

## **A study on site of perforation in acute appendicitis and its effect on post-operative complications.**

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### **Abstract**

#### **Aim of the Study**

To determine if the site of perforation of appendix has any effect on post-operative complications.

#### **Methodology**

Patients with diagnosis of appendicular perforation confirmed intra-operatively were allocated into 3 groups based on the site of perforation (Group A – Tip, Group B – Base, Group C – Body of appendix). The patients where a definite site of perforation could not be found were excluded. Baseline data, Intra-operative complications, prevalence of risk factors and post-operative outcomes were noted.

#### **Results**

Total of 57 patients were included in the study. Group A had 31 patients, Group B had 20 patients and Group C had 6 patients. The prevalence of risk factors found in this study were, time delay till appendectomy (68.42 %), male gender (68.42 %), presence of faecolith (57.89 %), age over 50 years (43.86 %), diabetes mellitus (33.33 %) and history of previous surgery (36.84 %). 4 out of 20 patients in Group B had iatrogenic bowel injury compared with 2 out of 31 patients of Group A. 3 patients of Group B had a gangrenous base without a residual healthy stump. The patients with perforation at the base had higher length of hospital stay (p- value 0.031) and mean CCI score (p- value 0.036) compared with other groups.

#### **Conclusion**

Patients with perforation of appendix base had higher incidence of intraoperative and post-operative complications. Knowing the site of perforation may help the surgeon to plan a proper intraoperative and postoperative management protocol.

#### **Keywords**

Appendix, Appendicular perforation, Risk factors

**INTRODUCTION**

Appendicular perforation is a serious complication of acute appendicitis. The incidence of appendicular perforation is estimated to be around 17 – 20 % , increasing to about 45 % in children below 5 years and up to 51 % in people over 65 years of age [1 , 2]. It is associated with increased rate of complications such as intra-abdominal abscess, diffuse peritonitis and sepsis [3 , 4]. Because of the significant morbidity and mortality associated, it is important to identify the various risk factors of appendicular perforation.

The clinical presentation associated with perforation of appendix is variable. The most common presentation is of abdominal pain with signs of peritonitis and sepsis. However, atypical presentations are also seen and depends on the position of the appendix. Perforation of retrocaecal appendix have been found to be associated with retroperitoneal abscess, perinephric abscess or thigh abscess as presenting complaints [5 - 7].

The clinical course of the patient is also affected by the site of perforation of appendix. The perforation at the base of appendix is sometimes associated with caecal perforation. This needs additional procedures like primary closure of the perforation with an omental patch with or without a stomy or in very complicated cases, resection of the bowel [8]. Post-appendectomy faecal fistulas occur mostly when there is severe inflammation involving the base of the appendix as well as the adjoining caecal wall or due to absence of a healthy stump. The leakage from appendiceal stump is incriminated as a major aetiological factor in such patients . The injuries to the caecum during appendectomy is another aetiological factor [9 - 10]. Similarly, perforation at the tip have been documented to present with parietal wall abscess [11].

The aim of this study was to determine if the site of perforation of appendix has any role in the postoperative course of the patient and to identify risk factors associated with appendicular perforation.

**METHODS**

After obtaining ethical clearance from the Institutional Ethical Committee, this prospective cohort study was conducted from November 2019 to November 2021 in the Department of General Surgery, SCB Medical College and Hospital, Odisha, India. All patients with a provisional diagnosis of appendicular perforation made from clinical examination or radiological investigation with age  $\geq$  18 years and the site of appendicular perforation confirmed intra-operatively were included in the study. Patients in whom no definite site of perforation could be found intra-operatively either because of sloughing of appendix in-vivo or due to difficult dissection due to dense adhesions or appendicular lump were excluded from the study. The patients who did not give consent for participation in the study were also excluded from the study.

