Position and Length of Appendix among Delhi Population-An Autopsy Based Study

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ABSTRACT

Vermiform appendix reportedly shows lots of variations in its position and length among different individuals. The signs and symptoms presented by acute appendicitis requiring medical or surgical intervention may vary accordingly. Hence, medical practitioners should have a fair knowledge of such variations to diagnose the underlying pathology. Knowledge about variations in the position and length of the appendix is also equally important for its removal through minimally invasive surgery. The present study was conducted at Lady Hardinge Medical College, New Delhi from October 2018 to March 2020 to observe the variations in position and length of appendix in the dead bodies brought for routine medico-legal autopsies. Among 200 randomly selected deceased individuals, males were 88.5% whereas females were 11.5%. Maximum numbers of individuals were found in the age group 31–40 years (23%), followed by 41–50 years (22.5%) and then 21–30 years (22%). The mean age of the individuals was 43 ± 14.98 years, with an age range varied from 14 to 90 years. Position of the appendix was found pre-ileal in 6.5%, post-ileal in 10%, promonteric in 12%, pelvic in 21%, retro-caecal in 27.5%, para-colic in 13.5%, sub-caecal in 6.5% and others in 3% cases. Retro-caecal position was the most common position in the present study. The mean length of the vermiform appendix was found to be in the range of 0–5 cm in 10.5%, 5–10 cm in 63%, 10–15 cm in 21.5%, 15–20 cm in 4.5%, and more than 20 cm in 0.5% cases. The mean (average) length of the vermiform appendix was 8.4 ± 3.07 cm, with a range varied from 4.2 cm to 21.1 cm. The position of the appendix could not be related to the sex and age of the individual or to the length of the appendix.

Keywords: Length, Position, Variations, Vermiform Appendix.

1. Introduction

Vermiform appendix even being a vestigial human organ, its importance has never ceased to date as prevalence of appendicitis leading to morbidity and health expenditure varies widely across the world. It has been reported that the position and length of appendix vary among different individuals, which may be based upon genetical, gender, age, dietary habits, industrialization, etc. Depending upon variations in the position and length of the appendix, the signs and symptoms presented by acute appendicitis may vary and, can pose diagnostic dilemma during clinical or radiological investigations. Early diagnosis of appendicitis is required for proper medical or surgical intervention to prevent complications like perforation, abscess or peritonitis to reduce morbidity and mortality among patients. Hence, the present study was conducted among the dead bodies brought for medico-legal autopsies at the tertiary care hospital of Lady Hardinge Medical College, New Delhi to get a fair idea about the variations of position and length of appendix among the population of Delhi metro city.

2. AIMS AND OBJECTIVES

1. To study the anatomical variations i.e., position and length of vermiform appendix among corpses autopsied in Lady Hardinge Medical College, New Delhi.
2. To correlate the position of vermiform appendix with sex, age, and length of the appendix.
3. MATERIALS AND METHODS

After obtaining ethical clearance from the institutional ethical committee, the present study was conducted at the Department of Forensic Medicine, Lady Hardinge Medical College, New Delhi from October 2018 to March 2020. Among the dead bodies brought for medico-legal autopsy at Lady Hardinge Medical College, New Delhi during the study period, a total of 200 individuals were selected randomly and studied, excluding decomposed dead bodies and individuals who had undergone appendectomy operations. Consent was obtained either from the relatives or the concerned police in each case. After opening the abdominal cavity using midline incision and reflection of abdominal flaps, the position of the vermiform appendix was observed in-situ. The length of the vermiform appendix from the base to the tip was measured using a cotton thread and then placed over either a measuring tape or measuring scale. For accuracy, the length of the vermiform appendix was measured three times and the mean length of the three measured lengths was taken. The relevant information and findings of the observation were recorded in a pre-designed structured proforma. For statistical analysis, SPSS 22.0 software was used.

4. RESULTS AND DISCUSSION

4.1. Sex

In the present study, out of 200 cases, there were 177 (88.5%) male individuals and only 23 (11.5%) female individuals (Table I). The equal number of female individuals could not be taken as we usually received less number of female dead bodies during routine medico-legal autopsy at Lady Hardinge Medical College, New Delhi.

The percentages of females in studies conducted by references [1]–[9] on vermiform appendix were 35%, 19.3%, 32%, 50%, 50%, 12.2%, 39.95%, 23.5% and 47%, respectively.

