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Research Article

Association between White Blood Cell Count, C-Reactive Protein, and Complications of Acute Appendicitis: A Retrospective Cohort Study

Aamer K[1]*, Mumtaz I[1], Shekar U[1], Nageeb H[1]

1) Department of Surgery, Sheikh Khalifa Medical City, Ajman, United Arab Emirates.

***Correspondence to**: Muhammad Aamer Kiani, Department of Surgery, Sheikh Khalifa Medical City Ajman, United Arab Emirates.

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Abstract

Background: *Acute appendicitis is a common surgical emergency, and early identification of complications such as perforation and gangrenous changes is crucial for optimal management. This study evaluates the association of white blood cell (WBC) count and C-reactive protein (CRP) levels with perforation and gangrenous appendicitis.*

Methods: *A retrospective analysis of 129 patients who underwent appendectomy was conducted. Laboratory values (WBC and CRP) were compared between uncomplicated and complicated (perforated/gangrenous) cases.*

Results: *Perforation was present in 34.1% (44/129) and gangrenous changes in 14.7% (19/129). Mean WBC was significantly higher in perforated (14.7 vs. 12.7, $p < 0.01$) and gangrenous cases (16.4 vs. 12.9, $p < 0.01$). CRP was markedly elevated in perforation (113.5 vs. 22.1 mg/L, $p < 0.001$) and gangrenous appendicitis (138.6 vs. 42.5 mg/L, $p < 0.001$). A CRP >50 mg/L had 68.2% sensitivity and 85.9% specificity for perforation, while a WBC >15 $\times 10^9$/L had 41.5% sensitivity and 77.6% specificity.*

Conclusion: *Elevated CRP and WBC are strongly associated with complicated appendicitis. CRP is a more discriminative marker than WBC for perforation and gangrenous changes. These findings support the use of CRP in risk stratification for surgical decision-making.*

Keywords*: Appendicitis, perforation, gangrenous, WBC, CRP, biomarkers.*

Introduction

Acute appendicitis remains one of the most common surgical emergencies worldwide, with a lifetime incidence of approximately 7% [1]. While most cases are straightforward, complications such as perforation and gangrenous appendicitis increase morbidity, length of hospital stay, and postoperative complications [2]. Early identification of these complications is essential for timely intervention and improved outcomes.

Laboratory markers, particularly WBC count and CRP, are routinely used in the diagnostic workup of appendicitis. However, their predictive value for complications remains debated. Some studies suggest CRP is superior to WBC in detecting perforation [3], while others propose combined scoring systems [4]. This study aims to clarify the association of WBC and CRP with perforation and gangrenous appendicitis in a single-center cohort.

Methods

Study Design and Population

A retrospective analysis was conducted on 129 consecutive patients who underwent appendectomy between May 2021 and July 2022. Data were extracted from electronic medical records, including demographics, admission WBC, CRP, radiological findings and intraoperative findings (perforation, gangrenous changes).

Definitions

- **Perforation:** Macroscopic hole in the appendix or fecal contamination noted intraoperatively.
- **Gangrenous appendicitis:** Necrotic or blackened appendix with documented finding in Radiology or Operative notes

Statistical Analysis

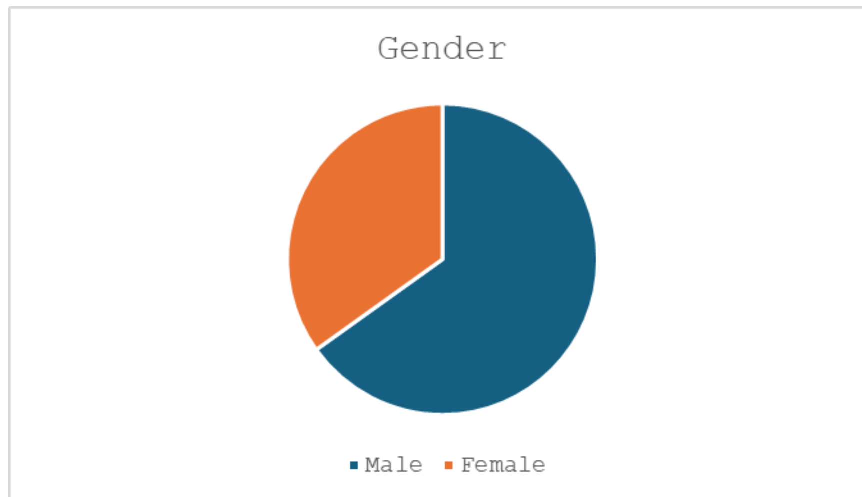
Continuous variables (WBC, CRP) were compared using Student's t-test. Sensitivity, specificity, and predictive values were calculated for different cutoff values. A p-value <0.05 was considered statistically significant.

