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ASSOCIATION OF DELAYED PRESENTATION WITH PERFORATION RATE AND POSTOPERATIVE COMPLICATIONS IN ACUTE APPENDICITIS

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ABSTRACT

Background: Acute appendicitis is a common surgical condition around the world. A delay in presenting to a medical facility may contribute to appendiceal perforation and worse postoperative outcomes. In low- and middle-income countries, delayed presentation is still a common clinical issue, and may be associated with disease severity and postoperative complications.

Aim: To assess the relationship between delayed presentation and appendiceal perforation and postoperative complications in acute appendicitis.

Methods: This cross-sectional analytical study was performed in the Department of General Surgery, Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat, Sindh a tertiary care teaching hospital in Pakistan from 1st August 2025 to 31st January 2026. Consecutive sampling of 120 patients, aged 15-60 years, who presented with acute appendicitis and were treated by appendectomy was done. Early presenters (≤24 hours) and delayed presenters (>24 hours) were defined according to the time elapsed from symptom onset to presentation. The presence of perforation at surgery and postoperative complications such as wound infection, fever, ileus, intra-abdominal collection, wound dehiscence and length of hospital stay were noted. SPSS version 26.0 was used for data analysis.

Results: Seventy (58.3%) patients presented more than 24 hours after symptom onset. A total of 39 patients (32.5%) had appendiceal perforation and this was significantly higher ($p<0.001$) in delayed presenters (47.1%) than in early presenters (12%). Complications after surgery were more common in delayed presenters (38.6%) than early presenters (16%) [$p=0.008$]. The mean length of hospital stay was also longer in delayed presenters 5.1±1.9 days than early presenters 2.9±1.2 days ($p<0.001$).

Conclusion: Late presentation with acute appendicitis is strongly linked to high perforation rate and postoperative complications. Early diagnosis and prompt surgical intervention are crucial to minimise complications and optimise patient outcomes.

Keywords: Acute appendicitis; Appendiceal perforation; Delayed presentation; Postoperative complications; Surgical site infection; Appendectomy

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INTRODUCTION

Acute appendicitis is a leading cause of acute abdominal pain that requires urgent surgical treatment and continues to be a significant burden on the world's surgical systems.[1] It occurs in all age groups, but is most common in teenagers and young adults. While it is often described as a condition that can be easily diagnosed and managed, the clinical presentation and outcomes can be highly variable and depend on the timing of diagnosis and treatment. Early diagnosis and treatment of appendicitis is generally uncomplicated and has a good prognosis, but if the condition progresses, it can result in appendiceal perforation, peritonitis, and postoperative complications.[2]

Acute appendicitis is thought to be caused by obstruction of the appendiceal lumen, typically by lymphoid hyperplasia, fecaliths, or, less commonly tumors.[3] This results in a rise in intraluminal pressure, decreased blood flow, bacterial proliferation and

subsequent inflammation. This can lead to ischemia, gangrene, and perforation of the appendix. Perforation of the appendix is a pivotal point in the severity of the disease, as it is associated with increased risk of intra-abdominal contamination, sepsis, and surgical complications including wound infection, abscess, ileus, and prolonged hospital length of stay.[4]

A key factor in the perforation of the appendix is the time elapsed from the onset of symptoms to definitive surgical treatment.[5] Recently, there has been a growing focus on the distinction between prehospital delay (time to presentation) and in-hospital delay (time to surgery). Recent research has shown that short in-hospital delays for diagnostic work-up may not significantly contribute to the risk of complications in uncomplicated appendicitis, while prolonged prehospital delay is more likely to result in perforation and complicated appendicitis. This distinction is significant in clinical practice as it emphasises the importance of patient behaviour, health literacy and access to health care in the management of disease.[6]

In developing nations, such as Pakistan, delayed presentation of acute appendicitis is a frequent occurrence.[7] This delay is attributed to a variety of factors, including a lack of awareness of early symptoms, self-medication, financial barriers, lack of access to health care facilities, transportation issues, and delayed referral from peripheral hospitals. This results in a delayed presentation with a higher risk of perforation and subsequent complications. These factors not only impact patient outcomes but also have a negative impact on the health-care system.[8]

