

Pre-Operative Predictors for Acute Complicated Appendicitis: A Retrospective Observational Study

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Abstract:

Background: Appendectomy can be challenging and occasionally converted to extensive resection for complicated appendicitis. However, optimal treatment strategies can be developed using preoperative risk assessment.

Objective: This hospital-based retrospective study aimed to study the diagnostic efficacy of biochemical parameters like hyperbilirubinemia, hyponatremia, neutrophil: lymphocyte ratio, CRP, thrombocytosis to preoperatively differentiate between acute appendicitis and acute complicated appendicitis.

Materials and Methods: A total number of 156 patients in whom the diagnosis of Acute appendicitis established was retrospectively investigated for a period of 6 months (December 2022 to May 2023). Amongst these 42 patients were diagnosed to have acute complicated appendicitis (based on USG report and Intra operative findings). The data was collected, coded and recorded on Microsoft Excel Spreadsheet program and descriptive statistical analysis was performed.

Result: Out of 156 cases, male gender constituted maximum proportion than the female gender (59.61% vs 40.39%). Our study recorded the ratio of male: female as 1.5:1. Out of 156 cases, uncomplicated type of acute appendicitis (73.07%) constituted maximum cases than the complicated type of acute appendicitis (26.93%). The patients with female gender were mostly affected by complicated type of acute appendicitis (n=24;57.15%).

Conclusion: Overall for Complicated Appendicitis, the more sensitive predictors are – CRP and Hyponatremia and the more specific predictors are Thrombocytosis and hyponatremia. In uncomplicated appendicitis, the most sensitive predictor was CRP and the most specific predictor was Thrombocytosis. Thus, the mean duration of surgery was prolonged in all complicated appendicitis. The surgical site infection was less common in laparoscopic surgeries for complicated appendicitis.

Keywords: Acute appendicitis, complicated appendicitis, hyperbilirubinemia, C-reactive protein, predictive factors

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Introduction

Acute appendicitis is the most well-known acute abdominal disease. However, not all diagnosed cases of acute appendicitis require emergency surgery.[1] Non-operative management is recommended for uncomplicated appendicitis, but preoperative distinction between uncomplicated and complicated disease is challenging.[2] In addition, cases of complicated appendicitis, which include perforated appendicitis and gangrenous appendicitis, may progress to acute peritonitis, a condition that necessitates emergency surgery regardless of the time of development.[3]

This emergent nature presents additional complications. In contrast, the short-term risk of perforation in cases of uncomplicated appendicitis, such as catarrhal and cellulitis appendicitis is low,

and these cases can be treated conservatively with antibiotics until sufficient medical staffs are available to perform surgery. In addition, some of these cases can continue receiving conservative treatment with antibiotics.[4]

Diagnosis of acute appendicitis is not always straightforward and the preoperative distinction between uncomplicated and complicated appendicitis's is difficult.[5] Sometimes, clinical presentation may be atypical, even the most experienced surgeon may deal with normal appendix or sit on the complicated one.[6] While CT plays an important role in detecting complicated appendicitis, combination of clinical and imaging features has been found to be essential for correctly identifying uncomplicated

appendicitis as well.[7,8] It implies that combining several factors, including imaging and clinical features, becomes important for the preoperative distinction between uncomplicated and complicated acute appendicitides.[9,10]

In view of the above, we sought to study the diagnostic efficacy of biochemical parameters like hyperbilirubinemia, hyponatremia, neutrophil: lymphocyte ratio, CRP, thrombocytosis to preoperatively differentiate between acute appendicitis and acute complicated appendicitis.

Method

A total number of 156 patients in whom the diagnosis of acute appendicitis established was retrospectively investigated for a period of 6 months (December 2022 to May 2023). Amongst these 42 patients were diagnosed to have acute complicated appendicitis (based on USG report and Intra operative findings). Inclusion criteria included All patients admitted for acute appendicitis, underwent surgery and post operatively confirmed histopathology.

Exclusion criteria included patients who admitted with acute appendicitis, managed conservatively like appendicular lump, patient not fit for surgery and not willing for surgery, patients with gastrointestinal malignancy, appendicular neoplasm, pre-existing chronic liver disease, history of chronic hyponatremia, history of hepatotoxic drug use, hemolytic jaundice, post hepatic jaundice, other acute inflammatory conditions and known case of platelet disorders. Hospital records of these patients were retrieved

from the MRD and data's like biodata, history, clinical examination findings, investigation reports, operative records and post-operative follow up were collected. Then, we analyzed the sensitivity and specificity of biochemical parameters like hyperbilirubinemia, hyponatremia, neutrophil: lymphocyte ratio, CRP, thrombocytosis. Also, we assessed the duration of surgery in complicated appendicitis and post-operative SSI in all appendicitis patient.

