Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

A Study to Correlate Different Anatomical Positions of Appendix with Clinical Findings and Intraoperative Findings

Dr. Raghuveer M.N.[1], Dr. Varun H.U.[2], Dr. Ashwin M. Hatwalne[3], Dr. Kuldeep R.[4], Dr. Hemanth Kumar G.K.[5], Dr. Vishal Patil[6]

[1]Associate Professor, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[2]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[3]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[4]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[5]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[6]Postgraduate student, Department of General surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.

Corresponding Author
Dr. Varun H.U., Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.

Received: 09-08-2024 / Revised: 16-08-2024 / Accepted: 25-09-2024

ABSTRACT

Background and Objectives
Acute appendicitis is a frequently challenging cause of acute abdominal pain due to the varying anatomical positions of the appendix, which can lead to diverse clinical symptoms. The aim of this study was to explore the correlation between the anatomical locations of the appendix and the associated clinical presentations. Additionally, the study sought to assess the frequency of different appendix positions in patients who underwent surgery for acute appendicitis.

Methods
This study was conducted at K.R. Hospital, Mysore, involving patients who were diagnosed with acute appendicitis and treated surgically in the Department of General Surgery. The study spanned 18 months, from January 2023, to June 2024, during which 100 cases were evaluated to examine the clinical features and anatomical positions of the appendix.

Results
The study revealed appendicitis predominantly affected individuals in their second decade of life, with a 60% incidence rate, and was more commonly seen in males (64%). Vomiting was reported in (54%) of the cases, and fever in (38%). Urinary symptoms were often linked to a pelvic appendix (16%), while bowel disturbances were predominantly associated with a pre-ileal position (63%). Leukocytosis was observed in 60% of the cases, especially in those with a retro-caecal appendix. The retro-caecal position was identified as the most frequent anatomical location, found in 50% of the cases, followed by pelvic, para-caecal, post-ileal, and sub-caecal positions.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

Conclusion
Acute appendicitis is a medical emergency that requires prompt intervention to prevent serious complications, including the risk of death. Understanding the anatomical position of the appendix in correlation with the clinical presentation can be crucial in determining the optimal surgical approach. This knowledge helps in selecting the appropriate incision site, thereby reducing patient morbidity, choice between open surgery and laparoscopic procedures, ultimately leading to reduced operative time.
Keywords: acute appendicitis, pelvic appendix, Leukocytosis, laparoscopy

INTRODUCTION

The term "appendix" dates back to the Egyptian era (3000 BC). Abdominal paris were taken out and put in Coptic jars with labels explaining what was within during the mummification process. An inscription about the "worm of the intestine" was found when these jars were opened.(1)

Because he was permitted to dissect prisoners who had been put to death by Caesar, Celsus (49 AD) discovered the appendix. The appendix was initially portrayed in anatomy drawings by Leonardo da Vinci in 1492. Anatomy professor Jacopo Beregari da Carpi of Bologna recognized the appendix as an anatomical component in 1521.(2)

Appendix was seen by Vesalius (1543) and Pare (1582) as a component of the caecum. The term appendix vermiformis was first used by Phillipe Verheyen in 1710, and Laurentine likened the appendix to a twisted worm in 1600.

From an embryological perspective, the appendix is a continuation of the cecum and is initially defined in the fifth month of pregnancy. The appendix takes longer to elongate than the remainder of the colon, which causes it to resemble a worm.(3)

The following are the several anatomical locations of the appendix:
It is possible for the appendix to move right and upward. This is the 11 o'clock or paracolic position.

Retrocaecal/retrocolic, or behind the colon or caecum, may be where it is at 12 o'clock.
To the left and upward, the appendix may pass. It points to the spleen. This is the position of the spleen, or two o'clock. The appendix can be located postileally, behind the ileum, or in front of it (preileal).(4)

The gradient may traverse horizontally to the left, seemingly indicating the sacral promontory known as the promontric or 3 O'clock position.

The 4 O'clock position, often known as the pelvic region, is where it may descend. It could be subcecal, or six o'clock, and lie beneath the caecum. Early symptoms and indicators of acute appendicitis are determined by the location of the appendix's tip.