4.2. Age

In the present study, maximum numbers of individuals were found in the age group 31–40 years (N = 46, 23%), followed by the age group 41–50 years (N = 45, 22.5%) and then age group 21–30 years (N = 44, 22%). Only one individual was in the age group more than 80 years whereas no case was found in the age group 0–10 years (Table II). The mean age of the individuals was 43 ± 14.98 years, with an age range varied from 14 to 90 years.

Among the 177 male individuals, most of them belonged to the age group 41–50 years (24.29%), followed by the age group 31–40 years (23.72%), and then the age group 21–30 years (20.90%) (Table II). The mean age of the male individuals was 42.97 ± 14.55 years, with an age range varied from 14 to 90 years.

 Among the 23 female individuals, most of them belonged to the age group 21–30 years (30.4%), followed by the age group 61–70 years (26.08%), and then the age group 31–40 years (17.39%) (Table III). The mean age of the female individuals was 43.17 ± 18.34 years, with an age range varied from 20 to 70 years.

Reference [10] reported that age ranged from 0 to 65 years. Reference [2] reported that there were 92.7% of adults (age ≥18 years old) and 4.3% of children (age <18 years old). Reference [3] reported that the age range was 50–90 years. Reference [11] reported that the age of the subjects ranged from 18 to 67 years. Reference [12] reported their study on 40 adult cadavers and 50 dead fetuses. Reference [6] hard reported that age ranged from 18 to 89 years (mean = 33.6 years). Reference [13] reported that the mean age was 40.46 years.

Most of the studies were found silent on age regarding variations of length and position of the vermiform appendix. Hence, no comment could be offered regarding the comparison of age of study subjects with other studies.

4.3. Position of the Vermiform Appendix

Among the 200 individuals taken for the study, position of the vermiform appendix was found pre-ileal in 13 (6.5%), post-ileal in 20 (10%), promonteric in 24 (12%), pelvic in 42 (21%), retro-caecal in 55 (27.5%), para-colic in 27 (13.5%), sub-caecal in 13 (6.5%) and others in 6 (3%) cases. Retro-caecal position was the most common position in the present study (Table III).

Among the 177 male individuals, position of the vermiform appendix was found pre-ileal in 12 (6.77%), post-ileal in 17 (9.60%), promonteric in 21 (11.86%), pelvic in 36 (20.33%), retro-caecal in 51 (28.81%), para-colic in 26 (14.68%), sub-caecal in 11 (6.21%) and others in 3 (1.69%) cases. Retro caecal position was the most common position in the males in the present study (Table III).

Among the 23 female individuals, the position of the vermiform appendix was found pre-ileal in 01 (4.3%), post-ileal in 03 (13.04%), promonteric in 03 (13.04%), pelvic in 06 (26.08%), retro-caecal in 04 (17.39%), para-colic in 01 (4.34%), sub-caecal in 02 (8.69%) and others in 03 (13.04%) cases. Pelvic position was the most common position followed by retro caecal position in the females in the present study (Table III). However, as the number of females in our study was too small, no relevance could be drawn out of it.

