

Comparison between Modified Alvarado Score & Pediatric Appendicitis Score in the Early Diagnosis and Management of Acute Appendicitis in Children

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Abstract

Early diagnosis of acute appendicitis in children is a challenge for the pediatric surgeons. The objectives of this study were to compare the accuracy of Modified Alvarado Score (MAS) & Pediatric Appendicitis Score (PAS) in the management of acute appendicitis in children, to make early diagnosis & treatment of acute appendicitis and to reduce morbidity of negative appendectomy or delayed appendectomy. It was a comparative prospective study. This study was carried out in Dhaka Shishu (Children) Hospital from January' 2004 to April '2005, a period of 16 months in the department of Pediatric Surgery. During this 16 months period, 106 patients with suspected acute appendicitis were admitted. Among these, 97 patients underwent surgery and 9 patients treated conservatively. Out of 97 patients, 90 specimens were sent for histological examination. Positive histological (Positive appendix) criteria of acute appendicitis required demonstration of acute inflammatory cells infiltration of the appendix wall. Only 85 histological reports were available finally & were included in this study. The sensitivity, specificity and diagnostic accuracy of MAS are 92.42%, 84.21% & 90.59% respectively. The sensitivity, specificity and diagnostic accuracy of PAS are 90.91%, 100% & 92.94% respectively. In these two scoring systems, the sensitivity, specificity and diagnostic accuracy are high. But in our study, PAS is better than the MAS regarding specificity & diagnostic accuracy.

Key words: Modified Alvarado Score (MAS), Pediatric Appendicitis Score (PAS).

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Introduction

In 1886, Harvard pathologist Reginald Fitz presented "Perforative Inflammation of the Vermiform Appendix with special reference to Its Early Diagnosis and Treatment" to the Association of American Physicians. Fitz was the first to describe "appendicitis" and suggested immediate surgical intervention (less than 3 days) to prevent spreading peritonitis or deteriorating clinical status¹. The entire spectrum of appendiceal disease was described in 1905 by Howard Kelly in his book, *The Vermiform Appendix and its Diseases*².

But after passing more than a century, diagnosis of acute appendicitis still remain an enigma³. The diagnosis of acute appendicitis based mainly on history taking and clinical examination and still remains a major problem despite our best effort. Definitive diagnosis of appendicitis is made in only 50% - 70% of children at the time of initial assessment⁴. Only 55% of patients with appendicitis present with classic history & physical findings⁵. Although various aids exist like abdominal ultrasonography, laparoscopy, computerized tomography, MRI, computer aid barium enema, the usefulness of these tests has not been established, moreover they need expertise, are costly, sometimes are not without complications⁶. Acute appendicitis is difficult to diagnose in children due to lack of communication and co-operation. There is still appreciable morbidity and occasional mortality, which is related to failure of making an early diagnosis. For this fear of complication from a missed diagnosis; 15-30% of negative appendectomy has been accepted with impunity by some authors⁷⁻⁸.

In recent years, to diagnose acute appendicitis and to reduce the incidence of negative appendectomy without increasing the risk of perforation, at least 6 different scores have been developed to face the patients with suspected acute appendicitis for observation &/or surgery⁹⁻¹⁰. The Alvarado score was described in 1986¹¹. This scoring system has subsequently been validated by prospective studies in adult¹². O. Bengezi and Al-Fallouji have modified the Alvarado score into a more practical and easy score to use in patient with acute appendicitis⁶. Pediatric Appendicitis Score (PAS) was proposed by Samuel Madan⁴. He evaluated 1170 children aged 4 to 15 years with abdominal pain suggestive of acute appendicitis & negative appendectomy was performed in 3% (36 of 1170)⁴.

Materials and Methods

This prospective comparative type of study was done on children 2.5 to 12 years of age admitted in Dhaka Shishu Hospital with the provisional diagnosis of acute appendicitis from January '2004 to April' 2006. Two diagnostic approaches, MAS & PAS, have been validated against the histological findings.

All available cases were selected for this study. The number of patients under study was 85. Patient in whom surgery was not performed, Appendix abscess or mass was confirmed and histopathology report was not available, were excluded in this study. Research instruments were General Questionnaire, Modified Alvarado Score & Pediatric Appendicitis Score. On admission, the patients were evaluated by using the MAS & PAS scores and recorded in data sheet. After collecting data, editing was done manually & prepared for data entry, which will be done by using computer Programmed, SPSS.

