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Original Article

Anatomy Section

Different Positions of Vermiform Appendix in Human Cadavers: A Cross-sectional Study

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ABSTRACT

Introduction: The vermiform appendix is a worm-like tube situated in the right iliac fossa. It arises from the posteromedial caecal wall, 2 cm or less below the end of the ileum and suspended by a peritoneal fold known as meso appendix. Position of the appendix influences its mobility. Most common position of appendix has been reported to be retrocaecal followed by pelvic position. But there are other variable positions also reported by many.

Aim: To study the anatomical variations of the positions of vermiform appendix in human cadavers.

Materials and Methods: This was a descriptive cross-sectional study which was carried out in the Department of Anatomy, Assam Medical College, Dibrugarh, Assam, India, from June 2020 to May 2021. Total 14 adult cadavers and 66 newborn cadavers were included in the study. All the cadavers were dissected and abdominal cavity was explored. The position of the appendix was then noted in all specimens.

Results: In most of the cases the position of vermiform appendix was found in retrocaecal position followed by pelvic, pre-ileal and paracolic. In adults, retrocaecal positions were more in males (88.9%) than females (40%) in contrast to newborns where retrocaecal positions were more in females (76.7%). As a whole, retrocaecal position (66.25%) of appendix was the commonest finding in all cadavers. This was followed by pelvic (30%) position. Paracolic (2.5%) and pre-ilial (1.25%) positions were also noted in newborn cadaver.

Conclusion: Knowing the variations in the position of appendix will guide the surgeons during intraoperative procedures. Since the positions of appendix vary considerably signs and symptoms also vary depending upon the different positions. Hence, the knowledge of its diverse anatomical positions is of utmost importance which helps the surgeons in proper management of appendicular pathology.

Keywords: Anatomical variation, Appendicular pathology, Paracolic, Pelvic, Retrocaecal

INTRODUCTION

The vermiform appendix which is highly variable in position is attached by its base to the point of convergence of the three taenia coli on the posteromedial wall of the caecum. The most common position of appendix is retrocaecal and retrocolic (65.28%) followed by pelvic (31.01%), subcaecal (2.26%), preileal (1.0%) and post-ileal (0.4%) as described by Wakeley in 1933 in a study done on 10,000 subjects [1]. All taenia of caecum converge to the base and serve as a guide for the identification of the appendix. Developmentally, the appendix appears as a narrow diverticulum from the caecal bud in the fifth month of intrauterine life. Though the appendix arises from caecal bud it does not grow as rapidly as the rest of the colon, thus forming a wormlike structure [1-8]. The length of the vermiform appendix varies between 2-20 cm with an average of 9 cm. However its length in children is more than that of adult [2]. The appendix is the only organ in the body that has no fixed anatomy [9]. Knowledge of various positions of appendix is important as the signs and symptoms of appendicitis vary according to its position. This will help surgeons in diagnosis and proper management of appendicitis [10,11].

The diagnosis of the appendicitis is entirely clinical and no investigative procedure gives a final diagnosis. The early signs and symptoms of appendicitis are primarily dependent upon the location of the tip of the appendix which is highly variable. When there is inflammation of the appendix in retrocaecal position the blood supply may be compromised as it is folded by caecum [12]. In post-ilial, pelvic and retroperitoneal positions the appendix is hidden. Incidence of advanced appendicitis with gangrene and perforation are more common in these positions leading to longer hospital stay [4,13,14]. Hence, there is importance of study of various positions of appendix even in present time. There is dearth of studies about different positions of vermiform appendix in human cadavers in the north-eastern part of India. The objective of the present study was to find out the anatomical variations of the positions of vermiform appendix in human cadavers, so as to help clinicians to diagnose and manage the appendicular pathology.

MATERIALS AND METHODS

The present study was a descriptive cross-sectional study conducted in the Department of Anatomy, Assam Medical College, Dibrugarh, Assam, India, after obtaining ethical clearance from Institutional Ethics Committee vide letter no. (AMC/EC/1606 dated 24/7/2020). The study duration was from June 2020 to May 2021.

Inclusion criteria: Expired babies (perinatal) in the Department of the Obstetrics and Gynaecology, which were not taken by their parents or guardians were taken for the study. The newborn cadavers included were all in perinatal period (between 28 weeks of gestation to the 7th day after birth). Normal as well as babies born with congenital anomalies was included in the study. The adult cadavers were taken from the dissection hall of Anatomy Department which were brought for routine dissection for students. The adult cadavers without any signs of decomposition and putrefaction were included in the study.

Exclusion criteria: Decomposed and malformed bodies were excluded from studies.