Surgical complications continue to pose a major challenge in the treatment of acute appendicitis, especially with perforation.[9] Complicated appendicitis is associated with a higher risk of surgical site infections, intra-abdominal abscesses, prolonged ileus, and longer hospital stays than uncomplicated appendicitis presenting early in the disease course. Understanding the role of modifiable risk factors, like delayed presentation, is therefore critical to improving outcomes and reducing healthcare costs.[10]

Although this is a critical clinical issue, there is a lack of local data on the association of delayed presentation with appendiceal perforation and postoperative complications in the Pakistani population.[11] It is important to understand this relationship in our local population to develop strategies for early diagnosis, prompt referral and patient education.[12]

Hence, this study was designed to assess the impact of delayed presentation on the perforation rate and complications in patients with acute appendicitis.[13] This study will help to understand the influence of symptom duration on disease severity and complications, which will help to guide clinical decision-making and patient care in emergency surgery.[14]

MATERIALS AND METHODS

This cross-sectional analytical study was carried out in the Department of General Surgery, Pir Abdul Qadir Shah Jeelani Institute of Medical Sciences, Gambat, Sindh from 1st August 2025 to 31st January 2026, a tertiary care teaching hospital in Pakistan to assess the impact of delayed presentation on appendiceal perforation and postoperative complications in patients presenting with acute appendicitis. We enrolled 120 patients presenting with acute appendicitis who later had appendectomy during the study period. Non-probability consecutive sampling was used. Every patient who met the inclusion criteria and presented during the study period was included in the study until the sample size was reached. Patients who presented to the emergency or surgical department with a clinical diagnosis of acute appendicitis and subsequently diagnosed by radiology, intraoperatively, or both, 15 and 60 years of age (both males and females) who had a clinical diagnosis of acute appendicitis and were subjected to emergency appendectomy were included. Those with an appendicular mass treated conservatively, appendicular abscess treated initially with drainage, previous abdominal surgery that may affect postoperative recovery, pregnancy, severe immunocompromised state, inflammatory bowel disease, or inadequate clinical and postoperative data were excluded. The delayed presentation was defined as reaching the hospital after 24 hours of the onset of abdominal symptoms. Using this definition, patients were divided into two groups: early presenters (presented to the hospital within 24 hours of the onset of symptoms) and delayed presenters (presented after 24 hours).

Following institutional ethical review committee approval, we used a predesigned proforma to gather data. All patients or their relatives gave written informed consent. Age, sex, and relevant clinical data including duration of symptoms before presenting to the hospital, abdominal pain, fever, nausea, vomiting, anorexia, local and/or generalised abdominal tenderness, rebound tenderness and guarding were documented. Time from symptom onset to presentation at the hospital was noted in hours as reported by the patients. Preoperative work-up was conducted in accordance with hospital protocol. This included complete blood count, urinalysis and abdominal ultrasound. Other tests, including C-reactive protein or computed tomography, were carried out as needed. All patients were then referred for urgent appendectomy after clinical and radiological evaluation. The surgeons recorded detailed findings at operation. Special attention was given to the macroscopic appearance of the appendix, gangrene, perforation, pus, localised peritonitis, generalised peritonitis, or faecal contamination of the abdominal cavity. Appendiceal perforation was confirmed during surgery, and was defined as visible rupture or perforation of the appendiceal wall, gangrenous disintegration with

breach, or gross contamination due to appendiceal rupture. This was the primary outcome of the study.

Complications were recorded during the patients' stay in hospital. Secondary outcomes were surgical site infection, postoperative fever, postoperative ileus, intra-abdominal collection or abscess, wound dehiscence, postoperative peritonitis if present, and length of stay. Surgical site infection was defined clinically as the presence of redness, swelling, tenderness, purulent discharge or wound infection following surgery. Postoperative fever was defined as a temperature above 38°C in the postoperative period. Postoperative ileus was defined as delayed bowel function with abdominal distention, vomiting or inability to tolerate oral fluids. Abdominal collection or abscess was diagnosed clinically and radiologically if required. Wound dehiscence was considered when there was partial or complete wound separation. Extended hospital stay was defined as the patient being in hospital beyond the expected time for recovery as per the hospital protocol.

Data were entered and analysed using SPSS-26.0. The patients were stratified based on the time of presentation and the association between delayed presentation and the study outcomes was tested. The Chi-square test was used to compare categorical variables such as perforation and complications between early and delayed presenters. The independent sample t-test was applied for comparison of continuous variables. A p-value of ≤0.05 was taken as significant.

