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Original article

A Comparative Study of RIPASA Score and Modified Alvarado Score in Acute Appendicitis in Nepalese Population

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ABSTRACT

Introduction: Although acute appendicitis is a common surgical condition, its diagnosis can be elusive at times with misdiagnosis leading to serious complications. Various scoring systems have been developed to overcome this dilemma and the reported accuracies of these scores vary greatly.

Materials and Methods: A retrospective review of charts was carried out to identify all patients admitted to KIST medical college teaching hospital from May 2015 to April 2016 with the diagnosis of acute appendicitis. A total of 120 cases that underwent surgery for suspected acute appendicitis were included. Modified Alvarado score and RIPASA scores were computed for each patient and the suggested cutoff values were used to find out the accuracy of these scores. Histopathological confirmation/report was considered as the standard for comparison.

Results: A negative appendectomy rate of 11.67 % was observed (9.64 % for males and 16.22 % for females). Complicated appendicitis was found in 27.36% of patients. Modified Alvarado score had a sensitivity of 61.32 % and specificity of 71.43 % at a cut of value of 7. At cut off of > 7.5 for acute appendicitis, RIPASA score had a sensitivity of 97.17% and specificity of 57.14%. Accuracy of MAS was 62.5% while it was 92.5% for RIPASA score.

Conclusions: RIPASA score demonstrated higher sensitivity and accuracy but lower specificity compared to the modified Alvarado score in our study group. More studies with larger sample size need to be carried out for further validation of this new score.

Keywords: Acute appendicitis, Modified Alvarado score, RIPASA.

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INTRODUCTION

Appendicitis is one of the most common reasons for emergency laparotomy, with a nearly 7% lifetime cumulative incidence.[1] It is the most common acute surgical problem of the abdomen, and appendectomy is the fifth most common surgical procedure performed on the gastrointestinal tract.[2] There have been numerous advances in the diagnosis and treatment of appendicitis. Nonetheless, acute appendicitis continues to challenge surgeons to this day. Diagnostic errors are common, resulting in a median incidence of perforation of 20% and a negative laparotomy rate ranging from 2% to 30%.[3] The rate of complications was 2.5% in the negative group compared with a rate of 1.8% in the appendicitis group, and the fatality rate was 1.5% in the negative appendectomy group compared with 0.2% for those with appendicitis. So it is opined that negative appendectomy is to be avoided when possible, due to the risk of surgical complications and the cost associated with unnecessary surgery.[4]

Various scoring systems have been devised to aid the clinician in the accurate diagnosis of acute appendicitis. Classic Alvarado score[5] included a shift to the left of neutrophil maturation (score

1) yielding a total score of 10. However, Kalan et al. omitted this parameter which was not routinely available in many laboratories and produced a Modified Alvarado score[6] with an aggregate score of 9. Chong et al from the Department of Surgery at Raja Isteri Pengiran Anak Saleha Hospital, Brunei Darussalam have recently developed a new appendicitis scoring system 'RIPASA Score[7] consisting of 15 clinical and laboratory variables with a maximum score of 16 pts; a cut-off score of 7.5 has been suggested to give a sensitivity of 88 percent, a specificity of 67 percent, a positive predictive value of 93 percent and a negative predictive value of 53 percent. The purpose of this study is to compare a relatively new scoring system "RIPASA" with Modified Alvarado score in acute appendicitis.

MATERIALS AND METHODS

A retrospective review of medical charts was carried out to identify all the cases admitted with the diagnosis of acute appendicitis in the surgery department of KIST Medical College and teaching hospital from May 2015 to April 2016. Patients who were managed conservatively were excluded. A total of 142 patients were identified, of whom, 22 were excluded because of incomplete data. Modified Alvarado score (Table 1) and modified RIPASA score (Table 2) in which foreign national identity was removed; thus scoring was done out of 15 instead of 16 pts were computed for each patient. Cut-off values as suggested by the authors of these scoresthe were taken for computation of sensitivity and specificity.

Table 1: Modified Alvarado Scoring system

Clinical feature	Score
Migratory RIF pain	1
Anorexia	1
Nausea / vomiting	1
Tender RIF	2
Rebound tenderness	1
Elevated temperature	1
Leucocytosis	2
Total	9

≥ 7- likely appendicitis; 5-6 less likely appendicitis; 0-4 probably not appendicitis

