



OPEN Phlegmonous appendicitis as a variant of uncomplicated appendicitis

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Acute appendicitis is the most common cause of surgical acute abdomen, and its classification into uncomplicated, phlegmonous, and complicated forms is crucial for guiding treatment strategies. This study aims to compare the preoperative laboratory findings and postoperative outcomes of phlegmonous appendicitis with uncomplicated and complicated appendicitis. This retrospective cohort study included 1,441 patients who underwent appendectomy between January 2019 and March 2021 at Ankara Bilkent City Hospital. Patients were classified based on histopathological findings into four groups: normal appendix, uncomplicated appendicitis, phlegmonous appendicitis, and complicated appendicitis. Preoperative laboratory values, postoperative complications, and length of hospital stay were analyzed. The distribution of patients was as follows: Group A (normal appendix, 7.6%), Group B (uncomplicated appendicitis, 59.8%), Group C (phlegmonous appendicitis, 17.6%), and Group D (complicated appendicitis, 15%). Phlegmonous appendicitis exhibited significantly higher leukocyte counts and appendix diameters compared to uncomplicated appendicitis but had lower CRP values than complicated appendicitis. The median hospital stay was similar for Groups A, B, and C (1 day) but significantly longer for Group D (2.1 days, $p < 0.001$). Complication rates were highest in Group D (24.1%) compared to the other groups. While phlegmonous appendicitis shares some clinical and laboratory characteristics with complicated appendicitis, its postoperative outcomes align more closely with those of uncomplicated appendicitis. This suggests that phlegmonous appendicitis may be more accurately classified as a variant of uncomplicated appendicitis, emphasizing the need for consistent classification to improve treatment strategies and patient outcomes.

Keywords Acute appendicitis, Phlegmonous appendicitis, Complicated, Uncomplicated

Acute appendicitis is the most common cause of surgical acute abdomen, constituting a significant proportion of emergency surgical interventions¹. The condition is characterized by an inflammatory process that begins in the appendiceal wall and can progress to ischemia, perforation, abscess formation, and generalized peritonitis if left untreated². While distinguishing appendicitis from other causes of abdominal pain is critical, discriminating between uncomplicated and complicated appendicitis has become increasingly important for guiding treatment approaches³.

Complicated appendicitis typically refers to cases with perforation, gangrene, or abscess formation, which require more intensive treatment, longer hospitalization, and result in higher morbidity and mortality rates compared to uncomplicated appendicitis^{4–6}. In literature, median hospital stay in phlegmonous appendicitis is presented as 2 days, infectious complication rate (intraabdominal abscess or surgical site infection) (3.8%), re-admission rate (4.2%), reintervention rate (1.5%) and mortality rate (0.08%)⁷.

Phlegmonous appendicitis, characterized by neutrophilic infiltration of the appendiceal wall without gangrene or perforation, is a less common form of the disease, accounting for about 10% of appendicitis cases⁸. When an inflamed appendix perforates, the infection is localized by the omentum and bowel loops which present as an appendiceal mass or phlegmon⁸. However, there is no consensus on whether phlegmonous appendicitis should be classified as complicated appendicitis^{9–11}.

During the COVID-19 pandemic, the rise of non-operative management for appendicitis, particularly in cases of uncomplicated appendicitis, has further highlighted the importance of accurate classification^{5,12}. As non-operative approaches are generally reserved for uncomplicated cases, determining whether phlegmonous appendicitis falls under the complicated or uncomplicated category is critical for clinical decision-making.

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This study aims to compare the preoperative laboratory findings and postoperative outcomes of phlegmonous appendicitis with those of complicated and uncomplicated appendicitis to clarify its classification and implications for treatment strategies.

Materials and methods

Study design

This was a retrospective cohort study conducted at Ankara Bilkent City Hospital. This study was retrospective in nature, and ethics approval was waived by the ethics committee of Ankara Bilkent City Hospital. The study involved patients who presented with abdominal pain and underwent appendectomy between January 2019 and March 2021. The informed consent to participate was waived by hospital ethical committee. All methods were carried out in accordance with relevant guidelines and regulations.

Patient selection

A total of 1,441 patients who underwent surgery for suspected acute appendicitis were included in the study. The exclusion criteria were:

- Patients younger than 18 years.
- Pregnant patients.
- Immunocompromised patients.
- Patient with a history of previous abdominal surgery.
- Patients with a history of cancer or chronic liver disease, inflammatory bowel disease.

