ORIGINAL ARTICLE

Variations in the Position and Length of the Vermiform Appendix in Pakistani Population

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ABSTRACT

Background: Though appendix is stated to be vestigial part of GIT, its narrow unilaterally blocked lumen, orifice composed of smooth muscle, its vessel terminates in the organ, lymphatic follicles present between mucosa and muscle layer, this part of gut most likely to acute appendicitis which is commonest cause of 'Acute abdomen' necessitating emergency surgery.

Methods: This cross sectional study was done in 76 cadavers used for routine dissection from the departments of human anatomy for undergraduate teaching of Fatima Jinnah Medical College, Ameerudin Medical College, Sahiwal Medical College and Forensic Medicine department of Mayo hospital. Variations in position, the length of appendix, relation of appendicular base with spinoumbilical line and extent of mesoappendix were documented. To understand association between topography of appendix with age, we made groups and investigated patients in following categories, 1: from birth to eighteen years, 2: from nineteen to thirty seven years, 3 from thirty eight to fifty seven years, 4: from fifty eight to seventy one years belonging to genders.

Results: Pelvic position was most commonly seen in 41.83%, followed by retrocaecal 35.95%, Post-ileal 8.87%, Pre-ileal 4.86%, Subcaecal 3.89%, Rt Paracolic 2.84% and Retrocolic 1.76%. The average length of appendix was 7.15cms in males and 6.13cms in females. Mesoappendix reached the tip in 76.16% of cases. The base of the appendix was located along spinoumbilical line in 57.5%, while it was below it in 17.6%, and above this line in 24.9% in our populations. Knowledge of these variations is important during appendicectomy.

Conclusion: In a striking 30% of cases, the base of the appendix was cephalic to the McBurney's point and furthest from anterior superior iliac spine.

Keywords: Vermiform appendix; Mesoappendix; Position; Length; Anatomy

INTRODUCTION

Variations are law of nature and vermiform appendix is the known to be most variable intra-abdominal organ in the context of position, extent, peritoneal, and organ relations[1]. Vermiform appendix is a part of the gastrointestinal tract located in right iliac fossa. It is wormlike arising during developmental period from the posteromedial wall of the cecum, about 2cm below the ileocecal valve[2,3]. Gladstone and Wakeley are pioneers of first comprehensive study on the position of the appendix, who studied 3000 anatomic dissections in 1924. Previous to this, other authors had stated their belief, from observations at necropsy or operation, that the majority of appendixes are situated anteriorly and that they are free and hang over the brim of the pelvis. Its length varies from 2 to 20cm, in average 9cm[1]. The base of appendix is connected to the cecum, but its head can be placed in different situations. The diversity of situations is categorized into six locations: retrocecal, pelvic, subcecal, preileal, retroileal, and ectopic[4]. Information about the variations in the anatomy of the vermiform appendix is significant because it can derange clinical presentation of appendicitis and complicate differential diagnosis.[5]

Undoubtedly undergoes wide variations in its anatomical positions which is by far most common feature of this part of GIT. No other organ in human body executes such wide spectrum of variations and this particular information is of huge clinical significance Vermiform appendix is the only organ in the human body which has no single definitive anatomical position and exhibits enormous individual variations. The position of the vermiform appendix has evolutionary, pathological and surgical importance. Exact clinical diagnosis of acute appendicitis depends upon anatomical position of vermiform appendix. Tenderness on palpation in the right iliac fossa is not a characteristic feature of retrocaecal appendicitis. When appendix is below caecum or behind caecum and it undergoes appendicitis, patient complaints of pain and clinician elicits tenderness on flexing the hip joint which is due to discomfort associated with psoas muscles. Clinical presentation of appendicitis when appendix is behind

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caecum is similar to that of when gallbladder undergoes infection. When inflamed appendix is present in pelvic territory, surgeon demonstrates parietal peritonitis in infraumbilical area and this is very common in kids and young adults. Post ileal appendix also called missed appendix is common. Preileal appendix is reputed to undergo perforation which leads to diffuse peritonitis[6].