A total of 14 of adult cadavers and 66 numbers of newborn cadavers were collected for the study before the putrefaction starts.

Study Procedure

The cadavers were kept supine on the dissection table. A midline incision extending from the xiphoid process of the sternum to the

upper border of the pubic symphysis was made to open the anterior abdominal wall and the peritoneal cavity. Anterior abdominal wall was pulled apart, the coils of jejunum and ileum were retracted very gently towards the epigastrium or left side of the abdominal cavity without disturbing the caecum and the appendix. Then appendix was seen and its positions were noted and recorded in the proforma.

If the appendix was not visualised, then the caecum was identified and the taenia coli were traced downwards to their point of convergence, the base of the appendix was identified and searched for the tip of appendix and recorded. The base of the appendix can be identified by a point which is about 2 cm below the intersection between the transtubercular and right lateral plane [2].

In the perinatal cadavers, a second incision was made from the umbilicus to the right anterior axillary line. The right lower part of anterior abdominal wall was retracted downwards and laterally and abdominal and peritoneal cavity was opened. Then, the technique was continued as in the adult cadavers and the position of the tip of the appendix was recorded.

STATISTICAL ANALYSIS

Data were presented in terms of frequency and percentage. Calculations were done using Microsoft excel.

RESULTS

In both groups in perinatal as well as adults, the commonest position of vermiform appendix was found to be retrocaecal in position [Table/Fig-1].

Positions of vermiform appendix in perinatal group: Out of total 66 numbers of perinatal cadavers 36 were male and 30 were female babies. Locations of vermiform appendix were found in four different positions i.e., retrocaecal, pelvic, pre-ileal, and paracolic. Appendix in other positions was not found. Out of 36 male cases, the positions of appendix was noted as- retrocaecal 20 (55.6%), pelvic 13 (36.1%), pre-ileal 1 (2.78%), paracolic 2 (5.56%) [Table/Fig-1], respectively. No cases were found in subcaecal, promontoric, post-ileal and ectopic positions.

Out of 30 female cases, positions of vermiform appendix were found in retrocaecal and pelvic positions in 23 (76.7%) and 7 (23.3%) cases, respectively [Table/Fig-1].

Positions of vermiform appendix	Perinatal Group No. of Cases		Adult Group No. of Cases		
	Males (36)	Females (30)	Males (9)	Females (5)	Total (80)
Retrocaecal	20 (55.6%)	23 (76.7%)	8 (88.9%)	2 (40%)	53 (66.25%)
Pelvic	13 (36.1%)	7 (23.3%)	1 (11.1%)	3 (60%)	24 (30%)
Subcaecal	0	0	0	0	0
Promontoric	0	0	0	0	0
Pre-ileal	1 (2.78%)	0	0	0	1 (1.25%)
Post-ileal	0	0	0	0	0
Paracolic	2 (5.56%)	0	0	0	2 (2.5%)
Ectopic	0	0	0	0	0

[Table/Fig-1]: Showing the variation of positions of vermiform appendix in both groups (perinatal and adult).

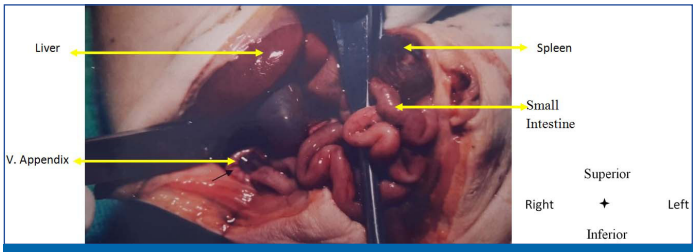
Out of 66 perinatal cadavers, 14 numbers of cases were having congenital malformations. Nine were males and five were females. As a whole, 8 cases (57.14%) had retrocaecal appendix and 6 cases (42.86%) had their appendix in pelvic position [Table/Fig-2].

Out of 9 males, 6 (66.67%) had their appendix in retrocaecal position [Table/Fig-3] and 3 (33.33%) had in pelvic position. Two males in the perinatal group had paracolic appendix [Table/Fig-4]. In female group, 2 (40%) had retrocaecal appendix and 3 (60%) had their appendix in pelvic positions.

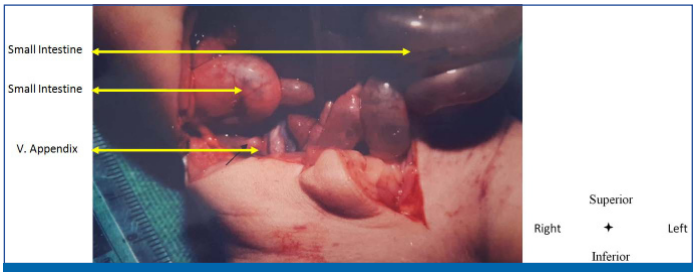
Positions of vermiform appendix in adult: Out of 14 adult cadavers, nine were males and five were females. Out of nine male cases, retrocaecal appendix [Table/Fig-5] was found in eight cases (88.9%). Appendix was found in pelvic position [Table/Fig-6] in one male cadaver (11.1%). Appendix in other positions was not found.