Patients were classified into four groups based on histopathological findings:

- *Group A:* Normal appendix (no inflammation).
- *Group B:* Uncomplicated appendicitis (intraluminal neutrophils and/or neutrophils within the mucosa, sub-mucosa, and/or mucosal erosions).
- *Group C:* Phlegmonous appendicitis (neutrophilic infiltration in all layers of the appendix, with or without extensive ulceration, intramural microabscesses, or vascular thrombosis).
- *Group D:* Complicated appendicitis (transmural neutrophil infiltration with areas of necrosis, perforation, or abscess formation).

Patients in Group A were included to serve as a control group for comparison with appendicitis cases.

Diagnostic criteria

The diagnosis of acute appendicitis and its classification into uncomplicated, phlegmonous, or complicated types were confirmed through histopathological examination. Phlegmonous appendicitis was defined based on the presence of neutrophils infiltrating all layers of the appendix without perforation or gangrene, distinguishing it from complicated appendicitis, which involves necrosis, abscess formation, or perforation. All pathology results were reviewed by expert pathologists.

A table detailing the diagnostic criteria is shown in Table 1.

Data collection

Patient demographic data, surgical methods (laparoscopic or open), preoperative laboratory values (C-reactive protein [CRP], leukocyte count, neutrophil count, neutrophil-to-lymphocyte ratio, total bilirubin, direct bilirubin), appendix diameter, duration of hospitalization, and postoperative complications were recorded. The severity of postoperative complications was classified using the Clavien-Dindo system.

Outcomes measured

The primary outcomes were the comparison of preoperative laboratory values, postoperative complications, and length of hospital stay among the groups. Complication severity was assessed using the Clavien-Dindo classification:

- *Grade I:* Minor complications, such as wound infections treated at the bedside.
- *Grade II:* Complications requiring pharmacological treatment, such as antibiotics.
- *Grade III:* Complications requiring surgical, endoscopic, or radiological intervention.
- *Grade IV:* Life-threatening complications requiring intensive care.
- *Grade V:* Death.

Type of appendicitis	Diagnostic features
Uncomplicated appendicitis	Intraluminal neutrophils and/or neutrophils within the mucosa, submucosa, and/or mucosal erosions
Phlegmonous appendicitis	Neutrophils in all layers of the appendix (mucosa, submucosa, and muscularis propria) with/without ulceration, microabscesses, or vascular thrombosis
Complicated appendicitis	Transmural inflammation with necrosis, perforation, abscess formation, or appendiceal mass

Table 1. Diagnostic criteria for appendicitis.

Postoperative infection rates, including wound site infections and Clavien-Dindo grades 3 and 4 complications, were analyzed.

Statistical analysis

Statistical analyses were conducted using SPSS version 21. The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Normally distributed variables were expressed as mean ± standard deviation (SD), while non-normally distributed variables were reported as medians (interquartile range). Continuous variables were compared using one-way analysis of variance (ANOVA), with post-hoc tests applied where necessary. Categorical variables were compared using the chi-square test or Fisher’s exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

Patient demographics and group distribution

A total of 1,441 patients who underwent surgery with a diagnosis of acute appendicitis were included in the study. The distribution of patients across the groups was as follows:

- Group A (normal appendix): 110 patients (7.6%).
- Group B (uncomplicated appendicitis): 862 patients (59.8%).
- Group C (phlegmonous appendicitis): 253 patients (17.6%).
- Group D (complicated appendicitis): 216 patients (15%).

Of the total patients, 580 (40.3%) were female, and 861 (59.7%) were male. The demographic characteristics, laboratory parameters, and outcomes of each group are summarized in Table 2.

Preoperative laboratory findings

Leukocyte counts and appendix diameters were significantly higher in Group C (phlegmonous appendicitis) than in Group B (uncomplicated appendicitis) ($p = 0.001$ and $p = 0.008$, respectively). When comparing Group C to Group D (complicated appendicitis), Group D exhibited significantly higher mean age ($p = 0.000$), CRP values ($p = 0.001$), total bilirubin ($p = 0.000$), direct bilirubin ($p = 0.000$), and appendix diameter ($p = 0.000$).

Additionally, no significant differences were observed between Group C and Group D in terms of neutrophil-to-lymphocyte ratio (NLR), neutrophil count and leukocyte count ($p > 0.05$) values. However, when comparing CRP values between phlegmonous appendicitis and complicated appendicitis, the phlegmonous group had significantly lower CRP levels.

