Original Research Article

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Diagnostic value of serum hyperbilirubinemia in acute appendicitis and its complications

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ABSTRACT

Background: To increase diagnostic accuracy and to decrease complication rates secondary to acute appendicitis, a variety of different approaches have been described, including predictive scoring systems. To prevent the catastrophic effects of perforated appendix, a surgeon needs diagnostic tools which may signal perforation of appendix at earliest, as a result of which the delay in the management of perforated appendix will not be witnessed. Keeping in view the above facts, the diagnostic value of serum bilirubin in acute appendicitis and its complications has been evaluated.

Methods: This prospective study was conducted on 100 patients who presented with clinical diagnosis of Acute Appendicitis. Role of serum bilirubin as a diagnostic tool in acute appendicitis and diagnostic value of hyperbilirubinemia as a predictive factor for appendiceal perforation was evaluated. Estimation of serum bilirubin was done by Jendrassik and Gorf method using Hitachi – 912 automatic biochemistry analyzer. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of the investigations in the diagnosis of the acute appendicitis were calculated.

Results: Serum bilirubin levels had a sensitivity of 84.1% and specificity of 83.3% in the diagnosis of acute appendicitis. The mean bilirubin level of patients with gangrenous appendicitis $(2.1\pm1.2\text{mg/dl})$ was significantly higher than the mean bilirubin level of patients with simple acute appendicitis (1.5 ± 0.6) (p1=0.030 sig). A statistically significant difference was also observed in the mean bilirubin level of patients with perforated appendicitis (mean=2.9±1.6mg/dl) and mean bilirubin level of patients with simple acute appendicitis (p2=<0.0001 sig). However statistically non-significant difference was observed between the mean bilirubin level of patients with gangrenous and perforated appendicitis (p3=0.056 non- sig).

Conclusions: Pre-operative assessment of serum bilirubin not only helps in acute appendicitis but also serves as a predictive factor for appendiceal perforation.

Keywords: Appendicitis, Complicated appendicitis, Serum bilirubin

INTRODUCTION

One of the most common and feared complication of the acute appendicitis is perforation of appendix. The overall rate of perforated appendix is 25.8%, children <5 years of age, patients >65 years of age have the highest rates of perforation (45% and 51%, respectively). The

perforation of appendix leads to higher incidence of postoperative sepsis and longer hospital stay.³ To decrease the morbidity and mortality of perforated appendix, a preoperative diagnosis of perforation should be sought at earliest. To prevent the catastrophic effects of perforated appendix, a surgeon needs diagnostic tools which may signal perforation of appendix at earliest, as a

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result of which the delay in the management of perforated appendix will not be witnessed. One newer diagnostic tool added to the spectrum is hyperbilirubinemia, as elevated total serum bilirubin has been seen to signal perforation.⁴

Hyperbilirubinemia in patients with appendicitis may have a predictive potential for preoperative diagnosis of appendiceal perforation. The sensitivity of elevated total serum bilirubin is almost similar to that of elevated total leucocyte count and C-reactive protein but specificity of elevated total serum bilirubin is higher (100%) as compared to elevated TLC and CRP.⁵

This study was undertaken to evaluate the sensitivity, specificity and predictive value of serum hyperbilirubinemia in acute appendicitis and its complications.

METHODS

This prospective study was conducted from May 2011 to April 2013 on 100 patients who presented with clinical diagnosis of acute appendicitis. All the patients were admitted in the emergency department with a provisional diagnosis of acute appendicitis. Detailed history, physical examination and laboratory investigations were done. In young females, a proper history of menstruation and that suggestive of pelvic inflammatory disease were taken. All the base line investigations including liver function test (LFT) and ultrasonography (USG) were done preoperatively for diagnosing acute appendicitis. Role of serum bilirubin as a diagnostic tool in acute appendicitis and diagnostic value of hyperbilirubinemia as a predictive factor for appendiceal perforation in acute appendicitis was evaluated. Estimation of serum bilirubin was done in clinical diagnostic biochemistry laboratory of the institute. The methodology applied for Serum Bilirubin estimation was Jendrassik and Gorf method using Hitachi-912 automatic biochemistry analyzer.

For estimation of serum bilirubin, a 3ml venous blood sample was drawn from each patient on admission. This sample was then centrifuged for one minute at 4000 rpm to separate the serum from the blood sample. The serum was then transferred to sample cups which were placed in the automatic analyzer for automatic estimation. All the standard recommended precautions were taken during processing of samples. The upper limit of normal serum bilirubin was taken as 1mg/dl.⁶

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of the investigations in the diagnosis of the acute appendicitis were calculated.