RESULTS

The mean age of the patients in the study was 29.8±11.2 years, with a range from adolescence to late adulthood. A total of 72 (60%) were males and 48 (40%) were females, with a male preponderance. The time interval between symptom onset and hospital arrival was used to classify patients into two groups: 50 (41.7%) patients who presented within 24 hours (early presenters) and 70 (58.3%) patients who presented after 24 hours (delayed presenters). The mean duration of symptoms before hospital presentation was 33.6±15.4 hours. Delayed presenters were more likely to have fever, vomiting and diffuse abdominal tenderness, suggesting that patients presenting later to the hospital had more severe inflammatory disease. This pattern is clinically in line with published data that demonstrate a strong correlation between longer duration of symptoms and more severe appendiceal disease and poorer outcomes (Table 1).

The majority of patients in this series presented late to the hospital, suggesting that delayed presentation was frequent in this series. This is particularly important in the field of emergency surgery because the duration of symptoms has been consistently shown to be associated with increased risk of gangrene, perforation and complications in patients with acute appendicitis. The relatively high proportion of young adult males in the current study also fits the typical epidemiological profile of appendicitis. The key message of this study was the significant association between delayed presentation and appendiceal perforation. Of the 120 patients, 39 (32.5%) had intra-operatively diagnosed perforated appendicitis and 81 (67.5%) had non-perforated appendicitis. On stratification of the patients by time of presentation, 6 (12%) of the 50 early presenters had perforation, while 33 (47.1%) of the 70 delayed presenters had perforated appendicitis. This was a highly significant difference ($p<0.001$). This study shows that patients presenting to the hospital after 24 hours of symptoms were at a significantly increased risk of having complicated appendicitis at the time of surgery (Table 2).

Delayed presenters also experienced more postoperative complications. A total of 35 (29.2%) patients experienced at least one postoperative complication during their hospital stay. Surgical site infection was the most frequent complication, followed by postoperative fever, postoperative ileus and intra-abdominal collection. Of the 70 delayed presenters, 27 (38.6%) had at least one postoperative complication, whereas only 8 (16.0%) of the 50 early presenters had at least one complication. Surgical site infection was seen in 13 (18.6%) delayed presenters and 3 (6.0%) early presenters. Postoperative fever occurred in 12 (17.1%) delayed presenters and 3 (6.0%) early presenters. Likewise, postoperative ileus was observed in 7 (10%) delayed presenters versus 1 (2%) early presenter and intra-abdominal collection in 6 (8.6%) delayed presenters and 1 (2%) early presenter. Wound dehiscence was also only observed in delayed presenters. The average length of stay in hospital after surgery was also significantly ($p<0.001$) longer in delayed presenters (5.1±1.9 days) compared with early presenters (2.9±1.2 days). Delayed presentation was not only associated with a higher perforation rate, but also resulted in increased postoperative complications. Late-presenting patients suffered a greater number of wound complications, postoperative infective symptoms and a significantly prolonged hospital stay. While some individual complications were not statistically significant, they were all more common in the delayed presentation group, indicating a more severe postoperative illness. These observations are consistent with other studies that have demonstrated higher rates of wound infection, intra-abdominal abscess, postoperative ileus and prolonged hospital stay in patients with perforated and delayed appendicitis. Overall, the findings of this study show that delayed presentation is significantly associated with appendiceal perforation and postoperative complications in acute appendicitis. Those presenting more than 24 hours after the onset of symptoms were more likely to have complicated disease at the time of surgery, and more likely to have complications after surgery. These results underline the importance of early presentation, diagnosis

and surgical intervention in preventing avoidable complications in acute appendicitis (Table 3).

Table 1: Baseline Clinical and Demographic Characteristics of Patients with Acute Appendicitis (n=120)

Variable	No.	%
Age (years)	29.8±11.2	
Symptom duration (hours)	33.6±15.4	
Gender		
Male	72	60.0
Female	48	40.0
Early presentation (≤24 h)	50	41.7
Delayed presentation (>24 h)	70	58.3
Fever on admission	49	40.8
Nausea/Vomiting	88	73.3
Generalized abdominal tenderness	36	30.0

Table 2: Association of delayed presentation with appendiceal perforation (n=120)

