

ORIGINAL ARTICLE

Evaluation of Hyperbilirubinemia as a Diagnostic Marker for Complicated Appendicitis and Other Causes of Right Iliac Fossa Pain

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ABSTRACT

Context: The risk of perforation and necrosis is elevated by delayed diagnosis of acute appendicitis, which is the most prevalent surgical emergency. The clinical relevance of identifying a simple biochemical marker for the early detection of complicated appendicitis remains intact.

Aims: To study the relationship between hyperbilirubinemia and acute appendicitis and to evaluate its usefulness as a diagnostic marker for complicated appendicitis, and to differentiate appendicitis from other causes of right iliac fossa pain.

Settings and Design: A prospective observational study was conducted at a tertiary care teaching hospital in India.

Methods and Material: One hundred twenty patients with right iliac fossa pain were enrolled. Patients were categorized into two groups according to serum bilirubin levels: hyperbilirubinemia (>1 mg/dl) and normal bilirubin (≤ 1 mg/dl). Operative findings and histology were regarded as the gold standard.

Statistical Analysis Used: Chi-square test and diagnostic accuracy measures.

Results: Hyperbilirubinemia demonstrated a statistically significant correlation with complex appendicitis ($p < 0.001$). Serum bilirubin exhibited significant sensitivity and negative predictive value in predicting complicated appendicitis.

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Conclusions: Hyperbilirubinemia is a valuable adjunctive diagnostic marker for complicated appendicitis; nevertheless, its limited specificity diminishes its capacity to reliably differentiate appendicitis from non-appendicular pathology.

Key Messages

1. Hyperbilirubinemia has a significant association with complicated appendicitis.
2. Normal bilirubin levels can help distinguishing severe appendicitis due to high negative predictive value.
3. Serum bilirubin is a simple, cost-effective adjunct in pre-operative assessment.

KEYWORDS

• Hyperbilirubinemia • Acute appendicitis • Complicated appendicitis • Right iliac fossa pain

INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdomen, requiring emergency surgical intervention. Despite developments in imaging technologies, distinguishing between uncomplicated and severe appendicitis in the preoperative period remains a clinical challenge.¹ Delay in diagnosis leads to higher morbidity from perforation, peritonitis, and sepsis. Hyperbilirubinemia has been described in individuals with complex appendicitis, which is due to endotoxemia-induced hepatic dysfunction and cholestasis.² Serum bilirubin estimate is a simple, inexpensive, and widely available investigation, making it a helpful addition to clinical evaluation, especially in limited resources settings.^{3,4}

MATERIALS AND METHODS

Study Design and Setting

This hospital-based prospective observational study was carried out in the Department of General Surgery at a tertiary care teaching hospital in India for a duration of twelve months. This study was conducted after the approval of the Institutional Ethics Committee.

Study Population and Sample Size

All patients presenting with symptoms indicating of acute appendicitis, appendicular perforation, appendicular lump, or right iliac fossa pain, and fulfilling the selection criteria, have been included into the study. According to available research reporting a prevalence

of perforated appendicitis at around 22%, a minimum required sample size has been determined to be 60 patients per group, assuming a 95% confidence interval and a 10% permissible error. A total of 120 patients were enrolled via a consecutive sampling technique.⁵

Inclusion and Exclusion Criteria

Patients aged 18-60, both sexes, with acute appendicitis, appendicular perforation/lump, or RIF pain and recorded liver function tests at admission were included. Exclusion criteria history of jaundice, hepatobiliary disease, chronic alcoholism, hemolytic disorders, hepatitis B or C infection, cholelithiasis, or hepatobiliary malignancy, and who refused to give permission.⁶

METHODOLOGY

All patients were clinically evaluated after informed written consent. Complete blood count, renal function tests, liver function tests, C-reactive protein, viral markers, urine analysis, and peripheral smear were performed. An automated analyzer estimated serum bilirubin. In all patients, abdominal ultrasound was done, and computed tomography was done where clinically required.

Patients fulfilling the criteria for eligibility were divided into two groups based on serum bilirubin levels: Group A (hyperbilirubinemia, n = 60) and Group B (normal bilirubin, n = 60). The prescribed surgeries were performed on all patients. Histopathological investigation of resected specimens, the gold standard for

diagnosis, was performed after recording intraoperative findings.⁷

Ethical Considerations

The Institutional Ethics Committee approved the study protocol. Informed written consent was obtained from each participant before enrollment.