Different clinical manifestations of acute appendicitis: A patient with acute appendicitis may initially report with periumbilical or epigastric abdominal pain that later shifts to the lower right quadrant. The discomfort starts out slowly and gets worse over time. Analgesics does not entirely relieve it. Usually, vomiting, nausea, and anorexia are linked to the illness. The patient can have a low-grade fever at first or start out afebrile. Peritonitis and a perforated appendix are linked to high fever.

Since movement exacerbates the pain, the patient is typically lying still during a physical examination. The patient feels pain in the right iliac fossa when he is asked to cough (Mc Burney)the right iliac fossa typically produces localized Tenderness on palpation. There can be rebound tenderness. This region also exhibits percussion tenderness.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

METHODOLOGY

The present cross sectional study was conducted in the department of General Surgery, Krishna Rajendra Hospital, Mysore Medical College and Research Institute, Mysore, Karnataka on 100 patients for a period of 18 months

Inclusion criteria

- all the patients who are diagnosed as appendicitis and operated in the department of general surgery, K. R hospital, mysore during the period of study are included.
- all the patients aged 18 and above.

Exclusion criteria:

- patient with appendicular mass.
- Patients in which conservative management was done and later posted for interval appendicectomy are also excluded.

Method of collection of data

After being inducted into the study population, patients will be examined thoroughly by both clinical and radiological examination and data including epidemiology clinical presentations and ultrasonography findings will be noted. Patients will be posted for appendicectomy and intraoperative findings including various anatomical positions are documented.

SAMPLE SIZE ESTIMATION

Sample size

With the prevalence of Retrocaecal appendix of 64%(p). Level of significance 5% (a) Absolute allowable error of 10% (d).
Using estimation setup technique for proportion:
Sample size = 4*PQ/d2
The Calculated sample size is 92
The Inflated Sample size is 100
With the prevalence of Retrocaecal appendix of 64% (p). level of significance 5% (a).
Absolute allowable error of 10% (d). Using estimation setup technique for proportion;
Sample size = 4*PQ/d2. The Calculated sample size is 92. The Inflated Sample size is 100.

Statistical analysis

- DESCRIPTIVE STATISTICS- mean, standard deviation, frequency and
- percentage.
- INFERENTIAL STATISTICS- Chi-square test and Crosstabs (Cramer's V Test).
- Results were depicted in tables and using Bar charts, Multiple Bar charts and Pie diagrams.
- Data analysis was performed using SPSS (statistical package for social sciences)

RESULTS

The Total numbers of cases studied are 100, which are histopathologically positive and represent the inflamed appendix. All the cases presented as acute appendicitis which were operated on emergency basis.Age Distribution
In our series appendicitis was more common between 18-27 years which are 60 cases (60%), followed by the 28-37 year age group with 27 cases (27%).

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

AGE GROUP(YRS)	NO.OF CASES	PERCENT
18-27	60	60
28-37	23	23
38-47	7	7
48-57	6	6
58-67	3	3
>68	1	1
TOTAL	100	100

Table 1: age distribution of cases

Sex distribution

Appendicitis was more commonly seen in male population 64 cases (64%) compared to females with 34 cases (34%).

SEX	No. Of Cases	Percent
Male	64	64
Female	36	36
Total	100	100

Table 2: sex distribution of cases

Frequency of various positions of appendix

The most common position is retrocaecal position 50 cases(50%), followed by pelvic, pre ileal, postileal, subcaecal

POSITION	NO. OF CASES	PERCENT
Retro-caecal	50	50
Para-caecal	6	6
Post-ileal	6	6
Pre-ileal	11	11
Pelvic	25	25
Sub-caecal	2	2
Total	100	100

Table 3 :Frequency of various positions of appendix

Clinical Presentations

Patients present with various complaints the most common being anorexia which was present in 70(70%) cases. Fever is also a common feature of appendix, there were 38 (38%) cases presenting with fever. In our study, we observed that 19 out of 50 cases (38%) of retro-caecal appendicitis presented with fever, This was followed by the pelvic and pre-ileal positions, where 8 out of 25 cases and 5 out of 6 cases) respectively had a history of fever. The distribution of fever incidence among the different appendix positions did not show a statistically significant difference (P-value > 0.05).