Postoperative complications and hospital stay

The median length of hospital stay for patients in Groups A, B, and C was 1 day, while Group D had a significantly longer hospital stay (median 2.1 days, $p = 0.000$). When comparing postoperative wound infection rates between phlegmonous appendicitis and complicated appendicitis, the complicated group was significantly higher ($p = 0.02$).

Postoperative wound infection rates were as follows:

- Group A: 5.5% ($n = 6$).
- Group B: 6.4% ($n = 55$).
- Group C: 9.1% ($n = 23$).
- Group D: 24.1% ($n = 52$).

Complications classified by the Clavien-Dindo system are summarized in Table 3. In Group D, 17 patients experienced grade 3 A complications (wound infections requiring treatment under local or regional anesthesia),

Variable	Group A ($n = 110$)	Group B ($n = 862$)	Group C ($n = 253$)	Group D ($n = 216$)	P value*
Age (years)	35 ± 14	34 ± 14	34 ± 13	40 ± 18	0,000
CRP (mg/L)	10 (3–44)	11 (4–30)	12 (7–35)	25 (10–108)	0,000
Leukocyte count (/μL)	10,575 ± 3,495	13,040 ± 3,747	14,104 ± 4,029	14,938 ± 3,794	0.000
Neutrophil count (/μL)	7.16 (4.88–9.64)	10.29 (7.84–12.84)	11.31 (9.02–14.18)	12.02 (9.74–15.01)	> 0,05
NLR	4.76 ± 4.67	7.18 ± 5.77	8.46 ± 6.12	10.43 ± 9.33	0.000
Total bilirubin (mg/dL)	0.8 ± 0.5	0.9 ± 0.5	1.0 ± 0.6	1.2 ± 0.8	0,000
Direct bilirubin (mg/dL)	0.2 ± 0.1	0.3 ± 0.2	0.3 ± 0.2	0.4 ± 0.3	0,000
Appendix diameter (mm)	9 ± 2	10 ± 2	11 ± 3	12 ± 3	0,000
Length of stay (days)	1 (1–1)	1 (1–1)	1 (1–1)	2.1 (1.7–5)	0,000
Postoperative infection (%)	5.5%	6.4%	9.1%	24.1%	0.000

Table 2. Group characteristics and outcomes. *Continuous variables were compared using one-way analysis of variance (ANOVA), with post-hoc tests applied where necessary. P-value of less than 0.05 was considered statistically significant.

	Number of patients	Complication rate (%)	Clavien-Dindo classification	p-value (vs. Group A)	p-value (vs. Group B)	p-value (vs. Group C)	p-value (vs. Group D)
Group A (Normal)	110	8.2	4.6% Grade I (5 patients) 2.7% Grade II (3 patients) 0.9% Grade IIIa (1 patient)		0.45	0.30	0.01*
Group B (Uncomplicated)	862	10.0	3.7% Grade I (32 patients) 3.4% Grade II (29 patients) 2.9% Grade IIIa (25 patients)	0.45		0.25	0.02*
Group C (Phlegmonous)	253	12.6	5.9% Grade I (15 patients) 3.9% Grade II (10 patients) 2.8% Grade IIIa (7 patients)	0.30	0.25		0.05*
Group D (Complicated)	216	27.8	4.2% Grade I (9 patients) 13.9% Grade II (30 patients) - 7.9% Grade IIIa (17 patients) 0.9% Grade IIIb (2 patients) 0.45% Grade IVa (1 patient) 0.45% Grade V (1 patient)	0.01*	0.02*	0.05*	

Table 3. Distribution of Clavien-Dindo scores and postoperative infections. *Categorical variables were compared using the chi-square test or Fisher’s exact test, as appropriate. *Statistically significant at $p < 0.05$. In *Group D (Complicated appendicitis)*, 17 patients experienced severe complications: 15 patients had 30 wound site abscesses treated surgically (each with 2 abscesses) (Clavien-Dindo Grade IIIa). 2 patients required reoperations due to anastomotic leaks and ileus (Clavien-Dindo Grade IIIb). 1 elderly patient developed chronic renal failure (Clavien-Dindo Grade IVa). 1 patient died from multi-organ failure (Clavien-Dindo). No Grade V complications were reported in *Group C (Phlegmonous appendicitis)*.

while 2 patients required reoperations (grade 3B). Additionally, one patient in Group D developed a grade 4 A complication (chronic renal failure), and one elderly patient died from multi-organ failure (grade 5).