<p>| TABLE II: AGE DISTRIBUTION OF THE INDIVIDUALS |</p>
<table>
<thead>
<tr>
<th>Sl. no</th>
<th>Age group (in years)</th>
<th>Male individuals N (%)</th>
<th>Female individuals N (%)</th>
<th>Total individuals N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0–10</td>
<td>00 (00)</td>
<td>00 (00)</td>
<td>00 (00)</td>
</tr>
<tr>
<td>2</td>
<td>11–20</td>
<td>07 (3.95)</td>
<td>01 (4.3)</td>
<td>08 (4)</td>
</tr>
<tr>
<td>3</td>
<td>21–30</td>
<td>37 (20.90)</td>
<td>07 (30.4)</td>
<td>44 (22)</td>
</tr>
<tr>
<td>4</td>
<td>31–40</td>
<td>42 (23.72)</td>
<td>04 (17.39)</td>
<td>46 (23)</td>
</tr>
<tr>
<td>5</td>
<td>41–50</td>
<td>43 (24.29)</td>
<td>02 (8.69)</td>
<td>45 (22.5)</td>
</tr>
<tr>
<td>6</td>
<td>51–60</td>
<td>28 (15.81)</td>
<td>03 (13.04)</td>
<td>31 (15.5)</td>
</tr>
<tr>
<td>7</td>
<td>61–70</td>
<td>16 (9.03)</td>
<td>06 (26.08)</td>
<td>22 (11)</td>
</tr>
<tr>
<td>8</td>
<td>71–80</td>
<td>03 (1.69)</td>
<td>00 (00)</td>
<td>03 (1.5)</td>
</tr>
<tr>
<td>9</td>
<td>&gt;80</td>
<td>01 (0.56)</td>
<td>00 (00)</td>
<td>01 (0.5)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>177 (100)</td>
<td>23 (100)</td>
<td>200 (100)</td>
</tr>
</tbody>
</table>
In one of the largest and earliest studies conducted by [14], Wakeley had reported that among 10,000 cases, the position of the appendix was in retrocecal (65.2%), pelvic (31.01%), subcecal (2.26%), pre-ileal (1%) and post-ileal (0.4%) cases. Reference [15] reported that pelvic position was the predominant position (in 33.3%), followed by retrocecal in 32.4%, preileal in 18.8%, and subcecal in 12.8% cases, respectively. Reference [10] reported that the majority (65%) of appendices were in retrocecal position followed by pelvic (31.7%) and post ileal (3.5%). Reference [12] reported position of appendix was the predominant position (79.3%), followed by retrocecal in 13.4%, post-ileal in 7%, and pre-ileal in 0.3% of cases, respectively. Reference [3] reported that the most common position of vermiform appendix was retrocecal (55.5%), followed by pelvic in 23.5%, post ileal 1 in 9%, subcecal in 6.5%, paracolic in 5% and subhepatic in 0.5% cases, respectively. Reference [11] reported that most common position of the appendix was retrocecal (53.57%) followed by pelvic (30.35%), post ileal (12.5%), and subcecal (3.5%). Reference [12] reported position of appendix in adults; 50% retrocecal, 10% subcecal, 15% pelvic, 5% promonteric, 5% mideguinal, 5% preileal, 10% post ileal. In foetuses; 54% retrocecal, 22% subcecal, 10% preileal, 12% post ileal, 2% mideguinal position. Reference [17] reported that the anatomical positions of the appendix were pelvic, subcecal, retrocecal, retroileal, ectopic, and preileal in 55.8%, 19%, 12.5%, 7%, 4.2%, and 1.5% cases, respectively. Reference [4] reported that most common position of vermiform appendix was retrocecal (56.67%) then pelvic (25%), preileal (15%), and post ileal (3.33%). In males, it was retrocecal (23.33%), then pelvic (15%), preileal (8.33%) and post ileal (3.33%). In females, it was retrocecal (33.33%), then pelvic (10%), preileal (6.67%). Reference [18] reported that common appendicular types in males were retrocecal (27%) and pelvic (27%), while in females it was subcecal (36.4%). Reference [5] reported that retrocecal position was observed in 60%, pelvic in 35%, post-ileal in 3.3%, and pre-ileal in 1.7% of cases. Reference [6] reported that positions of the appendix were retrocecal (43.5%), subcecal (24.4%), post-ileal (14.3%), pelvic (9.3%), paracecal (5.8%), pre-ileal (2.4%) and other positions (0.27%). Reference [19] reported that retrocecal appendix was found to be the most common (72.73%), followed by pelvic (11.69%), preileal (10.39%), and subcecal (5.19%). Reference [20] reported that the most common position of the appendix was retrocecal (64%) followed by pelvic (30%), post ileal (4%), and subcecal (2%). Reference [21] reported that retrocecal position of appendix was found in 44%, promontonic position in 29% and pelvic position in 24% of cases. Reference [13] reported that most common position of the appendix was retrocecal, seen in 71.7% of cases followed by pelvic (14.7%), retroileal (6.5%), retropelvic (3.5%), colic (1.2%) and subcecal (1.2%). Reference [22] had reported that pelvic position was most common, seen in 41.83%, followed by retrocecal 35.95%, post-ileal 8.87%, pre-ileal 4.86%, subcecal 3.89%, right paracolic 2.84% and retrocolic 1.76%. Reference [23] had reported that positions of the appendix were found as follow: retrocecal (66%), pelvic (27%), post-ileal (3%), subcecal (2%), paracolic (1%), pre-ileal (1%). Reference [24] reported that the most common position of the appendix was retrocecal (61%) while the second most common position was pelvic (21%). Reference [7] reported that locations of the appendix as follows: retrocecal (55.5%), pelvic (23.5%), retroileal (9.0%), subcecal (6.5%), paracolic (5.0%) and subhepatic (0.5%). Reference [25] reported that most common position encountered in their study was retrocecal (45%). Other positions of vermiform appendix were, pelvic (22.5%), mid-inguinal (20%), pre-ileal (5%), post-ileal (2.5%), paracolic (2.5%) and promonteric (2.5%). Reference [26] reported that positions of the vermiform appendix were retrocecal (62%) followed by pelvic (32%), post ileal (4%) and subcecal (2%). Reference [8] reported that retrocecal appendix was found out to be the most common (46%) followed by subcecal (30%), post ileal (14%), pelvic (8%), and ectopic (2%). Reference [9] reported that the common position of appendix were retrocecal (43%), pelvic (33%), subcecal (13%), post ileal (8%), and preileal (3%). Reference [27] reported that the most frequent position was retrocecal in adults and pelvic in children. Reference [28] reported that prevalence of retrocecal appendix among patients with appendicitis was 35.98%. Similarly, other positions noted were pelvic 25.37%, post-ileal 23.10% pre-ileal 4.16% and subcecal 11.36% cases. The most common position of appendix in patients with appendicitis is retrocecal position followed by pelvic position in both males and females. Reference [29] reported that the percentage frequencies of position of vermiform appendix were 43.33% pelvic 33.33% retrocecal-rectocele, 20% ileal, 3.3% subcecal-paracolic. Reference [30] conducted a systematic review and meta-analysis on variations and morphometric features of the vermiform appendix on 114,080 subjects. Overall, the vermiform appendix was most commonly found in the retrocecal location (32.1%, 95% CI: 29.2–35.1), followed by the pelvic (28.5%, 95% CI: 26.7–30.4) and ileal (14.5%, 95% CI: 11.8–17.7) locations.