VOMITING	TOTAL NO.OF CASES	PERCENT
PRESENT	54	54
NOT PRESENT	46	46
TOTAL	100	100

Table 5 :Number of cases with vomiting

Patients present with atypical symptoms like urinary symptoms, bowel disturbances and gynecological symptoms. In our study there were 8 cases which presented with urinary symptoms of which 4 cases were pelvic appendicitis and 4 were retro-caecal appendicitis. So pelvic appendicitis has more preponderance to urinary symptoms with 16% of cases with urinary symptoms compared to 8% of retrocaecal appendicitis

The distribution of incidence of urinary symptoms differs significantly across various positions of appendix (P-value<0.01).

Pelvic	25	4	16	21	84
Others	25	0	0	25	100
Total	100	8	8	92	92

Table 6 : Number of cases with urinary symptoms

Bowel disturbances seen in 16 cases out of which 7 cases has pre ileal appendix,5 had retrocecal, 3 had pelvic and 2 had post ileal appendix,The distribution of incidence of symptoms differs significantly across various positions of appendix (P-value<0.001) **Table**

POSITIONS	N	WITH BOWEL DISTURBANCE	PERCENT	WITHOUT BOWEL DISTURBANCE	PERCENT
Pre-ileal	11	7	63.3	4	36.3
Retro-caecal	50	5	10	45	9
Pelvic	25	3	12	22	88
Post-ileal	6	2	33.3	4	66.6
Other	8	0	0	0	0
Total	100	16	16	84	84

7 :Number of cases with bowel disturbances

Baldwin's test was positive in 15 cases of which 14 cases were retro- caecal in position and 1 was post-ileal.

Psoas test was positive in 15 (15%) cases of which 13 cases were retro-caecal in position, 1 post-ileal and 1 para-caecal.

Obturator test was positive in 24 (24%) cases of appendicitis mainly in pelvic appendicitis , out of which few presented with complications, in uncomplicated cases this test is rarely elicited.The distribution of outcome of Baldwin's test differs significantly across various positions of appendix (P-value<0.01).

POSITON	N	POSITIVE	PERCENT	NEGATIVE	PERCENT
Retro-caecal	50	14	28	36	72
Post-ileal	6	1	16	5	84
Others	44	0	0	44	100
Total	100	15	15	85	85

Table 8 :Baldwins Test

The PSOAS test differs significantly across various positions of appendix(Pvalue<0.01).

POSTION	N	POSITIVE	%	NEGATIVE	%

Retro-caecal	50	12	24	38	76
Post-ileal	6	0	0	6	100
Para-caecal	6	1	16	5	84
Pelvic	35	2	5.7	23	65.3
Other	13	0	0	13	100
Total	100	15	15	85	85

Table9 :PSOAS Test

CLINICAL SIGNS (TEST)	NO. OF PATIENTS	PERCENT
Baldwins Test	15	15
Psoas test	15	15
Obturator test	24	24
Rebound test	40	40

Table 10 : clinical tests

SITE OF MAXIMUM TENDERNESS

Tenderness in the right iliac fossa is a constant feature in all the cases of appendicitis, the site of maximum tenderness was in right iliac fossa in 76 in 100 cases even though few had tenderness at other site leading to difficulty in the diagnosis, only 24 cases had maximum tenderness at a site other than right iliac Fossa.22 cases had tenderness at McBurney's point.

Site of maximum tenderness	No. of Patients	Percent
Right iliac fossa	76	76
McBurney's point	22	22
Total	100	100

Table 11 :Site of maximum tenderness

Total Leucocyte Count (leukocytosis)

Leukocytosis or neutrophilia was present in 60 (60%) of 100 cases of which 30(60%) cases were retro-caecal, followed by 14 (56%) cases pelvic. But the highest preponderance was seen in para-caecal position in which 4 out 6 cases had raised leucocyte count, that is 66.6% of total cases of para-caecal,The distribution of incidence of raised TLC did not differ significantly across various positions of appendix (P-value>0.05).