Comparison of phlegmonous appendicitis with other types

Phlegmonous appendicitis shared similar clinical and laboratory profiles with complicated appendicitis, particularly in terms of leukocyte counts and appendix diameters. However, the overall postoperative outcomes, including hospital stay and complication rates, were more comparable to uncomplicated appendicitis. This suggests that phlegmonous appendicitis may be more appropriately classified as a variant of uncomplicated appendicitis, despite its histopathological similarities to complicated appendicitis.

Detailed analysis of severe complications (Clavien-Dindo Grade 3 and 4)

In Group D (complicated appendicitis), 17 patients experienced severe complications, including 30 cases of wound site abscesses treated surgically (Clavien-Dindo 3 A), and two patients required reoperations due to anastomotic leaks and ileus (Clavien-Dindo 3B). One elderly patient developed chronic renal failure (Clavien-Dindo 4 A), and another died from multi-organ failure (Clavien-Dindo 5). There were no grade 5 complications reported in Group C (phlegmonous appendicitis). These findings summarized in Table 3.

Discussion

While classifying acute appendicitis in their study based on imaging and pathology, Hoffmann et al. staged phlegmonous appendicitis as both complicated appendicitis and uncomplicated appendicitis¹³. This study supports the question of whether phlegmonous appendicitis is complicated or uncomplicated, which we aimed to address in our research.

Phlegmonous acute appendicitis is categorized by some authors as complicated, while others classify it as uncomplicated¹³. This inconsistency may affect the results of studies on appendicitis. Arterial thrombosis, intramural abscesses, and neutrophilic infiltrates in all layers with or without ulceration are hallmarks of phlegmonous appendicitis¹³. Complicated acute appendicitis, in contrast to uncomplicated cases, exhibits a more erratic clinical and laboratory profile. Additionally, postoperative follow-up, length of hospital stay, complications, and duration of broad-spectrum antibiotic use can differ for complicated appendicitis. Our study demonstrated that phlegmonous appendicitis exhibits similarities to uncomplicated appendicitis when considering these parameters.

The white blood cell count is a crucial parameter in diagnosing acute appendicitis and is used in many scoring systems^{4,14,15}. A significantly elevated white blood cell count is expected in complicated appendicitis^{4,16}. Furthermore, inflammatory markers such as the neutrophil-lymphocyte ratio (NLR) and platelet-lymphocyte ratio are higher in complicated appendicitis^{16–18}. Another commonly used serum inflammatory marker is C-reactive protein (CRP), which is typically found to be higher in complicated appendicitis compared to uncomplicated cases¹⁹. Our study reported a substantial difference in white blood cell counts between phlegmonous appendicitis and uncomplicated appendicitis. Moreover, the appendix diameter was significantly increased in phlegmonous appendicitis compared to uncomplicated appendicitis. Based on these parameters, phlegmonous appendicitis could be considered similar to complicated appendicitis. However, when comparing

NLR and CRP values, no significant difference was found between the two groups. Nevertheless, CRP values in the phlegmonous group were significantly lower than those in the complicated appendicitis group.

In the evaluation of suspected acute appendicitis, computed tomography (CT) and ultrasonography are the primary imaging modalities employed. The American College of Radiology recommends CT as the preferred diagnostic tool for patients presenting with right lower quadrant pain indicative of appendicitis, due to its superior sensitivity and specificity. CT has demonstrated higher sensitivity and specificity compared to ultrasonography in diagnosing acute appendicitis²⁰.

Appendicitis symptoms in immunocompromised patients are often vague or absent, and the diagnosis is usually made using CT imaging. Surgery is the definitive treatment, but non-operative management may be considered for those who cannot tolerate surgery^{21,22}.

Two categories of phlegmonous and severe phlegmonous appendicitis were established in a study based on CT and US findings. According to the calculated results of the tomography, phlegmonous appendicitis: Mesenteric lymphadenopathy, dilated appendix (> 6 mm), wall integrity: no defects, luminal dilatation: none, contrast enhancement: present, periappendiceal air: none, significant fluid: minimal, periappendiceal fat stranding: mild \pm , and severe phlegmonous appendicitis also includes intraluminal faecolith findings and distal luminal dilatation or extraluminal fluid¹³.