RESULTS

Most of the patients in present study were males in the age group of second to third decade of life. Out of 100

patients operated 82 of the patients had a positive histopathological diagnosis of acute appendicitis. 59 were simple acute appendicitis, 14 gangrenous and nine perforated appendices. 76 patients out of 82 histologically positive appendicitis had clinical signs suggestive of appendicitis (sensitivity=92.6%). This gives highest sensitivity for the diagnosis of acute appendicitis by clinical means (Table 1).

Table 1: Clinical assessment.

Clinical diagnosis	Histopathology positive	Histopathology negative	Total
Positive	76	13	89
Negative	06	05	11
Total	82	18	100

Sensitivity 92.6%, specificity 27.7%, positive predictive value 85.3%, negative predictive value 45.4%, accuracy=81%

Out of 100 cases of clinical suspected appendicitis, 87 cases had a Modified Alvarado score of \geq 7 and 13 cases had a score <7. Out of 87 cases with Alvarado score \geq 7, 74 cases were positive for histopathology and 13 were histopathologically negative with a sensitivity of 90.2%. Out of 13 cases with Alvarado score of <7, 8 cases were positive for histopathology with a sensitivity of 61.5% and 5 cases were histopathologically negative with a specificity of 27.7 % (Table 2).

Table 2: Modified Alvarado's score.

Modified Alvarado score	Histopathology positive	Histopathology negative	Total
≥7	74	13	87
<7	8	5	13
Total	82	18	100

Sensitivity of MAS\geq 7=90.2\%, Sensitivity of MAS\leq 7=61.5\%, Specificity of MAS\leq 7=27.7\%

The sensitivity and specificity of leukocytosis in the diagnosis of acute appendicitis was 76.8% and 83.3% respectively. 69 patients out of 82 who had histologically positive appendicitis had ultrasonography suggestive of appendicitis and 4 out of 18 with negative histopathology had ultrasonography positive for appendicitis. This gives the sensitivity of 84.1% and specificity of 77.7% of ultrasonography in the diagnosis of acute appendicitis (Table 3).

Table 3: Ultrasonography.

USG	Histopathology positive	Histopathology negative	Total
Positive	69	4	73
Negative	13	14	27
Total	82	18	100

Sensitivity=84.1 %, Specificity=77.7 %, Positive predictive value=94.5%, Negative predictive value=51.8%

Serum bilirubin levels had a sensitivity of 84.1% and specificity of 83.3% in the diagnosis of acute appendicitis. Out of 82 cases of histopathologically positive appendicitis, 69 patients had bilirubin level of >1 mg/dl and 13 patients had a bilirubin level of $\le 1 \text{mg/dl}$ (Table 4).

Table 4: Serum bilirubin.

Serum bilirubin	Histopathology positive	Histopathology negative	Total
Elevated	69	3	72
Normal	13	15	28
Total	82	18	100

Sensitivity=84.1%, Specificity=83.3%, Positive predictive value=95.8%, Negative predictive value=53.5%, Accuracy=84%

In present study, it was observed that the mean bilirubin level of patients with gangrenous appendicitis $(2.1\pm1.2\text{mg/dl})$ was significantly higher than the mean bilirubin level of patients with simple acute appendicitis (1.5 ± 0.6) (p1=0.030 sig) (Table 5).

Table 5: Distribution of cases of acute appendicitis according to level of serum bilirubin.

Histopathology	Serum bilirubin <1 mg/dl	Serum bilirubin >1 mg/dl	Total
Simple acute appendicitis	9	50	59
Gangrenous appendicitis	3	11	14
Perforated appendicitis	1	8	9
Total	13	69	82

A statistically significant difference was also observed in the mean bilirubin level of patients with perforated appendicitis (mean= 2.9 ± 1.6 mg/dl) and mean bilirubin level of patients with simple acute appendicitis (p2 \leq 0.0001 sig).

However statistically non-significant difference was observed between the mean bilirubin level of patients with gangrenous and perforated appendicitis (p3=0.056 non-sig).

DISCUSSION

In present study a total of 100 patients, who were operated upon for suspected acute appendicitis on the basis of suggestive clinical and or paraclinical parameters the age ranged from 5 years to 65 years with a mean age of 26.4years. Emmanuel A et al studied a total of 472 patients whose age ranged from 5 years to 82 years with a mean age of 27 years, which correlates with this study. Acute appendicitis was more prevalent in the age group

of second to third decade and males outnumbered females as was also seen in study by Khan S.⁸ The sensitivity and specificity of clinical parameters in acute appendicitis in our study were 92.6% and 27.7% respectively. Present results were comparable with the study conducted by Pruekprasert et al, they found that the surgeon's clinical diagnosis had a highest sensitivity of 96%. This shows the highest sensitivity of clinical assessment for the diagnosis of acute appendicitis.⁹

On the basis of modified Alvarado score 87 patients had a score of \geq 7 and 13 patients had a score of \leq 7. Patients with modified Alvarado score \geq 7 had a sensitivity of 92.2% and patients with modified Alvarado score \leq 7 had a sensitivity of 61.5%.

