

A Cross Sectional Study of the Position of Appendix in South Indian Population, Comparison with Western Population, and Its Diagnostic Dilemma

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ABSTRACT

BACKGROUND

Appendicitis is a common clinical condition but sometimes diagnosis is delayed when appendix is found at a rare location. The present study was conducted to find out various clinical presentations of appendicitis, to evaluate its various positions in South Indian population and compare the same with western population.

METHODS

The cross-sectional study was conducted among a total of 1000 patients (631 males and 369 females) taken from Government Stanley Medical College and Hospital, Tamil Nadu, India, from 2018 to 2019 with an age range of 18 to > 60 years of both sexes. The clinical symptoms were recorded, demographic details were collected.

RESULTS

The present study included 631 (63.1%) male and 369 (36.9%) female patients including the age category 18 to > 60 years old patients. The anatomical locations of the appendix which were as follows: retrocecal in 860 individuals (86%), pelvic in 110 patients (11%), postileal in 10 (10%), preileal in 10 (10%), subhepatic in 8 individuals (0.8%), paracolic and subcaecal in 1 person respectively (0.1%). In our study, the mean distribution of gender by age in the study population was 157.75 males and 92.25 females. Length of appendix > 119 mm was found in total individuals (32.9%) i.e., maximum than other studies. These results showed an extreme statistically significant P value.

CONCLUSIONS

The present study successfully compared south Indian population with western population. The clinical symptoms were recorded, details of demography, age and sex were collected successfully.

KEYWORDS

Anatomical Locations, Appendix, Appendectomy, South Indian, Western Population

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BACKGROUND

The appendix is regarded as a useless vestigial organ to man, with no known important function, but may develop into a seat of infection and can be a real nuisance at times. It is engulfed by numerous lymphoid tissues in the form of the gut associated lymphoid tissue and harbours beneficial bacteria which helps in the recolonisation of the bowels after flushing of the intestines. The diagnosis of appendix can be challenging, occasionally testing the clinical skills of the most experienced surgeon. The delay in arriving at a diagnosis are related to errors either from the patient or physicians.

It was once postulated that the appendix was used for digestion of plant fibres in earlier hominids since many animals have a long cecum that host bacteria are able to break down cellulose in plant fibre. This has been specifically observed in koalas. With time and progress of mankind and change in dietary habits to more easily digestible and cooked food, the cecum may have shrunk to its original size with the appendix being an atrophied organ.

The appendix is located at the base of the caecum, developing from the midgut. It is attached to a fold of peritoneum called the mesoappendix which provides the source of blood supply by means of the appendicular artery. It varies in thickness and length from just 2 cm in length to 20 cm and in position too.

Gladstone and Wakeley in 1924 conducted the first comprehensive study of the position of the appendix by studying 3000 anatomic dissections. Previous to this, other authors from observations at necropsy or operation had stated their belief, that the majority of appendices are situated anteriorly and that they are free and hang over the brim of the pelvis.¹ The appendix is a remarkably constant structure in man, but occasionally subjected to the extremes of variation like total suppression and duplicity. Its length varies from 2 to 20 cm, with an average of 9 cm.² The appendix is attached to the cecum at its base, but its head can be placed in different locations. The wide range of situations is categorized into six locations: retrocecal, pelvic, subcecal, preileal, retroileal and ectopic.³ The most common position of the appendix is variously described by many authors as retrocaecal (65.3 %), pelvic (78.5 %) and post-ileal.⁴⁻⁶

The studies have hypothesised that anatomic variations of the location of appendix are often responsible for delays in the diagnosis and treatment of acute appendicitis.⁷ In patients with hidden appendix, it has been stated that the paucity of symptoms and signs is responsible for the delayed diagnosis of appendicitis before perforation.⁸ They have observed that the retrocaecal position of the appendix, although less prone to infection, has shown a higher incidence of perforation and serious complications in acute appendicitis. Other studies, one prospective and two retrospective studies have stated that the retrocaecal position of the appendix does not change the clinical course of acute appendicitis.^{7, 9-11} Acute appendicitis is the most common aetiology of acute abdomen in young adults. However, it may also be seen in any age group.¹² The location of the appendix can be influenced by age, sex, race, geographic region and diet.³

