

# The Epidemiology of Appendicitis and Appendectomy in India: An Observational Study

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## ABSTRACT

**Background:** Acute inflammation of appendix may take a variety of forms. A histologic criterion for diagnosis of acute appendicitis is polymorphous leucocytic infiltration of muscularis mucosa. The aim of the present study is to study the incidence, epidemiology and histopathology of appendicitis and its surgical treatment.

**Methods:** A prospective study of 100 patients who were suspected enough to warrant surgery for acute appendicitis admitted in St. Stephens Hospital under various surgical units was conducted for a period of 2 years. Proper history and clinical examination of patients are done. Base line investigations (full blood count, urine routine examination, USG abdomen and peripheral smear for shift to left) are done.

**Results:** Male ratio female was 1.94: 1. Pain was the commonest symptom and has been observed in all cases (100%) in the present series. Next common symptoms observed were anorexia in 87 % and nausea/vomiting in 76 % of cases. Burning micturition was seen in 21% of cases and bowel disturbance was seen in the form of diarrhea (15%) and constipation (20%). Low grade fever was present in 42% of cases. On clinical examination, tenderness at McBurney's point was the commonest sign (97%). Guarding was present in 59% of patients. It. Rebound tenderness was present in 73%. Rovsing sign was present in 34 %. While psoas test and obturator test was positive in 18% and 9 % respectively. Of all these tests tenderness, guarding and rebound tenderness were statistically significant with p value < 0.05. In the present study TLC was increased in 62 % of cases with shift to left

noted in 74% of cases. Both of these variables are statistically significant. Out of 100, 10 patients had negative appendectomy. 6 patients were female and 4 were male. Negative appendectomy rate for females was 17.64% while for males it was 6.06%. Retrocaecal and pelvic were 2 most common positions seen in our study in 46% and 41 % cases respectively.

**Conclusion:** Acute surgical abdomen is an important problem faced by surgeons. The wide range of cause and varied patient presentation pose a formidable diagnostic and therapeutic challenge. As with all new developments however, enthusiasm for the new and modern techniques has sometimes overwhelmed good clinical judgment.

**Keywords:** Appendicitis, Histo-pathology, Epidemiology.

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## INTRODUCTION

The appendix was first described by the physician, anatomist Berengario Da Carpi in 1521. Morgagni in 1719 published a detailed account of appendix, its site and relation in his "Achersaria Anatomica". Verneys in 1710 coined the term "vermiform appendix". Vermiform means worm like. Claudius Amyand in 1736 performed first appendectomy on a boy of 11 years of age who had right scrotal hernia accompanied by fistula. Heister in 1755 recognized that appendix might be sight of primary inflammation. Hancock in 1848 successfully drained appendicular abscess in pregnant female during her eighth month of pregnancy. Reginald Fitz in 1886 first described acute appendicitis. He was also the first to use the term appendicitis. In 1889, Chester

McBurney described characteristic migratory pain as well as localization of the pain along an oblique line from the anterior superior iliac spine to the umbilicus. McBurney described a right lower quadrant muscle-splitting incision for removal of the appendix in 1894.<sup>1,2</sup>

Over the 10-year period from 1987 to 1997, the overall appendectomy rate for appendicitis has remained constant at 10 per 10,000 patients per year. Appendicitis is most frequently seen in patients in their second through fourth decades of life, with a mean age of 31.3 years and a median age of 22 years. There is a slight male: female predominance (1.2 to 1.3:1). The percentage of misdiagnosed cases of appendicitis is significantly higher

among women than among men (22.9 vs 9.3%). The negative appendectomy rate for women of reproductive age is 23.2% with the highest rates in women aged 40 to 49 years. The highest negative appendectomy rate is reported for women > 80 years of age.<sup>3-5</sup> Obstruction of the lumen is the dominant etiologic factor in acute appendicitis. Faecoliths are the most common cause of appendice obstruction. Less common causes are hypertrophy of lymphoid tissue, inspissated barium from previous x-ray studies, tumors, vegetable and fruit seeds, and intestinal parasites. The frequency of obstruction rises with the severity of the inflammatory process. Faecoliths are found in 40% of cases of simple acute appendicitis, in 65% of cases of gangrenous appendicitis without rupture, and in nearly 90% of cases of gangrenous appendicitis with rupture. The strong association between delay in presentation and appendice perforation supported the proposition that appendice perforation is the advanced stage of acute appendicitis. However, recent epidemiologic studies have suggested that non-perforated and perforated appendicitis may, in fact, be different diseases.<sup>6-9</sup>