Two anatomical positional variations of appendix are of clinical significance particularly with reference of gangrene, these are when appendix is behind caecum, or behind colon. Appendicitis in these two settings is commonly associated with kinking of their blood supply. Infraumbilical pain is presenting complaint of appendicitis when appendix is present in pelvis and this is due to parietal peritonitis covering urinary bladder and causing discomfort to the organ. Chronic appendicitis when appendix occupies area below liver s strong differential diagnostic condition and presentation is similar to infection of gallbladder[7]. Patient complaints of pain in right lumber region or low backache when appendix is present in a place behind colon and gets inflamed. When appendix is found in front of ileum, it accounts for difficult clinical settings because it is more prone to parietal peritonitis. Current research work was conducted to establish a Pakistani standard of wide spectrum of clinical presentation, related to knowing different anatomical locations of “appendix” and this is crucially important as the ultimate objective quick diagnosis and to avoid unwanted outcomes. Regarding more information of these variations is important during other intra-abdominal procedures.[8] The length of the vermiform appendix is important in influencing the differential diagnosis of acute abdomen[9].

Ethnic and geographical variations have been reported regarding the position of the appendix. This variable anatomy may pose a challenge during appendectomy because it may necessitate extension of a transverse incision or additional muscle splitting. Both these may complicate the surgery, prolong the operating time, and can affect the cosmetic outcome[10,11]. Awareness of these variations is therefore important for preoperative planning. Although appendectomy still remains one of the most commonly performed surgical procedures in Pakistan, there is still scarcity of data on variant anatomy of the vermiform appendix in Pakistan

MATERIALS AND METHODS

The study population of present study was involved 76 bodies. Out of them 17 bodies (14 females and 03 males) were randomly selected from the dead bodies that had been referred to local forensic medicine department of Mayo Hospital for medicolegal autopsy since 12 January 2014 to 12 January 2015. These randomly chosen cadavers needed autopsy to determine their cause of death. They were from different ages and sexes. The study population also included fifty nine human cadavers (42 males and 17 females) obtained during regular DH of FJMC anatomy department, Ameerudin Medical college, and Sahiwal Medical college, were studied. Ethical approval was obtained from the Advanced Study and Research Board, University of the Punjab and Review Committee before commencement of the study.

The inclusion criteria were Pakistani citizen and necessity to perform autopsy. Unknown cadavers, non-Pakistani cadavers, cadavers with severe burns, disintegrated cadavers, decomposed cadavers, cadavers with congenital anomalies, old or new abdominal surgery, peritonitis, intestinal distension, and any reason which might change the anatomical position of the appendix were excluded from the study. Subjects with any gross abnormalities of abdominal organs, fibrosis, kinking or adhesions, and history of abdominal surgery were excluded. Following resection of the anterior abdominal wall, we observed and documented anatomical location of appendix. Current research work involved till seventy one years. Measurement of the length of appendix from its base was taken using a string and a ruler. After noting down its position, the length of appendix and mesoappendix were also measured using vernier caliper. The distance from anterior superior iliac spine (ASIS) and umbilicus (the spinoumbilical line) was measured. Incision point for appendix was the junction of medial two third and lateral one third of a line joining anterior superior iliac spinej and umbilicus . The relation of the base of the appendix with McBurney’s point was determined and classified as cephalad, caudad, or along the spinoumbilical line. Appendix length was measured in centimeters with a ruler and later also by vernier caliper. Completeness of mesoappendix was determined by one of the authors. Sex of the bodies was determined based on the observed phenotype, and their age was recorded based on their identity document. For convenience of differentiating the changes of vermi form appendix in relation to age, collected specimens were grouped in Number of specimen in different age groups. Group A comprised 10 males and 9 females age upto 19 years, Group B comprised 19 males and 12 females age between 19-37 years, group C comprised 10 males and 5 females age between 38-57 years and group D comprised 7 males and 5 females age between 58-71 years. Representative photographs were taken using a Fujifilm A235 digital camera. Data collected was coded and entered in Microsoft Office

Access and analyzed using SPSS version 18.0. The results were tabulated and the data was analyzed and compared with statistical student-t-test and Chi-Square test ($P<0.05$).

RESULTS

The study population of present study was involved 76 bodies. The mean age of the study population was 39.3 years. According to the results, pelvic position was most commonly seen in 41.83%, followed by retrocaecal 35.95%, post-ileal 8.87%, pre-ileal 4.86%, subcaecal 3.89%, right paracolic 2.84% and retrocolic 1.76 photographic representations of variable positions of vermiform appendix in our study.

Fig. 1: Pelvic appendix

Fig. 2: Retocaecal

Fig. 3: Postileal

Fig. 4: Subcaecal

Fig. 5: Retrocolic

Fig. 6: Right paracolic

In males, the minimum length of appendix was 5.15cm and its maximum length was 9.15cm. Average length of appendix in males was 7.15cm and in female the minimum length of appendix was 4.13centimeters and its maximum length was 8.13centimeters. The average length of appendix in female was 6.13cms.When appendix was classified according to its length. The most individuals lie in length range from 4.89cm to 7.98cm.