Positions of V. appendix	No. of Cases		Total (14)
	Males (9)	Females (5)	
Retrocaecal	6 (66.67%)	2 (40%)	8 (57.14%)
Pelvic	3 (33.3%)	3 (60%)	6 (42.86%)
Subcaecal	0	0	0
Promontoric	0	0	0
Pre-ileal	0	0	0
Post-ileal	0	0	0
Paracolic	0	0	0
Ectopic	0	0	0

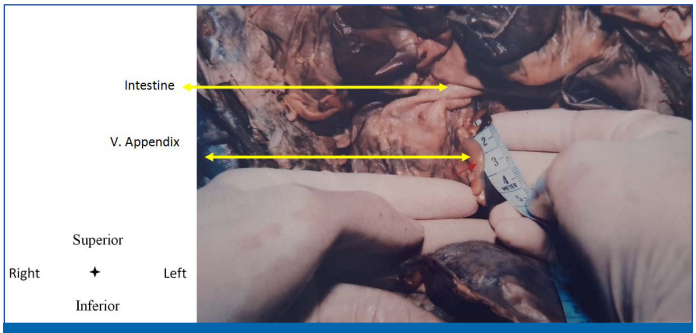
[Table/Fig-2]: Showing the distribution of cases in different positions of V. appendix having congenital malformation (perinatal group).



[Table/Fig-3]: Appendix in retrocolic position (perinatal cadaver).



[Table/Fig-4]: Appendix in paracolic position (perinatal cadaver).

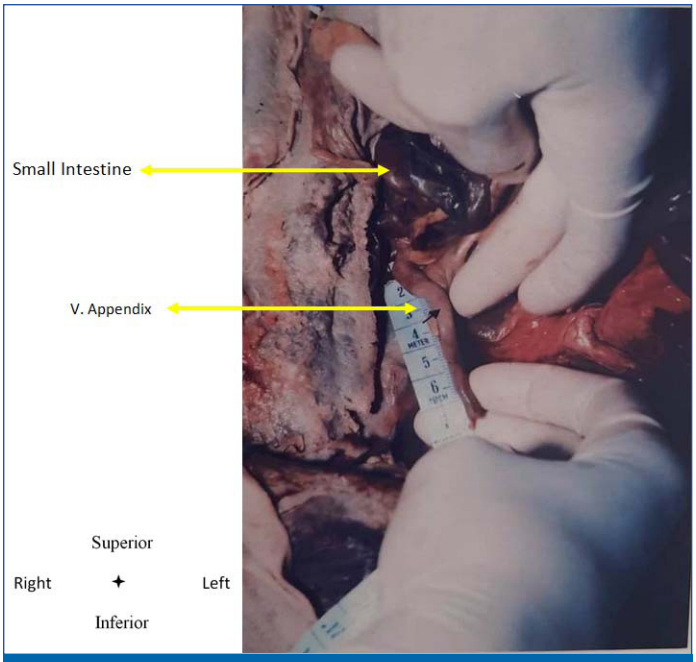


[Table/Fig-5]: Appendix in retrocolic position (adult cadaver).

Out of five female cadavers, appendix in retrocaecal and pelvic positions were found in 2 (40%) and 3 (60%) cases, respectively. So, out of total 14 cadavers, retrocaecal position was recorded in 10 (71.4%) cases and pelvic position was recorded in 4(28.6%) cases. Hence, in adult group retrocaecal position was the commonest in this study [Table/Fig-1].

DISCUSSION

In the present study, the percentage of distributions of the different positions of vermiform appendix was found out. It has been observed that in perinatal group of babies, retrocaecal position was found in highest number of cases (65.15%), followed by pelvic (30.3%), paracolic (3.03%) and pre-ileal (1.52%) positions. Limited literature is available regarding position of appendix in perinatal group in various regions of world [15]. During migration of appendix in intrauterine developmental stage, it may occupy a position which



[Table/Fig-6]: Appendix in pelvic position (adult cadaver).

may be either retrocaecal or retroileal or it may descend into the pelvis [16]. In the present study, maximum cases were retrocaecal, followed by pelvic. However, post-ileal position was absent.

