.2	1.0	0.9	.34	.28	5.9	5.89

Table 2: Length (cm) and luminal diameter (mm) of fallopian tube in reproductive age (Group II)

Number of Specimen	Length (cm)		Luminal diameter (mm)					
			Intramural		Isthmus		Ampulla	
	Left	Right	Left	Right	Left	Right	Left	Right
1	10.1	10.1	0.6	0.5	0.3	0.2	6.0	5.8
2	9.9	9.8	0.5	0.5	0.2	0.2	6.3	6.1
3	9.9	9.7	0.7	0.7	0.2	0.2	5.9	5.8
4	10.2	10.1	0.8	0.8	0.3	0.3	6.8	6.8
5	9.8	9.7	0.5	0.5	0.2	0.2	6.8	6.7
6	11.0	10.9	0.5	0.5	0.3	0.3	7.2	7.1
7	10.0	9.9	0.6	0.5	0.2	0.2	6.5	6.5
8	10.1	10.0	0.6	0.6	0.4	0.3	6.6	6.5
9	9.9	9.8	0.6	0.5	0.2	0.2	6.4	6.3
10	10.1	10.0	0.7	0.6	0.3	0.3	6.5	6.4
Average	10.1	10.0	0.61	0.57	0.26	0.24	6.5	6.4

Table 3: Length (cm) and luminal diameter (mm) of fallopian tube in postmenopausal age (Group III)

Number of Specimen	Length (cm)		Luminal diameter (mm)					
			Intramural		Isthmus		Ampulla	
	Left	Right	Left	Right	Left	Right	Left	Right
1	10.0	9.9	1.9	1.9	0.4	0.3	5.9	5.8
2	10.2	10.1	1.8	1.8	0.4	0.4	7.0	6.9
3	9.9	9.7	1.7	1.7	0.2	0.2	6.5	6.4
4	10.0	9.9	2.0	2.0	0.3	0.2	6.8	6.7
5	10.0	10.0	1.9	1.8	0.5	0.3	5.9	5.7
6	9.8	9.7	1.8	1.8	0.2	0.2	5.7	5.6
7	10.1	10.0	2.0	2.0	0.3	0.3	6.4	6.3
8	10.0	9.9	1.9	1.8	0.4	0.3	6.3	6.3
9	9.9	9.8	1.8	1.7	0.3	0.2	6.3	6.2
10	10.1	10.0	1.9	1.9	0.3	0.3	6.2	6.1
Average	10.0	9.9	1.87	1.84	0.33	0.27	6.3	6.2



Fig.1. Photograph of prereproductive fallopian tube showing more number of convolutions and graphical method of measuring length



Fig.2. Photograph of reproductive fallopian tube showing more number of convolutions and mesosalpinx with thread method of measurement



Fig.3. Photograph of postmenopausal fallopian tube showing less number of convolutions & mesosalpinx and method of measuring length with thread and scale

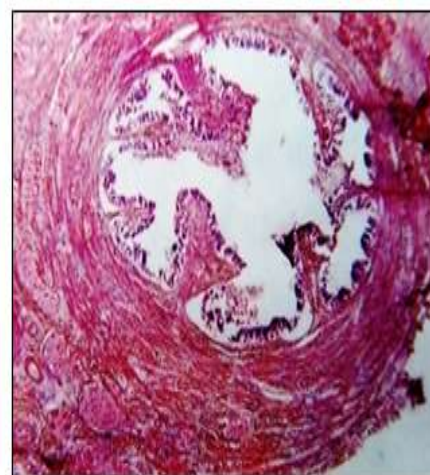


Fig.4. Photomicrograph of isthmus of fallopian tube of prereproductive age showing lumen of the tube (Magnification x 100)



Fig.5. Photomicrograph of isthmus of fallopian tube of reproductive age showing lumen of the tube (Magnification x 100)

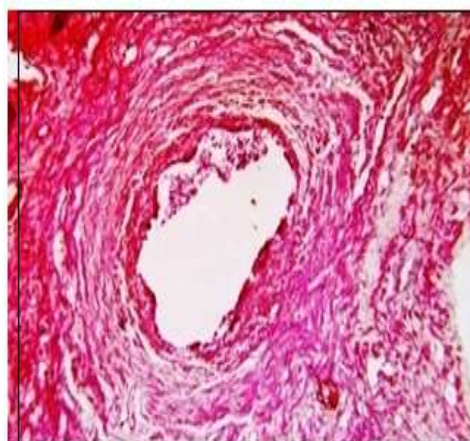


Fig.6. Photomicrograph of isthmus of fallopian tube of postmenopausal age showing lumen of the tube (Magnification x 100)

Table 4: Mean values for length and luminal diameter of fallopian tube in different age groups

