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FREQUENCY OF FECOLITH AS A CAUSE OF ACUTE APPENDICITIS IN CHILDREN AND ITS IMPACT ON DISEASE SEVERITY

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Abstract

To determine the frequency of fecolith as a cause of acute appendicitis and to examine their association with patients age, duration of symptoms, disease severity and operative findings.

METHODOLOGY

This Cross-sectional study was conducted in the Department of Pediatric Surgery at the National Institute of Child Health (NICH) from October 2024 to March 2025 after IERB approval (61/2023). Patients aged from 1 to 15 years who presented to the emergency department and were clinically diagnosed with acute appendicitis based on history, physical examination, radiological findings were included. Patients referred after undergoing surgery elsewhere for postoperative complications were excluded from the study. The duration of symptoms was recorded and stratified into two categories. Intraoperative findings were recorded including the type and severity of appendicitis, classified as catarrhal, suppurative, gangrenous, or perforated. All the details were collected on a structured proforma.

RESULTS

The study included 173 children with the diagnosis of acute appendicitis.39 (22.5%) had fecolith and 134 (77.5%) did not. In the study group of fecolith, 12.8% were belonged to the age of ≤5 years, 53.8% were in the age group of 6-10 years and 33.3% were in the age group of 11-14 years. In comparison the non-fecolith population disclosed that 6.7% were ≤5 years, 59.0% aged 6–10 years and 34.3% were 11–14 years. The difference in age distribution was not statistically significant (p=0.464). Symptom duration was longer in the fecolith group, 79.5% were > 24 hours vs. 70.9% > 24 hours in the non-fecolith group (p=0.288). A marked difference was noticed in ultrasound findings (p=0.0001); 71.8% of patients with fecolith had perforation appendicitis as compared to 33.6% of patients without fecolith. Operative findings also had strong correlation

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with fecolith (p=0.0001). Perforated appendicitis was determined in 79.5% of patients that were fecolith positive in contrast with 35.1% of patients that did not have fecolith present. The average of total leukocyte count was slightly higher in patients with fecolith (15.56 ± 3.14) than in those without fecolith (14.94 ± 4.12), but there was no significant difference (p=0.386).

CONCLUSION

This study demonstrated a strong association between the presence of fecolith and the severity of appendicitis predominantly in cases of perforation. Fecolith was significantly more frequent in severe cases such as perforated appendicitis while it was rarely observed in catarrhal appendicitis. It strengthened fecolith role as a key factor in disease progression of appendicitis.

INTRODUCTION

Appendicitis is a common surgical emergency in Pakistan, with a significant burden on healthcare facilities. This condition predominantly affects young adults, with the highest incidence reported in individuals aged 5 to 45 years (1) Epidemiological studies indicate that the prevalence of appendicitis in Pakistan ranges between 7% and 10% of all abdominal emergencies (20). Limited access to healthcare in rural areas contributes to delayed diagnosis and higher rates of complications such as perforation and peritonitis. Seasonal variations have been observed as its incidence increases during the summer months and they are mostly linked to dietary patterns and infections (1,30). Risk factors include low fiber intake, high consumption of refined carbohydrates and a family history of appendicitis. The male-to-female ratio varies between 1.2:1 and 1.5:1 (1,30). The lifetime probability of developing acute appendicitis is marginally greater in males (8.6%) compared to females (6.7%).

Appendicitis is a common surgical emergency in Pakistan, with a significant burden on healthcare facilities. (16). Recent studies suggest that fecoliths are found in approximately 20.7% of appendiceal specimens with reported variations ranging between 1.4% and 67% and is due to the population and diagnostic criteria used (24). In a retrospective cohort study of 860 patients, 35% were found to have fecoliths, and among these, 53% developed complicated appendicitis, compared to 23% in patients without fecoliths (11). Additionally, studies have demonstrated that the presence of a fecolith is a critical predictor of nonoperative management failure in cases of uncomplicated appendicitis, further reinforcing its role in disease severity (2). While imaging modalities such as CT scans have improved the detection of appendiceal fecoliths there are variations in reported prevalence that suggest that some cases may remain undiagnosed or underreported (4).

Studies have demonstrated that fecoliths are associated with an increased risk of perforation, gangrene and abscess formation and can lead to higher morbidity rates (23). A large prospective analysis found that patients with appendicoliths were nearly three times more likely to develop perforated appendicitis compared to those without (22). Additionally, the presence of a fecolith has been linked to higher rates of postoperative complications, including intra-abdominal abscesses and readmission following appendectomy (11,16). A large retrospective analysis by Min, & He,(13) demonstrated that children with appendicoliths had a significantly higher rate of postoperative abscess formation and failure of non-operative management compared to those without. Additionally, the presence of an appendicolith has been cited as a key predictor of recurrence in cases managed conservatively with antibiotics alone (19,31).

