ISSN 2638-1451 | Volume 11

Clinics of Surgery

Research Open Access

Impact of Fecolith on Appendiceal Perforation and Gangrene: A Retrospective Cohort Analysis

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Received: 08 Apr 2025
Accepted: 22 Apr 2025
Published: 27 Apr 2025
J Short Name: COS

Keywords: Acute appendicitis; Fecoliths; Perforation; Gangrene; Appendectomy

Key Observations: Cases with Feoolith: 55; Gangrene (Yes): 12 (21.8%); Gangrene (No): 43 (78.2%); Cases without Feoolith: 74; Gangrene (Yes): 7 (9.5%); Gangrene (No): 67 (90.5%)

Citation: MA Kiani. Impact of Fecolith on Appendiceal Perforation and Gangrene: A Retrospective Cohort Analysis. Clin Surg. 2025; 11 (2): 1-4

1. Abstract

1.1. Background

Acute appendicitis remains one of the most common surgical emergencies worldwide. While most cases are straightforward, complications like perforation and gangrene significantly increase morbidity. Fecoliths, calcified masses within the appendix, have been implicated in the pathogenesis of complicated appendicitis, though their exact role remains debated.

1.2. Objective

To evaluate the association between fecolith presence and the development of perforation or gangrene in patients with acute appendicitis.

1.3. Methods

We conducted a retrospective cohort study of 129 patients who underwent appendectomy for acute appendicitis at our institution between May 2021 and July 2022. Data on fecolith presence (confirmed by imaging or surgical notes), perforation, and gangrene were analyzed using chi-square tests and relative risk (RR) calculations.

Results: Fecoliths were identified in 42.6% (55/129) of cases. The perforation rate was significantly higher in patients with fecoliths (41.8% vs 14.8%, RR=2.81, p<0.001). Similarly, gangrene was more common in the fecolith group (21.8% vs 9.5%, RR=2.30, p=0.033).

1.4. Conclusion

The presence of a fecolith is strongly associated with both perforation and gangrene in acute appendicitis. These findings support the role of fecoliths as an important risk factor for complicated appendicitis and suggest that their identification should prompt consideration of early surgical intervention.

2. Introduction

Acute appendicitis is one of the most common surgical emergencies worldwide, with a lifetime incidence of approximately 7-8% [1]. While most cases are uncomplicated, perforation occurs in 20-30% of patients and is associated with increased morbidity, prolonged hospitalization, and higher healthcare costs [2,3]. The pathophysiology of appendicitis typically involves luminal obstruction leading to increased intraluminal pressure, bacterial proliferation, and subsequent inflammation [4]. Among the various causes of obstruction, fecolithscalcified masses composed of inspissated fecal material and mineral deposits-have been implicated in the progression to complicated appendicitis [5].

Several studies suggest that fecoliths may accelerate inflammation, increasing the risk of perforation and gangrene [6,7], though the strength of this association remains debated [8,9]. Given the clinical implications of these complications, identifying risk factors for severe appendicitis is crucial for timely surgical intervention. This study aimed to evaluate the association between fecolith presence and the development of perforation or gangrene in patients with acute appendicitis.

2.1. Hypothesis and Specific Objectives

There is an association between the presence of a fecolith with perforation/gangrene of appendix

3. Methodology

3.1. Study Design

This study employed a *retrospective cohort design* to investigate the association between the presence of a fecolith and complications (perforation and gangrene) in patients diagnosed with acute appendicitis. Retrospective analysis was chosen to efficiently utilize existing clinical data while minimizing the need for additional patient recruitment and follow-up.

3.2. Study Population

The study population consisted of patients who underwent appendectomy for acute appendicitis at Sheikh Khalifa Medical city Ajman,UAE between May 2021 to July 2022. Data were extracted from electronic medical records (EMRs) and surgical databases.

3.3. Inclusion Criteria

1. Patients diagnosed with acute appendicitis clinically and radiologically.
2. Patients who underwent either laparoscopic or open appendectomy.
3. Availability of complete medical records, including preoperative imaging, surgical notes

3.4. Exclusion Criteria

1. Patients with incomplete or missing medical records.
2. Cases where appendicitis was secondary to other conditions (e.g., malignancy or inflammatory bowel disease).
3. Patients who underwent incidental appendectomy during other surgical procedures.

3.5. Data Collection

Data were collected from EMRs and surgical databases using a standardized data extraction form. The following variables were recorded for each patient:

- Demographics: Age, gender.

- Clinical Data: Admission date, date of surgery, type of procedure (laparoscopic or open appendectomy).
- Imaging Findings:Presence or absence of a fecolith on preoperative imaging (e.g., ultrasound, CT scan).
- Surgical Findings: Presence of perforation or gangrene, as documented in surgical notes.

