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The Study of Accuracy of Alvarado Score, CRP, Bilirubin Level and Mean Platelet Volume in the Diagnosis of Acute Appendicitis in a Tertiary Care Centre

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Abstract **Original Research Article**

Acute appendicitis is one of the common surgical emergencies and when it progresses to appendicular perforation, morbidity and mortality becomes much higher. Nearly 6% of the population is expected to have appendicitis in their lifetime. Though absolute diagnosis is only possible at operation and histopathological examination of the specimen, many scoring systems are available for the diagnosis of acute appendicitis. Among them Alvarado scoring system is an important one which is based on history, clinical examinations and few laboratory tests. Recent studies have shown the association of hyperbilirubinemia with acute appendicitis and appendicular perforation. Many reports have investigated the value of raised C reactive protein (CRP) and reduced mean platelet volume (MPV) in improving the diagnosis of acute appendicitis. The objective of our study was to evaluate the accuracy of Alvarado scoring system and CRP as a preoperative diagnostic tool in acute appendicitis and to evaluate whether hyperbilirubinemia and reduced MPV has a predictive potential for its diagnosis. A total of one hundred one patients coming to our emergency in a study period of one year were included. It was observed that the sensitivity, specificity, positive predictive value of Alvarado score was 82.7%, 70% and 96%, CRP level- 96.5%, 63.6%, 95.4%, total bilirubin level- 96.4%, 19%, 60.91%, MPV level- 95.7%, 16%, 51.72% respectively and the P value was clinically significant for Alvarado score, CRP level, total bilirubin level but not for MPV. We conclude that Alvarado score, raised total bilirubin level and CRP level are very effective in the diagnosis of acute appendicitis in both men and women but some other diagnostic modality may be necessary to ascertain the diagnosis in females to rule out pelvic pathology and to reduce negative appendicectomy rate.

Keywords: Acute appendicitis, appendicular perforation, Alvarado score, C reactive protein, mean platelet volume, total bilirubin level.

INTRODUCTION

Acute appendicitis is one of the common surgical emergencies. Morbidity and mortality are much higher when simple appendicitis progress to perforation [1]. The appendix was first described in 1521 and Reginald Fitz described the condition of inflamed appendix as appendicitis in 1886 [2-4]. Near about 6% of the population is expected to have appendicitis in their lifetime. Though absolute diagnosis is only possible at operation and histological examination of the specimen, routine history and physical examination still remain the most practical diagnostic modalities [5]. As par the world literature, the rate of negative appendicectomy varies from 18-20% and associated morbidity is around 10% [5]. Many scoring systems are available for the diagnosis of acute appendicitis and Alvarado scoring system is one of them which is based on history, clinical examination and few laboratory tests. The Alvarado system can reduce the negative appendicectomy rate from 0-5% [6]. Recent studies have shown the association of elevated bilirubin with acute appendicitis and appendicular perforation was seen to be >2.5 times higher for patients with hyperbilirubinemia [7]. C-reactive protein (CRP) along with other acute phase proteins, increases in response to tissue injury. Many reports have investigated the value of raised serum CRP measurement in improving the diagnosis of acute appendicitis. Mean platelet volume (MPV) is an index of platelet production and activation and it is known to be decreased in diseases of acute pancreatitis, ulcerative colitis, rheumatoid arthritis and ankylosing spondylitis as well as local inflammatory conditions including acute appendicitis

due to migration and consumption of highly reactive large platelets into sites of inflammation [9].

This study is an aid in diagnosing acute appendicitis and assist in arriving at a conclusion whether a particular case should be operated or not, so that number of negative laparotomies will be reduced.

MATERIAL AND METHODS

A prospective study was conducted in the department of General Surgery, North Bengal medical college, Darjeeling for a period of one year. Considering a specificity of 92.6% as par the study using Alvarado score by Subotic AM, 95% confidence interval and power of 60%, a two-sided sample size calculation yields a sample size of 101. Clinical diagnosis of acute appendicitis was done in the department of surgery based on symptoms of migration of pain, nausea and vomiting, anorexia, elevated temperature and signs of peritoneal inflammation like right iliac fossa tenderness, rebound tenderness and guarding. Once acute appendicitis was suspected, patients were subjected to routine investigations as par the hospital protocol. For assessment of Alvarado score the patients were categorized into 3 groups based on MANTRELS criteria-migration of pain, anorexia, nausea, tenderness, rebound tenderness, elevation of temperature, leukocytosis, shifting to left. Group 1: those patients with scores ≥ 7-10, group2: those with scores 5-6 and group3: those with score <5. Groups 1 and 2 underwent appendicectomy and group3 were observed, managed conservatively and reassessed, showing usefulness of Alvarado score. CRP, total leukocyte count, differential count, mean platelet volume, total bilirubin level was done in all cases. WBC count of more than 10000/cubicmm was considered positive. Ultrasonography of abdomen was done in all cases to confirm the diagnosis and rule out other causes of pain abdomen. CRP of more than 2.5mg/dl was considered to be positive, less than 2.5mg/dl considered to be negative [10]. Total bilirubin level more than 1gm/dl was considered to be positive and less than 1 mg/dl considered to be negative. Mean platelet volume less than 7.6 fl was considered to be positive and more than 7.6fl considered to be negative [11]. Patients with strong suspicion of acute appendicitis was advised emergency appendicectomy. They were operated and the specimen was sent for histopathological examination. The histopathology report was considered as the final diagnosis. For statistical analysis all data of study parameters were entered in the Microsoft Excel spreadsheet and analyzed by SPSS (version 22) software.