Data analysis was done by using standard statistical Methods. Appendicitis & non-appendicitis group were compared by using unpaired student's t test and sex by using chi-square test. To determine and compare the sensitivity, specificity & diagnostic accuracy of MAS & PAS with histological findings in acute appendicitis, the following formulas have been used:

$$\text{Sensitivity} = \text{TP} \times 100\% / (\text{TP} + \text{FN}).$$

$$\text{Specificity} = \text{TN} \times 100\% / (\text{TN} + \text{FP}).$$

$$\text{Accuracy} = (\text{TP} + \text{TN}) \times 100\% / (\text{TP} + \text{TN} + \text{FP} + \text{FN}).$$

(Where, TP = True positive, TN = True negative, FP = False positive, FN = False negative).

Results

Study population

Total 106 patients were admitted with suspected acute appendicitis out of 2763 admissions in pediatric surgery department of Dhaka Shishu Hospital within 16 months period. Of which 97 cases were operated & 9 cases were treated conservatively. Total 90 specimens were sent for histopathology and 7 samples were missed. Histopathology reports were available in 85 cases & 5 reports were missed (figure-I). So, total study population was 85.

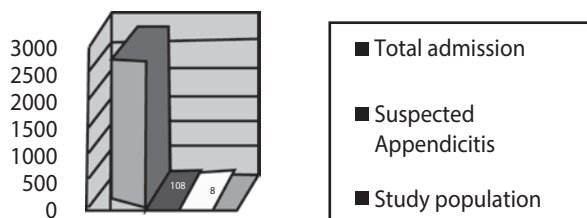


Fig-I: Hospital Incidence

Symptoms of acute appendicitis

Migratory right iliac fossa (RIF) pain was present in 60 (70.58%) cases. The most common symptom, anorexia was present in 81 (95.24%) cases & nausea/vomiting was in 69 (81.18%) cases. Scoring value of each of the symptom is 1 (one).

Signs of acute appendicitis

All the patients (100%) were present tenderness in RLQ. Rigidity/rebound tenderness was present in 67 (78.82%) cases, Elevated temperature/pyrexia was 58 (68.24%) cases, Rovsing's sign was 62 (72.94%) cases & Percussion tenderness (figure-II) was 69 (81.18%) cases.

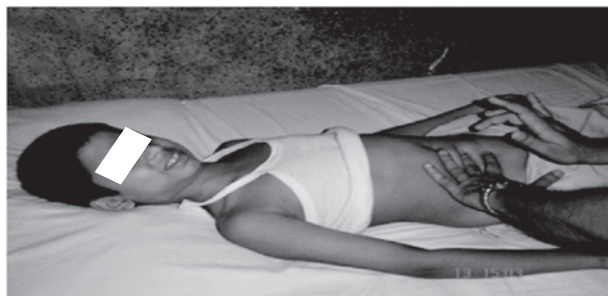


Fig-II: Percussion Tenderness with facial expression.

Laboratory investigation

Blood for Haemoglobin, TC, DC, and ESR was done in all patients. Leukocytosis ($\geq 10,000/\text{c.mm}$) was present in 75 (88.24%) cases & Neutrophilia was in 50 (59%) cases. Scoring value of Leukocytosis is 2 in MAS & 1 in PAS and of Neutrophilia is 0 in MAS 1 in PAS.

Histological findings

Histopathology is the gold standard for the confirmatory diagnosis of acute appendicitis. Histopathology proven Acute Appendicitis was present in 66 (77.65%) cases & non appendicitis was present in 19 (22.35%) cases which was shown in Table I.

Table-I: Histological findings

Histology	Cases (n=85)	Percentage (%)
Positive (appendicitis)	66	77.65
Negative (No appendicitis)	19	22.35
Total	85	100.00

Relationship between histological and MAS findings

MAS were divided into 3 groups according to the interpretation of scores (Table II). P value is highly significant (<0.001) in relation to histological finding of positive and Negative appendectomy with MAS.