In group A, age group upto 18 years, pelvic variety was highest in percentages, 38.14%, total number of observation was 19, preileal and postileal was the minimum in number of variety (9.12%) in each. In group B, age group 19 to 37 years pelvic

variety was maximum, in percentages 43.12%, post ileal was the minimum preileal variety (4.04%) and total number of observation was 31. In group C age group 38 to 57 years, pelvic variety was 48.18%. Retrocolic position was nil in position Total number of observation were 15. In group D age group 58 to 71 pelvic variety were 57%, pre ileal position were nil in position. , pelvic variety were 59%, pre ileal position were nil in position. Total number of observation was 11. The highest length of appendix was seen in people 12–18 years old. A significant association was found between the appendix length and different age groups (p value >0.001). Appendix length was significantly greater in men (p value>0.01).

It reached the tip in 79.12% of cases. Mesoappendix was complete in 159 (85.5%) of the studied sample. Incomplete mesoappendix was mostly seen in the age group below 15 years. There was not any significant relationship between gender and status of mesoappendix (p value=0.30).

Results of this study indicates a very large variability of anatomy of vermiform appendix, which together with other factors (age, sex, degree of inflammation etc.) form a complete spectrum of clinical presentation of acute appendicitis.

The base of the appendix was located along spinoumbilical line in 57.5%, while it was below it in 17.6%, and above this line in 24.9% in our populations. The average distance between the anterior superior iliac spine and umbilicus (spinoumbilical line) was 155.5 mm, with a minimum of 116 mm and a maximum of 195 mm. The base of the appendix was located along spinoumbilical line in 57.5%. In the remaining half it was not located along the spinoumbilical line. It was below it in 17.6%, and above this line in 24.9%.

Table 1: Position of appendix inmale and female

Sex	Pelvic	Retro caecal	Post ileal	Pre ileal	Sub caecal	Rt. para colic	Retro colic	Total
Male l*evel of significance P<0.001*	14(41.83%)	12(35.95%)	7(8.87%)	4(4.86%)	3(3.89%)	3(2.84%)	2(1.76%)	45
Female l*evel of significance P<0.001*	9(39.09%)	12(44.46%)	37.14%)	3(3.13%)	2(3.05%)	1(2.18%)	1(1.94%)	31
Total	23	24	10	07	05	04	03	76

Table 2: Average length of differently located Appendices

Position	Average Length Male (cms)	Average Length Female (cms)
Pelvic	7.3	6.9
Retro Caecal	5.5	5.6
Post Ileal	5.6	5.8
Pre Ileal	5.6	4.9
Sub Caecal	5.9	5.9
Retro Colic	9.98	6.7
Average length of Appendix(cms)	7.15cm	6.13cms

Table 3: Position of Appendix according to various authors

Author, Year, no. of specimen	Percentage occurrence of various positions					
	Retro Caecal	Pelvic	Post Ileal	Pre Ileal	Sub Saecal	Rt.Paracaecal
Wakely,1933, 10000	62%	31%	0.4%	1%	2%	-
Shah & Shah, 1942, 59151	4%	16.6%	15.8%	11.7%	4.7%	-
Solanke T F, 1970, 125	38.4%	31.2%	4%	12%	11.2%	2.4%
Golalipur M J, 2003, 117	32.4%	33.3%	2.6%	18.8%	12.8%	-
Present Study	32.69%	36.54%	11.53%	9.62%	5.44%	1.92%

Table 4: Comparison of average length of the appendix according to various authors

Author, Year	Shortest Length (cms)	Longest Length (cms)	Average Length (cms)
Monks & Blake, 1902	1.0	24.0	7.9
Deaver, 1913	1.0	23.0	8.9
Lewis, 1918	2.0	20.0	8.3
Robinson, 1923	1.8	23.0	9.2
Royster, 1927	2.5	20.0	7.5
Hafferl, 1953	2.5	20.0	9.0
Present Study	4.2	10.3	5.9

DISCUSSION

Traditional demonstrations in many surgical training centers is that the appendix lies deep at the meeting point of proximal and distal thirds of the line which is drawn extending from anterior superior iliac spine to umbilicus, so-called Mc. Burney's point [12]. However, in the current study, 42.8% of appendicular bases were not along the spinoumbilical line. This finding is clinically significant. In Africa where open appendectomies form the significant majority [13], surgeons need to be aware of this variation for preoperative planning and better surgical outcomes. Current results postulate that trainee surgeons should not be surprised if the appendix is not easily visualized when a transverse incision is made at the McBurney's point.

