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Original Article

Position and Length of the Vermiform Appendix: A Study of 400 Cases in Iranian Population

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ABSTRACT

Background:
The vermiform appendix, the worm-shaped, closed-ended tube containing a large number of lymphoid follicles, displays variations in its position and macroscopic dimensions according to age, sex, race, and other relevant factors. Variable locations of the appendix may mislead physicians into making an incorrect decision or identification of other diseases. Hence there is a necessity for the study of the different positions of the appendix in patients with appendicitis.

Materials and Methods:
The present study was carried out on 400 bodies (253 males, 147 females) in the autopsy hall of the Forensic Medicine Organization, Tehran province, Iran, from March 2020 to March 2021. The anatomical position of the appendix was recorded during the autopsy. Appendix length and diameter were measured in millimeters using a ruler. The sex of the bodies was recorded based on the observed phenotype, and their age was verified based on their identity document. The data obtained were analyzed using SPSS software version 20.

Results:
The pelvic appendix was found to be the most common (29.7%) in both men and women, followed by paracecal in (21.8%), prececal (19.5%), retrocecal (12.5%), subcecal (8%), pre-ileal (6%), and post-ileal (2.5%). The association between sex and appendiceal length was statistically significant, with women having longer appendices than men (85.1 ± 13.8 mm vs. 81.9 ± 13.4 mm, $P = 0.028$). Also, the appendiceal diameter was significantly larger in women than in men (3.81 ± 0.7 mm vs. 3.45 ± 0.66 mm, $P = 0.017$). There was a significant association between sex and position of the appendix, with paracecal position being more prevalent in men and retrocecal in women ($P = 0.04$). The mesoappendix was complete in all cases.

Conclusion:
In our study, the commonest position of the appendix was pelvic. The maximal length and diameter of the appendix were 85.1±13.8 and 3.81±0.7 mm, respectively. This shows variations with related reports from other populations. Knowledge of these variations is essential for early detection, treatment, and fewer complications for related diseases.

Keywords: Vermiform appendix; Appendicitis; Variable locations; Iranian population

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INTRODUCTION

The appendix is a worm-like, narrow, elongated, blind-ended extension of the large intestine of certain mammals, having an immunological function. It varies in position and macroscopic dimensions from person to person (1,2). Nevertheless, variations can also be identified even within the same age, sex, and race (3-5). Its length varies from 20 to 200 mm with an average of 90 mm and is usually about 5 mm longer in men than in women (6). Appendix emerges during embryological life

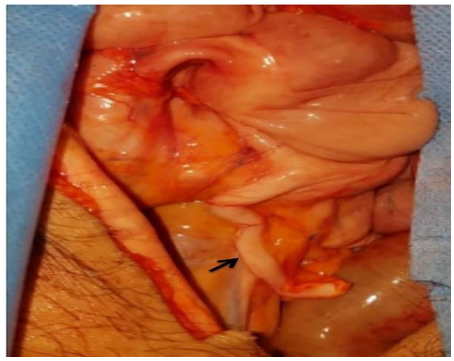

Figure 1: **Photograph of a vermiform appendix found in the current study to be in the pelvic position (arrow)**

from the posteromedial wall of the cecum, below the ileocecal valve, and located in the right lower region of the abdomen (7). The connection of the base of the appendix to the cecum remains constant, while its head can be located in different situations. Retrocecal, paracaecal, subcecal, pre-ileal, pos-tileal, and pelvic are six classified situations for appendix location (8). Therefore, variations in the anatomical location affect pathogenesis, surgical approach, presentation, and prognosis of appendicitis. Variable locations of the appendix may mislead physicians to make an incorrect decision or identification of other diseases, delayed diagnosis of acute appendicitis may cause its perforation and following abscess or peritonitis, then knowing common location(s) of the appendix helps on-time diagnosis of acute appendicitis (9). So, precise information about the anatomical position of the appendix can ameliorate the prognosis of the disease. Hence there is a necessity for the study of the different positions of the appendix in patients with appendicitis. This study aimed to determine the anatomical position of the appendix, its length, and their relationship with age and sex on the dead bodies that had been referred for medicolegal autopsy.

MATERIALA AND METHODS

The present study was carried out on 400 bodies (253 males, 147 females) in the autopsy hall of the Forensic Medicine Organization, Tehran province, Iran, from March 2020 to March 2021. The population of the study was randomly selected from the dead bodies that needed an autopsy to identify their cause of death. The study was performed on corpses of different ages and sexes. Inclusion criteria were Iranian citizens and the necessity to perform autopsies on the corpses to identify the cause of death. Moreover, non-Iranian corpses, unidentified corpses, disintegrated corpses, corpses with severe burns, advanced mortis-corruption corpses, corpses with fetal anomalies, old or new abdominal surgery, peritonitis, intestinal distension, and any reason to modify the anatomical location of the appendix were excluded from the study.

This study was confirmed by the Ethics Committee of the Legal Medicine Organization with the ethics code of IR.LMO.REC.1398.049. Appendix length was determined by a trained doctor and measured in millimeters with a ruler and completeness of mesoappendix. The sex of the bodies was recorded based on the observed phenotype, and their age was verified based on their identity documents. Raw data were collected and analyzed using SPSS software version 20 (IBM, Chicago, USA). Chi-square test was used in the analysis of descriptive statistics for the frequency, and $P< 0.05$ was considered statistically significant.

