

Original Article

MORPHOLOGY AND MORPHOMETRY OF VERMIFORM APPENDIX IN HUMAN FETUSES AT DIFFERENT GESTATIONAL AGES

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ABSTRACT

Vermiform appendix is characterized by great variability of its location & morphology. It has diverse anatomical positions, lengths and conditions of mesoappendix and limited information is available on developmental morphology & morphometry of fetal vermiform appendix. Since the appendix develops during descent of colon, its final position frequently is posterior to the caecum or colon that is retrocaecal or retrocolic respectively. The present study aims to locate the situation and growth of vermiform appendix at different gestational ages of fetuses. Thirty eight human fetuses (n=38) of 11-40 wks gestational ages were procured from Dr. Sushila Tiwari Memorial Hospital, Haldwani. Fetuses were dissected and the position, length & width of appendix, length of mesoappendix were recorded in situ. The location of appendix in relation to abdominal regions presented higher incidence of subhepatic position in less than 30 weeks fetuses and right iliac fossa position in more than 30 weeks fetuses. Length and width of appendix increases with increase in gestational age. Mesoappendix was not extended upto tip of appendix in most of fetuses. The observations are in favor of developmental process on the localization of vermiform appendix.

Key words : Vermiform appendix, Caecum, Mesoappendix, Subhepatic position.

INTRODUCTION

The vermiform appendix is an anatomic organ with considerable significance in clinical practice. It is considered as the organ with the highest topographic variation in the abdomen & is characterized by variability of its location and morphology. Therefore, it is important to know the normal developmental anatomy of vermiform appendix for better understanding of its various positions and other morphological and morphometrical features.

Vermiform appendix is the continuation of caecum and undergoes a very early and rapid developmental process. During the sixth to tenth week of embryonic life, the gut tube grows at a faster rate than the abdominal cavity; therefore, a portion of the midgut loop normally projects into the umbilical cord as primary intestinal loop. At about the

tenth week the abdominal cavity grows at an accelerated rate and the mid-gut returns by normally definite sequence through the umbilical orifice to the abdominal cavity [1, 2]. The proximal portion of the jejunum is the first part to return the abdominal cavity. As it recedes into the abdomen it rotates in a counter-clockwise direction thus it comes to lie on the left side. The later returning loops gradually settle more and more to the right. The caecal bud, which appears at about the sixth week as a small conical dilation of the caudal limb of the primary intestinal loop, is the last part of the gut to reenter the abdominal cavity. During this process the distal end of the caecal bud forms a narrow diverticulum, the appendix. On completion of this return the caecum first lies free near the umbilicus and ventral to the small intestine and mesenteric artery. However, the colon now begins to straighten and carries the

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caecum with it upward and to the right, the colon itself lying across the pedicle of the intestinal mass and mesenteric artery, the caecum lodging beneath the liver [3, 4].

By the eleventh week, the caecum and the first portion of the colon momentarily lies in the right upper quadrant directly below the right lobe of the liver. Subsequently, by apparent retraction of the liver and by linear growth of the colon, the caecum reaches its final position in the right iliac region. This descent of the caecum from sub hepatic to iliac region has been described in many textbooks of anatomy and embryology [5].

Thus, it finally descends into the right iliac fossa, placing the ascending colon and hepatic flexure on the right side of the abdominal cavity. After this rotation is completed, the ascending mesocolon and the descending mesocolon both fuse to the posterior wall of the abdomen.

There are various studies done on different positions and dimensions of vermiform appendix all over the world. But limited information is available on this morphological and morphometrical aspects of appendicular anatomy of human fetal appendix. In the literature various parameters of human fetal appendix at different gestational ages were observed by Malas et al[6,7] on Turkish population and Mohammad et al[8] in Andhra Pradesh region of Indian Population.

Therefore, the present study was conducted with the aim to determine the location, growth and development of vermiform appendix during fetal period.

MATERIAL AND METHODS

Study was carried out in the Department of Anatomy, Government Medical College, Haldwani. The material for the study consisted of 38 aborted human fetuses and whose gestational ages were between 11 and 40 weeks. Fetuses were obtained from the labour room and operation theatre of Department of Obstetrics and Gynecology, Dr Susheela Tiwari Memorial Hospital associated with Government Medical College Haldwani, over a period of two years, with relevant obstetric records available in the department. Human fetuses of age groups 11-40 weeks that exhibited neither external pathology

nor anomaly were selected for present study. These fetuses were utilized after taking consent from their parents. After procurement of fetuses with due regard on ethical ground, fetuses were embalmed and preserved in 10% formalin. Gestational age was determined by the obstetric history and the ultrasonographic reports available in the department. However crown rump length and foot length were also used for those fetuses, in which proper history and ultrasonographic reports were not available. Determination of sex was done by observing the external genitalia.