A remarkable finding of the present study was that, of the 42.5% appendices that were not along the spinoumbilical line, approximately 27% were cephalic to this line and furthest from anterior superior iliac spine (ASIS). Naraynsingh et al[8] using a double contrast post-evacuation barium enemas for evaluating the McBurney's point, found that, for appendices that were cephalic to McBurney's point, their average distance from ASIS was 42 mm.[14] Our study found an average distance of 93.5±17.5 mm, which is about twice the previous study. This finding is clinically important because if the appendix is cephalic, access to the cecum becomes considerably more difficult when a transverse incision is made at the McBurney's point[15]. It means surgeons in the study population may not find it uncommon to extend their incisions cephalad and do additional muscle splitting to locate the appendicular base. Our findings also concur with Ramsden et al from UK who found 15% of appendices were more than 10 cm from ASIS[16].

A study by Hegde and Hegde[17], using 100 patients in whom a radio-opaque marker was placed during appendectomy, found a more superomedial location of the appendix in 75% of cases. The study by Naraynsingh et al[8] also found 67% prevalence of appendices that were cephalic to spinoumbilical line. However, other studies found a more caudal location of the appendix in their populations.[18] Ramsden et al[18] from UK, for instance, found a more caudal position of the appendix in 75% of cases. Our study found prevalence of only 17%. This difference may be due to ethnic variations in the location of the appendix.

The anatomical position of the appendix is of significance when it comes to clinical presentation of a patient with appendicitis. The area of tenderness in appendicitis will depend upon the length, position of the appendix, part of the appendix with inflammation, direction of the appendix, presence of fibrosis, and kinking or adhesions.[19] In the current study, most appendices were retrocecal[18] followed by pelvic (22%). Our results are concordant with a similar African study from Ghana, which found retrocecal prevalence of 67%. A study among Indians also found a predominant retrocecal position in 68% of cases.[17] However, another African study from Zambia[20] found a predominant pelvic position (43.6%). These differences may be due to genetic and lifestyle factors like nutritional regimens.[21]

The retrocecal position of the appendix is worth appraising. Retrocaecal appendicitis lacks distinctive clinical pattern and has been theorized to follow a more insidious course than other anatomic variants.[22] There is often limited systemic upset and no progression to affect the general peritoneal cavity. In retrocaecal appendicitis it is difficult to elicit tenderness on palpation in the right iliac region and even deep pressure may fail to elicit tenderness because the caecum, distended with gas, prevents the pressure exerted by the palpating hand from reaching the inflamed appendix, so it has been termed "silent appendicitis.[23] Retrocecal appendix has also been postulated to have high chances of gangrenous complication because their blood supply is more prone to kinking and more liable to inflammation when fixed retrocecally.[24]

Two studies looked at the retrocecal position of the appendix and its influence on clinical presentation. Stranding[1], found no distinctive clinical pattern in a series of 105 cases The study by Chaudhari et al[25]. which looked at retrocecal anatomy and perforation rates at presentation, also found no significant association between retrocecal position and perforation rates. However, the risk of perforation was 60% higher in the retrocecal group. Comparing these two studies with previous ones, further research is needed to definitively quantify the clinical relevance of retrocecal appendix.

Subhepatic location of the appendix is generally rare with most cases being documented in case reports.[26] A notable observation in the present study was the relatively high frequency of subhepatic appendix (4.2%), only comparable to 4% reported among Pakistani's. This position is thought to be caused by defective migration of the caecum during development or due to adhesions[27]. Knowledge of this position is important because subhepatic appendicitis can cause a diagnostic dilemma as it may mimic hepatobiliary or renal disease[28].

The average length of appendix was 91.2 mm for men and 80.3mm for women, within the range reported in the literature[29]. When inflamed, abnormally longer appendices may simulate inflammation of other structures such as enteritis,

salpingitis, scrotal pains, and endometriosis[30]. Accordingly, appendicitis should always be considered as a differential diagnosis in acute abdomen even when the pattern of pain or tenderness is not at the right iliac fossa.[31]

CONCLUSION

The topography of vermiform appendix in Pakistani population shows variation from other populations. In a striking 30% of cases, the base of the appendix was cephalic to the McBurney's point and furthest from anterior superior iliac spine. This means surgeons employing transverse incisions may need to do additional muscle splitting to locate the appendicular base. In this part of the world where open appendectomies are common, surgeons need to be aware of this variation for better operative outcomes.

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