

Original Research Article

Study of serum bilirubin as a diagnostic method to predict acute perforated appendicitis

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ABSTRACT

Background: Acute appendicitis is the commonest cause of 'acute surgical abdomen'. Appendectomy is the most frequently performed urgent abdominal operation and is often the first major procedure performed by a surgeon in training. The aim of the study was to whether hyperbilirubinemia might be used as a diagnostic tool to predict perforated appendicitis.

Methods: This study comprised patients who presented with the condition of appendicitis and abnormal liver function tests on admission and had a laparoscopic or open appendectomy. The age information, duration of symptoms, temperature, white blood cell counts, bilirubin levels, and histology data were gathered. Peritoneal fluid was cultured and examined for sensitivity.

Results: The average bilirubin level of all participating patients was 0.92 mg/dl (range, 0.1-4.3 mg/dl). The mean bilirubin levels were higher for patients with simple appendicitis compared to those with a non-inflamed appendix (0.7 mg/dl and 0.4 mg/dl, $p < 0.001$). Hyperbilirubinaemia was reported to have a specificity of 89% and a positive predictive value of 90.02% for acute appendicitis. Patients with appendiceal perforation, however, had a mean bilirubin level of 1.7 mg/dl and were more likely to have hyperbilirubinaemia ($p < 0.001$). The specificity of hyperbilirubinaemia for perforation or gangrene was 73%.

Conclusions: Patients with hyperbilirubinemia with appendicitis condition should be screened for a greater risk of appendiceal perforation than those with normal bilirubin levels.

Keywords: Hyperbilirubinemia, Appendicitis, Gangrenous appendix, Perforated appendicitis

INTRODUCTION

In any general surgical practice, acute appendicitis is one of the most prevalent causes of acute abdomen. It has been a subject of recurrent study efforts for numerous variables ranging from its aetiology to its treatment possibilities since Reginald Heber Fitz originally reported it in 1886.^{1,2}

In the emergency department, appendicitis is one of the most prevalent acute illnesses appearing as abdominal pain. Appendectomy is performed at a rate of 12% for men and 25% for women during their lives, with appendectomy affecting around 7% of the population. The second to fourth decades of life are the most typically afflicted, with a mean age of 31.3 years and a median age of 22 years.

Both sexes are affected, with around a 1.2-1.3:1 male to female preponderance.³ The many approaches of diagnosis have been emphasised so extensively because they are incredibly important. Appendicitis may be a relatively painless procedure if detected early and handled properly, but it can potentially evolve into an illness with high morbidity and death if overlooked. The aim of the study was to determine the effectiveness of hyperbilirubinemia as a diagnostic tool to predict perforated appendicitis.

METHODS

This prospective observational study was done in the department of general surgery at Sree Balaji Medical College and Hospital on patients who presented with

clinical characteristics of appendicitis from February 2018 and February 2020.

Inclusion criteria

Patients over the age of 18 who with the condition of acute appendicitis and underwent appendectomy (laparoscopic or open) and liver function tests on admission were included in the study.

Exclusion criteria

Patients with established liver illness, a history of drunkenness, hemolytic disease, and other acquired or congenital biliary disease were excluded from the study. During the study period, a total of 118 appendectomies were performed, with 100 patients being included in our analysis. We had to rule out 18 patients since the appendectomy was part of another treatment.

Based on the histology results, the 100 patients were divided into four groups: patients with non-inflamed appendices were assigned to group 1, those with acute appendicitis were assigned to group 2, while those with appendicitis with an inflammatory infiltrate extending through the full thickness of the appendiceal wall to the serosa were assigned to group 3, and those with a perforated or gangrenous appendix were assigned to group 4.

The pre-operative White blood count (WBC), Total bilirubin level, Glutamic-oxaloacetic transaminase (GOT) and Glutamic-pyruvic transaminase (GPT) levels of Glutamic-pyruvic transaminase (GPT) were all examined for diagnostic qualities (GPT). Hyperbilirubinemia was defined as total bilirubin levels of more than 1 mg/dl. WBC normal values ranged from 4 to 11 10⁹ cells, while GOT and GPT normal values ranged from 10 to 35 μ /l.

Microbiological samples, including aerobic and anaerobic cultures, were taken from the blood of 35 patients before surgery and from the peritoneal cavity of 60 patients after appendectomy.

For the aforementioned categories, the diagnostic value of WCC and bilirubin was predicted using sensitivity, specificity, Positive predictive value (PPV), and Negative predictive value (NPV) for each test or when combined.

Patients with non-inflamed appendices were compared to those with acute appendicitis that was not perforated or gangrenous (simple acute appendicitis), and those with appendiceal perforation or gangrene were compared to those with simple acute appendicitis.

Statistical analysis

Frequency and percentages were used to show categorical information. The Chi-square test was employed to

investigate the relationship between categorical variables. Significant is defined as a p value of less than 0.05.

The IBM SPSS application for Windows version 22 was used to conduct statistical analysis.

RESULTS

Among 100 patients included in this study, 52 patients (52%) were females, 48 (48%) were males. The mean age was 31 years (range: 18-68 years). Table 1 shows the distribution of patients by histology group. Seventeen (17%) had a non-inflamed appendix.

The patients with simple acute appendicitis (group 2) were observed with higher mean bilirubin levels as compared to those with a non-inflamed appendix (group 1), (0.7 mg versus 0.4 mg, $p < 0.001$) and more patients in group 2 had hyperbilirubinemia on admission (28% versus 10%, $p < 0.001$).