### 4.4. Mean Length of Vermiform Appendix

Among the 200 individuals taken for the study, the mean length of the vermiform appendix was found to be in the

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**Table III: Positions of Vermiform Appendix among the Individuals**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Position</th>
<th>Male individuals N (%)</th>
<th>Female individuals N (%)</th>
<th>Total individuals N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pre-ileal</td>
<td>12 (6.77)</td>
<td>01 (4.34)</td>
<td>13 (6.5)</td>
</tr>
<tr>
<td>2</td>
<td>Post-ileal</td>
<td>17 (9.60)</td>
<td>03 (13.04)</td>
<td>20 (10)</td>
</tr>
<tr>
<td>3</td>
<td>Promonteric</td>
<td>21 (11.86)</td>
<td>03 (13.04)</td>
<td>24 (12)</td>
</tr>
<tr>
<td>4</td>
<td>Pelvic</td>
<td>36 (20.33)</td>
<td>06 (26.08)</td>
<td>42 (21)</td>
</tr>
<tr>
<td>5</td>
<td>Retro-caecal</td>
<td>51 (28.81)</td>
<td>04 (17.39)</td>
<td>55 (27.5)</td>
</tr>
<tr>
<td>6</td>
<td>Para colic</td>
<td>26 (14.68)</td>
<td>01 (4.34)</td>
<td>27 (13.5)</td>
</tr>
<tr>
<td>7</td>
<td>Sub caecal</td>
<td>11 (6.21)</td>
<td>02 (8.69)</td>
<td>13 (6.5)</td>
</tr>
<tr>
<td>8</td>
<td>Others</td>
<td>03 (1.69)</td>
<td>03 (13.04)</td>
<td>06 (3)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>177 (100)</td>
<td>23 (100)</td>
<td>200 (100)</td>
</tr>
</tbody>
</table>
range of 0–5 cm in 21(10.5%), 5–10 cm in 126 (63%), 10–15 cm in 43 (21.5%), 15–20 cm in 09 (4.5%) and more than 20 cm in 1 (0.5%) cases (Table IV). Mean (average) length of the vermiform appendix was 8.4 ± 3.07 cm, with a range varied from 4.2 cm to 21.1 cm.