Surgical intervention remains the standard treatment for acute appendicitis. Laparoscopic appendectomy is preferred due to its association with reduced postoperative pain, shorter recovery times, and lower rates of surgical site infections compared to open appendectomy.

The study aimed to evaluate the prevalence of fecoliths in children with acute appendicitis in the population of Pakistan. Since there was a lack of

Frontier in Medical & Health Research

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studies in Pakistan focusing on the role of fecoliths in pediatric appendicitis, this study was indispensable. This research sought to determine the proportion of fecoliths as a contributing factor in developing appendicitis and its impact on disease severity. By analyzing data and ultrasound findings, this study provided region-specific data to improve the understanding of pediatric appendicitis in Pakistan. This research contributed to evidence-based recommendations for optimizing diagnostic and treatment strategies and eventually improving pediatric appendicitis management in Pakistan.

METHODOLOGY

This Cross-sectional study was conducted in the Department of Paediatric Surgery at the National Institute of Child Health (NICH), Jinnah Sindh Medical University (JSMU), and Karachi from October 2024 to March 2025 after IERB approval (61/2023). The study aimed to determine the frequency of fecolith as a cause of acute appendicitis and to examine their association with patients age, duration of symptoms and disease severity .The study included pediatric patients aged from 1 to 15 years who presented to the emergency department and were clinically diagnosed with acute appendicitis based on history, physical examination, radiological findings, and confirmed during surgical exploration. Patients referred after undergoing surgery elsewhere for postoperative complications were excluded from the study. Demographics details included the patient's age, which was further categorized into three groups: up to 5 years, 6 to 10 years and 11 to 15 years, and area of residence. Clinical evaluation covered presenting complaints such as abdominal pain, fever and vomiting that were used to assess using Paediatric Appendicitis Score (PSA).The duration of symptoms was recorded and stratified into two categories: less than 24 hours and more than 24 hours. The laboratory investigations included a complete blood count specifically focusing on Total leucocytes count (TLC). All patients underwent ultrasonography, with documentation of relevant findings including appendiceal dilatation greater than 6mm in diameter, wall thickness exceeding 3mm, peri-appendiceal inflammation and presence of fecolith. Intraoperative findings were recorded including the type and severity of appendicitis, classified as catarrhal, suppurative, gangrenous, or perforated. All the details were collected on a structured proforma.

Statistical analysis was conducted using SPSS software version 25. Descriptive statistics including means, standard deviations, frequencies and percentages, were applied to summarize demographic variables and distribution of appendicitis type. The chi-square test was applied to evaluate the associations between duration of symptoms, presence of fecolith and the severity of appendicitis. Additionally, a one-way ANOVA test was conducted to compare TLC levels across different categories of appendicitis severity. A p- value of less than 0.05 was considered statistically significant. Patient confidentiality was maintained by anonymizing all collected data and no identifiable information was included in the analysis.

RESULTS:

The study included 173 children with the diagnosis of acute appendicitis. TABLE I depicts demographics and clinical characteristics of appendicitis in children.

In the analysis of the patient characteristics according to the presence of fecolith among those with appendicitis (n=173), 39 (22.5%) had fecolith and 134 (77.5%) did not. In the study group of fecolith, 12.8% were belonged to the age of ≤5 years, 53.8% were in the age group of 6-10 years and 33.3% were in the age group of 11-14 years. In comparison the non-fecolith population disclosed that 6.7% were ≤5 years, 59.0% aged 6–10 years and 34.3% were 11–14 years. The difference in age distribution was not statistically significant (p=0.464). The gender varied similarly among the groups (p=0.822); the proportion of the male subjects was 82.1% for the fecolith group, and 83.6% for the non-fecolith group. Urban resident status was available for 87.2% patients with fecolith compared to 94.0% without fecolith; difference neared but did not meet statistical significance (p=0.153). Symptom duration was longer in the fecolith group, 79.5% were > 24 hours vs. 70.9% > 24 hours in the non-fecolith group (p=0.288). A marked difference was noticed in ultrasound findings (p=0.0001); 71.8% of patients with fecolith

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

had perforation appendicitis as compared to 33.6% of patients without fecolith. On the other hand, acute appendicitis was more common in the non-fecolith group (66.4%) than the fecolith group (28.2%). Operative findings also had strong correlation with fecolith (p=0.0001). Perforated appendicitis was determined in 79.5% of patients that were fecolith positive in contrast with 35.1% of patients that did not have fecolith present. No patients with fecolith had catarrhal appendicitis; 21.6% of the patients without fecolith did. Appendicitis with suppurative was present in 17.9% of the fecolith group and in 39.6% of the non-fecolith group. Gangrenous appendicitis occurred 2.6% and 3.7% of cases with and without fecoliths. The average of total leukocyte count was slightly higher in patients with fecolith (15.56 ± 3.14) than in those without fecolith (14.94 ± 4.12), but there was no significant difference (p=0.386). However, the proportion of neutrophils was significantly higher in the fecolith group (79.92 ± 6.65) than in the non-fecolith group (76.19 ± 9.03) (p=0.018) (TABLE II).