The bacterial population of the normal appendix is similar to that of the normal colon. The appendice flora remains constant throughout life with the exception of *Porphyromonas gingivalis*. This bacterium is seen only in adults. The bacteria cultured in cases of appendicitis are therefore similar to those seen in other colonic infections such as diverticulitis. The principal organisms seen in the normal appendix, in acute appendicitis, and in perforated appendicitis are *Escherichia coli* and *Bacteroides fragilis*. However, a wide variety of both facultative and anaerobic bacteria and mycobacteria may be present. Appendicitis is a polymicrobial infection, with some series reporting the culture of up to 14 different organisms in patients with perforation.<sup>10,11</sup>

Acute inflammation of appendix may take a variety of forms. A histologic criterion for diagnosis of acute appendicitis is polymorphous leucocytic infiltration of muscularis mucosa. In 1905, Murphy clearly described the appropriate sequence of symptoms of pain followed by nausea and vomiting with fever and exaggerated local tenderness in the position occupied by the appendix. A patient with acute appendicitis may present with triad of pain, vomiting and fever (Murphy's triad), but it is not always so. Atypical presentations are common.<sup>12-16</sup>

The aim of the present study is to study the incidence, epidemiology and histopathology of appendicitis and its surgical treatment.

## MATERIALS AND METHODS

A prospective study of 100 patients who were suspected enough to warrant surgery for acute appendicitis admitted in St. Stephens Hospital under various surgical units was conducted for a period of 2 years.

### Inclusion Criteria

All patients admitted with age more than 13 years and irrespective of sex presenting with right iliac fossa pain suspected to be of acute appendicitis and undergone appendectomy.

### Exclusion Criteria

1. Patients presenting with any form of non- right iliac fossa pain such as right upper quadrant pain etc.
2. Patients who had undergone other emergency laparotomy where appendectomy was also performed as a part of procedure
3. Patients with appendicular lump

4. Patients undergoing elective appendectomies after appendicular lump.

5. Pregnant females.

### Diagnostic Criteria for Acute appendicitis

- History of right lower quadrant pain or peri-umbilical pain migrating to right lower quadrant with nausea and/ or vomiting
- Fever of more than 38 °C.
- Right lower quadrant guarding and tenderness on physical examination.

Base line investigations (full blood count, urine routine examination, USG abdomen and peripheral smear for shift to left) are done. USG is an optional study. Decisions for appendectomy were based on clinical judgement. Diagnosis of acute appendicitis is confirmed by operative findings and histo-pathological assessment of the appendectomy specimen. The Appendix specimen is sent for histopathology report and the report is noted. Histo-pathological diagnosis is considered as final.

Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Continuous variables are presented as mean  $\pm$  SD, and categorical variables are presented as absolute numbers and percentage. The comparison of normally distributed continuous variables between the groups was performed using Student's t test. Nominal categorical data between the groups were compared using Chi-squared test or Fisher's exact test as appropriate. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

**Table 1: Age distribution.**

Age (yrs)	Number of patients	Percentage
<40yrs	67	67%
$\geq$ 40yrs	33	33%
<b>Total</b>	<b>100</b>	<b>100%</b>

**Table 2: Sex distribution.**

SEX	Number of patients	Percentage
<b>Male</b>	66	66%
<b>Female</b>	34	34%
<b>Total</b>	<b>100</b>	<b>100%</b>