Intra-operatively the site of perforation of appendix was recorded and the patients were allocated into groups A, B or C if the site of perforation of appendix was at tip, base or body of appendix respectively. The baseline demographic data and routine investigations of the patients were collected. The intra-operative variables like type of anaesthesia, recovery after anaesthesia, operative time, intra-operative complications and additional procedures required were noted. The

postoperative variables included mean VAS score (Visual Analogue Scale) for pain measured at 6 hours, 12 hours, 24 hours, 3 days, 5 days and 14 days post surgery, mean length of hospital stay and the mean Comprehensive Complication Index Score (CCI Score) over 30 days.

The statistical analysis was performed using SPSS Version 22.0. Continuous data was expressed as Mean  $\pm$  Standard deviation. Categorical data was expressed as percentage. Anova test for continuous data and Chi square test for categorical data were used to compare groups for statistical significance.  $p$  value  $< 0.05$  was considered statistically significant.

## RESULTS

A total of 78 patients with a provisional diagnosis of appendicular perforation made based on clinical examination and radiological imaging findings, USG and CT, were assessed for eligibility for inclusion in the study. Of them, 4 patients did not give consent for participation in the study. 17 patients were excluded from the study because no definite site of perforation could be found intra-operatively. 57 patients had a definite site of perforation and were allocated to groups. Group A patients had perforation of the tip of appendix, Group B had perforation of the base of appendix and Group C patients had perforation of the body of appendix. This is represented in Table 1.

An analysis of the baseline data of patients was done to assess the prevalence of the different risk factors of appendicular perforation. As can be seen in Table - 2, the most prevalent risk factors associated with appendicular perforation found in this study include a time delay till appendectomy beyond 72 hours (68.42%), male gender (68.42%), presence of faecolith (57.89%), age over 50 years (43.86%), diabetes mellitus (33.33%), and previous surgery (36.84%).

The time delay till appendectomy is the time from the onset of symptoms, as recalled by the patient, to the starting of surgery. Therefore, it is a measure of both pre-hospital delay as well as in-hospital delay in decision making till surgery. The result is shown in Table-3. As shown, most of the patients had a time delay of 72 to 96 hours (43.86%). Only 2 patients (3.51%) presented with a time delay of less than 36 hours.

The analysis of age specific data of the patients is shown in Table-4. As can be seen the most common group of patients affected were those over 50 years of age (43.86%).

The baseline demographic data of the three groups of patients is shown in Table – 5. This shows that all the three groups are comparable and the difference between the groups is not statistically significant ( $p < 0.05$  is considered statistically significant).

The mean operative time was compared among the three groups of patients and found to be not statistically significant. (Table – 6)

The intra-operative complications occurring during surgery is represented in Table – 7. As shown, 2 patients in Group A had iatrogenic Ileal perforation. 1 of the patient was managed with primary closure of perforation while the other was managed with resection and anastomosis of the perforated segment.

Similarly, 2 patients of Group B had iatrogenic Ileal perforation. 1 of the patient was managed with primary closure of the perforation and the other with resection and anastomosis of the involved segment. 2 patients had iatrogenic caecal perforation while dissecting the appendix base

due to severe peri-appendiceal inflammation and gangrene extending to the caecal wall. 1 patient was managed with primary closure of the perforation and the other with primary closure of perforation with Ileostomy. 3 patients of Group B had a gangrene of the base and absence of a residual healthy stump. They were managed with primary closure of caecal wall in 2 layers with an omental patch, to prevent faecal leak.

The patients in Group C did not have any intra-operative complications.

The mean VAS score for pain of the three groups of patients was recorded at 6 hours, 12 hours, 24 hours, 3 days, 5 days and 14 days. This is shown in Table – 8. As can be seen there is no statistically significant difference between the three groups with respect to pain after surgery.

Table – 9 compares the different postoperative complications among the groups. The individual postoperative complication events have been represented according to the Clavien-Dindo classification system. As can be seen Group B patients had higher number of postoperative complication events. 3 patients in Group B had repair site leak (CD 3B) of which 2 patients had leak from the primary closure site in caecum where primary repair was done because of gangrenous base of appendix without a healthy stump while 1 patient had iatrogenic caecal perforation during surgery which was closed primarily.