Fetuses were divided into three groups, depending on their gestational age. First group containing 8 fetuses whose gestational age were between 11-20 weeks. Second group containing 9 fetuses, whose gestational age were between 21-30 weeks. Third group containing 21 fetuses, having gestational ages between 31-40 weeks.

Groups	Gestational Age (weeks)	No. of males	No. of females	Total
I	11-20	4	4	8
II	21-30	6	3	9
III	31-40	11	10	21

Fetuses were dissected by putting a midline incision from xiphisternum to symphysis pubis in anterior abdominal wall and a horizontal incision along the side of umbilicus. Ileocaecal region was displayed and the various morphological parameters & measurements were recorded in situ. The location of the vermiform appendix and caecum was established. Total vermiform appendix length, vermiform appendix diameter at base, middle & tip, length of mesoappendix were measured (Photograph I and II).

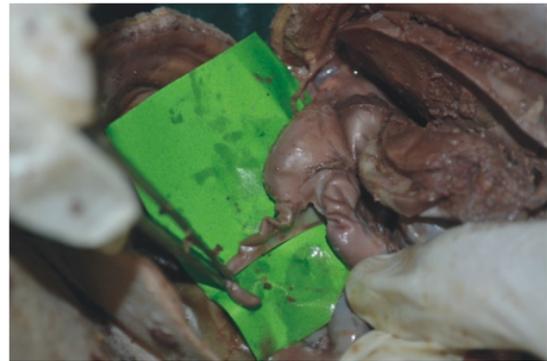
Statistical data analysis was done by using SPSS software version 22, statistical package for windows and the significance was calculated by determining the p-value.

OBSERVATIONS

Taenia coli were absent on caecum and large intestine in fetuses of all age groups. In our study of



Photograph I- Gross photograph of ileocaecal region, showing subhepatic position of caecum & appendix in a MALE FOETUS of 40 WEEKS gestational age



Photograph II- Gross photograph of ileocaecal region showing extent of mesoappendix

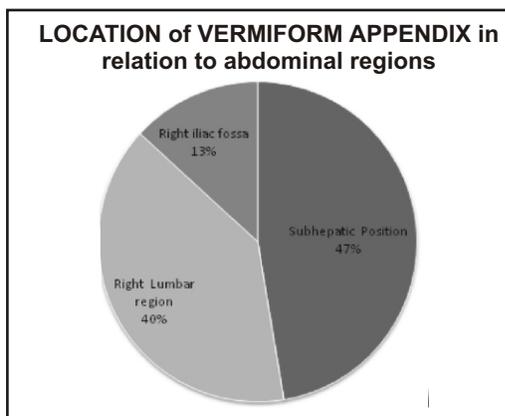


Figure 1A - Distribution of Location of vermiform appendix in relation to abdominal regions among all the fetuses of present study

38 fetuses, the incidence of subhepatic position is highest among all, followed by the right lumbar position. While the right iliac position that is found most commonly in adults, was found in least frequency in fetuses of our study (Table no.I, Figure IA, Figure IB).

The shape of appendix was tubular, with two or three coils, being rarely straight. Tubular appendix with coiling was found in 22 fetuses (69%), while

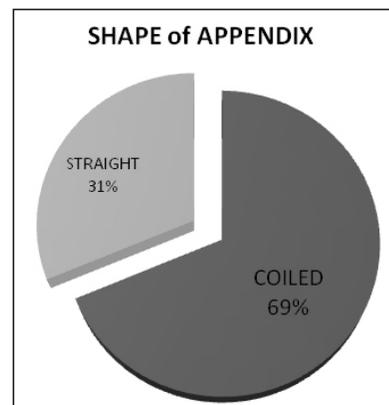


Figure II- Distribution of Shape of appendix among all the fetuses of present study