**Table 3: Frequency of symptoms of Appendicitis.**

Symptom	Number of patients	Percentage
<b>Pain in RIF</b>	100	100
<b>Migratory Pain from Umbilicus to RIF</b>	36	36%
<b>Anorexia</b>	87	87%
<b>Nausea/Vomiting</b>	76	76%
<b>Fever</b>	42	42%
<b>Constipation</b>	20	20%
<b>Diarrhea</b>	15	15%
<b>Burning micturition</b>	21	21%

**Table 4: Duration of pain.**

Pain Duration	Number of patients	Percentage
<48 hrs	70	70%
$\geq$ 48 hrs	30	30%
<b>Total</b>	<b>100%</b>	<b>100%</b>

Table 5: Statistical significance analysis of symptoms.

Symptom		Acute Appendicitis (Histopathologically)	Non Appendicitis (Histopathologically)	p value
Pain In RIF	Present	90 (100%)	10 (100%)	-
	Absent	0 (0%)	0 (0%)	
Migratory Pain from Umbilicus to RIF	Present	35 (38.9%)	1 (10%)	0.090
	Absent	55 (61.1%)	9 (90%)	
Anorexia	Present	80 (88.9%)	7 (70%)	0.120
	Absent	10 (11.1%)	3 (30%)	
Nausea/V	Present	70 (77.8%)	6 (60%)	0.246
	Absent	20 (22.2%)	4 (40%)	
Fever	Present	41 (45.6%)	1 (10%)	0.042*
	Absent	49 (54.4%)	9 (90%)	
Constipation	Present	16 (17.8%)	4 (40%)	0.110
	Absent	74 (82.2%)	6 (60%)	
Diarrhoea	Present	13 (14.4%)	2 (20%)	0.643
	Absent	77 (85.6%)	8 (80%)	
Burning micturition	Present	17 (18.9%)	4 (40%)	0.211
	Absent	73 (81.1%)	6 (60%)	

Figure 1: Graphical representation of frequency of symptoms.