RESULTS

This study was performed on 400 bodies: 253 of them (63.3%) were males, and 147 (36.7%) were females. The mean age of the study population was 43.3 ± 15.66 years (range: 15-90 years). Most cases belonged to the age group of 36-55 years. The mean length of appendices was 83 ± 13.6 mm (range 10-120 mm). The mean diameter of the appendices was 3.5 ± 0.68 mm (range: 2-5 mm). The mean age did not significantly differ between the sex groups ($P = 0.97$). Moreover, there was not any significant association

Table 1: Association between the position of appendix and sex in Iranian cadavers

Position, N (%)	Male(N=253)	Female(N=147)	Total	Chi-square	*P value*
Retrocecal	21 (8.3%)	29 (19.7%)	50 (12.5%)	13.144	0.0.04
Prececal	50 (19.8%)	28 (19%)	78 (19.5%)		
Paracecal	63 (24.9%)	24 (16.3%)	87 (21.8%)		
Subcecal	21 (8.3%)	11 (7.5%)	32 (8%)		
Preileal	16 (6.3%)	8 (5.4%)	24 (6%)		
Postileal	6 (2.4%)	4 (2.7%)	11 (2.8%)		
Pelvic	76 (30%)	43 (29.3%)	118 (29.5%)		
Total	253 (100%)	147 (100%)	400 (100%)		

Table 2: Association between the position of appendix and age group in Iranian cadavers

Position	Age group (in years)				Total	Chi-square	*P value*
	15-35	36-55	56-75	≥76			
Retrocecal	14 (10.7%)	27 (14.7%)	9 (12.7%)	0 (0%)	50 (12.5%)	16.043	0.59
Prececal	25 (19.1%)	37 (20.1%)	12 (16.9%)	4 (28.6%)	78 (19.5%)		
Paracecal	33 (25.2%)	37 (20.1%)	16 (22.5%)	1 (7.1%)	87 (21.8%)		
Subcecal	9 (6.9%)	14 (7.6%)	7 (9.9%)	2 (14.3%)	32 (8%)		
Preileal	8 (6.1%)	6 (3.3%)	8 (11.3%)	2 (14.3%)	24 (6%)		
Postileal	3 (2.3%)	5 (2.7%)	2 (2.8%)	0 (0%)	11 (2.8%)		
Pelvic	39 (29.7%)	58 (31.5%)	17 (23.9%)	5 (35.7%)	118 (29.5%)		
Total	131 (100%)	184 (100%)	71 (100%)	14 (100%)	400 (100%)		

between age groups and appendix length ($P = 0.35$), and diameter ($P = 0.65$). The association between sex and appendiceal length was statistically significant, with women having longer appendices than men (85.1 ± 13.8 mm vs. 81.9 ± 13.4 mm, $P = 0.028$). Also, the appendiceal diameter was significantly larger in women than in men (3.81 ± 0.7 mm vs. 3.45 ± 0.66 mm, P=0.017). The most common position of appendix cases was pelvic (29/7%) in both men and women (figure1).

Other variations include paracecal (21.8%), prececal (19.5%), retrocecal (12.5%), subcecal (8%), pre-ileal (6%) and post-ileal (2.8%), respectively. Notably, there was a significant association between sex and position of the appendix, with paracecal position being more prevalent in men and retrocecal in women ($P = 0.04$, table 1).

Also, the mesoappendix was complete in all cases. In this study, the pelvic position was the most common appendiceal position in all age groups. As shown in table 2, no significant association was found between appendiceal position and age groups ($P = 0.59$).

DISCUSSION

In this study, the most common position of the appendix was pelvic with 29.7%, and the lowest was postileal position in 2.8 % of the study population. Pelvic location was the dominant location in other studies with a different population, such as Mohammad Ashfaqur Rahman (1), Katzurski, et al (10) Ojeifo et al. (11), Rahman et al. (12), Paul et al. (13), and also in Iranian population in Ghorbani et al. (14) and Tofighi

(15) studies. On the other hand, some studies reported that the most common position of the appendix is retrocecal and pelvic such as Ojeifo et al. in Bosnia (11), Clegg-Lamptey et al. in Ghana (16), L. Ajmani and K. Ajmani in India (17), and S. Mohammadi et al. in Iran (18). These similarities and differences among the studies show that many factors are involved in determining the appendix position. Race can be one of the main factors in all of the studies. The most common location of the appendix in both men and women was the pelvic position. Its frequency was 76 (30%) in the male population and 43(29.3%) in the female population. It shows no significant differences in the pelvic location of both sexes. However, Ahmad Ghorbani and colleagues (14) showed that pelvic location in women is more frequent than in men. We posit that the differences are due to sampling and methodological variations.

According to our results, the appendix length was longer in women than in men. Similar studies of Bakheit and Warille (19) and Rahman et al. (12) show the same results, but it is contrary to studies done by Katzurski et al. (11), Gholalipour et al. (20), and L. Ajmani and K. Ajmani (17), that have indicated that length of the appendix in men is longer than in women. Thus, it is likely that the variation between our results and previous studies is due to population differences.

In our study, the mesoappendix was complete in all cases. As shown in the study by Gorbani and colleagues (15) incomplete mesoappendix is highest in the age group below 10 years and leads to the severity of appendicitis in childhood. Therefore, in our study, the age group that was above 15 years can be one of the reasons for complete mesoappendix in all cases. The minimum age group was 15 to 35, and the maximum age group was ≥ 76. We did not find any statistically significant association between age groups and appendix location. Also, a larger sample size is needed to make better decisions and also using in all age groups, especially those below 10 years, to reach a strong confirmation of the association between age and appendix position.

In conclusion, this study revealed the most common position of the appendix among the Iranian population, which can likely help in the diagnosis and treatment of appendicitis.

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CONFLICT OF INTEREST

The authors declare no conflict of interest related to this work.

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