Similar results were found in a study conducted by Kalan M et al in their study with sensitivity of 83.6% in patients with Alvarado score \geq 7 and a sensitivity of 61.5% in patients with Alvarado score of <7.10

Similar results were found in a study conducted by Ashmawy H et al (2005). The sensitivity and specificity of Alvarado Score was 97.8% and 24.6% respectively.¹¹

Present results were consistent with the results of the study conducted by Denizbasi et al (2003).¹² The sensitivity and specificity of the Alvarado Score were 95.4% and 45.7% respectively.

Lau et al (1989) found that leucocyte count was raised in 81.4% with a specificity of 77.3% which was comparable to present study.¹³ A prospective study by Nordback in 1988 have found a sensitivity of 78.5%.¹⁴

The sensitivity, specificity and accuracy of ultrasound in the present study was 84.1%, 77.7% and 83.0% respectively.

Present results were consistent with those observed by John H et al, with a sensitivity of 78% and specificity of 73% with overall accuracy of 76%. ¹⁵

Present results were comparable with the study conducted by Shah NA et al, who evaluated the use of ultrasonography in the diagnosis of acute appendicitis in 130 patients. The sensitivity and specificity of ultrasonography for the diagnosis of acute appendicitis was 97% and 75% respectively.¹⁶

In a recent meta-analysis of 14 prospective studies showed ultrasonography to have a sensitivity of 86% and specificity of 81%.¹⁷

These results are higher than the present study, reason may be that ultrasonography is highly operator dependent. In the present study, sensitivity and specificity of serum bilirubin in the diagnosis of acute appendicitis was 84.1% and 83.3% respectively. Present results were comparable to a study conducted by Sand M et al (2009),

in which the sensitivity and specificity of serum bilirubin in the diagnosis of acute appendicitis was 70% and 86% respectively.⁴

In a study conducted by Emmanuel a et al (2011), the sensitivity and specificity of serum bilirubin in the diagnosis of acute appendicitis was 30% and 88% respectively.⁷

In a study conducted by Atahan K et al, the sensitivity and specificity of serum bilirubin in the diagnosis of acute appendicitis was 77.7% and 87.2% respectively, which were comparable to present study.¹⁸

There were 23 patients with complicated appendicitis that is perforated/gangrenous, out of 82 patients whose histopathological findings were suggestive of acute appendicitis.

The mean bilirubin level of all patients was 1.8 (\pm 1.0 SD mg/dl), range 0.1-5.5mg/dl. Patients with simple acute appendicitis had a mean bilirubin level of 1.5 (\pm 0.6 SD mg/dl), range 0.4-4.0mg/dl. Patients with complicated appendicitis (gangrenous and perforated appendicitis), however had a mean bilirubin level of 2.73mg/dl, range=0.4-5.5mg/dl) which was significantly higher than those with simple acute appendicitis (p \leq 0.0001). Statistically no significant difference was observed between the mean bilirubin levels of patients with gangrenous appendicitis and perforated appendicitis. (p=0.056).

Present results were consistent with the study conducted by Sand M et al. They found that the mean bilirubin levels of all patients were 0.9mg/dl (± 0.65 SD mg/dl), range 0.1-4.3mg/dl, median 0.7mg/dl. Patients with appendiceal perforation however had a mean bilirubin level of 1.5mg/dl (± 0.9 SD mg/dl.), range 0.4-4.3, median 1.4mg/dl, which was significantly higher than those with a non-perforated appendicitis (P<0.05).⁴

Present results are comparable with study conducted by Emmanuel et al (2011), they found in their study that the patients with a gangrenous and perforated appendicitis had higher mean bilirubin levels than those with simple acute appendicitis (p=0.01).⁷

Atahan K et al and Ghimire P et al also found in their studies that the mean bilirubin levels of patients with complicated appendicitis were higher than those with simple acute appendicitis (P<0.001). 18,19

CONCLUSION

We can conclude that, in addition to already existing diagnostic modalities, preoperative assessment of serum bilirubin should be routinely performed in cases of appendicitis. It does not only help in diagnosis of acute appendicitis, but also serves as an important marker of acute gangrenous or perforated appendicitis.

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