Among the 177 male individuals, the length of the vermiform appendix was found to be in the range 0–5 cm in 19 (10.7%), 5–10 cm in 110 (62.14%), 10–15 cm in 40 (22.59%), 15–20 cm in 07 (3.95%) and more than 20 cm in 1 (0.56%) cases (Table IV). The mean (average) length of the vermiform appendix in the males was 8.4 ± 3.07 cm, with a range varied from 4.2 cm to 21.1 cm.

Among the 23 female individuals, the length of the appendix was found to be in the range 0–5 cm in 02 (8.69%), 5–10 cm in 16 (69.56%), 10–15 cm in 03 (13.04%), 15–20 cm in 02 (8.69) and more than 20 cm in none case (Table IV). The mean (average) length of the vermiform appendix in the females was 8.6 ± 3.36 cm, with a range varied from 4.4 cm to 16.5 cm.

No statistical relevance was found related to the position of the vermiform appendix either with the sex and age of the subject or with the length of the vermiform appendix.

Reference [15] reported that the average length of the appendix was 6.61 cm in males and 6.06 cm in females. Reference [16] reported that the average length of the appendix was 6.47 cm in males and 5.34 cm in females. Reference [1] reported that the length of the appendix varied from 3–14 cm with a mean of 8.2 cm. Reference [2] reported that the average length was 7.6 cm (range 3–16 cm). Reference [3] reported that the average length of the vermiform appendix was found to be 5.436 cm (range 2 cm to 9 cm). Reference [11] reported that appendicular length varied from 6.00 cm to 16.30 cm with a mean (±SD) value of 10.21 ± 2.50 cm and a median value of 10.00 cm. Reference [17] reported that the mean length of vermiform appendix was 91.2 mm and 80.3 mm in men and women, respectively. Reference [4] reported that the average length of the appendix was 5.93 cm. In males, it was 6.30 cm, and in females, it was 5.55 cm. Reference [18] reported that the average length of the appendix was 76.5 ± 23.6 mm, with a minimum of 35 mm and a maximum of 145 mm. Reference [5] reported that lengths of the appendix were found <69 mm in 23.3%, 70–110 mm in 60%, and >110 mm in 16.7%, also the study showed an insignificant difference between the lengths and ages (p < 0.08), and between males and females (p = 0.23). Reference [6] reported that appendix length ranged from 1.0 to 20.0 cm (mean = 11.4 cm). Reference [31] reported that the average length of the appendix was 78.9 ± 18.1 mm ranging from 37 to 120 mm in males, while its length ranged from 38 mm to 96 mm in females with an average of 65.5 ± 17.5 mm. The highest mean length of the vermiform appendix was found in the 41–50 years age group in both genders. Reference [21] reported that the maximum length of the appendix found was 12.1 cm at the age of 33 years. The average length of foetal appendix was 5.4 cm. The average length was 9.2 cm for all other age groups. The average length of all specimens was 7.5 cm. The female appendices were slightly shorter (by around 1 cm) than the male appendices of the same age group. Also, there was a gradual increase in the length of the appendix till the early 4th decade and then showed a gradual decrease. Reference [13] reported that the mean value of the appendix length was 8.52 cm (range, 0.5–16 cm). Reference [22] reported that the average length of the appendix was 7.15 cm in males and 6.13 cm in females. Reference [24] reported that the mean length of the appendix was found to be 5.98 ± 1.6 cm. Reference [7] reported that the average length of the appendix was 55 mm for men and 51 mm for women. Reference [25] reported that the average length of the vermiform appendix in female cadavers was found to be 61.72 mm. The average length of the vermiform appendix in male cadavers was found to be 64.785 mm. Reference [26] reported that the mean length of the vermiform appendix was 7.5 ± 3.2 cm. Reference [28] reported that the length of the appendix ranged from 1.7 cm to 14.7 cm and the mean length was 8.67 ± 2.44 cm. Reference [30] reported that the overall pooled mean length of the vermiform appendix was 80.29 mm (95% CI: 76.68–83.89). Significant differences were found in size of the vermiform appendix between imaging modalities.

5. Conclusion

The present study reconfirmed that variations were seen in the position and length of the vermiform appendix. On statistical analysis, no association was found regarding the position of the appendix either with the sex and age of the individuals or with the length of the vermiform appendix. Therefore, a larger study with an equal number of male and female subjects from different age groups should be conducted to observe any relevance related to the position of the vermiform appendix either with the sex and age of the subjects or with the length of the vermiform appendix.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

References