RESULTS

Among the 101 patients in this study, the males accounted for 58.4% and the females 41.6%. the number of patients were highest in the age group of 18 to 29 years 42 (41.6%) followed by 30 to 39 years 31 (30.7%), out of the 101 patients, 59 (58.4%) were male and 42 (41.6%) were female. This result shows that there is predominance of the disease in the younger age group and the incidence peaks around 18 to 39 years and decreases as the age progressed. Pain was the commonest presenting symptom and migratory RIF pain has been observed in 96 (95%) patients in the present series. Other symptoms observed were nausea/vomiting in 62(61%), and anorexia in 63(62%) patients. Low grade fever was present in 89(88%) cases. On clinical examination, mcburney's point tenderness was the commonest sign seen in 96(95%) cases and rebound tenderness was present in 63(62%) patients. On laboratory test, leukocytosis was seen in 87(86%) cases and leukocyte shift to left was seen in 39(39%) patients. In our study, 4 patients with Alvarado score <5 had normal CRP, total bilirubin and MPV level also. So, they were managed conservatively and not included in the analysis. Rest of 97 patients underwent appendicectomy, out of which 65(67%) patients had simple acute appendicitis, 22(22.7%) patients had acute perforated appendicitis and 10(10.3%) patients had normal appendix with other diseases according to histopathology report. So total 87 patients had acute appendicitis and 10 patients had normal appendix.

In this study, the sensitivity, specificity, positive predictive value and negative predictive value for Alvarado score was 82.7%, 70%, 96%, 31.81%. The P value was 0.001(<0.05), indicates that it was clinically significant.

Table 1: Showing distribution of Alvarado score & HPE report and final results of the Alvarado score

	HPE		Total	
Alvarado score	Normal appendix	Acute appendicitis		
5-6	7	15	22	
	31.8%	68.2%	100%	
7-10	3	72	75	
	4%	96%	100%	
total	10	87	97	
	% within Alvarado score	10.3%	89.7%	
sensitivity	specificity	Positive predictive value	Negative predictive value	P-value
82.7%	70%	96%	31.81%	0.001

In the present series, among 97 patients 86 patients had elevated serum CRP level (>2.5mg/dl) which is 85.14% of total study group. In these patients 3 patients had high serum CRP level in spite of normal

appendix that was proved histopathologically. The cause of raised serum level of CRP in this patient was mesenteric lymphadenitis which was found intraoperatively. 11 patients had normal serum CRP values (<=2.5). in these patients 7(63.6%) had normal appendix on histopathological examination, whereas in 4 patients it was proved by histopathological examination that appendix was inflamed even though levels of CRP was normal in serum. In this study the sensitivity, specificity and positive predictive value, negative predictive value of CRP level was 96.5%, 63.6%, 95.4%, 70%. The P value of CRP level was 0.001 which indicates that the result was clinically significant.

Table 2: Showing distribution of CRP value & HPE report and final result of CRP level

	HPE			
CRP value	Normal appendix	Acute appendicitis	Total	
Less than equal to 2.5	7 63.6%	4 36.4%	11 100%	
More than 2.5	3 3.5%	83 96.5%	86 100%	
Total	10 10.3%	87 89.7%	97 100%	
sensitivity	specificity	Positive predictive value	Negative predictive value	P value
96.5%	63.6%	95.4%	70%	0.001

In the present series, among 97 patients 55 had elevated serum TBL level (>1mg/dl) which is 54.5% of total study group. In these patients, 2 had high serum TBL level in spite of normal appendix that was proved histopathologically. 42 patients had normal serum TBL values (<=1mg/dl). In these patients 8(19%) had normal appendix on histopathological examination, whereas in 34 patients it was proved by histopathological examination that appendix was inflamed even though levels of TBL was normal in serum. In this study the sensitivity, specificity and positive predictive value, negative predictive value of total bilirubin level was 96.4%, 19%, 60.91%, 80%. The P value of total bilirubin level was 0.013 which indicates that the result was clinically significant.