Table 2: Modified RIPASA scoring system

RIPASA SCORE	
Parameter	Score
Age	1 pt (if <40 yr) or 0.5 pt (if >40 yr)
Sex	1 pt (if M)or 0.5 pt (if F)
RIF pain	0.5 pt
Migration to RIF	0.5 pt
Nausea/ Vomiting	1 pt
Anorexia	1 pt
Duration of symptoms	1 pt (if < 48 hr) or 0.5 pt (if > 48 hr)
RIF tenderness	1 pt
RIF rebound tenderness	1 pt
RIF guarding	2 pt
Rovsing's sign	2 pt
Fever	1 pt
Raised WBC count	1 pt
Negative urinalysis	1 pt
Maximum score/ min score	15 pt / 2 pt

Interpretation: At suggested cut off score of 7.5, sensitivity = 88%; specificity = 67%

Intraoperative findings were documented as a normal appendix, acute appendicitis, complicated appendicitis or other pathology. Complicated appendicitis was defined as a perforated, gangrenous, abscess or lump formation. All operated specimens were subjected to histopathological examination. Biopsy reports were taken as the ultimate standard for comparison.

Data analysis

Patients were stratified into different groups on the basis of cut off values suggested for each of Modified Alvarado and modified RIPASA score. The sensitivity, specificity, positive predictive value and negative predictive value of these scores were calculated by using the cut-off scores as advised by the authors. ROC curves were also obtained for these scores and area under the curves was compared for accuracy of the scores. Data analysis was done using SPSS version 16.0. A p-value of < .05 was taken as significant; a confidence interval of 95 % was accepted. An unpaired t-test was used to test the significance of the distribution of scores among different groups (uncomplicated appendicitis, complicated appendicitis, and not appendicitis groups). Pearsons test was used to compare the performance of two different scoring systems.

RESULTS

A total of 142 patients were eligible; 22 were excluded because of incomplete data. So the final sample size (n) was 120. Of these, 106 (88.33%) patients had histopathologically proven acute appendicitis (Table 3). Hence, the accuracy of the clinical decision was 88.33%. Overall negative appendicectomy rate was 11.67% (14/120) which was higher (16.22 %, 6 out of 37) for females. The male to female ratio was 2.42 and the mean age was 27.08 years with the most common age group being 21-30 years (32.1%; 34/106).

Table 3: Histopathological diagnosis among study population (n=120)

Histopathological diagnosis	Number (%)
Appendicitis	106 (88.33%)
Normal appendix, no other pathology found	7 (5.83%)
Mesenteric lymphadenitis	1 (0.83%)
Caecal carcinoma	1 (0.83%)
Caecal inflammatory mass	1 (0.83%)
Perforated Meckel's diverticulum	1 (0.83%)
Perforated Ileal inflammatory Ulcer	1 (0.83%)
Benign ovarian cysts	2 (1.66%)
Total	120 (100%)

Among the patients who underwent appendicectomy, 72.64 % had uncomplicated acute appendicitis with the remaining 27.36 % of appendicitis cases were complicated (fig.1).

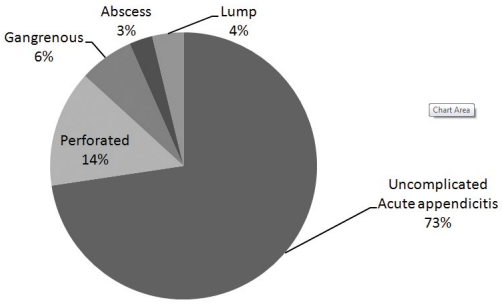

Figure 1: Frequency of type of acute appendicitis (n=106)

Among those with a MAS ≥7, 65 out of 69 (94.2%) had acute appendicitis while 66.67% (10 out of 15) with score ≤ 4 had appendicitis. At a cut off value of ≥7, MAS had a sensitivity of 61.32%, a specificity of 71.43% and an accuracy of 62.5 percent (Table 4).

Table 4: Sensitivity & specificity of Modified Alvarado score at cut off ≥ 7

MAS	AA*(n=106)	Not AA(n=14)	Total (n=120)
≥ 7.5	65	4	69
0-6	41	10	51
Total	**106**	**14**	**120**

Sensitivity= 61.32% Specificity = 71.43% Accuracy = 62.5%
Positive predictive value = 94.2%; Negative predictive value = 19.61%

AA*- Acute appendicitis

Table 5: Sensitivity & specificity of RIPASA score categories

RIPASA score	AA	Not AA	Total
≥ 7.5	103	6	109
<7.0	3	8	11
Total	**106**	**14**	**120**

Sensitivity= 97.17% Specificity = 57.14% Accuracy = 92.5%
Positive predictive value = 94.5%; Negative predictive value = 72.73%

At a cut off score of > 7.5 for acute appendicitis, the RIPASA score had a high sensitivity of 97.17% but specificity was low at only 57.14%. Among those with a score >7.5, 94.5% had appendicitis; however, only 27.3% with lower scores had appendicitis.