The inciting factor for acute appendicitis is the obstruction of the lumen by fecoliths, worms, lymphadenitis and bezoars. This leads to increase in pressure within the appendix causing thrombosis and collapse of the vessels supplying the appendicular wall and proceeding to gangrene and perforation. Diets low in fibre and high in processed foods cause right sided colonic stasis of digested foods precipitating fecolith formation and predisposing to acute appendicitis. The inflammation of the appendix causes irritation of the surrounding peritoneum and is responsible for the various signs in acute appendicitis. The overgrowth of bacteria within the appendix is responsible for the toxic features and release of the endotoxins causes systemic effects.

Inflammation of the appendix usually presents as pain in the abdomen initially around the umbilicus and later localising to the right iliac fossa. In retrocaecal and subhepatic positions of the appendix, it may be around the right lumbar and right hypochondriac site. This may mimic an acute cholecystitis pain or right pyelonephritis pain. In female patients, a right sided adnexal cyst that has undergone torsion or haemorrhage may also be present in the same manner. Patient will also have fever, nausea, vomiting and diarrhoea or constipation. If the appendix is in a retrocecal or paracecal position the presentation of symptoms may be somewhat delayed and patients may come to us with a perforated appendix or appendicular abscess or mass formation. A duodenal perforation may also have pain initially around the right lower abdomen i.e. valentino syndrome. Acute appendicitis is also characterised by many signs like Rovsing sign (pain in right lower abdomen on palpation of left lower quadrant), Dunphys sign (Coughing aggravates the abdominal pain), McBurney's point tenderness (tenderness at a point between the medial two-thirds and lateral one-third on the line joining the umbilicus and the anterior superior iliac spine), Psoas sign (increase in pain on extension of the right thigh) and Obturator sign (internal rotation of the right thigh causing exasperation of the pain). A complete hemogram in a patient with acute appendicitis will show signs of inflammation like leukocytosis and left shift of the neutrophils.

A comprehensive scoring system has been developed to help in the diagnosis of acute appendicitis based on these signs and symptoms called the Alvarado scoring system and the Tzanakis scoring system. Other differential diagnosis for acute appendicitis may include right iliopsoas abscess, mesenteric lymphadenitis, pelvic inflammatory disease, and inflamed Meckel's diverticulum. The various complications arising out of acute appendicitis include gangrene of the appendix, perforation, appendicular abscess formation and appendicular phlegmon or mass formation. The systemic effects include sepsis, shock, and death.

Mortality rate of non perforated appendicitis is 0.1 % which is slightly higher than the mortality rate of a general anaesthesia. But, the mortality rate in perforated appendicitis is about 3 % and in the elderly population it may be as high as 15 %. A study on 65 patients who underwent open appendectomy in Serbia had reported pelvic position as the most common position (57.71 %) and paracecal as the least one (3.07 %).¹³

Clinical examination and medical evaluation are the mainstays for diagnosis of acute appendicitis which includes numerous signs and tests to find the position of an inflamed appendix.¹⁴

Diagnosis of acute appendicitis can be aided by knowledge of the common position(s) of the appendix. Physicians may be misleading into making wrong decisions and diagnosis by variations in the positions of the appendix. This delay in diagnosis of acute appendicitis may lead to its perforation and subsequent abscess or peritonitis. Hence, the diagnosis and prognosis may improve with accurate information about the anatomical location of appendix. From the above information it is concluded that, there are lots of conflicting theories regarding the various positions of appendix and also clinical presentation of appendicitis, in relation to different positions.

Hence, there is a need for the study of the various positions of appendix in patients with appendicitis and also the clinical picture and complication in the various positions. The present study was conducted to find out various clinical presentations of appendix and its position in south Indian population and compared with western population.

