Original Article

Assessment of Length, External Outer Diameter and Positional Variations in Normal and Inflamed Appendix

Parameters in Normal and Inflamed Appendix

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ABSTRACT

Objective: To assess the length, external outer diameter and positional variations in normal and inflamed appendix among the adult population of Rawalpindi operated for acute appendicitis.

Study Design: Cross sectional

Place and Duration of Study: This study was conducted at the Department of Surgery and histopathology of Benazir Bhutto Hospital. Two years (Jan 2018 to Feb 2020).

Materials and Methods: Two hundred patients operated for acute appendicitis were included in the study. Out of these, patients confirmed on gross examination and histopathology were classed as true cases. Length and external outer diameter were calculated for both inflamed and non-inflamed appendices. Mean length and external out diameter was compared in both the groups. Positional variations were also noted for all the appendices removed may they be inflamed or not inflamed.

Results: Out of 200 patients operated with clinical suspicion of acute appendicitis, 179 (89.5%) showed the presence of inflammation on gross and histopathology while 21 (10.5%) had non-inflamed appendix. Mean age of the study participants was 30.6±2.17 years. Mean length of the appendix in cases with confirmed inflammation was 08.37 ± 3.4 cm while without inflammation was 6.72 ± 3.1cm (p-value<0.01). Mean external outer diameter of the appendix in cases with confirmed inflammation was 4.22 ± 2.1mm while without inflammation was 3.37 ± 1.4 mm (p-value<0.01). Most common type of location in both the groups was retrocecal.

Conclusion: Inflammation may pose a direct effect on length and diameter of the appendix as there was a significant increased length and diameter recorded in patients with confirmed inflammation as compared to those without any inflammation. Position of appendix was almost same in both the groups.

Key Words: Appendicitis; Anatomical Parameters; Relationship

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INTRODUCTION

Statistics from studies performed around the globe conclude that acute appendicitis has been a common clinical condition.[1] Appendectomy has been one of the most commonly performed surgical procedures around the world.[2] Diagnosis is usually clinical, supported by the relevant investigations.

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Most of the patients undergo surgical management for this inflammatory condition.[3] Infalmation may bring about certain anatomical changes in the organ or there may be certain anatomical predispositions which could increase the chance of getting inflamed.

Appendix has a unique anatomical profile. It is basically a true diverticulum at the base of the cecum. It is worm-like, long organ with tubular architecture. In comparison to take an abnormal sac or pouch formed at a weak point in the wall of the alimentary tract, it is a true an abnormal sac or pouch formed at a weak point in the wall of the alimentary tract of the colon and contains all of the layers of colon: mucosa, submucosa, longitudinal and circular muscles, and tissue of a serous membrane. It has multiple variations in its position which include retrocecal, subcecal, pre-ileal and post-ileal, and pelvic. Usually when this organ gets inflamed there is disruption in routine anatomical profile and length or diameter of this organ may vary depending upon the duration and extent of inflammation.[4,5]

Various anatomical parameters related to appendix and variation in them due to inflammation have been discussed in various papers published in the past.

Willekens et al. in 2014 did a backdated evaluation of one hundred eighty-six sick persons undergoing CT of abdomen without feeling of acute appendicitis. In a given sample of representation and measurements (including maximum outer diameter, thickness of wall, length, content, location of base and tip) of normal tube-shaped sac attached to and opening into the lower end of the large intestine were noted. They came up with the findings that the mean maximal diameter of the appendix was 8.19 mm±1.6 (SD) (range, 4.2-12.8 mm). The mean length of the tube-shaped sac attached to and opening into the lower end of the large intestine was eighty-one point eleven mm± twenty-eight point forty-four (SD) (range, seven point two-one hundred fifty-eight point eight mm). The mean thickness of wall the tube-shaped sac attached to and opening into the lower end of the large intestine was two point twenty-two mm± zero point fifty-six (SD) (range, one point fifteen-three point eighty-five mm). The most common site of the tube-shaped sac attached to and opening into the lower end tip of the large intestine was pelvic in sixty-six percent appendices. The most common location of the tube-shaped sac attached to and opening into the lower end of the large intestine base was inferior, medial, and posterior in thirty-seven percent. The normal appendix contained high-density material in 2.2%. There was a significant correlation between gender and appendiceal length, with men having longer appendices than women.6 Park et al. studied this phenomenon long ago in 2007 and concluded that a maximum outer diameter (MOD) >6 mm has been regarded as the most reliable feature in diagnosing acute appendicitis. In a recent report, a MOD > 5.7 mm was suggested as the optimal criterion to diagnose acute appendicitis in children.[7] Mwachaka et al. in 2014 performed a similar study on the normal population and revealed that commonest appendicular types in males were retrocecal 10 (27%) while in females was subileal 4 (36.4%). The average length of the appendix was seventy-six point five ± twenty-three point six mm. The base of the appendix was located along, below, and above the spinoumbilical line in 25 (52.1%), 9 (18.8%), and 14(29.2%) cases, respectively.[8] Abegaz et al published a similar study in 2016 with a conclusion that retrocecal appendix was found to be the most common (72.73%), followed by pelvic (11.69%), preileal (10.39%), and subcecal (5.19%). Postileal position was not observed in this study. The association between age of the patients and the occurrence of appendicitis was statistically significant ($P < 0.05$) while the association between sex and position of appendix was not significant.[9]