3.6. Definitions

- **Fecolith:** A calcified mass within the appendix, confirmed by imaging or surgical notes
- **Perforation:** Evidence of a hole or tear in the appendiceal wall, as documented in radiological finding or surgical notes
- **Gangrene:** Obvious Necrosis of the appendiceal wall, as documented in surgical notes.

4. Statistical Analysis

Data were analyzed using statistical software (e.g., SPSS-26). Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages.The primary analysis involved assessing the association between fecolith presence and appendiceal complications (perforation and gangrene) using the chi-square test of independence. The chi-square test was chosen because both the exposure (fecolith presence) and outcomes (perforation, gangrene) were categorical variables. A p-value of <0.05 was considered statistically significant.

5. Limitations

1. Retrospective Design:The study is subject to biases inherent in retrospective analyses, such as incomplete or inaccurate documentation.
2. Single-Center Study: The findings may not be generalizable to other populations or settings.
3. Imaging Variability: The detection of fecoliths may vary depending on the type and quality of preoperative imaging.

6. Results

6.1. Demographics

Age Distribution Insights

1. High-Risk Age Groups

- Peak Incidence:
  - 11-20 years (37 patients, 28.7% of total)
  - 31-40 years (38 patients, 29.5% of total)
  - 21-30 years (30 patients, 23.3% of total)
- Combined, these three groups (11-40 years) account for 81.4% of all cases, aligning with known epidemiological patterns of appendicitis being most common in adolescents and young adults.

2. Pediatric and Geriatric Cases

- Children (0-10 years): 14 cases (10.9%)
  - Suggests appendicitis is less frequent but still notable in young children.
- Elderly (≥51 years): Only 3 cases (2.3%)
  - Rare in older adults, consistent with literature showing lower incidence but higher complication risks in this group.

Fecolith Present (Yes):

- Total cases with fecolith present: 55
- Cases with perforation: 23 (out of 55)
- Percentage of perforation when fecolith is present: 41.8%

Fecolith Absent (No):

- Total cases with fecolith absent: 74
- Cases with perforation: 11(out of 74)
- Percentage of perforation when fecolith is absent: 14.8%

6.2. Conclusion

The presence of a fecolith is associated with a higher likelihood of perforation (41.8% vs. 14.8%)

- Fecolith Present (Yes):
- Total cases with fecolith present: 55
- Cases with gangrene: 19 (out of 55)
- Percentage of gangrene when fecolith is present: 34.5.
- Fecolith Absent (No):
- Total cases with fecolith absent: 74
- Cases with gangrene: 7 (out of 74)
- Percentage of gangrene when fecolith is absent: 9.5%

6.3. Conclusion

The presence of a fecolith is associated with a higher likelihood of gangrene (34.5% vs. 9.5%).

3. Chi-Square Test for Association

To determine whether the observed associations are statistically significant, a Chi-Square Test was performed for both complications.

- Feoolith vs. Perforation:

Test Statistics

- Chi-Square (χ^2): 11.96
- Degrees of Freedom (df): 1
- Critical Value (α=0.05): 3.841
- p-value: <0.001
- The chi-square statistic (11.96) exceeds the critical value (3.841), and the p-value is <0.001.
- Decision: Reject the null hypothesis.

Age Groups and Frequency: We can group the ages into bins (e.g., 0-10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70,71-80) and count the number of patients in each group:

Age Group	Frequency
0-10	14
11-20	37
21-30	30
31-40	38
41-50	7
51-60	1
61-70	1
71-80	1