METHODS

The cross-sectional study was conducted on a total of 1000 patients (631 males and 369 females) taken from Government Stanley Medical College and Hospital, Tamil Nadu, India from January 2018 to December 2019 after taking permission from institutional ethics committee with an age range of 18 to > 60 years of both sexes.

The study was conducted in patients with acute appendicitis diagnosed with the help of clinical examination and other investigations. The clinical symptoms were recorded, demographic details, age, sex were collected. All patients who underwent appendectomy were given antibiotics for 5 to 7 days. Length of vermiform appendix was measured by nylon thread from root to tip of appendix. Thread's length was measured by vernier caliper. External diameter was measured by vernier caliper at a maximum external diameter of the appendix.

Statistical Analysis

The comparative distribution data of patients was presented as percentage. Continuous variables were presented as mean \pm standard deviation with significant P value. 2 - sample Z test was used to compare difference among the groups. Data analysis was performed using the statistical package for social sciences version 20 (SPSS, Chicago, IL, USA).

RESULTS

Table 1 shows that present study included 631 (63.1%) male and 369 (36.9 %) female patients including the age category 18 to > 60 years old patients. Highest number of patients

belonged to age group of 18 to 30 years. The total number of patients belonging to age group of 18 to 30 years showed 75.5 % patients recruited. The total number of patients belonging to age group of 31 to 45 years showed 19.2 % patients recruited. The total number of patients belonging to age group of 46 to 60 years showed 04.3 % patients recruited and the minimum patients recruited to the age group of > 60 years showed 01.0 % patients. The mean gender of the study population was 157.75 ± 228.17 in males and 92.25 ± 118.90 in females. These results showed extremely significant P value.

Age (in Years)	Gender		Total (%)
	Male	Female	
18 - 30	495	260	755 (75.5)
31 - 45	99	93	192 (19.2)
46 - 60	29	14	43 (4.3)
> 60	8	2	10 (1.0)
Total (%)	631 (63.1)	369 (36.9)	1000 (100.0)
Mean \pm SD	157.75 \pm 228.17	92.25 \pm 118.90	
P Value	< 0.001*		

Table 1. Age and Gender Distribution of the Study Subjects (N=1000)

*Extremely statistically significant

Position of Appendix	Gender		Total (%)
	Male	Female	
Retrocecal	529	331	860 (86)
Pelvic	92	18	110 (11)
Postileal	3	7	10 (1)
Preileal	4	6	10 (1)
Paracolic	0	1	1 (0.1)
Subcecal	0	1	1 (0.1)
Subhepatic	3	5	8 (0.8)
Total (%)	631 (63.1)	369 (36.9)	1000 (100.0)
Mean \pm SD	114 \pm 73.52	28.86 \pm 39.67	
P value	<0.001*		

Table 2. Distribution of Study Subjects According to Gender and Position of Appendix (N = 1000)

*Extremely statistically significant

Table 2 shows anatomical locations of the appendix which were as recorded: retrocecal in 860 individuals (86%), pelvic in 110 patients (11%), postileal in 10 individuals (10%), preileal in 10 (10%), subhepatic in 8 (0.8%), paracolic and subcaecal in 1 person respectively (0.1%). The highest position of appendix was found in retrocaecal anatomical position i.e. (86%). Less anatomical position of the paracolic and subcecal was observed in female population. The mean gender of the study population was 114 ± 73.52 in males and 28.86 ± 39.67 in females. These results showed an extreme statistically significant P value.

Age (in Years)	Length of the Appendix (in mm)				Total (%)
	< 40	40 - 79	80 - 119	> 119	
18 - 30	150	44	67	144	405 (40.5)
31 - 45	55	56	66	96	273 (27.3)
46 - 60	27	23	55	65	170 (17.0)
> 60	18	42	68	24	152 (15.2)
Total (%)	250 (25.0)	165 (16.5)	256 (25.6)	329 (32.9)	1000 (100.0)
Mean \pm SD	62.5 \pm 60.42	41.25 \pm 13.65	64.00 \pm 6.06	82.25 \pm 50.64	
P Value	< 0.001*				

Table 3. Association between Length of Appendix and Age among the Study Subjects (N = 1000)

*Extremely statistically significant

Table 3 shows the minimum length of appendix as 19 mm and its maximum length as 91 mm in males and in females respectively.