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Surgery and histopathology of Benazir Bhutto Hospital. Two years (Jan 2018 to Feb 2020). WHO sample size calculator was used to calculate the sample size for this study with population prevalence proportion of 12.5%.[11] Nonprobability consecutive sampling was done to recruit the patients for this study. All the patients between the age of 18 and 60 years presenting with symptoms of acute appendicitis and diagnosed and operated at the surgical unit by the consultant surgeon. Exclusion criteria were the patients more than 60 years of age or those who did not consent to or those with a past or current history of any abdominal surgery. Patients with any autoimmune disorder or hematological or lymphoid malignancy were also excluded from the study.

Ethical approval (IREB letter number: F,2/IUIC-ANMC/EC-127/2016) was granted by the ethical committee and formal consent from the patients and controls after providing them all the information regarding the study and mentioning them their right to withdraw at any time from the study if they don't feel comfortable being the part of study. The abdomen was opened by a xifopubic midline incision. The vermiform appendix was located by simple exposure of the lower ileocecal recess or, in difficult cases, we followed the teniae to their junction at the apex of the cecum and base of the appendix.[12] The appendix positions were defined as follows: Retrocecal/ retrocolic: the appendix courses upwardly behind the cecum, and may reach the initial portion of the ascending colon; pelvic: the appendix is directed downward, over the psoas major, with its tip surpassing the upper edge of the lower pelvis. Post-ileal: the distal portion of the appendix is in a position posterior-superior to the terminal ileum and directed to the spleen; Subcecal: the appendix is located under the cecum, resting on the right iliac fossa and separated from the iliac muscle by a local peritoneal lining; Pre-ileal: the distal portion of the appendix is located in a position anterior-superior to the terminal ileum and directed to the spleen; Paracecal position: the appendix is situated laterally to the cecum and ascending colon; Other (ectopic) positions: the appendix does not fit in any of the positions above described.[13,14]

Length and external diameter was measured in each case according to the standard method.[15]

Descriptive statistics were used in the study to describe the variables of the study. Qualitative variables like patients with and without obvious inflammation and variations in anatomical position of appendix were mentioned in frequency and percentage. Mean and standard deviation was calculated for age, length of appendix and external diameter in patients with and without obvious inflammation. Student t-test was applied to look for the difference of mean values of length and external diameter in patients with and without confirmed inflammation. SPSS-23.0 was the software used to process all the data and perform the analysis. Differences between groups were considered significant if p-values were less than or equal to 0.05.

RESULTS

Out of 200 patients operated with clinical suspicion of acute appendicitis, 179 (89.5%) showed the presence of inflammation on gross and histopathology while 21 (10.5%) had non-inflamed appendix. Mean age of the study participants was 30.6±2.17 years. Table I shows the general characteristics of the study participant. Table II shows that mean length of the appendix in cases with confirmed inflammation was 08.37 ± 3.4 cm while without inflammation was 6.72 ± 3.1cm (p-value<0.01 on student t-test). Table II also reveals that mean external outer diameter of the appendix in cases with confirmed inflammation was 4.22 ± 2.1mm while without inflammation was 3.37 ± 1.4 mm (p-value<0.01 on student t-test). Most common type of location in both the groups was retrocecal followed by pelvic.