Results

Baseline Characteristics

- **Total patients:** 129
- **Mean age:** 26.4 ± 12.1 years

- **Gender distribution:** 84 male (65.1%), 45 female (34.9%)
- **Surgical approach:** 125 laparoscopic (96.9%), 4 open (3.1%)



Complication Rates

- **Perforation:** 44/129 (34.1%)
- **Gangrenous changes:** 17/129 (13.2%)
- **Both perforation and gangrenous:** 7/129 (5.4%)

Laboratory Markers

Parameter	Perforation (+)	Perforation (–)	p-value	Gangrenous (+)	Gangrenous (–)	p-value
WBC (×10⁹/L)	14.7 ± 4.2	12.7 ± 4.1	**<0.01**	16.4 ± 5.1	12.9 ± 4.0	**<0.01**
CRP (mg/L)	113.5 ± 98.3	22.1 ± 32.6	**<0.001**	138.6 ± 112.4	42.5 ± 62.8	**<0.001**

Diagnostic Performance

Cutoff	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
WBC >15	41.5	77.6	52.6	69.2
CRP >50	68.2	85.9	71.4	83.9
CRP >100	47.7	94.1	80.8	77.8

Discussion

Our findings demonstrate that both WBC and CRP are significantly elevated in complicated appendicitis, with CRP showing superior discriminative ability. This aligns with multiple studies highlighting CRP as a more reliable predictor of perforation than WBC alone [5-7]. The marked elevation of CRP in perforated cases (113.5 vs. 22.1 mg/L, $p<0.001$) supports its role as a key biomarker for severe inflammation, consistent with the pathophysiology of appendiceal wall breakdown and systemic inflammatory response [8].

Comparison with Previous Studies

Our results corroborate the findings of Wu et al. [9], who reported that CRP >50 mg/L had 75% sensitivity for perforation, similar to our 68.2%. Additionally, our data support the meta-analysis by Andersson et al. [10], which concluded that CRP is more accurate than WBC in predicting complicated appendicitis. However, some studies suggest combining WBC and CRP improves diagnostic accuracy [11], which warrants further investigation in larger cohorts.

The higher WBC in gangrenous appendicitis (16.4 vs. 12.9, $p<0.01$) may reflect more advanced neutrophilic infiltration, as described by Buckius et al. [12]. However, CRP remained more discriminative, likely due to its rapid rise in response to tissue necrosis [13].

Clinical Implications

1. CRP >50 mg/L should raise suspicion for perforation (71.4% PPV).

2. CRP >100 mg/L is highly specific (94.1%) and may guide early surgical planning.

3. WBC >15 $\times 10^9$/L, while less sensitive, may support the diagnosis when combined with CRP.

These findings are particularly relevant in settings where imaging is limited, as highlighted by the World Society of Emergency Surgery guidelines [14].

Limitations

- Retrospective design (risk of selection bias).
- Single-center data (may limit generalizability).
- No standardized timing of lab tests relative to symptom onset, which affects CRP kinetics [15].

Conclusion

CRP is a more reliable biomarker than WBC for identifying perforated and gangrenous appendicitis. A CRP >50 mg/L should raise suspicion for complications, while CRP >100 mg/L strongly suggests perforation. Incorporating CRP into clinical decision-making may improve preoperative risk stratification. Future studies should explore combined biomarkers or scoring systems to enhance predictive accuracy.

Conflict of Interest

The authors declare no conflicts of interest.

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