Length of appendix 80 - 119 mm was found in total individuals (25.6 %). Length of appendix > 119 mm was found in total individuals (32.9 %) i.e., maximum than other length of appendix. These results showed an extreme statistically significant P value.

In this study, an extremely significant association was found between the different age groups and the appendix length (P value < 0.001).

Test of Statistical Significance

To compare sample proportions 2 - sample z-test was used. Test of statistical significance was calculated as follows

	Sample 1	Sample 2
Sample proportion	0.85	0.65
Sample size	1000	3000
Significance level	0.05	
1 or 2 tailed test	1 tailed	

Table 4. Inputs

	Sample 1 (Our Study)	Sample 2 (Gladstone and Wakeley)	Difference
Sample proportion	0.85	0.65	0.2
95 % CI (Asymptotic)	0.8314 - .08686	0.6357 - 0.6643	0.1725 - 0.2275
Z Value	12		
P Value	< 0.001		
Interpretation	Statistically significant, reject null hypothesis that sample proportions are equal		
n by pi	n*pi > 5, test ok		

Table 5. Results

DISCUSSION

The comparative study was conducted on total 1000 patients (631 males and 369 females) with acute appendicitis diagnosed with help of clinical examination and other investigations. The clinical symptoms were recorded, demographic details, age, sex were collected. Data analysis was performed using SPSS version 20.

The present study included 631 (63.1 %) male and 369 (36.9 %) female patients including the age category 18 to > 60 years old patients. The anatomical locations of the appendix were as follows: retrocecal in 860 individuals (86 %), pelvic in 110 patients (11 %), postileal in 10 individuals (10 %), preileal in 10 (10 %), subhepatic in 8 (0.8 %), paracolic and subcaecal in 1 person respectively (0.1 %). The mean gender of the study population was 114 ± 73.52 in males and 28.86 ± 39.67 in females. Similar study, retrocaecal appendix was found to be most common (63 %) position followed by pelvic (18 %), post-ileal (7 %), paracaecal (5 %), subcaecal (3 %), pre ileal (2 %) & sub-hepatic (2 %) when seen intra-operatively.⁷ The anatomical locations of the appendix which were as follows: retrocecal in 111 patients (55.5 %), pelvic in 47 (23.5 %), retroileal in 18 (9.0 %), subcaecal in 13 (6.5 %), paracaecal in 10 (5.0 %), and subhepatic in 1 (0.5 %).¹⁵ Our study shows that an extremely significant association was found between the different age groups and the appendix length (P value < 0.001). In our study, the mean distribution of gender by age

in the study population was 157.75 males and 92.25 females which was comparable with the similar study done.¹ In present study, the most common position of appendix was retrocaecal in 148 individuals (14.8 %) and the lowest was subhepatic position in 8 individuals (0.8 %). This finding correlates with the similar study done.¹⁶⁻¹⁹ Our study found mean lower length of appendix in comparison with other similar study.^{10,20}

CONCLUSIONS

The most common position of appendix is retrocecal which may present as ureteric pain, or right lumbar pain. Also, rarely appendix is seen in left iliac fossa due to malrotation of gut. One should keep in mind that pain and tenderness not present in right iliac fossa does not rule out acute appendicitis.