DISCUSSION:

This cross-sectional study included 173 patient's insights into the demographic, clinical and laboratory characteristics of acute appendicitis patients. This study also demonstrated trends in disease severity, leukocyte count variations and urban-rural distribution. The findings suggested a prevalence 22.5 % of fecoliths in children with acute appendicitis. The predominance of perforated appendicitis (69 cases, 40.1%) raised concerns about delayed diagnosis and treatment. The high prevalence also suggested challenges in early diagnosis. One possible explanation was limited awareness or delayed access to healthcare. Alternatively, symptoms progression in pediatric patients might be more rapid and it led to a higher likelihood of perforation by the time of presentation. Recent studies highlighted that delayed diagnosis of appendicitis in children was frequently associated with an incorrect diagnosis during an earlier visit (25,28). It was also found to be linked with misdiagnosed conditions including constipation, gastroenteritis or symptom-based diagnoses such as vomiting or diarrhea (14). Studies had shown that younger children mainly those below five years were more likely to present with perforation due to delayed symptom recognition (7,18). Our study's findings implied a need for improved early detection strategies.

The mean TLC of 14.49 $\times 10^9$/L were consistent with studies showing that elevated leukocyte counts are common in appendicitis (12). The higher values often were associated with perforation or gangrene. However, the wide range (4.7 to 29 $\times 10^9$/L) suggested that while TLC was useful in diagnosis, it was not a definitive predictor of appendicitis severity. Studies established that while TLC has moderate diagnostic accuracy, its specificity in distinguishing simple from complicated appendicitis remains limited (6). Our findings indicated that further stratification using neutrophil-to-lymphocyte ratio (NLR) or C-reactive protein (CRP) levels may provide more accurate risk assessment (3). Literature supported combining TLC with NLR and ultrasound findings to enhance diagnostic accuracy. These are considered to be complementary markers for predicting complicated appendicitis as well as they can aid in guiding non-operative management in children (3).

Additionally, a striking 92.4% of cases were from urban areas and it greatly raised questions about access to healthcare, diagnostic practices and environmental risk factors. While one possible explanation was better healthcare access in urban areas, there is an alternative hypothesis as well. It is that lifestyle factors such as dietary patterns and sedentary behavior may increase appendicitis risk in urban populations (17). Conversely, the lower rural representation could indicate underdiagnosis or delayed presentation and it may cause a potential underestimation of rural appendicitis burden.

The presence of fecolith was significantly associated with perforated and severe appendicitis cases. This was in association with the previous studies that also established a fact that fecolith obstruction increased the risk of complicated appendicitis (15). The presence of fecolith has long been considered a contributing factor in the pathogenesis of appendicitis especially in cases that progress to perforation or gangrene, especially in adult population (19). In the present study, a strong association was found between fecolith presence and

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severe appendicitis in pediatric population. Specifically, 41% of perforated appendicitis cases had a fecolith present while one out of six gangrenous cases also exhibited a fecolith. No fecolith was identified in catarrhal or inflamed cases.

Fecoliths are hardened masses of stool that obstruct the appendiceal lumen and lead to increased intraluminal pressure and bacterial overgrowth. If it continues to be present, it ultimately produces inflammation and ischemia of the appendiceal wall. This process can further progress to perforation or gangrene if the obstruction persists. Several studies have suggested that fecoliths are more commonly associated with complicated appendicitis rather than simple appendicitis. Different studies on different populations also reported that patients with perforated appendicitis were significantly more likely to have a fecolith than those with non-complicated cases (19,21,27). Fecolith-related appendicitis had been shown to correlate with higher rates of postoperative complications and longer hospital stays. Therefore, it is important to consider the significance of early surgical intervention in such cases. A retrospective cohort study by Lee, Purcell, McCombie, Frizelle, & Eglinton, (11) demonstrated that the presence of a fecolith was an independent predictor of acute appendicitis and complications, thus, reinforcing the link of fecoliths with a complicated disease course as well as the significance in prioritizing urgent surgery intervention and even monitoring of postoperative complications.