Table 3: Showing distribution of total bilirubin with HPE report and final result of total bilirubin level

	HPE			
TBL	Normal appendix	Acute appendicitis	Total	
<=1	8 19.0%	34 81%	42 100%	
>1	2 3.6%	53 96.4%	55 100%	
total	10 10.3%	87 89.7%	97 100%	
sensitivity	specificity	Positive predictive value	Negative predictive value	P value
96.4%	19%	60.91%	80%	0.013

In the present series, among 97 patients 47 had reduced serum MPV level (<=7.6fl) which is 46,5% of total study group. In these patients 2 had reduced MPV level in spite of normal appendix that was proved histologically. 50 patients had normal MPV value (>7.6fl). in these patients 8(16%) had normal appendix on histopathological examination, whereas in 42 patients it was proved by histopathological examination that appendix was inflamed even though level of MPV was normal in serum. In this study the sensitivity, specificity and positive predictive value, negative predictive value of MPV level was 95.7%, 16%, 51.72%, 80%. The P value of MPV level was 0.06 which indicates that the result was not clinically significant.

Table 4: Showing distribution of MPV with HPE report and final result of MPV

	HPE			
MPV	Normal appendix	Acute appendicitis	Total	
<=7.6	2 4.3%	45 95.7%	47 100%	
>7.6	8 16%	42 84%	50 100%	
Total	10 10.3%	87 89.7%	97 100%	
Sensitivity	specificity	Positive predictive value	Negative predictive value	P value
95.7%	16%	51.72%	80%	0.06

DISCUSSION

Acute appendicitis remains a common abdominal emergency throughout the world. Early and accurate diagnosis of acute appendicitis is required to reduce morbidity and mortality associated with delayed diagnosis and its complications. Negative appendicectomy is responsible for significant morbidity, mortality and loss of precious staff hours and financial resources. The diagnosis of acute appendicitis continues to be difficult due to variable presentation of the disease and lack of reliable diagnostic test. None of the investigations like USG, CT scan conclusively diagnose appendicitis. Even today, a thorough clinical examination with basic investigations remains the cornerstone in the diagnosis of acute appendicitis. The diagnostic accuracy of clinical assessment of acute appendicitis varies from 50-80%. The series from US Naval hospital, San diego, California, revealed an accuracy of 87%.

The present study was undertaken to evaluate the usefulness of Alvarado scoring system, CRP, total bilirubin level, mean platelet volume in reducing the number of negative appendicectomy and to evaluate their sensitivity and positive predictive value in the diagnosis of acute appendicitis. In our series when the Alvarado score was more than 7 indicating strong possibility of intraabdominal infection localized to the right iliac fossa, emergency surgery was performed within 6 hours. These patients were found to have badly inflamed appendix sometime with perforation once again indicating the sensitivity and specificity of the scoring system. In patients in whom score was between 5 and 6 were observed for a period of 12-24 hours and reassessed, where there was persistence of abdominal tenderness appendicectomy was carried out. These patients were found to have congested and inflamed appendix. Patients with score less than 5 were not operated but managed conservatively indicating the usefulness of the Alvarado scoring system.

In the present series 86 patients had elevated serum CRP level (>2.5mg/dl) which is 85.14% of total study group. In these patients 3 had high serum CRP level in spite of normal appendix that was proved histologically. The cause of raised serum level of CRP in these patients was mesenteric lymphadenitis which was found intraoperatively. 11 patients had normal CRP values. Among them 7 patients had normal appendix on histopathological examination, whereas in 4 patients it was proved by histopathological examination that appendix was inflamed even though levels of CRP was normal in serum.

In this study 55 patients had elevated serum total bilirubin level (>1mg/dl) which is 56.7% of the study group. In these patients 53 had acute appendicitis and 2 had high serum TBL levels in spite of normal appendix that was proved histologically.

Among 97 patients in this study 47 had reduced MPV (<=7.6), out of which 45 patients had acute appendicitis and 2 had normal appendix histopathologically. Rest of the 50 patients had normal MPV (>7.6), out of which 42 patients had acute appendicitis and 8 had normal appendix on HPE.

The P value for the Alvarado score, CRP level, total bilirubin level was clinically significant (< 0.05) but it was 0.06 for MPV level which indicated that the result had no significance. In this study the negative appendicectomy rate was 10,3% with the rate being higher in females (12.5%) than in males (8.77%) as other diseases like pelvic inflammatory diseases were more common in the reproductive age group.

CONCLUSION

Alvarado score is very effective in the diagnosis of acute appendicitis in both men and women but some other diagnostic modality may be necessary to ascertain the diagnosis in females to rule out pelvic pathology and to reduce negative appendicectomy rate. Normal CRP level after 12 hours of onset of symptoms should be used as a basis for the decision to defer surgery to reduce the rate of negative appendicectomies and also to reduce the burden on patient as well as health system. Serum bilirubin level appears to be a promising new laboratory marker for diagnosing acute appendicitis, however the diagnosis of appendicitis remains essentially still clinical. MPV level can not be used as a supportive parameter in the diagnosis of acute appendicitis.

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