Position	N	Raised TLC	Percent	Normal	Percent
Retro-caecal	50	30	60	20	40
Pelvic	25	14	56	11	44
Pre-ileal	11	8	72.7	3	27.2
Post-ileal	6	3	50	3	50
Para-caecal	6	4	66.6	2	33.3
Other	2	1	50	1	50
Total	100	60	60	40	40

Table 12 :Total Leucocyte count and relation with various position

Per rectal Examination

Per rectal tenderness seen in 8 cases of pelvic appendicitis.

Per rectal Examination	No. Of Patients	Percent
Tender	10	10

Non Tender	90	90
Total	100	100

Table 13 :Per rectal Examination

Complications

There was a perforated or gangrenous appendix in 38 out of 100 cases, of which 12 were in pelvic position, 20 were in retro-caecal, 3 in pre ileal, 2 in post-ileal and 1 in sub caecal and para-caecal each. This shows that there is a high chance of a pelvic appendix to get complicated.The distribution of incidence of complications did not differ significantly across various positions of appendix (P-value>0.05).

POSITION	N	PRESENT	PERCENT	NOT PRESENT	PERCENT
Retrocaecal	50	20	40	30	60
Pelvic	25	12	48	13	52
Post-ileal	6	2	33.3	4	66.6
Para-caecal	6	1	16.6	5	83.3
Pre-ileal	11	3	27.2	8	72.7
Sub Caecal	2	1	50	1	50
Total	100	38	38	62	62

Table 15 :Complications in various positions

DISCUSSION

Diagnosing acute appendicitis preoperatively continues to be a significant challenge due to the numerous other conditions that can mimic its symptoms. This difficulty is further complicated by the varying anatomical positions of the appendix, which can lead to diverse clinical presentations. In this study, we evaluated cases based on their clinical features at presentation, the appendix's position observed during surgery, and any associated complications. Histopathological analysis confirmed all diagnoses. We employed Cramer's V test to examine the relationships between categorical variables.

Our findings indicate that appendicitis is most prevalent in individuals aged 18-27 years, followed by those aged 28-37 years, accounting for 60% and 23% of cases, respectively. The mean age of onset was 21 years. Similarly, Lewis et al.[5] (1975) identified the second and third decades of life as the most common age ranges for acute appendicitis.

The study comprised 64 male patients and 36 female patients, with a higher incidence observed in men. This male predominance may be related to higher stress levels, as suggested by Boyd in 1961. This finding is consistent with reports by Addis et al. and Korner et al.[6], who documented a slight male predominance, with male-to-female ratios ranging from 1.2:1 to 1.3:1.

Regarding symptoms, anorexia was present in 70% of cases, nausea in 40%, and vomiting in 54%, typically involving a few episodes. Lewis et al. (1975) also reported that 66% of appendicitis cases presented with anorexia, nausea, or vomiting.

Fever was another common symptom, occurring in 38% of our patients. The fever was generally mild, except in cases where an abscess was present, which was associated with more severe fever. This finding underscores the role of fever as a crucial indicator in diagnosing acute appendicitis. Most frequently found in the paracaecal and pre-ileal positions, followed by the retrocaecal position, with respective occurrences of 84%, 46%, and 38%. However, these findings were not statistically significant (P-value > 0.05).

Berry et al.[7] (1984) noted that in cases of acute appendicitis, a rise in body

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

temperature is typically modest, rarely exceeding 1 degree Celsius (1.8°F). An increase beyond this range may suggest complications or the presence of an alternative diagnosis.

The relationship between the anatomical position of the appendix and the clinical presentation and progression of acute appendicitis has been debated, with different studies yielding varied conclusions.

Varshney et al.[8] proposed that the retrocaecal position of the appendix might be less susceptible to infection. They suggested that the retrocaecal position could be beneficial because gravity-assisted drainage of the appendicular lumen may prevent luminal obstruction, thereby reducing the incidence of appendicitis. In contrast, Shen GK et al.[9] and Williamson WA et al.[10] found that the retrocaecal position does not significantly alter the clinical course of appendicitis.