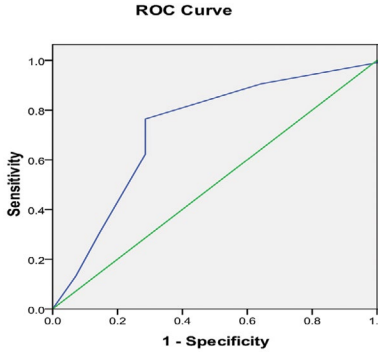

Figure 2: ROC curve for Modified Alvarado score

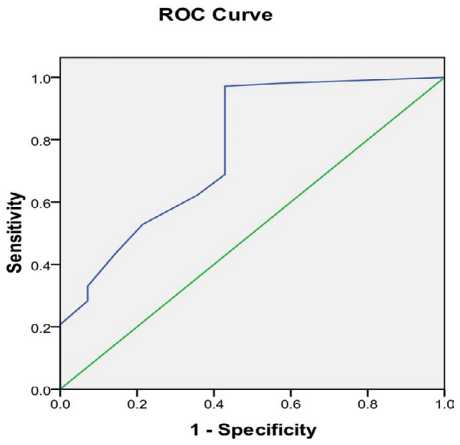

Figure 3: ROC curve for RIPASA Score

The area under the ROC curves was calculated for both MAS and RIPASA scores. The area was 0.723 for MAS (fig. 2) and 0.772 for RIPASA (fig.3) score demonstrating a higher discriminatory power for RIPASA score when compared to MAS (p-value: 0.001 vs. 0.007).

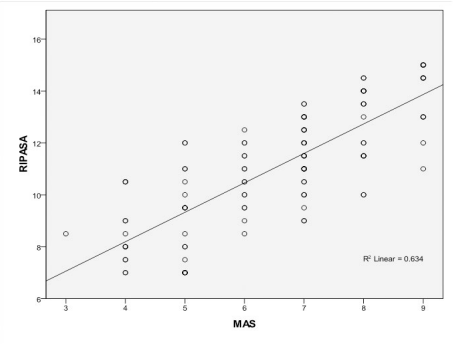

Figure 4: Correlation between Modified Alvarado score and RIPASA score

Analysis of correlation between Modified Alvarado score and RIPASA score showed a correlation between Modified Alvarado score and RIPASA score (correlation coefficient 0.790) with p-value <0.001.(fig. 4)

Table 6: Comparison between RIPASA and Modified Alvarado scores

Score system		Sensitivity (%)	Specificity (%)	PPV * (%)	NPV** (%)	Accuracy
MAS	**≥7**	61.3	71.4	94.2	19.6	62.5
RIPASA> 7.5		97.2	57.1	94.5	72.7	92.5

***PPV = Positive predictive value; **NPV= Negative predictive value**

Modified Alvarado score had a higher specificity but lower sensitivity compared to the RIPASA score at suggested cut-offs (Table 6). Both the scores had a high positive predictive value. Overall, the RIPASA score had a higher accuracy than MAS (92.5% vs 62.5%). In comparison, the clinical diagnosis had an accuracy of 88.3%. The difference in means between 'Appendicitis' and 'Not appendicitis' groups was significant for both the scores with a p-value of 0.004 for MAS and <0.001 for the RIPASA scoring system.

DISCUSSION

Acute appendicitis is a common surgical emergency; the lifetime risk of appendicitis is 8.6% for males and 6.7% for females; the lifetime risk of appendectomy is 12.0% for males and 23.1% for females.[1] Various literature quotes negative appendectomy rates between 10-30%.[3,8] A delay in performing an appendicectomy in order to improve its diagnostic accuracy increases the risk of appendicular perforation and sepsis, which in turn increases morbidity and mortality.[9]

The overall negative appendectomy rate in our series was 11.67 %. It was higher in females (16.22%) compared to males (9.64%). There are studies that report higher overall negative appendectomy rates as well as those with lower rates.[10,11] However, most literature reports higher negative rates in females.[8,10,11] In females, there are more differential diagnoses that mimic appendicitis and these may increase the diagnostic dilemma leading to a higher negative appendectomy rate.

Out of 106 cases of acute appendicitis in this study, 29 were of the complicated variety, defined here as either of perforation, gangrene, abscess or lump formation. This gives a complicated appendicitis rate of 27.36%. This is slightly higher than reported in most literature. A study by Flum et al[12] has reported a perforation rate of 25.8 %. Korner[13] et al reported a perforation rate of 19%. Higher rates in our study could be the result of late presentation; the meantime from the onset of symptoms to the presentation at the hospital was 41.2 hours in our patients.