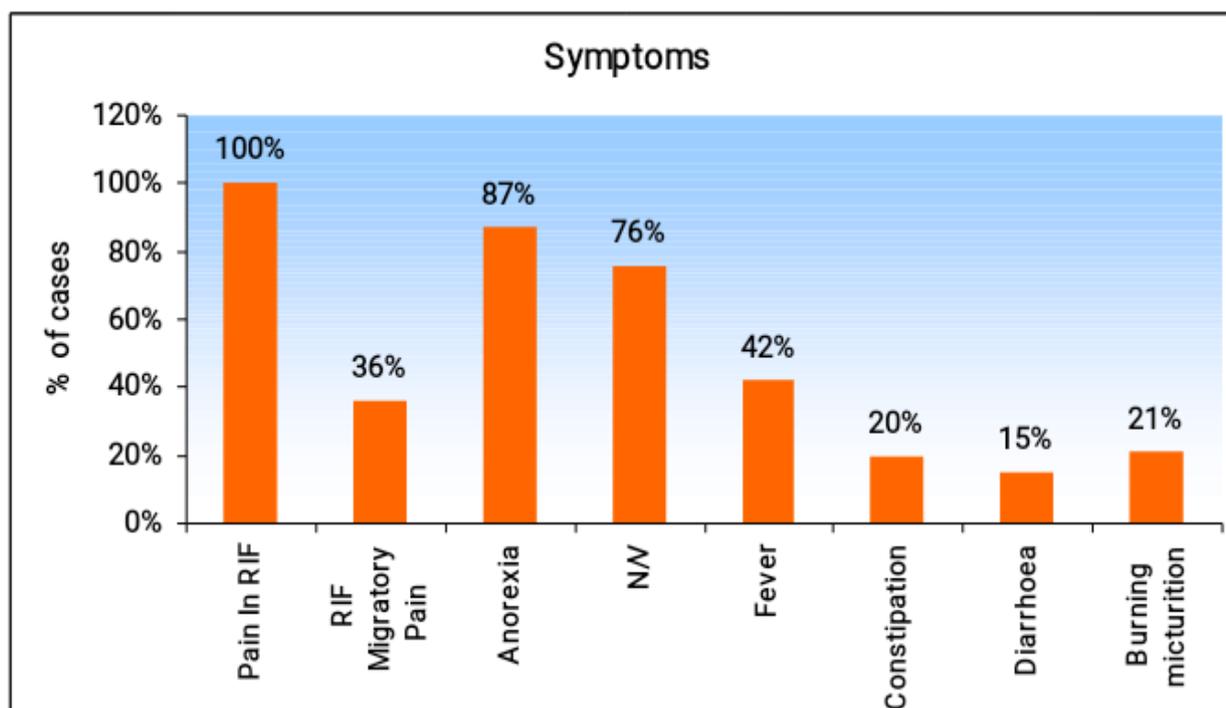


Table 6: Frequency of signs of Appendicitis.

Signs	Number of patients	Percentage
Tenderness RIF	97	97%
Guarding	59	59%
Rebound tenderness	73	73%
Obturator Sign	9	9%
Rovsing Sign	34	34%
Psoas Sign	18	18%

## RESULTS

The study was conducted in Department of Surgery, St Stephens Hospital for a period of 2 years. A total of 100 patients attending surgical emergency were offered to be part of study.

33% patients were less than 40 yrs of age and 67% patient's  $\geq$  40 yrs. The mean age of subjects in study was 32.37 yrs and SD was 15.96. The age ranged from 13 – 76 yrs [Table 1]. 66 % patients were male while 34% were female [Table 2].

Right iliac fossa pain was the most consistent symptom present in 100% of the patients. Migration of pain was observed in 36% patients. Anorexia was present in 87% patients. Nausea and

vomiting were present in 76% patients; Fever was seen in 42% patients. Altered bowel habit was observed in 35% patients with 20% having constipation and 15% having diarrhea [Table 3, Figure 1]. Most of the patients (70%) had pain of duration <48hrs. The mean time to presentation was 12 to 24 hours [Table 4]. The analysis shows that fever was statistically significant. Out of 36 patients with migration of pain 35 patients had appendicitis [Table 5].

RIF tenderness was the most consistent sign present in 97% of the patients. Guarding was observed in 59% patients. Rebound tenderness was present in 73% patients. Obturator sign, Rovsing Sign, Psoas sign were present in 9%, 34%, 18% patients respectively [Table 6, Figure 2].

The analysis shows that tenderness, guarding and rebound tenderness are statistically significant in patients with acute appendicitis [Table 7].

Figure 2: Graphical representation of frequency of signs.