Our study observed a higher incidence of complications in patients with typical clinical presentations compared to those with atypical presentations.

Varshney et al. also noted that advanced appendicitis, such as cases involving perforation or gangrene, is more common when the appendix is retrocaecal. They hypothesized that early misdiagnosis, possibly as a urinary tract infection, might delay proper diagnosis, leading to an increased risk of complications.

In Collins' analysis of 751[1] patients with retrocaecal appendicitis, only 10% exhibited typical symptoms. Instead, 18% reported diffuse, non-localized pain, 28% experienced right flank pain, and 12% had pain in the right shoulder. Notably, 53% of these cases were complicated by perforation. Guidry S et al. (1994) concluded that patients with gangrene or perforation were more likely to experience pain and tenderness in locations other than the right lower quadrant. In these cases, the appendix was often located in concealed positions such as retrocaecal, retroperitoneal, pelvic, or extraperitoneal, with 76% of such patients exhibiting these hidden locations.

Poole GV (1990)[11] similarly identified that in 69% of patients with gangrene or perforation appendicitis, the appendix was situated in one of three locations: extraperitoneal retrocaecal, post-ileal, or pelvic. In our study, complications were observed in 38 cases, with the pelvic position being the most common site 12 cases(48%), followed by retrocaecal 20 cases (40%), post-ileal 2 case (33%), and paracaecal 1 case(16.6%). Among these, the pelvic position had the highest complication rate, with 48% of cases involving the pelvic appendix being

complicated. However, this finding was not statistically significant (P-value > 0.5).

Regarding laboratory findings, most patients exhibited elevated white blood cell counts, with more than 75% neutrophils. Approximately 10% of patients with acute appendicitis had normal leukocyte counts and differential. In our study, 60% of patients had an elevated leukocyte count, with the highest incidence in the pre ileal position, where 72.75% of cases showed elevated counts. This finding was also not statistically significant (P-value > 0.05).

In terms of surgical technique, the most commonly used incision was the McArthur's incision, followed by the Lanz incision. Among the 4 cases requiring the Rutherford Morrison incision, all involved a retrocaecal appendix. In 3 of these cases, the incision had to be converted from a Lanz incision due to technical difficulties.

Varshney et al.[8], in their study of 600 cases, found that 19% of appendices were in the retrocaecal position, while 53% were in the pelvic position. Shah's research revealed that 51.4% of appendices were retrocaecal, with the remainder predominantly pre-ileal. Wakeley's examination of 10,000 specimens showed that 62% of appendices were retrocaecal and 31% were pelvic (70). In our research, the retrocaecal position was the most prevalent, found in 50 cases (50%), followed by the pelvic position, which was noted in 25 cases (25%).

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

CONCLUSION

This research was carried out over a 18-month period from January 2023, to June 2024, in the Department of General Surgery at MMC & RI, Mysore, and involved 100 cases that were histopathologically confirmed as appendicitis.

The study's key findings include:

- The most frequent occurrence of appendicitis was in the 18-27 year age group, followed by the 28-37 year age group, representing 60% and 23% of the cases, respectively.
- A higher incidence of appendicitis was observed in males compared to females.
- Pain was a universal symptom among all patients, with a typical presentation of pain (76%) being more common than atypical presentations (24%). The pain's location varied according to the appendix's position, with patients experiencing supra-pubic pain when the appendix was pelvic, and right lumbar or flank pain when it was retro-caecal.
- Patients with post-ileal and pelvic appendices often exhibited bowel disturbances, such as constipation or diarrhea.
- Per rectal tenderness was a frequent finding in patients with pelvic appendicitis, many of whom had complications.
- Retro-caecal appendix were commonly associated with symptoms suggestive of upper urinary tract infections due to the nearby ureter irritation, whereas pelvic appendices were linked to lower urinary tract symptoms caused by bladder irritation. Anorexia was the most prevalent symptom, occurring in 75% of the cases, followed by vomiting (54%) .
- Patients with retrocecal appendicitis tend to experience a higher incidence and severity of vomiting, and it generally does not provide any pain relief.
- Tenderness was consistently noted in all acute appendicitis cases, but its specific location varied based on the appendix’s position. When the appendix is in a retrocecal position, tenderness is often observed in the right flank or right lumbar area, particularly if the appendix is adhered or extraperitoneally located. In these scenarios, tenderness is more prominent in these regions than in the right iliac fossa. For pelvic appendicitis, tenderness may be found in the suprapubic region, and rectal tenderness might also be present.
- The most common signs were tenderness in the right iliac fossa and rebound tenderness, occurring in 76% and 4O% of cases, respectively.
- Tenderness at McBurney’s point was identified in only 22% patients, while in others, tenderness was found either medial or lateral to this point.
- The Psoas sign and Baldwin test were not consistently positive in every case of retrocecal appendicitis but were typically positive when the appendix was fixed in the retrocecal position.
- The Obturator test was not universally positive in cases of pelvic appendicitis, but it was often positive in more complicated cases.
- Rectal examinations proved useful for identifying pelvic peritonitis or abscesses in cases of pelvic appendicitis, with rectal tenderness noted in 10 cases.
- Patients with a mobile appendix usually exhibited typical signs and symptoms, whereas those with a fixed appendix, either due to inflammation or extraperitoneal positioning, tended to present with atypical signs and symptoms.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 10, 2024

- In retrocecal, post-ileal, and pelvic appendicitis cases, symptoms are often subtle or atypical, leading to an increased risk of complications due to delayed recognition.
- Acute appendicitis generally presents with moderate leukocytosis, where there is a predominance of polymorphonuclear cells. A particularly high white blood cell (WBC) count may suggest that complications are present.
- Leukocytosis was detected in 60% of the cases.
- Surgically, the appendix was most frequently found in the retrocecal position, followed by pelvic, pre-ileal, para-cecal, post-ileal, and sub-cecal positions.
- No particular position of the appendix appears to predispose it to developing appendicitis.
- Patients exhibiting atypical symptoms, such as those with the appendix in retrocecal, post-ileal, or pelvic positions, are at greater risk for complications compared to those with typical symptoms. This increased risk is largely due to delayed diagnosis caused by the unusual clinical presentations.
- The appendix's position plays a significant role in its clinical presentation. While pain and tenderness in the right iliac fossa are common, the specific position of the appendix can produce additional symptoms and signs, which often result in a delay in diagnosis.

REFERENCES

1. Collins DC. Historic phases of acute appendicitis. Ann Surg. 1931;94:179-96.
2. Herrod PJJ, Kwok AT, Lobo DN. Three centuries of appendicectomy. World J Surg. 2023;47:928-936.
3. Williams RG. Presidential address: a history of appendicitis. Ann Surg. 1983 May;197(5):495-506.
4. Buschaard K, Kjeldgaard A. Investigation and analysis of position, length, fixation, and embryology of vermiform appendix. Acta Chir Scand. 1973;139:293.
5. Lewis FR, Holcroft JW, Boey. Appendicitis: a critical review of the diagnosis and treatment in 1000 cases. Arch Surg. 1975;110:677-84.
6. Addis DG, Shaffer N, Fowler BS. The epidemiology of acute appendicitis in United States. Am J Epidemiol. 1990;132:910.
7. Berry J, Malt RA. Appendicitis near its centenary. Ann Surg. 1984;200:567.
8. Varshney S, Jhonson CD, Rangnekar GV. Retrocaecal appendix appears to be less prone to infection. Br J Surg. 1996;83:223-4.
9. Shen GK, Wong R, Daller J, et al. Does the retrocaecal position of the vermiform appendix alter the clinical course of acute appendicitis? Arch Surg 1991;126(5):569-570.
10. Williamson WA, Bush RD, William LF. Retrocaecal appendicitis. Am J Surg 1981;141:507-509
11. Poole GV. Anatomic basis for delayed diagnosis of appendicitis. South Med J 1990;83(7):771-773.