Table-II: Relationship between histological & MAS findings

Histology	MAS Score						P value
	Negative (1-4)		Doubtful (5-7)		Positive (8-10)		
	No.	%	No.	%	No.	%	
Positive (n=66)	0	0	5	7.6	61	92.4	<0.001
Negative (n=19)	1	5.3	15	78.9	3	15.8	
Total (n=85)	1	1.18	20	23.53	64	75.29	

Relationship between histological & PAS findings

PAS were also divided into 3 groups according to the interpretation of scores (Table III). P value is also highly significant (<0.001) in relation to positive and Negative appendectomy with PAS.

Table-III: Relationship between histological & PAS findings

Histology	PAS Score						P value
	Negative (≤ 5)		Doubtful (6-7)		Positive (8-10)		
	No.	%	No.	%	No.	%	
Positive (n=66)	0	0	6	9.1	60	90.9	<0.001
Negative (n=19)	10	52.6	9	47.4	0	0	
Total (n=85)	10	11.76	15	21.18	60	70.59	

Relationship between histological finding and MAS & PAS finding of acute appendicitis

Histological study showed that 66 cases were acute appendicitis & 19 cases were normal. In MAS, 61 were true positive & 3 were false positive within the score of 8-10 and 16 were true negative & 5 were false negative within the score of 1-7. In PAS, 60 patients were true positive & there was no false positive within the score of 8-10 and 19 patients were true negative & 6 were false negative within the score of $\leq 5-7$.

Statistical analysis of MAS & PAS

Sensitivity of MAS is 92.42% & that of PAS is 90.91%. Specificity of MAS & PAS is 84.21% & 100% respectively. Diagnostic accuracy of PAS & MAS is 92.94% & 90.59% respectively (Table IV).

Table-IV: Statistical analysis of MAS & PAS

Scoring Systems	Sensitivity (%)	Specificity (%)	Diagnostic Accuracy (%)
MAS	92.42	84.21	90.59
PAS	90.91	100.00	92.94

Discussion

In recent years, various scoring systems totaling about 12 have been developed to aid the early diagnosis of acute appendicitis & to reduce negative appendectomy¹⁰. Notably of them are Alvarado score (AS), MAS & lastly PAS⁴. AS and MAS were applied in all age groups not confined to the pediatric age group only. The accuracy of MAS in children was studied by Matin¹³ in DSH. PAS was proposed by Madan Samuel⁴ for evaluates exclusively pediatric age group patients of suspected acute appendicitis. In this series, acute appendicitis was diagnosed histologically in 66 cases & 19 cases were normal out of 85 cases. In this study, MAS suggested definite acute appendicitis for score 8-10 and 64 cases were in this range of score. Among them 61 cases were true positive and 3 cases were false positive proven histologically. Among the 21 cases of score 1-7, 16 were true negative and 5 were false negative. So, the sensitivity, specificity and diagnostic accuracy of MAS are 92.42%,

84.21% & 90.59% respectively & it is correlated with the study of Matin¹³, Al-Fallouji⁶. PAS suggested definite acute appendicitis for score 8-10 and 60 cases were in this range of score. Among them all 60 cases were true positive & there was no false positive case. Rests of the 25 cases of score 1-7, 19 were true negative & 6 were false negative. So, the sensitivity, specificity and diagnostic accuracy of PAS are 90.91%, 100% & 92.94% respectively & these findings are correlated with the study of Madan Samuel⁴. In these two scoring systems, the sensitivity, specificity and diagnostic accuracy are high. But in our study, PAS is better than the MAS regarding specificity & diagnostic accuracy which is proven statistically. The study was carried out in a small number of patients. It shows that the use of these scoring systems in these patients provides a high degree of sensitivity and specificity. These scoring tools have an easy application because of they rely on purely history, examination and a simple investigation which are easily available.

In conclusion, this study showed histological validation of Modified Alvarado Score (MAS) & Pediatric Appendicitis Score (PAS) in the early diagnosis and management of acute appendicitis in children. These organized scoring systems give us accurate guide line about hospitalization, observation and indication of immediate appendectomy in children and based only on symptoms, signs & simple blood test which are easily available. PAS is more accurate than MAS in higher degree of specificity & diagnostic accuracy. Besides, patient compliance is better in eliciting the sign of PAS which is devoid of the irritating sign (rebound tenderness) of MAS. So, this study recommends to general practitioners, pediatricians, pediatric & general surgeons to follow the guide line of PAS in their practice.

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