The odds of a patient with hyperbilirubinemia having simple acute appendicitis were over three times higher than those without hyperbilirubinemia [Odds ratio (OR): 3.128]. The specificity of hyperbilirubinemia for simple acute appendicitis was 89% and its positive predictive value was 90.02% (Table 3).

Patients with a perforated or gangrenous appendix (group 4) had higher mean bilirubin levels than those with simple acute appendicitis (1.4 mg versus 0.8 mg, $p = 0.01$).

More patients with a perforated or gangrenous appendix had hyperbilirubinemia than those with simple acute appendicitis (73% versus 27%, $p < 0.001$) and the odds of a patient with hyperbilirubinaemia having a perforated or gangrenous appendix were over five times higher. The specificity of hyperbilirubinemia for a perforated or gangrenous appendix was 73% (Table 4). The specificity of WBC for simple acute appendicitis was 82% and for appendiceal perforation or gangrene was 17.3%. There was no significant difference in mean LFT values between patients with simple acute appendicitis and non-inflamed appendices or between patients with a ruptured or gangrenous appendix and those with simple acute appendicitis.

Bacterial cultures

Eight of the 35 patients had a positive blood culture (22.85%). Patients with a positive blood culture had a substantially greater prevalence of increased bilirubin than those with a negative blood culture ($p = 0.008$). A total of 60 intraperitoneal fluid samples were obtained for bacterial culture intraoperatively, with 22 (36.66%) yielding a positive culture. Escherichia coli and bacteroides were the most commonly grown species, with 64% and 36% of positive cultures, respectively.

Table 1: Grouping of the patients as per histology.

Groups	Details	Total		No. of patients with hyperbilirubinaemia	
		N	%	N	%
1	No acute inflammation	17	17	2	11.76
2	Acute appendicitis	51	51	15	29.41
3	Acute appendicitis with inflammatory infiltrate extending through the full thickness of the appendiceal wall	16	16	7	43.75
4	Perforated or gangrenous appendix	16	16	11	68.75
Total		100		35	

Table 2: The concentrations of bilirubin in patients.

Groups	Description	Mean bilirubin (mg in range)
1	No acute inflammation	0.4 (0.1 to 0.7)
2	Acute appendicitis	0.7 (0.1 to 4)
3	Acute appendicitis with inflammatory infiltrate extending through the full thickness of the appendiceal wall	1 (0.2 to 2.5)
4	Perforated or gangrenous appendix	1.4 (0.4 to 3.3)

Table 3: Values of WBC and bilirubin for differentiating acute appendicitis from non-appendix.

Variables	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Likelihood ratio (95%CI)		Frequency (%)	Accuracy (%)
					Positive	Negative		
Bilirubin	73	89	90.02	27.12	2.32	0.78	75.62	44.38
WBC	27	82	88	34	2.06	0.22	--	--

Table 4: Values of bilirubin and WBC for differentiating simple acute appendicitis from the perforated or gangrenous appendix.

Variables	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Likelihood ratio (95%CI)		Frequency (%)	Accuracy (%)
					Positive	Negative		
Bilirubin	72.15	71	28.72	92.15	2.41	0.38	15.45	71.45
WBC	90.14	16.4	12	92	1.43	0.27		

DISCUSSION

The most common kind of appendicitis is simple. While non-perforated acute appendicitis may be treated with an appendectomy and a brief recovery time, perforated acute appendicitis can be fatal. As a result, detecting perforation early improves the prognosis and permits the surgeon to operate and prepare for potentially tough treatment.

Hyperbilirubinemia in sepsis is a well-known condition that has been linked to several bacteria, with gram-negative bacteria being the most often implicated.^{4,5}

Several pathways have been identified that lead to hyperbilirubinemia in systemic infections. Mucosal ulceration in appendicitis occurs early in the disease's progression, before the appendix dilates, according to Sisson et al.⁶ This allows germs to enter the appendix's muscularis propria, resulting in typical acute suppurative appendicitis. Following that, a nonspecific host immune response occurs, resulting in edoema, increased intraluminal pressure, and ischemia necrosis of the mucosa, resulting in tissue gangrene and perforation.^{7,8}

Bacterial levels in the appendix are high enough to induce direct invasion or transfer into the portal venous system. Direct bacterial infiltration of the hepatic parenchyma interferes with bilirubin excretion into the bile canaliculi by a biochemical rather than obstructive process presumed to be induced by the bacterial endotoxin.

There have been multiple investigations of appendicitis causing hyperbilirubinemia.⁹⁻¹² Estrada et colleagues hypothesized that hyperbilirubinemia was linked to appendiceal perforation, and found that individuals with a perforated or gangrenous appendix had higher levels of bilirubin than those with uncomplicated acute appendicitis. According to Sand et al, hyperbilirubinemia had an 86 percent specificity for appendiceal perforation or gangrene, compared to just 35 percent for CRP.¹³ The findings of this investigation are congruent with those of the previous studies.

CONCLUSION

Because no one clinical or laboratory test can accurately predict appendicular perforation, serum bilirubin levels are

obtained upon admission and combined with the history, clinical examination, laboratory and radiographic tests to establish the diagnosis and determine suitable care. Also, hyperbilirubinemia is not a strong enough predictor on its own, but it may be more effective when combined with other factors in a scoring system.

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