Knowledge about different positions of the appendix is helpful in identifying the site of occurrence of pain during appendicitis and predicting the possible outcome of appendicitis. The end artery supplying the appendix is one of the causes of occurrence of appendicitis in addition to presence of fecolith and worms.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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REFERENCES

- [1] Ghorbani A, Forouzesh M, Kazemifar AM. Variation in anatomical position of vermiform appendix among Iranian population: an old issue which has not lost its importance. *Anatomy Research International* 2014;2014:313575.
- [2] Tofighi H, Taghadossi-Nejad F, Abbaspour A, et al. The anatomical position of appendix in Iranian cadavers. *International Journal of Medical Toxicology and Forensic Medicine* 2013;3(4):126-130.
- [3] Schwartz SI. Principles of surgery: Pre-Test self-assessment and review. 7th edn. McGraw-Hill, Health Professions Division, 1999.
- [4] Beltré RLR, Franklin R. Topographic presentation of the appendix in 100 cases. *Acta Scientiae Anatomica* 2019;1(2):144-147.
- [5] Kwizera C, Wagner B, Wagner JB, et al. Uncommon differential diagnosis of acute right-sided abdominal pain—case report. *Journal of Interdisciplinary Medicine* 2019;4(1):33-36.
- [6] Kim DW, Suh CH, Yoon HM, et al. Visibility of normal appendix on CT, MRI and sonography: a systematic review and meta-analysis. *American Journal of Roentgenology* 2018;211(3):W140-W150.
- [7] Patel K, Thekdi PI, Nathwani P, et al. A comparative study of different anatomical position, clinical presentation and USG findings with operative findings

- in patients of appendicitis. *Int J Res Med Sci* 2013;1(4):349-353.
- [8] Murthy A. A comparative study of non-perforated and perforated appendicitis. *Global Journal of Medical Research* 2018;18(4).
- [9] Prudhviraaj S, Meghamsha GSL. A clinical study of acute appendicitis in relation to position and size. *Indian Journal of Applied Research* 2019;9(3):1-4.
- [10] Khatun S, Thakur D, Shah DK. Prevalence of retrocaecal appendix among patients with appendicitis in a tertiary care hospital of Nepal. *Journal of the Nepal Medical Association* 2019;57(217):150-153.
- [11] de Souza SC, da Costa SRMR, de Souza IGS. Vermiform appendix: positions and length—a study of 377 cases and literature review. *Journal of Coloproctology* 2015;35(4):212-216.
- [12] Sabiston Jr DC. *Textbook of surgery: the biological basis of modern surgical practice*. 14th edn. WB Saunders Company, 1991.
- [13] Denjalic A, Delic J, Delic-Custendil S, et al. Variations in position and place of formation of appendix vermiformis found in the course of open appendectomy. *Medical Archives* 2009;63(2):100-101.
- [14] Ramsden W, Mannion R, Simpkins K, et al. Is the appendix where you think it is—and if not does it matter? *Clinical Radiology* 1993;47(2):100-103.
- [15] Lamture YR, Salunke B. Anatomical variations related to position of appendix. *Journal of Evolution of Medical and Dental Sciences* 2018;7(46):5830-5834.
- [16] Hicham L, Mohamed L, Mohamed E, et al. An unusual presentation of appendicitis: a 23 cm long appendix in Morocco. *The Pan African Medical Journal* 2019;32:72.
- [17] De Paiva LVE, Bonato LM, da Silva GGP, et al. Congenital abnormalities and anatomical variations of the vermiform appendix and mesoappendix. *Journal of Coloproctology* 2019.
- [18] Sahni D, Aggarwal A, Gupta T, et al. Abdominal Aorta. Chap – 54. In: Tubbs SR, Shoja MM, Loukas M, et al. eds. *Bergman's Comprehensive Encyclopedia of Human Anatomic Variation*. Hoboken, New Jersey: John Wiley & Sons Inc., 2016: p. 619-681.
- [19] Ahmed I, Asgeirsson KS, Beckingham IJ, et al. The position of the vermiform appendix at laparoscopy. *Surgical and Radiologic Anatomy* 2007;29(2):165-168.
- [20] Chaudhari ML, Kapadia DM, Kanani SD, et al. A study of morphology of vermiform appendix in 200 cases. *International Journal of Medical Research & Health Sciences* 2013;2(4):780-785.