Parameters		Group-I	Group-II	Group-III
Length of fallopian tube (cm)	Left	7.4	10.1	10.0
	Right	7.2	10.0	9.9
	SE ±	0.031	0.030	0.030
	Value of 't'	1.970 NS	2.017 NS	2.017 NS
Luminal diameter at intramural part (D ₁) (mm)	Left	1.00	0.61	1.87
	Right	0.90	0.57	1.84
	SE ±	0.020	0.020	0.184
	Value of 't'	1.978 NS	1.978 NS	1.627 NS
Luminal diameter at isthmus (D ₂) (mm)	Left	0.34	0.26	0.33
	Right	0.28	0.24	0.27
	SE ±	0.020	0.030	0.297
	Value of 't'	2.072 NS	1.674 NS	2.017 NS
Luminal diameter at ampulla (D ₃) (mm)	Left	5.91	6.50	6.30
	Right	5.89	6.40	6.20
	SE ±	0.039	0.036	0.036
	Value of 't'	1.345 NS	1.947 NS	1.947 NS

Group-I : Prereproductive

Group-II : Reproductive

Group-III : Postmenopausal

NS – Non significant

Table 5 : Average length (cm) and luminal diameter (mm) of left fallopian tube in different age groups

Age group	Length (cm)	Luminal diameter (mm)		
		Intramural (D ₁)	Isthmus (D ₂)	Ampulla (D ₃)
Prereproductive (Group - I)	7.4	1.0	0.34	5.91
Reproductive (Group - II)	10.1	0.61	0.26	6.5
Postmenopausal (Group - I)	10.0	1.87	0.33	6.3

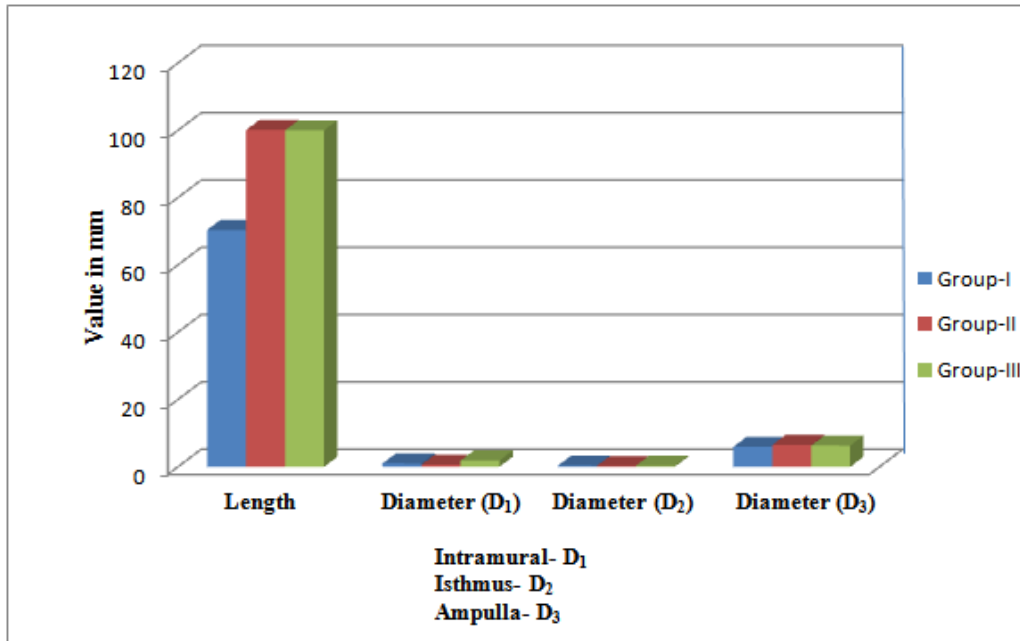


Fig.7. Bar diagram showing intergroup variation in length and luminal diameter of left fallopian tube

Table 6 : Average Length (cm) and luminal diameter (mm) of right fallopian age tube in different groups

Age group	Length (cm)	Luminal diameter (mm)		
		Intramural (D ₁)	Isthmus (D ₂)	Ampulla (D ₃)
Prereproductive (Group – I)	7.2	0.9	0.28	5.89
Reproductive (Group – II)	10.1	0.57	0.24	6.40
Postmenopausal (Group – III)	9.9	1.87	0.27	6.20