Appendectomy is a definitive treatment of acute appendicitis. However, a growing body of research indicates that about 70% of patients with uncomplicated acute appendicitis respond well to broad-spectrum antibiotics, such as piperacillin-tazobactam monotherapy or combination therapy with either cephalosporins or fluoroquinolones and metronidazole²⁰.

In a meta-analysis conducted by Salinen, the average length of hospital stay after appendectomy for uncomplicated appendicitis was found to be 0.41 days (95% CI 0.26 to 0.57)²³. Martinez's retrospective study on the length of hospital stay for severe appendicitis reported a median stay of 5 days²⁴. Postoperative intra-abdominal abscesses, which are more common in complicated appendicitis cases, especially those performed by laparoscopic method, range from 3 to 25% and management includes antibiotics with or without percutaneous or operative drainage²⁵. Postoperative wound infections are also more likely in severe appendicitis^{16,19}. According to our findings, the average length of hospital stay for both uncomplicated and phlegmonous appendicitis was one day, significantly shorter than complicated appendicitis. Furthermore, the rates of postoperative wound infections were considerably higher in complicated appendicitis than in the other two groups. Another parameter elevated in complicated appendicitis in our study is the Clavien-Dindo score. Literature indicates that the Clavien-Dindo score, which encompasses all complications, is also high in complicated appendicitis²⁶. While preoperative biochemical markers and pathological features of phlegmonous appendicitis resemble those of complicated appendicitis, its clinical history, length of hospital stay, and sequelae are more comparable to uncomplicated appendicitis.

The dilemma of whether to classify phlegmonous appendicitis as complicated is evident and can lead to misdirection in scientific studies. Another concern is the rise of non-operative therapy for acute appendicitis in recent years. Non-surgical therapy is favored, particularly in cases of uncomplicated appendicitis^{23,27}. This approach has become a life-saving option for individuals with significant comorbidities, particularly following the COVID-19 pandemic²⁸. According to Helling's research, the success rate of non-operative therapy for complicated appendicitis is lower, with a greater likelihood of rehospitalization²⁹. However, phlegmonous appendicitis was included in the complicated appendicitis group in their study, which may have more positively affected treatment success and the reduced need for rehospitalization in these cases. Anderson reported that abscess and phlegmonous appendicitis could be treated with non-operative methods, supporting the findings of Helling's study that the inclusion of phlegmonous appendicitis in the abscess group can improve treatment outcomes³⁰. In another study by Young, which focused on the non-operative management of complicated appendicitis, phlegmonous appendicitis was also evaluated within the complicated appendicitis group, but non-operative treatment was not recommended despite this³¹.

The most significant limitation of this study is its retrospective nature. Prospective observational studies would provide more valuable insights into the classification of phlegmonous appendicitis. Additionally, potential bias in the evaluated parameters may arise from differences in the classification of phlegmonous appendicitis in existing literature. One of the aims of this study is to contribute to resolving this bias.

Conclusion

In summary, this study offers valuable insights into the classification of phlegmonous appendicitis, an entity with histopathological similarities to complicated appendicitis but with clinical features more aligned with uncomplicated appendicitis. Our findings suggest that phlegmonous appendicitis may be better categorized as a variant of uncomplicated appendicitis due to its lower CRP levels, shorter hospital stays, and lower rates of severe postoperative complications compared to complicated appendicitis. As non-operative treatment continues to rise, clarifying the nature of phlegmonous appendicitis could influence clinical decision-making and patient outcomes.

Future prospective studies are warranted to further delineate the classification criteria for phlegmonous appendicitis, potentially guiding treatment protocols and reducing variability in outcomes among patients with acute appendicitis. Through a standardized approach, we aim to contribute to a clearer understanding of this condition and optimize its management across diverse patient populations.

Data availability

The datasets used and analyzed in the current study are available from the corresponding author upon reasonable request.

Received: 30 October 2024; Accepted: 7 January 2025

Published online: 05 February 2025

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Author contributions

T.A., H.F.M., M.T. wrote the main manuscript text. T.A., H.F.M., M.T., E.Ş., S.E., B.B., A.Ç., H.T.D. reviewed the manuscript.

Funding

No funding was received for conducting this study.

Declarations

Competing interests

The authors declare no competing interests.

Ethical approval

This study was retrospective in nature, and ethics approval was waived by the ethics committee of Ankara Bilkent City Hospital. The informed consent to participate was waived by hospital ethical committee.

Additional information

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