In adult group of male cadavers, vermiform appendix was found in retrocaecal position in (88.9%) of cases, followed by pelvic position in (11.1%) of cases. However, in adult female cadavers, retrocaecal position was found in (40%) of cases and pelvic position in (60%) of cases. As a whole, in adult cadavers, retrocaecal position was found in (71.4%) and pelvic position in (28.6%) of cases. Highest incidence of retrocaecal appendix followed by pelvic and post-ileal positions were reported in the adults of different races around the world [17-21]. However in the present study, other positions were not found as the number of cadavers was limited.

In the present study as a whole, highest number of appendix were found in retrocaecal position which is in accordance to the findings of other studies [22,23]. The second commonest findings was pelvic position which was also noticed by other authors [24,25].

But some contradictory findings to the present study have also been reported by authors like Peterson L, 1934; Wass MJ, 1960; Liertz R, 1909; and Smith GM, 1911 [31-34]. The variation may probably be due to different demography, different data collection methodology or different inclusion and exclusion criteria adopted by the researchers. The most common position i.e retrocaecal (66.25%) found in the present study was supported by various researchers like Wakeley CPG, 1933; Maisel H, 1960; Buschard K and Kjaeldgaard A, 1973; and Collins DC, 1963 in the range between 20.21%-74% [1,17,26,30]. Previous episodes of appendicitis may result in fibrosis leading to fixing of appendix in retrocaecal position [13,14]. The caecal migration may also modify the final position of appendix [1]. As the appendix is fully intraperitoneal in subcaecal position, it can cause diffuse peritonitis, if it is inflamed [12]. The pelvic position which appears to be the second commonest position in the studies done by Ajmani ML and Ajmani K, 1983; Ojeifo JO et al., 1989; Barkheit MA, and Warielle AA, 1999; has been found more prevalent in nonsurgical cases and older individuals [12,15,27].

Limitation(s)

The only limitation of the present study was that there was scarcity of adult cadavers during the study period. As there is dearth of study about perinatal appendix, so, the newborn cadavers were included in the study.

CONCLUSION(S)

Anatomically and developmentally the position of the appendix varies to a great extent. In appendicitis, the signs and symptoms varies from patient to patient depending upon the position of the appendix. In the present study most common position found was retrocaecal. Second commonest position was pelvic. Hence, a thorough knowledge regarding the anatomical variation of appendix is of utmost importance. Otherwise, appendicitis may be misdiagnosed with other medical or surgical conditions. This will lead to development of other complications and longer hospital stay. So, knowledge of various positions of appendix is helpful even in present days. Further research in cadavers and radiological investigations might be helpful in early diagnosis and management of any appendicular pathology.

Study	Place	n	Retrocaecal	Pelvic	Pre-ileal	Post-ileal	Paracaecal	Subcaecal	Ectopic
Collins DC, [30]	-	40,000	25.95%	Appendices anterior to caecum: 74.05%					
Buschard K and Kjaeldgaard A [26]	-	141	56.7%	33.4%	78%		--	2.1%	
Ojeifo JO et al., [15]	Nigeria	548	45.07%	25%	1.82%	14.78%	6.39%	2.37%	4.74%
Maisel H, [17]	Cape Town	300	26.7%	58%	1.3%	3.3%		5%	---
Collins DC, [13]	Los Angeles,USA.	4680	20.21%	7.9%	Appendices with anterior location: 70.72%			1.24%	---
Wakeley CPG, [1]	UK	10,000	65.28%	31.01%	1.00%	O.4%	--	2.26%	0.05%
Ajmani ML and Ajmani K, [12]	India	100	58%	23%	2%	10%	7%	-	-
Solanke TE 1970, [29]	Nigeria	125	38.4%	11.2%	31.2%		Paracolic, paraileal, ectopic =19%		
Bakheit MA and Warielle AA [27]	Sudan	60	58.3%	21.7%	11.7%		11.7%	-	-
Peterson L, [31]	Finland	373	31.0%	42.2%	26.8%		0.0%	-	-
Delic J, [28]	Croatia	50	52.0%	32.0%	10.0%		8.0%	-	-
Prakash DP et al., [24]	India	100	66%	27%	1%	3%	1%	2%	-
Present study 2021 (north-east India)	North-east India	80	66.25%	30%	1.25%	--	2.5%	--	--

[Table/Fig-7]: Frequency of positions of appendix by various authors [1,12,13,15,17,24,26,27-31].

So from the literature reviewed, it has been observed that there were number of studies on different positions of appendix from time to time in different regions of the world. The findings of the present study correlates with the findings of Ajmani ML and Ajmani K, 1983; Bakheit MA and Warielle AA, 1996; Delic J, 2002; as shown in [Table/Fig-7] [1,12,13,15,17,24,26,27-31].

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