In each of these patients a revision laparotomy was done and the site of faecal leak was identified and repaired. The patients in each case had an uneventful recovery following surgery.

The mean comprehensive complication index score (mean CCI score) was also analysed (Table – 10). The CCI Score is calculated as the sum of all the complications, graded according to the Clavien-Dindo classification, that are weighted for their severity. The mean CCI score is the mean of the individual patient CCI scores. As shown the mean CCI Score was highest in patients of Group B with a value of  $10.37 \pm 13.39$  and this finding was significant with a p - value of 0.036.

The length of hospital stay was compared among the three groups (Table -10). As shown in the table, the length of hospital stay was higher in patients of Group B (base perforation) and this was statistically significant with a p-value of 0.031.

## DISCUSSION

The risk factors of appendicular perforation identified in this study were time delay till appendectomy of greater than 72 hours (68.42 % ), male gender (68.42 %), presence of faecolith (57.89 %), age over 50 years (43.86 %), history of previous surgery (36.84 %) and diabetes mellitus (33.33 %). This is consistent with the risk factors identified in previous studies [1 , 2]

The time delay till appendectomy was the single most important modifiable risk factor identified in this study. 68.42 % of patients in this study had a time delay of  $\geq 72$  hours. Only 2 patients (3.51 %) of the study population had a delay of 36 hours. This is similar to the findings of the study by Bickell et al [12] who reported a  $\leq 2$  % incidence of perforation in less than 36 hours of untreated symptoms. Therefore, early diagnosis and reducing the in-hospital delay can help in decreasing the burden of appendicular perforation.

The most common age group affected were those over 50 years (43.86 %). Elderly usually have increased risk of perforation due to sluggish bodily physiological reaction [13] and atypical

presentation leading to a delay in seeking medical help[14]. Therefore, early diagnosis with imaging studies can help in early detection and lesser delay in management in this subset of patients. History of co-morbidities conferred a lesser risk of perforation according to this study. The patients with perforation in the base of appendix had a higher risk of intra-operative complications in this study. 2 patients had iatrogenic caecal perforation while dissecting the appendix base due to severe peri-appendiceal inflammation and gangrene extending to the caecal wall. 3 patients had a gangrene of the base and absence of a residual healthy stump. These complications increase the likelihood of additional procedures like bowel resection or stomy and post-operative complications like faecal fistula.

The mean VAS score for pain among the three groups didn't show any statistically significant difference.

The mean CCI score was higher in patients of Group B and was statistically significant with a p-value of 0.036. Hence, this represents that the patients of Group B had a higher incidence of postoperative complications compared to the other groups.

The length of hospital stay was also higher in Group B patients and was statistically significant with a p-value of 0.031. This is because the patients of Group B had a greater incidence of complications in the postoperative period.

## **LIMITATIONS**

This study has some limitations. First, the sample size of the study was less. Future studies with larger sample size are required to confirm the findings of this study. Secondly, this study excludes the population below 18 years of age. Both acute appendicitis and appendicular perforation are very common in this age group. Therefore, inclusion of these groups in future studies may help in confirming these findings and may help provide new evidences about risk factors. Thirdly, in this study, the patients were followed up for 30 days postoperatively. Studies with long term follow-up will allow a better comparison of the postoperative outcomes among the different groups.

## **CONCLUSION**

Appendicular perforation is associated with a high rate of morbidity and mortality. The findings of this study establish that perforation of the appendix at its base is associated with a higher risk of complications. Early detection of cases of appendicitis, decreasing the time delay till appendectomy, better techniques at surgery and proper postoperative follow up may help in minimizing complications in these patients.

## **BIBLIOGRAPHY**

1. B.-F. Sheu, T.-F. Chiu, J.-C. Chen, M.-S. Tung, M.-W. Chang, and Y.-R. Young, "Risk factors associated with perforated appendicitis in elderly patients presenting with signs and symptoms of acute appendicitis," ANZ Journal of Surgery, vol. 77, no. 8, pp. 662–666, 2007.
2. Omari et al.: Acute appendicitis in the elderly: risk factors for perforation. World Journal of Emergency Surgery 2014 9:6.