Presentation Timing	Perforated Appendicitis	Non-Perforated Appendicitis	P value
Early presentation (≤24 h)	6 (12%)	44 (88%)	<0.001
Delayed presentation (>24 h)	33 (47.1%)	37 (52.9%)	
Total	39 (32.5%)	81 (67.5%)	

Table 3: Postoperative Complications According to Timing of Presentation

Variable	Early presentation (n=50)	Delayed presentation (=70)	P value
Any postoperative complication	8 (16%)	27 (38.6%)	0.008
Surgical site infection	3 (6%)	13 (18.6%)	0.044
Postoperative fever	3 (6%)	12 (17.1%)	0.071
Postoperative ileus	1 (2%)	7 (10%)	0.093
Intra-abdominal collection	1 (2%)	6 (8.6%)	0.139
Wound dehiscence	-	3 (4.3%)	0.154
Hospital stay (days)	2.9±1.2	5.1±1.9	<0.001

DISCUSSION

The study clearly showed that late presentation (defined as presenting to hospital more than 24 hours after the onset of symptoms) is strongly linked to more severe disease and worse post-operative complications. Late presenters were more likely to have appendiceal perforation, postoperative complications, and longer hospital stay than early presenters. In the present study, over half of the patients presented more than 24 hours after the onset of symptoms, suggesting that delayed presentation is a common problem. This finding is of particular importance in low-and middle-income countries where delayed presentation is due to a lack of awareness, self-medication, difficulty in accessing transport and delayed referral from peripheral hospitals. The age and gender distribution of the patients in the current study is in line with the known epidemiology of acute appendicitis, which is most prevalent among young adults in the second and third decades of life.[4]

The current study's most important finding was the increased frequency of appendiceal perforation in late presenters.[5] Almost half of the late presenters had perforated appendicitis, whereas this was rare in early presenters. This finding reinforces the long-held notion that time is a significant factor in the development of appendiceal perforation, as the appendix becomes increasingly inflamed, ischaemic and finally ruptures. This is in line with other studies that have found symptom duration of more than 24-48 hours is a significant predictor of complicated appendicitis. Crucially, recent studies highlight that prehospital delay is more important in predicting the risk of perforation than short delays in hospital, suggesting that the timing of presentation is more important than the timing of surgery once the patient has arrived in hospital.[6]

The researchers also found a significantly greater incidence of complications in patients who presented late.[7] The most frequent complications were wound infection, fever, ileus and intra-abdominal collection. These complications were found to be more common in delayed presenters. This is due to the greater inflammatory response and contamination in patients with perforated appendicitis. Perforation results in the release of infected material into the peritoneal cavity, triggering local and systemic inflammatory responses, which increase the risk of wound infection, abscess formation, and prolonged recovery.[8]

The other key finding of this study was the longer length of stay in patients presenting late. Delayed presenters had a longer stay in hospital after surgery, which is a marker of more severe disease, longer course of antibiotics and complications. This observation has significant implications for patient care and health-care resource allocation, particularly in resource-constrained environments.[10]

Our findings are consistent with the published literature, which has shown that delayed presentation is a significant predictor of perforation and poor outcomes in acute appendicitis.[11] It has shown that delayed presentation is associated with increased likelihood of gangrenous or perforated appendicitis and increased risk of postoperative complications such as wound infections and intra-abdominal abscesses. The lack of variability in these findings across different populations lends credibility to the current study.[12]

The study findings have clinical implications as they highlight the importance of early diagnosis and timely treatment for acute appendicitis.[13-15] Education campaigns highlighting early symptoms of right lower abdominal pain, fever and vomiting may help with early presentation to health services. Furthermore, general practitioners must

be vigilant and refer suspected cases to surgical units. Timely appendectomy following an early diagnosis can prevent perforation and complications.[16-18]

However, the study presents compelling evidence for the link between delayed presentation and poor outcomes in acute appendicitis and identifies a potentially modifiable risk factor that can be addressed to improve outcomes. The study highlights the need for timely diagnosis, referral and surgical treatment for acute appendicitis. Efforts to enhance public education, decrease time to presentation, and improve access to emergency surgical care can help in reducing complications and improving patient outcomes.

CONCLUSION

The timing of presentation in acute appendicitis is strongly associated with appendiceal perforation and post-operative complications. Those presenting 24 hours or more after the onset of symptoms are more likely to have complicated appendicitis, surgical site infections, postoperative fever, ileus, intra-abdominal collections, and longer hospital stays.

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