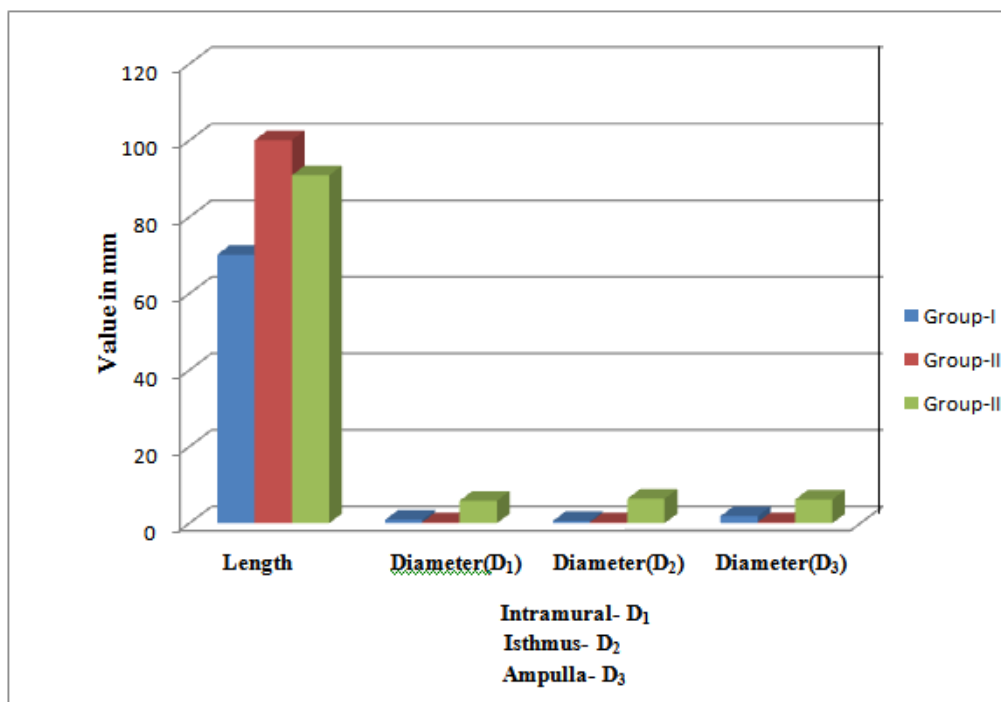


Fig.8 : Bar diagram showing intergroup variation in length and luminal diameter of right fallopian tube

IV. Discussion

Results and observations obtained in the present study revealed several points of interest having marked importance in practical life which may help in investigation and management of infertility cases.

Morphology: As well known fallopian tube is a flexuous organ, in the present study it was found that number of convolutions were more in reproductive age group than the prereproductive and postmenopausal groups which might be due to strong muscular activity required to propel the ovum and zygote to the uterine cavity as has been stated by previous research worker [6,19]. In all the tubes infundibulum was funnel shaped and prominent fimbriae surrounded its opening. In all the three groups, uterine tubes were enclosed in a peritoneal fold derived from broad ligament [7] and mesosalpinx were present (Fig.1,2,3). These findings also corroborate with the findings of other workers [9,12].

Length: The average length of uterine tubes obtained in the prereproductive age group (7.4cm and 7.2 cm) was shorter (Fig.7 & 8) than the reproductive and postmenopausal groups. The average length recorded in reproductive (10.1 cm and 10.0cm) and postmenopausal (10.0 and 9.9 cm) groups (Table 5 & 6 and Fig.7 & 8) were similar with that recorded by several workers [13,14]. The reason for shorter length of uterine tube in prereproductive group might be explained in the light of that the tube is still in the process of growth and while, in other two groups the growth process has already been completed. In all the groups it was recorded that left fallopian tube was little longer than the right one though there was no significant difference (Table 4) which could possibly due to the fact that the left tube might get little more space during growth and development than the right one.
Luminal diameter: In all the groups it was noted that the luminal diameter of both the tubes were narrowest in the isthmus segment and widest in the ampullary segment (Table 5,6 & Fig. 4,5) and has been confirmed by some workers [13,18] and could be possibly due to variation of thickness of musculature. Average luminal diameter recorded in the intramural segment of prereproductive and reproductive group (Table. 4) were within the range of the most of the investigators [16,17,18]. Intergroup comparison showed that luminal diameter of both the tubes in the same segment found to be narrowest in reproductive and widest in postmenopausal which is suggestive of strong muscular activity in reproductive age as has been confirmed by some investigators [18,19,20].

V. Conclusion

From the study the following findings were summarized:

1. Fallopian tubes of reproductive group were more convoluted than the prereproductive and postmenopausal group.
2. Among the three groups average length of the fallopian tube is shortest in prereproductive group (7.2-7.4 cm) than the reproductive (10.0 - 10.1 cm) and postmenopausal (9.9 -10.0 cm) group. In all the groups left uterine tube was found to be longer than the right tube.
3. In all the groups the luminal diameter was recorded narrowest in the isthmus (prereproductive- 0.28 mm, reproductive- 0.24 mm and postmenopausal- 0.27 mm). Intergroup comparison of oviductal luminal diameter in the same segment (isthmus) narrowest diameter was recorded in reproductive group (0.24- 0.26 mm) and widest in postmenopausal group (0.27-0.33 mm).

As infertility is one of the major subject of research and tubal block being a common cause, the present study on fallopian tube in relation to different ages may open scopes for investigation and treatment of infertility cases as well as postmenopausal diseases.

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