Statistical Analysis

Data was entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software. Categorical variables were represented as frequencies and percentages. The correlation between serum bilirubin levels and complicated appendicitis was evaluated using the Chi-square test. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated. A p-value < 0.05 is considered statistically significant.

RESULTS

The study comprised 120 patients presenting pain in the right iliac fossa. Patients were equally allocated into two groups according to serum bilirubin levels, one exhibiting hyperbilirubinemia and the other presenting normal bilirubin levels.

The age distribution of the study population indicated that the majority of patients were young adults, with the highest frequency in the 21–30 years category. The study population included both sexes, with a majority of males.

Histopathological analysis of the resected appendices confirmed appendicitis in the majority of the cases, although a smaller proportion of patients exhibited either a normal appendix or other pathology conditions. Histopathology was considered the gold standard for final diagnosis.

Elevated serum bilirubin levels demonstrated a statistically significant correlation with complicated appendicitis. Patients exhibiting hyperbilirubinemia demonstrated a higher risk for perforated or gangrenous appendicitis in comparison with those had normal bilirubin levels. The correlation between serum bilirubin levels and complicated appendicitis has been found to be statistically significant.

The evaluation of diagnostic efficacy indicated that serum bilirubin exhibited high sensitivity and negative predictive value for detecting complicated appendicitis,

emphasizing its importance in ruling out severe disease when bilirubin levels were within normal limits.

While hyperbilirubinemia was significantly associated with disease severity, it was not specific for appendicitis when compared with non-appendicular pathology. Therefore, serum bilirubin estimation may be more useful as an **adjunct marker for complicated appendicitis** rather than for differentiating appendicitis from other etiologies.

DISCUSSION

The mean age of participants in this study was 34.36 ± 13.21 years, with the highest prevalence noted in the 21–30 years age group. The study by Chandel UK et al.⁶ found a similar peak incidence in young adults, with a mean age of 31.7 ± 14.8 years. In line with the finding that acute appendicitis primarily affects young adults, Cardall T et al.⁸ and West WM et al.⁹ have likewise documented mean ages ranging from the late twenties to the early thirties. The male predominance identified in this study aligns with Chandel et al., who documented a male-to-female ratio of 1.8:1.

In this study, histological examination confirmed appendicitis in 86.7% of cases, with a negative appendectomy rate of 13.3%. Similar findings have been reported by Khan S et al.⁴ and Khan S et al.¹⁰ who showed that in clinically suspected cases of acute appendicitis, histopathological confirmation rates exceeded 90%. Atahan K et al.¹¹ also reported similar proportions of acute, perforated, and normal appendices on histopathological examination.

The current study showed a statistically significant correlation between complicated appendicitis and increased serum bilirubin levels. Hyperbilirubinemia demonstrated a sensitivity of 84.5%, specificity of 82.3%, positive predictive value of 81.7%, negative predictive value of 85.0%, and an overall diagnostic accuracy of 83.3%. The results align with those of Sand M et al.² who documented a sensitivity of 70%, specificity of 86%, positive predictive value (PPV) of 51%, and negative predictive value (NPV) of 93%, as well as Atahan K et al.,¹¹ who noted a sensitivity of 77%, specificity of 87%, PPV of 47%, and NPV of 97%. In comparison, Emmanuel A et al.¹² showed 30% lower sensitivity but 88% higher specificity and 91% PPV. Bakshi S et al.³ found

that serum bilirubin has strong diagnostic performance 91.4% sensitivity and 88% specificity supporting its use as an additional marker. In this study, serum bilirubin shown higher sensitivity and negative predictive value, making it a valuable rule-out test for complicated appendicitis alongside clinical assessment.

According to the current study, patients with appendicitis (46/104 cases) had a considerably higher prevalence of hyperbilirubinemia than patients with **non-appendicular** causes (14/16 cases). This finding indicates that hyperbilirubinemia is **not specific to appendicitis alone** and may be present in other **non-appendicular** causes.