Table No.1: Characteristics of study participants

Age (years)	
Mean ± SD	30.6±2.17
Range (min-max)	12 years - 59 years
Gender	
Male	150 (75%)
Female	50 (25%)
Gross and histopathology	
Inflamed	179 (89.5%)
Not inflamed	21 (10.5%)
Position of Appendix in Inflammed	
Retrocecal	54 (30.1%)
Pelvic	50 (27.9%)
Sub cecal	7 (3.9%)
Para cecal	3 (1.6%)
Post ileal	31 (17.3%)
Pre ileal	30 (16.7%)
Sub hepatic	3 (1.6%)
other	1 (0.5%)
Position of Appendix in Non-Inflammed	
Retrocecal	6 (28.5%)
Pelvic	4 (19.1%)
Sub cecal	1 (4.7%)
Para cecal	1 (4.7%)
Post ileal	3 (14.3%)
Pre ileal	3 (14.3%)
Sub hepatic	2 (9.5%)
	1 (4.7%)

Table No.2: Comparison of Study Parameters in both the groups

Groups	Inflamed	Not inflamed	p-Value
N	179	21	
Appendix Length (cm)	08.37 ± 3.4	6.72 ± 3.1	<0.001
EOD (mm)	4.22 ± 2.1	3.37 ± 1.4	<0.001

DISCUSSION

This study is instrumental in understanding the changes that occur in the normal anatomical parameters of this organ known as appendix. Acute appendicitis has not been uncommon condition all over the world.[1] Situation is not different in our part of the world and all age groups get affected by this condition but young population is usually more at risk.[10] It would be of utmost importance if clinicians and researchers first fine the normal anatomical parameters associated with this organ and then look for the changes that take place once inflammation has set in Clinicians of Europe, expert of diet and expert of research have been studying on this event for years but limited study has been done in Pakistan. We therefore planned this study with the objective to assess the length, external outer diameter and positional variations in normal and inflamed appendix among the adult population of Rawalpindi operated for acute appendicitis.

Iqbal et al. published a study on Pakistani population in 2012 with the conclusion that retrocaecal position of appendix was most commonly seen (57%) followed by pelvic (28.6%), post-ileal (9.4%) and pre-ileal (4%). The paracaecal and ectopic varieties were 5%.[16] Results of our study were in accordance with their results and most common type of location in both the groups of our study was retrocecal followed by pelvic.

Rettenbacher et al. in 2001 conducted a study with the objective to evaluate the usefulness and limitations of the outer diameter of the vermiform appendix at cross-sectional ultrasonography to confirm or rule out acute appendicitis. They came up with the results that outer appendiceal diameters in the control subjects ranged between 2 and 13 mm, and in 55 (23%) of 240 control subjects, diameters were 6 mm or more. Parameters in the symptomatic sick persons without acute inflammation of appendix ranged between two and eleven mm, and fifty-seven (thirty-two percent) of one hundred eighty sick persons had parameters of six mm or more. Parameters of acute inflammation appendix ranged between six and thirty mm. A diameter of six mm or more confirmed acute inflammation of appendix with a sensitivity of hundred percent; a specificity of sixty-eight percent; positive and negative given values of sixty-three percent and one hundred percent, respectively; and an accuracy of 79%.[17] Our results also supported their findings as mean diameter in inflamed case was significantly higher than the diameter in non-inflamed cases.

Yaqoob et al. published an interesting study with the objective to assess the frequency of visualization, position and diameter of normal appendix on 128-slice multi detector computed tomography (MDCT) in adult population. Their statistics showed that appendix was noted as definitely visualized in ninety-nine percent of sick persons and mean outside diameter of the appendix was five point six ± one point three mm (range three-eleven mm).[18] Though our study design was very different and we confirmed inflammation after the surgery and then measured the length and diameter and

they both turned out to be increased significantly among the inflamed cases.

Mwachaka et al. in 2014 performed a study on the normal population and revealed that commonest appendicular types in males were retrocecal 10 (27%) while in females was subileal 4 (36.4%). The average length of the appendix was 76.5 ± 23.6 mm.8Results of our study strengthened their results both in terms of length and positional variations of the appendix.

There was no record of appendicular parameters before the diagnosis of acute appendicitis therefore it cannot be concluded that current length and diameter of appendix determined during the study has been merely due to the current inflammation. Multiple studies with involvement of cases and healthy controls may help us in determining the exact figures regarding the anatomical parameters of inflammed and non-inflamed appendix.

CONCLUSION

Inflammation may pose a direct effect on length and diameter of the appendix as there was a significant increased length and diameter recorded in patients with confirmed inflammation as compared to those without any inflammation. Position of appendix was almost same in both the groups.

Author's Contribution:

Concept & Design of Study:	Fauzia Siraj
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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