Table 7: Comparison of accuracy of different scores by various authors

Author/Study	Scoring system	Sensitivity	Specificity	Other data	Conclusion/recommendation
Lone et al[11]	MAS	Total =88% Male= 94% female =81 %			Clinical diagnosis better
Gwynn et al[14]	MAS	91.6%	84.7%		
Sooriakumaran et al [15]	MAS	50%	96%	PPV=85.7% NPV= 8.6%	Clinical diagnosis better
	Clinical diagnosis	100 %	87 %	PPV= 80% NPV=100 %	
Chong et al[7]	RIPASA	88 %	67 %	PPV = 93 % NPV = 53%	
Klabtawee et al[16]	RIPASA	41.7	90.8		Alvarado better
	Alvarado	62.6 %	66.67		

This study showed that MAS had the lowest sensitivity (61.3%) while it had slightly higher specificities compared to the RIPASA score (71.4% vs. 57.1%). Both scoring systems had a high positive predictive value (94-95%). However negative predictive value for MAS was only 19.6 %. If we had used MAS with a cutoff ≥7 for appendicitis, we would have missed the diagnosis of appendicitis in 41 patients who actually had appendicitis.

Comparing this to other literature shows mixed results (Table 7). Lone et al[11] has shown higher sensitivities for MAS compared to our study while Siddique et al[10], Sooriakumaran et al[15] have obtained lesser sensitivities for this system. Siddique[10] et al and Gwynn et al[14] have higher sensitivities as well as specificities compared to us.

This study has observed the RIPASA scoring system to be more sensitive but less specific with 94.5 % of patients with score > 7.5 had appendicitis as compared to 27 % of those with score ≤ 7.5. This was in contrast with the original report by Chong et al[7] in their development study of this score. Klabtawee et al16 also have reported a very low (41.7%) sensitivity of RIPASA score and higher specificity.

In this study, MAS had an overall accuracy of 62.5 % using a cut off of ≥7; it would have increased to 84.2% if a cut off of ≥ 5 were used but this would result in a decrease in specificity from 71.4 % to 35.7%. Accuracy for the RIPASA score was 92.5 percent.

Lone et al[11] and Sooriakumaran et al[15] have also reported higher accuracy for clinical diagnosis as compared to Modified Alvarado scores. Meanwhile, Kalan et al[6], Siddique et al[10] and Malik et al[8] have found MAS acceptable for men but not women. On the other hand, Klabtawee[16] et al have found Alvarado score to be more accurate than the RIPASA score which is contrary to our results. Butt et al have reported a sensitivity of 96.7%, specificity 93.0%, diagnostic accuracy 95.1%, positive predictive value 94.8% and negative predictive value 95.54% for RIPASA score.[17]

Bhabatosh et al found a sensitivity of 98.1% in the RIPASA score and 96.2% in Alvarado score. Specificity was 98.1% and 96.2% by using the RIPASA score and Alvarado score respectively. Positive predictive value, negative predictive and accuracy for RIPASA score and Alvarado score were 98.1%, 87.5% and 96.6% and 94%, 71.4% and 91.6% respectively. In their study, RIPASA was better in all the parameters compared.

Receiver operating characteristic curve analysis was done for both the score systems. The area under the curve was 0.723 and 0.772 for Modified Alvarado and RIPASA scores respectively. The correlation coefficient was also calculated to compare the performance of the scores to each other. The Pearsons correlation coefficient between Modified Alvarado and RIPASA score was 0.790. The high degree of correlation between RIPASA and MAS score is to be expected as the RIPASA score includes all the parameters in the MAS score.

Thus, from our study, it may be inferred that clinical examination should still form the mainstay of decision making; scoring systems and imaging modalities may be used as an adjunct to diagnosis but cannot be a substitute for a careful history and physical examination.

There are certain limitations to our study. Firstly the sample size is not very big and we have not included the pediatric population. Secondly, we only analysed suspected acute appendicitis cases; so the power of discrimination of the scoring systems to rule out appendicitis may not have been accurately studied, giving falsely low negative predictive values. Thirdly, clinical findings vary when the same patient is examined at different points in time or by different clinicians, i.e. interobserver variation may be present. So the clinical findings, and consequently the aggregate scores based on them, could have differed had the patients been examined at different times. In other words, time from onset of disease to the presentation at the hospital is important in the evolution of signs and symptoms. In our case, patients usually presented beyond 24 hours (> 60 %), so the accuracy of clinical diagnosis may have improved.

CONCLUSIONS

RIPASA score demonstrated higher sensitivity and accuracy but lower specificity compared to the MAS in our study group. However none of the scoring systems being studied here best fulfilled all the parameters for a valid test. The clinical diagnosis of acute appendicitis was found to be more accurate than using any of these scores. A careful history and physical examination can still provide valuable information for the diagnosis of acute appendicitis.

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