Statistical Analysis

The data was collected, coded and recorded on Microsoft Excel Spreadsheet program and descriptive statistical analysis was performed. Data analysis was performed using Statistical Package for the Social Sciences (SPSS) software (version 24). Statistical significance was kept at $p < 0.001$.

Results

Study variables

Our study recorded clinical data from the study population from four variables viz. a) Patient demographics (Table 1), b) Efficacy of biochemical parameters (sensitivity and specificity) in diagnosing complicated acute appendicitis and uncomplicated acute appendicitis (Table 2), c) intra operative difficulty for the surgeons in complicated acute appendicitis in terms of adhesions, increased duration of surgery and conversion to open surgery (Table 3) and d) post-operative SSI and duration of hospital stay in complicated acute appendicitis patient (Table 4).

Table 1: Tabulation of study variables

Category	Number of patients (n, %)
Number of patients recorded in our study	156 (100%)
Gender of patients recorded in our study	
Male	93 (59.61%)
Female	63 (40.39%)
Total	156 (100%)
Ratio of male: female	1.5:1
Type of acute appendicitis recorded in our study	
Uncomplicated	114 (73.07%)
Complicated	42 (26.93%)
Total	156 (100%)
Gender distribution among complicated acute appendicitis recorded in our study	
Male	18 (42.85%)
Female	24 (57.15%)
Total	42 (100%)
Type of complicated acute appendicitis recorded in our study	
Gangrenous complicated appendicitis	18 (42.85%)
Perforated complicated appendicitis	24 (57.15%)
Total	42 (100%)

In our study, clinical data from a total of 156 patients were recorded. Out of 156 cases, male

gender constituted maximum proportion than the female gender (59.61% vs 40.39%). Our study

recorded the ratio of male: female as 1.5:1. Out of 156 cases, uncomplicated type of acute appendicitis (73.07%) constituted maximum cases than the complicated type of acute appendicitis (26.93%). The patients with female gender were mostly affected by complicated type of acute appendicitis

(n=24;57.15%). Also, our study recorded two types of complicated acute appendicitis viz. gangrenous complicated appendicitis and perforated complicated appendicitis. Out of which, majority of the cases of complicated acute appendicitis were recorded from perforated complicated appendicitis.

Table 2: Efficacy of biochemical parameters (sensitivity and specificity) in diagnosing complicated acute appendicitis and uncomplicated acute appendicitis

Biochemical parameters recorded for uncomplicated acute appendicitis (n=114)	No. of patients (Sensitivity %)	No. of patients (Specificity %)
Hyperbilirubinemia	42 (37.2%)	102 (90%)
Hyponatremia	51 (45%)	45 (40%)
NLR	90 (79%)	(67%)
CRP	102 (90%)	22 (20%)
Thrombocytosis	3 (3.2%)	45 (40%)
Total	114 (100%)	114 (100%)
Biochemical parameters recorded for complicated acute appendicitis (n=42)	No. of patients (Sensitivity %)	No. of patients (Specificity %)
Hyperbilirubinemia	38 (91.42%)	37 (90%)
Hyponatremia	39 (94%)	42 (100%)
NLR	29 (70.92%)	20 (48.5%)
CRP	42 (100%)	22 (54%)
Thrombocytosis	4 (11.6%)	42 (100%)
Total	42 (100%)	42 (100%)

Five biochemical parameters like hyperbilirubinemia, hyponatremia, NLR, CRP and Thrombocytosis were recorded for both uncomplicated acute appendicitis and complicated acute appendicitis. The efficacy of these five biochemical parameters was assessed by sensitivity and specificity. CRP recorded for the highest

sensitivity among the cases with uncomplicated acute appendicitis (90%) and complicated acute appendicitis (100%). Whereas, thrombocytosis recorded for the lowest sensitivity among the cases with uncomplicated acute appendicitis (3.2%) and complicated acute appendicitis (11.6%).

Table 3: Assessment of the intra-operative difficulty for the surgeons in complicated acute appendicitis in terms of adhesions, increased duration of surgery and conversion to open surgery

Intra operative difficulty parameters (n=114)	Number of patients (n, %)
Delay in surgery due to adhesion to surrounding structures with peri appendicular pus formation	
Yes	24 (57.15%)
No	18 (42.85%)
Total	42 (100%)
Duration of surgery (in hours) (mean)	2.5 hours
Conversion from laparoscopic to open surgery	
Yes	6 (14.28%)
No	36 (85.72%)
Total	42 (100%)
Patient who underwent laparoscopic appendectomy	
Yes	36 (85.72%)
No	6 (14.28%)
Total	42 (100%)
Patient developed SSI who underwent laparoscopic appendectomy	
Yes	1 (2.78%)
No	35 (97.22%)
Total	36 (100%)

Intra-operative difficulty for the surgeons in complicated acute appendicitis was recorded in terms of adhesions, increased duration of surgery

and conversion to open surgery. Around 24 cases recorded for delay in surgery due to adhesion to surrounding structures with peri appendicular pus

formation. Out of 42 complicated acute appendicitis cases, there were 6 cases (14.28%) which were converted from laparoscopic surgery to open surgery. The remaining 36 cases underwent

laparoscopic appendectomy (85.72%) and out of which one case developed surgical site infection (over the Umbilical port site). Also, the duration of surgery (in hours) was recorded as 2.5 hours.