Sex Distribution

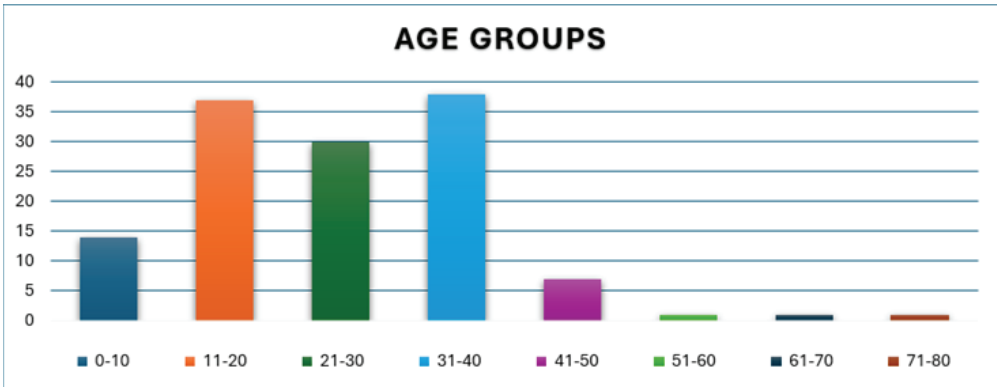
Gender	Frequency
Male	84
Female	45

Fecolith Presence and Perforation

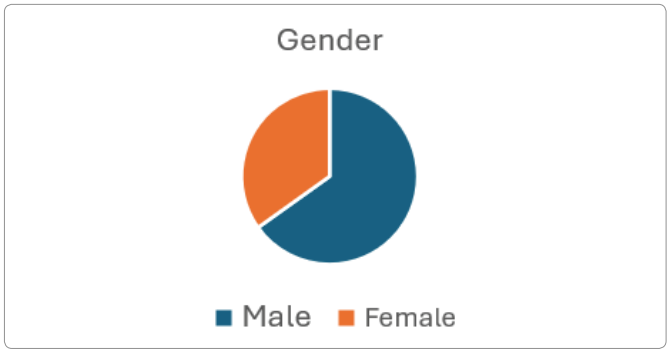
	Perforation(Yes)	Perforation(No)	Total
Fecolith (Yes)	**23**	**32**	**55**
Fecolith (No)	**11**	**63**	**74**
Total	**34**	**95**	**129**

Fecolith Presence and Gangrene

	Gangrene (Yes)	Gangrene (No)	Total
Fecolith (Yes)	**12**	**43**	**55**
Fecolith (No)	**7**	**67**	**74**
Total	**19**	**110**	**129**



- Males make up the majority of the dataset, with 84 patients (65.11% of the total).
- Females account for 45 patients (34.8% of the total).



- Interpretation: A statistically significant association exists between fecolith presence and perforation ($p < 0.001$).
- Feoolith vs. Gangrene:
- Chi-Square Value: 4.56
- p-value: 0.033
- Conclusion: The association between feoolith and gangrene is statistically significant but weaker than perforation.

7. Relative Risk (RR) Calculation

7.1. Relative Risk for Perforation

RR = 2.81: Patients with a fecolith are 2.81 times more likely to develop perforation compared to those without a fecolith.

- Feoolith and Gangrene:
- Relative Risk (RR): 2.30
- Interpretation: Patients with a feoolith are 2.30 times more likely to develop gangrene.

7.2. Overall Conclusion

- The presence of a feoolith is a significant risk factor for complications in appendicitis, particularly perforation.
- The association between feoolith and gangrene is also significant but less pronounced.

8. Discussion

Our findings demonstrate a significant association between fecolith presence and complications of acute appendicitis, particularly perforation and gangrene. Patients with fecoliths had a 2.81 times higher risk of perforation (41.8% vs. 14.8%, $p < 0.001$) and a 2.30 times higher risk of gangrene(21.8% vs. 9.5%, $p = 0.033$) compared to those without fecoliths. These results align with previous studies suggesting that fecolith-induced obstruction leads to increased intraluminal pressure, vascular compromise, and subsequent necrosis [6,10].

8.1. Comparison with Existing Literature

Our findings are consistent with prior research indicating that fecoliths are a major risk factor for perforation. Andersson et al. [11] reported that appendiceal calculi were present in 32% of perforated cases, while Lee et al. [12] found that fecoliths increased the odds of perforation by 3.5 times. Similarly, a meta-analysis by Buckius et al. [13] concluded that fecoliths were significantly associated with complicated appendicitis.However, some studies have reported conflicting results. Almaramhy et al. [8] found no significant difference in perforation rates between fecolith and non-fecolith groups, suggesting that other factors (e.g., delayed presentation, immune response) may also contribute to complications. Our study strengthens the evidence supporting fecoliths as an independent risk factor, but further prospective studies are needed to account for confounding variables.

8.2. Clinical Implications

Given the strong association between fecoliths and complications, early imaging (e.g., CT scans) may help identify high-risk patients who would benefit from prompt surgical intervention. Some authors advocate for non-operative management of uncomplicated appendicitis [14], but our data suggest that fecolith presence should be a consideration in treatment decisions, as these patients may have a higher likelihood of progression to perforation.

8.3. Limitations

1. Retrospective Design: Subject to documentation biases and variability in imaging interpretation.
2. Single-Center Study: May limit generalizability to other populations.
3. Imaging Variability: Detection of fecoliths depends on imaging modality and radiologist expertise.

9. Conclusion

Fecoliths are strongly associated with perforation and gangrene in acute appendicitis. These findings support their role as a key risk factor for complicated disease and suggest that their identification should prompt consideration of early surgical intervention to prevent adverse outcomes.

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