3. Lounis, Y.; Hugo, J.; Demarche, M.; Seghaye, M.C. Influence of age on clinical presentation, diagnosis delay and outcome in pre-school children with acute appendicitis. *BMC Pediatr.* 2020, 20, 151
4. Pogorelić, Z.; Domjanović, J.; Jukić, M.; Peričić, T.P. Acute appendicitis in children younger than five years of age: Diagnostic challenge for pediatric surgeons. *Surg. Infect. (Larchmt.)* 2020, 21, 239–245
5. B. P. Suresh, M. L. Ramachandra, and S. Charudut, “Retrocaecal appendicular perforation causing retroperitoneal abscess extending to mediastinum with pneumomediastinum,” *The Internet Journal of Surgery*, vol. 28, no. 2, 2012.
6. N. A. Wani, M. Farooq, T. Gofwari, and T. Kosar, “Perinephric abscess caused by ruptured retrocecal appendix: MDCT demonstration,” *Urology Annals*, vol. 2, pp. 29–31, 2010.
7. S. B. Sharma, V. Gupta, and S. C. Sharma, “Acute appendicitis presenting as thigh abscess in a child: a case report,” *Pediatric Surgery International*, vol. 21, no. 4, pp. 298–300, 2005.
8. Wong, C.S., Naqvi, S.A. Appendicular perforation at the base of the caecum, a rare operative challenge in acute appendicitis, a literature review. *World J Emerg Surg* 6, 36 (2011).
9. Mohamed, Abbas. (2010). Faecal Fistula, the Most Unfortunate Sequelae of Appendectomy. *Case Report.. internet journal of surgery.* 27.
10. Nelson Agostinho, Harinder K. Bains, Franko Sardelic, "Enterocutaneous Fistula Secondary to Stump Appendicitis", *Case Reports in Surgery*, vol. 2017, Article ID 6135251, 3 pages, 2017.
11. Souza, I., Nunes, D., Massuqueto, C., Veiga, M., & Tamada, H. (2017). Complicated acute appendicitis presenting as an abscess in the abdominal wall in an elderly patient: A case report. *International journal of surgery case reports*, 41, 5–8
12. Bickell, N. A., Aufses, A. H., Jr, Rojas, M., & Bodian, C. (2006). How time affects the risk of rupture in appendicitis. *Journal of the American College of Surgeons*, 202(3), 401–406.
13. Smithy WB, Wexner SD, Daily TH. The diagnosis and treatment of acute appendicitis in the aged. *Dis Colon Rectum.* 1986;**29**:170–173. doi: 10.1007/BF02555015.
14. Storm-Dickerson TL, Horattas MC. What we have learned over the past 20 years about appendicitis in the elderly? *Am J Surg.* 2003;**185**:198–201. doi: 10.1016/S0002-9610(02)01390-9.

Total patients assessed for inclusion in the study : 78

Excluded from study :

Did not give consent – 4

Site of perforation not found – 17

Included in study : 57

Group A (Tip perforation) : 31

Group B (Base perforation) : 20

Group C (Body perforation) : 06

Lost to follow up : 0

**Table – 1 Patient Selection**

RISK FACTORS	No. of patients (n)	%
Time delay till appendectomy ( ≥ 72 hours )	39	68.42
Male	39	68.42
Faecolith	33	57.89
Age ( ≥ 50 years )	31	43.86.
Diabetes	19	33.33
Previous Surgery	21	36.84
Others ( HTN, CKD, Malg., ↓RTx, CAD Steroid, Immunocompromised)	18	31.58