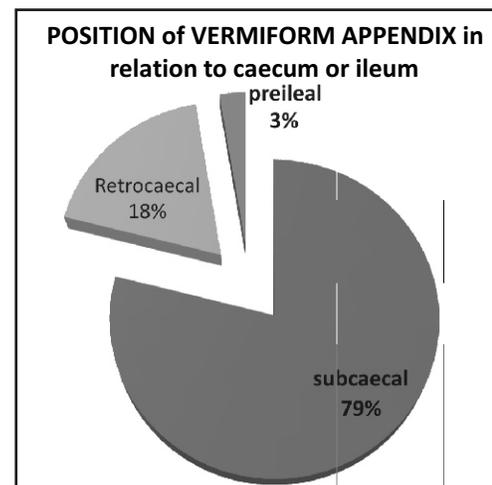


Figure III- Distribution of Position of Vermiform appendix among all the fetuses of present study

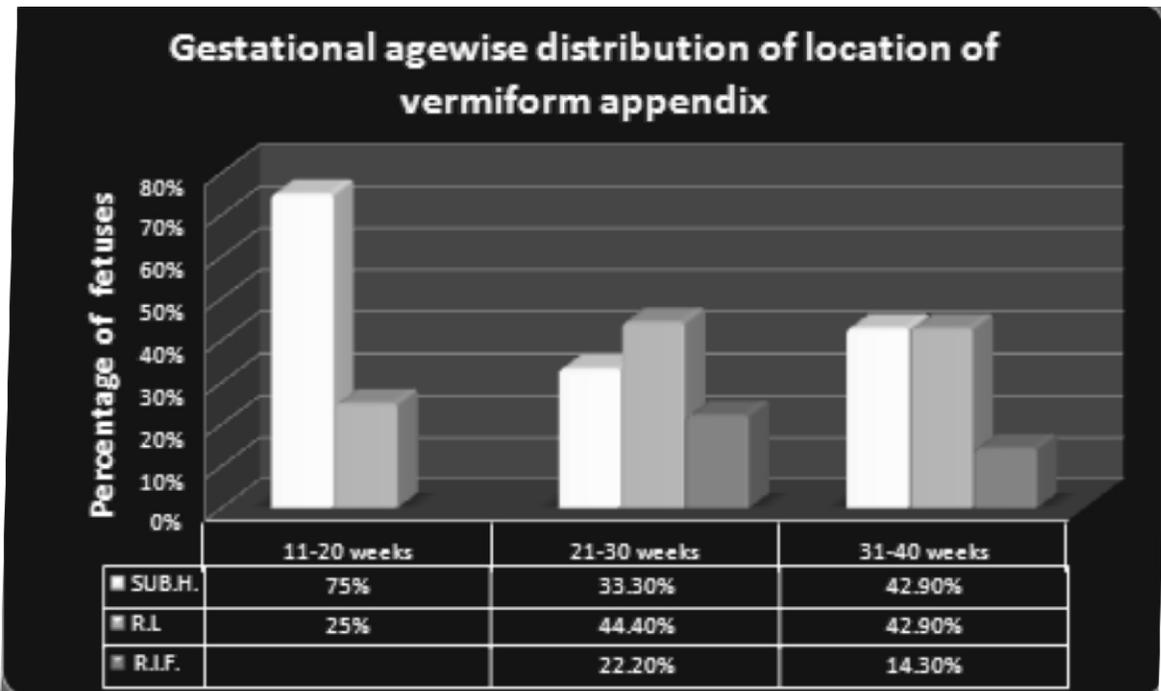
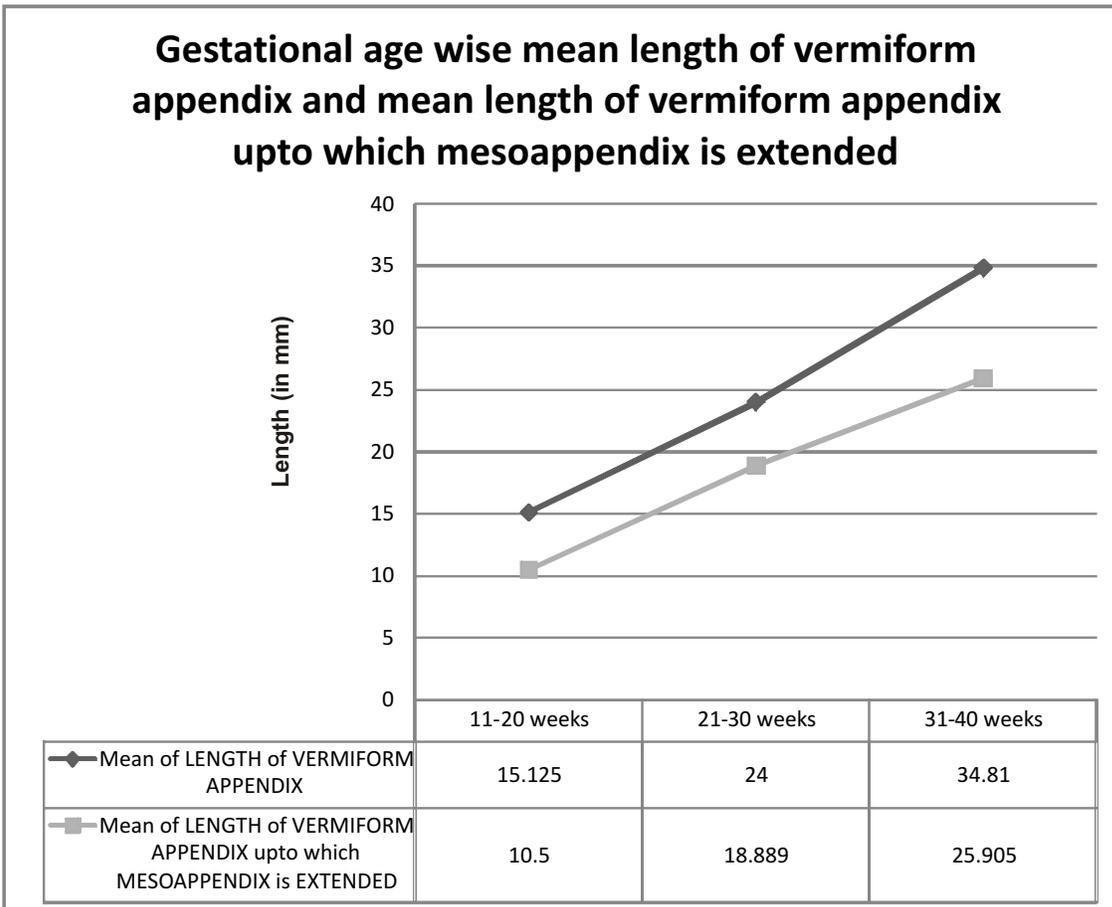
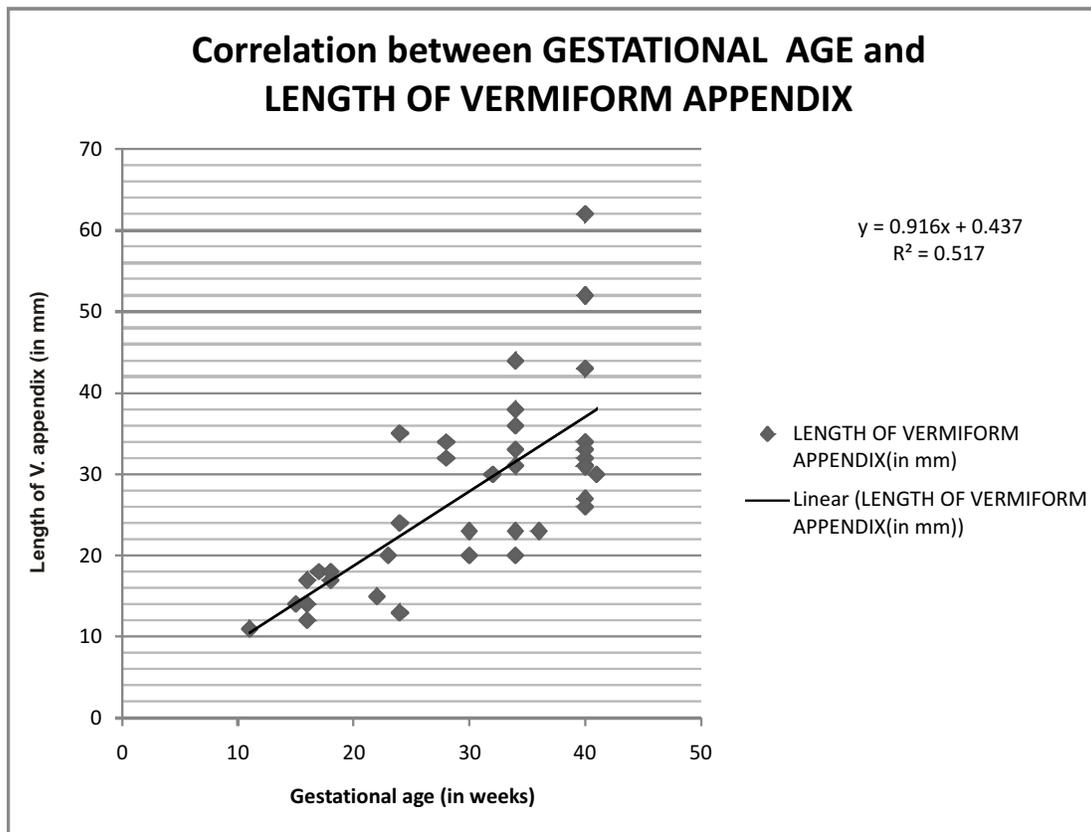