Table 4: Assessment of the post-operative SSI and duration of hospital stay in complicated acute appendicitis patient

Post-operative parameters	Number of patients (n, %)
Patient developed post-operative surgical site infection	
Yes	6 (14.28%)
No	36 (85.72%)
Total	42 (100%)
Duration of hospital stay (in days)	<3 days

In our study, a total of 6 patients with acute appendicitis developed post-operative surgical site infection. The duration of hospital stay (in days) was recorded to be less than 3 days without any surgical site infection. 1 laparoscopic port site infected patient returned home on 6th post-operative day. All open converted patients developed SSI and returned home by 8th, 9th, 10th post-operative day.

Discussion

Acute appendicitis can be cured by appendectomy, however complicated appendicitis (perforated or gangrenous) may cause complications such as bacterial peritonitis, urinary disorders, small bowel obstruction, or intra-abdominal abscess formation. These complications may become life-threatening, thus highlighting the need for a correct diagnosis.[11]

The association between hyperbilirubinemia and acute appendicitis has been examined over the last decade.[12, 13] Hyperbilirubinemia has previously been reported as a predictive factor of appendicitis. Svinc et al.[10] reported that hyperbilirubinemia (>1.0 mg/dL) and high neutrophil-to-lymphocyte ratio (>4.8) were significantly associated with perforated appendicitis among 3392 cases.[14]

Early identification of preoperative hyponatremia involves a low-cost, routine laboratory examination, could indicate increased possibility of appendiceal gangrene and/or perforation. This finding could potentially affect the course of patient management, leading to earlier operative intervention and abandonment of observational or non-operative strategy. Previous efforts to evaluate a possible relation between hyponatremia and the severity of appendicitis have been reported in both adult and pediatric populations.[15] Kim et al.[16] investigated the association between various clinical and laboratory parameters with intraoperatively identified perforated or gangrenous appendicitis and found that hyponatremia could be suggestive of complicated appendicitis. Lindestam et al.[17] confirmed that there is a strong association between plasma sodium concentration ≤ 136 mmol/L and appendiceal perforation.

Pogorelic et al.[18], in a study including 184 pediatric patients, reported that the sodium concentration cutoff value of ≤ 135 mmol/L was shown to give the best possible sensitivity (94.7%) and specificity (88.5%), also confirming hyponatremia as a promising new biochemical marker indicating complicated appendicitis.

Fanjul et al.[19] have found a significantly higher proportion of pediatric patients with thrombocytosis (52%) when complications associated with acute appendicitis are present. CRP may be one useful indicator of complicated appendicitis due to simplicity and objectivity. Regarding high CRP levels, Eren et al.[20] reported that this was an important marker for predicting gangrenous or perforated appendicitis. Because complicated appendicitis is associated with more severe inflammation than simple appendicitis, high CRP levels may thus also be an important predictive factor for complicated appendicitis.

The overall conversion rate in the present study was 14%. Hellberg A et al conducted a study which included 244 patients who underwent laparoscopic appendectomy with the overall conversion rate being 12%.[21] The small number of patients and single-center nature of this study are the major limitations. In addition, this is a retrospective, non-comparative study, and does not include remote follow-up data. Hence, to endorse our findings, we recommend conducting appropriately designed prospective studies in our setting in the future.

Conclusion

In this study, hyperbilirubinemia exhibited sensitivity of 91.42% and specificity of 90%, and hyponatremia is associated with high sensitivity of 94% with 100 % specificity, NLR is associated with sensitivity of 70.92% and specificity of 48.5%, CRP is associated with 100 % sensitivity for complicated appendicitis while Thrombocytosis is associated with 100 % specificity for complicated appendicitis. The mean duration of surgery was prolonged in all complicated appendicitis. The surgical site infection was less common in laparoscopic surgeries for complicated

appendicitis. In conclusion, all these biochemical parameters predict both diagnosis and severity of appendicitis, thereby prioritizing patients for early surgery. It also makes the operating surgeon decide on his need for laparoscopic surgery and thereby reducing complications for patients in terms of surgical site infection, duration of hospital stay and intra operative difficulty.

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