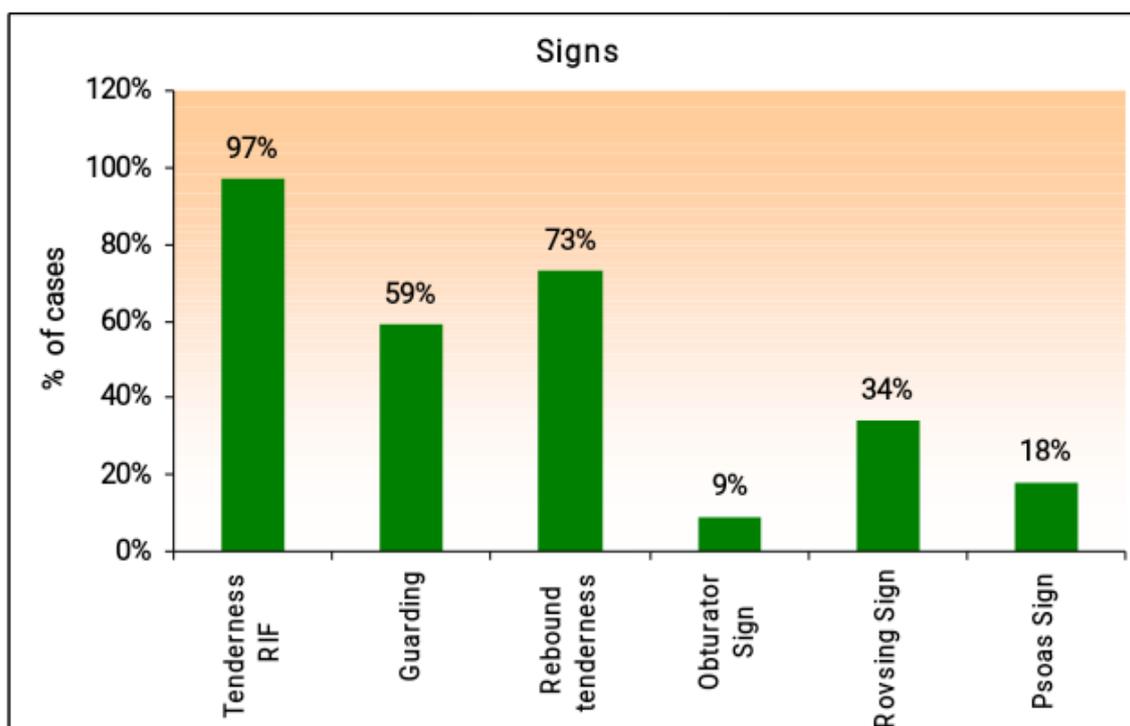


Table 7: Statistical significance analysis of signs.

Signs		Acute Appendicitis (Histopathologically)	Non Appendicitis (Histopathologically)	p value
Tenderness RIF	Present	89 (98.9%)	8 (80%)	0.026*
	Absent	1 (1.1%)	2 (20%)	
Guarding	Present	57 (63.3%)	2 (20%)	0.014*
	Absent	33 (36.7%)	8 (80%)	
Rebound tenderness	Present	69 (76.7%)	4 (40%)	0.022*
	Absent	21 (23.3%)	6 (60%)	
Obturator Sign	Present	9	0	0.593
	Absent	81	10	
Rovsing Sign	Present	33 (36.7%)	1 (10%)	0.158
	Absent	57 (63.3%)	9 (90%)	
Psoas Sign	Present	17	1	0.685
	Absent	73	9	

Table 8: Laboratory Studies.

Test	Number of patients	Percentage
Leucocytosis > 11000	62	62%
Negative Urinalysis	75	75%
Left Shift	74	74%

Leukocytosis was present in 62% patients of total patients in our study. Negative urinalysis was present in 75% patients [Table 8]. Results have shown that both leucocytosis and left shift are statistically significant [Table 9]. Results showed that patients with appendicular perforation have statistically significant increase in hospital stay [Table 10]. Retrocaecal and Pelvic are the two most common positions of appendix observed [Figure 4].

Figure 3: Graphical representation of laboratory findings.