Figure 1B- Distribution of Location of vermiform appendix according to gestational age



Graph I- Comparison between length of appendix and length up to which mesoappendix is extended

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Graph II-Correlation between gestational age and length of vermiform appendix

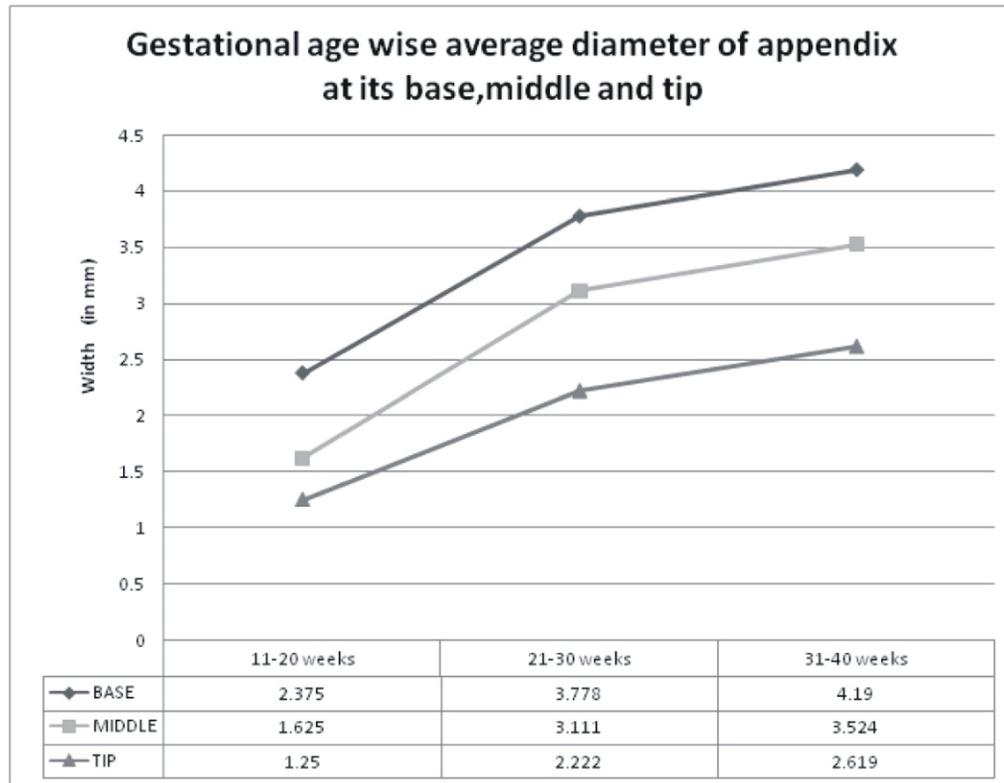
Table I - Distribution of Location of vermiform appendix according to gestational age

		LOCATION OF VERMIFORM APPENDIX			Total	p-value*
		Subhepatic Position	Right Lumbar region	Right iliac fossa		
FOETUS	11-20 weeks	6	2	0	8	0.415
GROUPS	21-30 weeks	3	4	2	9	
	31-40 weeks	9	9	3	21	
Total		18	15	5	38	

*Chi-Square Test

Table II-Gestational age wise average length of appendix

LENGTH of VERMIFORM APPENDIX (in mm)				
FORTUS groups	n	Mean	Std. Deviation	p-value*
11-20 weeks	8	15.125	2.7484	<0.001
21-30 weeks	9	24	8.0623	
31-40 weeks	21	34.81	10.5718	



Graph III- Gestational age wise average diameter of appendix at its base, middle and tip

*ANOVA Test

Table III-Gestational age wise average length of appendix upto which mesoappendix is extended