**Table – 2 : Prevalence of the common risk factors of appendicular perforation**

Time delay till appendectomy (in hours)	No. of Patients (n)	%
0 - 24	0	0

24 - 48	10	17.54
48 - 72	12	21.05
72 - 96	25	43.86
96 - 120	10	17.54

**Table – 3 : Comparison of the time delay till appendectomy**

Age Distribution (in years)	No. of patients (n)	%
18 - 30	12	21.05
30 - 40	14	24.56
40 - 50	6	10.53
>50	25	43.86

**Table – 4 : Age specific comparison of the study population**

Patient Profile (Mean ± SD)	GROUP A	GROUP B	GROUP C	p- value
	(Tip) N = 31	(Base) N = 20	( Body) N = 6	
Age (in years)	46.64 ± 15.12	39.9 ± 15.89	40.5 ± 15.90	0.282
M:F	22 : 9	13 : 7	4 : 2	0.9
BMI (in kg/m2)	21.07 ± 1.71	21.35 ± 1.73	19.88 ± 1.82	0.194

**Table 5 : Patient profile of the three groups (p < 0.05 is statistically significant)**

Peri-Operative Characteristics (Mean ± SD)	GROUP A	GROUP B	GROUP C	p - value
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<b>Operative time (in mins.)</b>	<b>53.45 ± 9.73</b>	<b>58.85 ± 12.89</b>	<b>52.5 ± 5.39</b>	<b>0.178</b>
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**Table 6 : Comparison of Operative time between the three groups**

<b>Intra-Operative Complications</b>	<b>Group A</b>	<b>Group B</b>	<b>Group C</b>
<b>Ileal Perforation</b>	2	2	0
<b>Caecal Perforation</b>		2	
<b>Gangrenous base without a healthy Stump</b>		3	

**Table – 7 : Comparison of the intra-operative complications among the three groups**

<b>Time from Surgery</b>	<b>GROUP A</b>	<b>GROUP B</b>	<b>GROUP C</b>	<b>p - value</b>
<b>6 hours</b>	<b>4.90 ± 0.79</b>	<b>5.1 ± 0.79</b>	<b>5.16 ± 0.41</b>	<b>0.571</b>
<b>12 hours</b>	<b>4.29 ± 0.46</b>	<b>4.5 ± 0.61</b>	<b>4.67 ± 0.52</b>	<b>0.169</b>
<b>24 hours</b>	<b>3.48 ± 0.72</b>	<b>3.45 ± 0.69</b>	<b>3.67 ± 0.52</b>	<b>0.796</b>
<b>3 days</b>	<b>1.45 ± 0.57</b>	<b>1.6 ± 0.50</b>	<b>1.33 ± 0.52</b>	<b>0.48</b>
<b>5 days</b>	<b>1.03 ± 0.60</b>	<b>1 ± 0.46</b>	<b>0.5 ± 0.55</b>	<b>0.1</b>
<b>14 days</b>	<b>0.032 ± 0.18</b>	<b>0.15 ± 0.49</b>	<b>0.33 ± 0.52</b>	<b>0.14</b>

**Table 8 : VAS score ( Mean ± SD) of the three groups.**

Complications (Clavien-Dindo Grade)	Group A	Group B	Group C
Seroma (CD 1)	2	1	0
SSI (CD 1)	2	1	0
SSI requiring antibiotics (CD 2)	1	2	1
Ileus (CD 2)	1	1	0
Wound Dehiscence (CD 3A)	1	1	0
Leak Repair Site (CD 3B)	0	3	0

**Table 9 : Comparison of individual complication events based on Clavien-Dindo grade between the groups**

Post-Operative Outcomes	GROUP A	GROUP B	GROUP C	p - value
Mean CCI Score (Mean $\pm$ SD)	2.92 $\pm$ 7.30	10.37 $\pm$ 13.39	3.48 $\pm$ 8.53	<b>0.036</b>
Length of Hospital stay in days (Mean $\pm$ SD)	6.32 $\pm$ 1.78	8.2 $\pm$ 3.46	6.33 $\pm$ 1.50	<b>0.031</b>

**Table – 10 : Comparison of Postoperative outcomes among the three groups (p < 0.05 is statistically significant)**