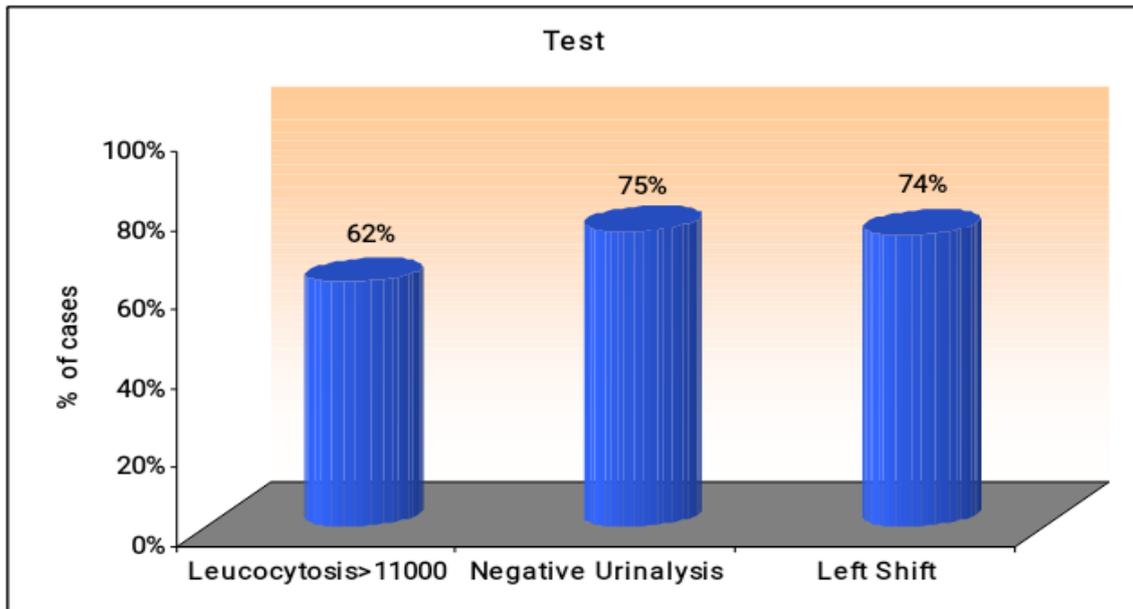


Table 9: Comparison of laboratory findings.

Test		Acute Appendicitis (Histopathologically)	Non Appendicitis (Histopathologically)	p value
Leucocytosis	>11000	59 (65.6%)	2 (20%)	0.012*
	<=11000	31 (54.4%)	8 (80%)	
Urinalysis	Negative	66 (73.4%)	9 (90%)	0.444
	Positive	24 (26.7%)	1 (10%)	
Left shift	Present	73 (81.1%)	1 (10%)	<0.001*
	Absent	17 (18.9%)	9 (90%)	

Table 10: Comparison of hospital stay in patients with perforation/non-perforation.

	Overall	Appendicular perforation		No Appendicular perforation		P value
	Median (range)	Median	Range	Median	Range	
Length of Stay	3 (1 - 10)	3	1 - 9	4	2 - 10	0.004*

Figure 4: Graphical representation of position of appendix.