LENGTH of VERMIFORM APPENDIX upto which MESOAPPENDIX is EXTENDED(in mm)				
FORTUS groups	n	Mean	Std. Deviation	p-value*
11-20 weeks	8	10.5	2.3905	<0.001
21-30 weeks	9	18.889	8.6811	
31-40 weeks	21	25.905	9.1154	

The length of the appendix and the attachment length of the meso-appendix to the vermiform appendix were found to be increased with the gestational age and there is a positive correlation between length of appendix and gestational age of fetuses (TableII,TableIII, Graph I and Graph II). The measured length of the appendix ranged from 3mm

to 7cm. The mesoappendix was not extended up to tip of appendix and was so transparent that the contained blood vessels can be seen. The morphologic development of the vermiform appendix is almost uniform from the proximal to distal part (Table IV, GraphIII). Positive and significant correlation was found between gestational age and morphometric parameters of the vermiform appendix.

DISCUSSION

Higher incidence of sub hepatic position in younger fetuses and right lumbar and right iliac fossa location in older fetuses in the present study suggests that there is migration of caecum and appendix from the initial sub hepatic to right lumbar region in fetuses belonging to less gestational ages and to right iliac fossa in fetuses of higher gestational ages.

So, the present study suggests that with increasing gestational age location of appendix changes from right subhepatic position to right iliac fossa.

The incidences of pelvic and right inguinal location of caecum and appendix that were reported in adults were not observed in the present study.

Developmental anatomy of caecum suggests that caecum is subject to positional variation during fetal period. Stage of development and rotation of gut influence the position of caecum and vermiform appendix development has a close relationship with caecal development during the fetal period. The ultimate position of appendix depends on growth of caecum and the extent of elongation of proximal part of large intestine. The results in the present study on position of caecum in fetal life are similar to the observations of Mohammad et al [8], which states that there is migration caecum and vermiform appendix from the initial sub hepatic to right lumbar region and right iliac fossa during fetal life.

The vermiform appendix, in adults, is a narrow, blind, vermiform (worm-like) tube which arises from the posteromedial caecal wall, approximately 2 cm below the end of the ileum.

In our study as well, that is on fetal material, morphological shapes of the appendix were evidenced as in postnatal life of man. We have found that the appendix is tubular in shape, with two or three coils, and it is rarely straight in fetuses. The results in the present study on shape of appendix in foetal life are similar to the observations of Antic et al [9].

Out of all the fetuses studied in the present study the incidence of subcaecal position (79%) was highest among all, followed by the retrocaecal position (18%) and then preileal position(3%), that was lowest .The results in the present study are in agreement with that reported by Malas et al[6,7]. According to whom the vermiform appendix was almost always observed in the subcaecal region during the fetal period and position of appendix changes with the shape of caecum. Maisel H[10] reported higher incidence of pelvic position in fetuses though he did not specify the age range. Jorge et al[11] stated that the most common caecal fixation site is right iliac fossa and pelvic position incidence is higher at birth followed by post-ileal position during first year after birth. Tahir et al[12] found a higher incidence of pelvic position in 1- 20 years age group was also reported in the literature. In the study of

Mohammad et al[8] majority of appendices are post-ileal in position.

There are reasons in literature to justify the different locations of the vermiform appendix and the morphologic alterations of the caecal region after birth is a relevant contribution for the determination of the ultimate position of the vermiform appendix. During its (caecum and appendix) migration from subhepatic position to right iliac fossa position it may occupy a position posterior to caecum (retocaecal), posterior to ileum (retroileal) or descends into the pelvis (Pelvic) [2].

In the present study the length of appendix and the attachment length of the meso-appendix to the vermiform appendix increased with increase in gestational age and is in agreement with that reported in the fetuses in literature Malas et al [7].The present study was in agreement with the previous authors Katzarski & Dutta [13], Ajmani & Ajmani [14] and Golalipour et al [15] that the length of the appendix in males is more than in females.

In the present study, positive and significant correlation was found between gestational age and morphometric parameters of the vermiform appendix.The morphologic development of the appendix is almost uniform from the proximal to distal part. Results in the present study on these aspects are in accordance with the study of Malas et al [6,7] and Mohammad et al [8].

CONCLUSION

Subhepatic caecum and appendix, when associated with appendicitis, it can lead to misdiagnosis & severe complications during operations. Failure to identify these misplacements may lead to grave errors in procedure. Awareness of nature & characteristics of this location of appendix should be known to surgeons & radiologists.

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