The presence of fecolith was closely linked to the severity of appendicitis as observed in this study. Fifty percent of perforated appendicitis cases had fecolith compared to only 15.4% of catarrhal appendicitis cases. This signifies that fecolith played a role in disease progression. The high prevalence of fecolith in perforated appendicitis cases in this study aligns with previous findings. The mechanical obstruction caused by the fecolith can lead to localized ischemia, resulting in necrosis and perforation of the appendix (15). Moreover, the presence of a fecolith has been linked to a more aggressive disease course with higher rates of complications such as abscess formation and peritonitis (8). This finding was consistent with the study by Serrano, Barceló, Mateos, Álvarez, & Rey (29) that indicated that fecolith contributed to luminal obstruction, increased intraluminal pressure and subsequent ischemia and ultimately leading to perforation.

Interestingly, appendicular abscess cases showed no evidence of fecoliths. This indicated that such cases were more influenced by bacterial invasion and delayed presentation rather than mechanical obstruction (26). The absence of fecolith in catarrhal and less severe cases in this study might be because of alternative mechanisms. For example, it might be attributable to lymphoid hyperplasia due to infection (15). This might play a more significant role in the pathogenesis of milder forms of appendicitis. Additionally, the absence of fecolith in catarrhal and inflamed appendicitis further supported the hypothesis that its presence was a marker of more severe disease progression rather than an incidental finding.

The data suggested a strong correlation between higher anteroposterior (AP) diameters (>0.6 cm) and perforated cases in fecolith-positive patients. This finding highlighted the importance of AP diameter as a potential predictive marker for severity. This signifies the role of luminal obstruction in determining the disease course. Hence, patients who presented with fecolith and an enlarged AP diameter on imaging appeared to be at higher risk for perforation and required careful monitoring or early surgical intervention. Further research with larger datasets is necessary to validate these observations and refine management strategies for appendicitis based on fecolith presence and US parameters.

While our findings provided important clinical insights there were several limitations that needed to be considered. Selection bias was a concern since the study primarily included patients who underwent surgical intervention. Therefore, this potentially excluding milder cases that were treated conservatively. The cross-sectional nature of the study further limited the establishment of direct causality. A cross-sectional study captures data at a single point in time and it means it cannot establish cause-and-effect relationships. Instead, it identifies correlations or associations between variables. Thus, it is necessary for future prospective studies with standardized diagnostic criteria to strengthen these findings. Another limitation was the lack of

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additional biomarkers such as C-reactive protein (CRP) and neutrophil-to lymphocyte ratio (NLR). Both could have provided a more refined analysis of inflammatory responses in different severities of appendicitis.

CONCLUSION

This study demonstrated a strong association between the presence of fecolith and the severity of appendicitis predominantly in cases of perforation. Fecolith was significantly more frequent in severe cases such as perforated appendicitis while it was rarely observed in catarrhal appendicitis. It strengthened fecolith role as a key factor in disease progression. Improving early detection strategies is essential to prevent complications associated with delayed intervention. The integration of additional inflammatory markers, improved ultrasound evaluation and structured clinical assessment tools may improve diagnostic accurac

Table 1: Clinical Characteristics of Appendicitis among Children (n=173)

Variable	n (%)
Gender	
Male	144 (83.2)
Female	29 (16.8)
Age (Mean ± SD) = 9.37 ± 2.32 years	
≤5 years	14 (8.1)
6 - 10 years	100 (57.8)
11 - 14 years	59 (34.1)
Residential Status	
Urban	160 (92.5)
Rural	13 (7.5)
Duration of Symptoms (Mean ± SD) = 64.64 ± 38.24 hours	
≤ 24 hours	47 (27.2)
> 24hours	126 (72.8)
US Findings	
Acute Appendicitis	100 (57.8)
Perforated	73 (42. 2)
Operative Findings	
Catarrhal	29 (16.8)
Suppurative	60 (34.7)
Gangrenous	6 (3.5)
Perforated	78 (45.1)
Weight (Mean ± SD) = 23.65 ± 6.01 kg	
Total Leukocyte Count (Mean ± SD) = 15.08 ± 3.92	
Neutrophils (Mean ± SD) = 77.03 ± 8.68	

Table 2: Comparison of Patient Characteristics According to Fecolith Presence in Appendicitis (n=173)

Patient Characteristics (%)		Fecolith		P-Value
		Yes (n=39)	No (n=134)	
Age Group (Years)	≤ 5 years	5 (12.8)	9 (6.7)	0.464
	6 - 10 years	21 (53.8)	79 (59.0)	
	11 - 15 years	13 (33.3)	46 (34.3)	

Frontier in Medical & Health Research

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Duration of Symptoms (hours)	≤ 24 hours	8 (20.5)	39 (29.1)	0.288
	> 24 hours	31 (79.5)	95 (70.9)	
Operative Findings	Catarrhal	0 (0.0)	29 (21.6)	0.0001
	Suppurative	7 (17.9)	53 (39.6)	
	Gangrenous	1 (2.6)	5 (3.7)	
	Perforated	31 (79.5)	47 (35.1)	

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