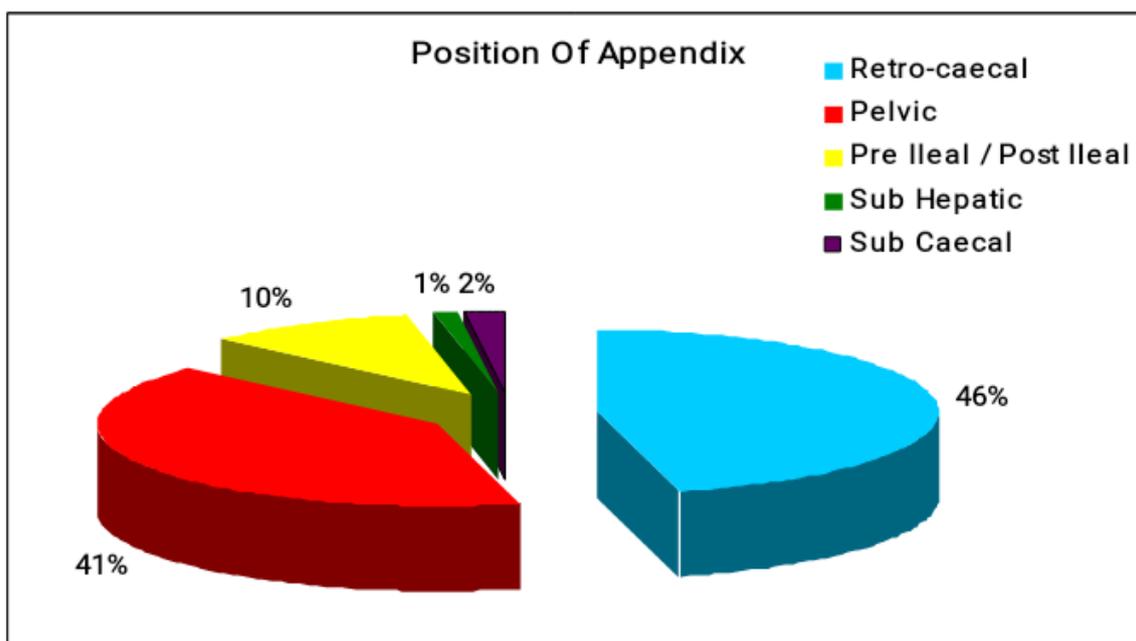
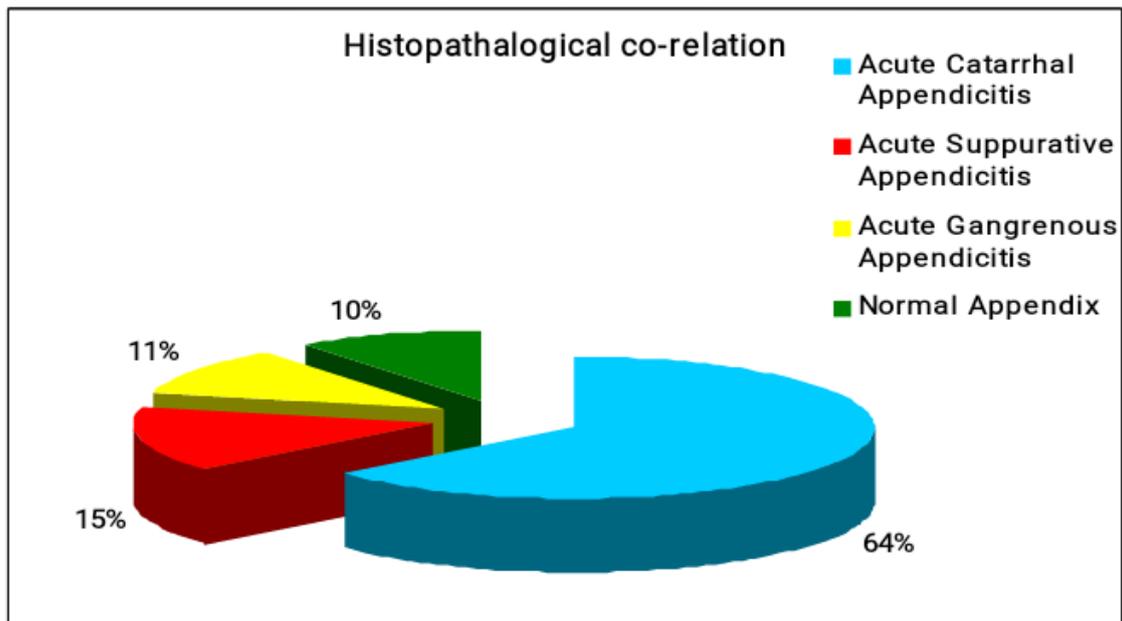


Figure 5: Histo-pathological co-relation.



## DISCUSSION

In this study a total of 100 patients were included. Out of these 66 patients were male while 34 were female. Male ratio female was 1.94: 1. The age group in which appendicitis occurred commonly was 13-40 years. We had not included patients with age < 13 years in our study. Mean age in our study was 32.7 years. Although it is clear that incidence is less in younger and older age groups with peak incidence in 2<sup>nd</sup> to 3<sup>rd</sup> decade. Some researchers found that the mean age of the patients (92 male, 100 female) was  $25.1 \pm 12.7$  years. The reason of slightly higher mean age in our study was that we have not included patients with age 1 to 13 years. In other studies appendicitis is most frequently seen in patients in their second through fourth decades of life, with a mean age of 31.3 years and a median age of 22 years. There is a slight male: female predominance (1.2 to 1.3:1).<sup>16-19</sup>

Median duration of stay in our patients without appendicular perforation was 3 (Range 1-10) and with perforation it was 4 (range 2-10). Statistical analysis showed that patients with perforation have increased duration of hospital stay (p value 0.004). In study by Chong FC et al<sup>13</sup> the mean duration of hospital stay was  $4.3 \pm 2.0$  (range 1-18) days.