Chandel UK et al.⁶ found elevated serum bilirubin in 71.7% of acute and 90% of perforated appendicitis cases, compared to significantly lower levels in non-appendicular conditions. Bakshi S et al.³ found that hyperbilirubinemia is primarily linked to appendicitis and rare in non-appendicular causes. In the current study, hyperbilirubinemia has been observed in non-appendicular conditions, suggesting restricted specificity. The data indicate that serum bilirubin has limited effectiveness in distinguishing appendicitis from other conditions, but it may be a valuable **adjunct** marker for detecting complicated appendicitis.

Table 1: Allocation of study subjects according to serum bilirubin levels

Group	Serum Bilirubin Status	Number of Patients	Percentage (%)
Group A	Hyperbilirubinemia (>1.2 mg/dl)	60	50.0
Group B	Normal bilirubin (≤1.2 mg/dl)	60	50.0
Total		120	100.0

mg/dl – milligrams per decilitre

Table 2: Age-wise distribution of the study population

Age Group (years)	Number of Patients	Percentage (%)
≤20	22	17.2
21–30	38	29.7
31–40	19	14.8
41–50	24	18.8
>50	17	13.3
Total	120	100.0

Table 3: Sex-wise distribution of the study population

Sex	Number of Patients	Percentage (%)
Male	84	70.0
Female	36	30.0
Total	120	100.0

Table 4: Distribution of cases according to histopathological examination

Histopathology Report	Number of Cases	Percentage (%)
Acute appendicitis	104	86.7
Complicated appendicitis	16	13.3
Total	120	100.0

HPE – histopathological examination

Table 5: Association between serum bilirubin levels and status of appendix

Serum Bilirubin Level	Complicated Appendix	Non-complicated Appendix	Total
Raised (>1.2 mg/dl)	49 (TP)	11 (FP)	60
Normal (≤1.2 mg/dl)	9 (FN)	51 (TN)	60
Total	58	62	120

TP – true positive; FP – false positive; FN – false negative; TN – true negative

Table 6: Diagnostic accuracy of hyperbilirubinemia for complicated appendicitis

Diagnostic Parameter	Value (%)
Sensitivity	84.5
Specificity	82.3
Positive Predictive Value	81.7
Negative Predictive Value	85.0
Diagnostic Accuracy	83.3

PV – positive predictive value; NPV – negative predictive value

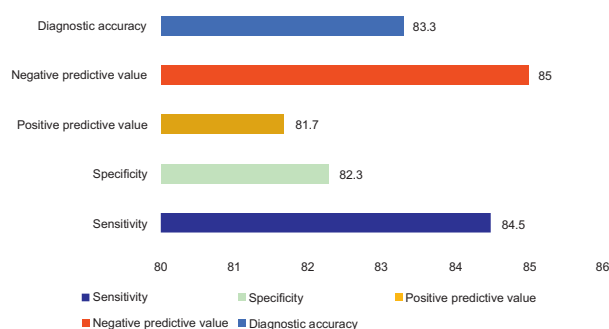


Figure 1: Diagnostic performance of serum bilirubin in predicting complicated appendicitis showing sensitivity, specificity, positive predictive value, and negative predictive value based on histopathological diagnosis.

■ Appendicitis ■ Complicated appendicitis

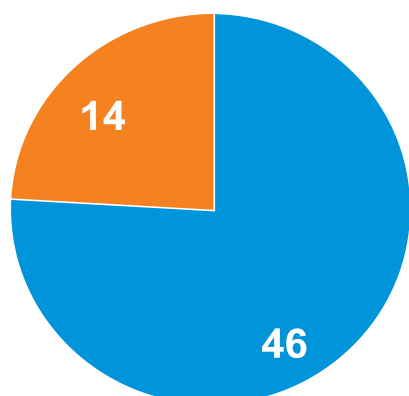


Figure 2: Distribution of Serum Total Bilirubin Levels in Appendicitis and Complicated Appendicitis

CONCLUSION

This study shows that increased serum bilirubin levels are substantially linked to complicated appendicitis. Despite hyperbilirubinemia being associated in various non-appendicular cause, its non-specificity constrains its efficacy in distinguishing appendicitis from non-appendicular conditions. An evaluation of serum bilirubin may serve as a valuable, cost-effective additional diagnostic marker for predicting complicated appendicitis, especially in resource-constrained settings.

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Conflict of Interest: None declared.

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