Pain was the commonest symptom and has been observed in all cases (100%) in the present series. Reason being that pain in right iliac fossa was our inclusion criteria. The classical shift of pain from umbilical region to RIF was seen only in 36 % cases. Out of these 36 cases, 35 patients had appendicitis, P value (0.090). In 52 % of the cases pain was localized to RIF and 12 % cases had diffuse pain abdomen which was initially started in right lower abdomen. 70 % of all patients present within 48 hours of onset of pain, with most of them presenting between 12-24 hours of onset of pain. Next common symptoms observed were anorexia in 87 % and nausea/vomiting in 76 % of cases. Burning micturition was seen in 21% of cases and bowel disturbance was seen in the form of diarrhea (15%) and constipation (20%). Low grade fever was present in 42% of cases. Statistical analysis showed that of all symptoms, fever was statistically significant (p value = 0.042). On clinical examination, tenderness at Mc Burney's point was the

commonest sign (97%). Guarding was present in 59% of patients. It was present when inflammation was severe. Rebound tenderness was present in 73%. In these cases there was local peritonitis or appendix was anteriorly placed. Rovsing sign was present in 34%. While psoas test and obturator test was positive in 18% and 9 % respectively. Of all these tests tenderness, guarding and rebound tenderness were statistically significant with p value < 0.05. In a study by Shrivastava UK et al<sup>20</sup> tenderness in right iliac fossa was found in 170 (91.8%) cases, rebound tenderness in 149 (80.54%) cases, elevated temperature in 156 (84.32%) cases and Rovsing's sign in 103 (55.67%) cases.

In the present study TLC was increased in 62 % of cases with shift to left noted in 74% of cases. Both of these variables are statistically significant. None of the patients with perforated appendix showed free gas under diaphragm. Only 4 patients X-Ray showed ground glass opacity suggestive of diffuse peritonitis. Surgeons found normal appendix only in 4 patients but histopathology confirmed 10 cases with no specific lesion in appendix. In 6 patients there were no cause found for pain while remaining 4 patients had mesenteric lymphadenitis, ovarian cyst, meckels diverticulitis and ileo-ileal band causing ileal obstruction respectively as cause of pain. Post operatively in follow up, no patients with negative appendectomy had recurrence of pain in right iliac fossa.

Retrocaecal and pelvic were 2 most common positions seen in our study in 46% and 41 % cases respectively. In a study by Chong CF<sup>21</sup> relative incidence of positions is as Retrocolic and Retrocaecal – 74 %, Pelvic – 21 %, Subcaecal – 1.5 %, Pre Ileal – 1 %, Post Ileal – 0.5 %. In another study by Fitz RH<sup>9</sup> pelvic position was the predominant position (in 33.3%) followed by retrocaecal in 32.4%, preileal in 18.8% and subcaecal in 12.8% respectively. So there is considerable variation in different studies.

## CONCLUSION

Male ratio female was 1.94: 1. The age group in which appendicitis occurred commonly was 13-40 years. Mean age in our study was 32.7 years.

Pain was the commonest symptom and has been observed in all cases (100%) in the present series. The classical shift of pain from umbilical region to RIF was seen only in 36 % cases.. 70 % of all patients present within 48 hours of onset of pain, with most of them presenting between 12-24 hours of onset of pain.

Next common symptoms observed were anorexia in 87 % and nausea/vomiting in 76 % of cases. Burning micturition was seen in 21% of cases and bowel disturbance was seen in the form of diarrhea (15%) and constipation (20%). Low grade fever was present in 42% of cases.

On clinical examination, tenderness at McBurney's point was the commonest sign (97%). Guarding was present in 59% of patients. It. Rebound tenderness was present in 73%. Rovsing sign was present in 34 %. While psoas test and obturator test was positive in 18% and 9 % respectively. Of all these tests tenderness, guarding and rebound tenderness were statistically significant with p value < 0.05.

In the present study TLC was increased in 62 % of cases with shift to left noted in 74% of cases. Both of these variables are statistically significant.

A total of 100 patients had undergone appendectomy. Out of 100, 10 patients had negative appendectomy. 6 patients were female and 4 were male. Negative appendectomy rate for females was 17.64% while for males it was 6.06%.

Retrocaecal and pelvic were 2 most common positions seen in our study in 46% and 41 % cases respectively.

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