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Original Research Article

A comparative study of RIPASA score and ALVARADO score in diagnosis of acute appendicitis

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ABSTRACT

Background: The RIPASA Score is a new diagnostic scoring system developed for the diagnosis of Acute Appendicitis which showed higher sensitivity, specificity and diagnostic accuracy compared to ALVARADO Score, particularly when applied to Asian population. Not many studies have been conducted to compare RIPASA and ALVARADO scoring systems. Hence, author want to compare prospectively Alvarado and RIPASA score by applying them to the patients attending the hospital with right iliac fossa pain that could probably be acute appendicitis.
Methods: A prospective analysis of 116 cases admitted with RIF pain during a 2 years period was performed. Patients between 15-60 years were scored as per Alvarado and RIPASA scoring system. Histopathological reports of the cases were collected and compared with the scores. ROC curve area analysis was performed to examine diagnostic accuracy of RIPASA and ALVARADO scores.
Results: The sensitivity of ALVARADO score is estimated to be 52.08 for a cut off of 6. The specificity is 80%, positive predictive value is 92.59, negative predictive value is 25.81. The Diagnostic accuracy of ALVARADO scoring is found to be 56.9. The sensitivity, specificity, positive predictive value and negative predictive values of RIPASA scoring system are 75%, 65%, 91.14%, 35.14%. The diagnostic accuracy of RIPASA score is 73.28.
Conclusions: The difference in the diagnostic accuracy between ALVARADO and RIPASA scoring system is significant indicating that the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis. When the ROC curve was observed the area under the curve is high for RIPASA scoring system.

Keywords: Acute appendicitis, ALVARADO score, Diagnostic accuracy, Histopathology, RIPASA score

INTRODUCTION

Acute appendicitis is the most common cause of right iliac fossa pain. Traditionally, the diagnosis of appendicitis was made solely based on clinical symptoms and signs, and later diagnosis included results of inflammatory laboratory variables. This practice in diagnostics led to a false positive diagnosis (negative appendicectomy) rates in the range of 15-30%.[1-3]

Many scoring systems for the diagnosis of acute appendicitis have been tried, but most of these are complex and not feasible in emergency setting.

The modified Alvarado scoring system MASS has been shown by recent studies to be easy, simple and cheap diagnostic tool for supporting the diagnosis of acute appendicitis especially for junior surgeons.[4-7] The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) is a

new diagnostic scoring system developed for the diagnosis of Acute Appendicitis and has been shown to have significantly higher sensitivity, specificity and diagnostic accuracy particularly when applied to Asian population.[8,9]

The RIPASA scoring system includes more parameters than Alvarado system and the latter did not contain certain parameters such as age, gender, duration of symptoms prior to presentation.[10]

These parameters are shown to affect the sensitivity and specificity of ALVARADO scoring system in the diagnosis of acute appendicitis.[7]

Table 1: RIPASA appendicitis score.

Characteristics	RIPASA score
Patients	
Female	0.5
Male	1.0
Age <39.9 years	1.0
Age >40 years	0.5
Symptoms	
Rif pain	0.5
Pain migration to RIF	0.5
Anorexia	1.0
Nausea and vomiting	1.0
Duration of symptoms <48 hrs.	1.0
Duration of symptoms >48 hrs	0.5
Signs	
Rif tenderness	1.0
Guarding	2.0
Rebound tenderness	1.0
Rovsing sign	2.0
Fever >37°C <39°C	1.0
Investigation	
Raised WBC	1.0
Negative urine analysis	1.0
Additional score	
Foreign NRIC	1.0
Total score	17.5

Table 2: RIPASA scoring system interpretation.

Total RIPASA score	Decision-making guidelines
<5.0	Probability of acute appendicitis is unlikely
5.0-7.0	Low probability of acute appendicitis
7.5-11.5	Probability of acute appendicitis is high
≥12	Definite acute appendicitis

A score of 7.5 is taken as high probability of acute appendicitis for RIPASA scoring system.

Table 3: ALVARADO appendicitis scoring system.

Symptoms	Score
Pain migration to RIF	01
Anorexia	01
Nausea -vomiting	01
Signs	
Rif tenderness	02
Rebound tenderness	01
Fever	01
Investigation	
Raised WBC	02
Shift of WBC to left	01
Total score	10

Table 4: Interpretation of ALVARADO score.

RIPASA score	Interpretation
Score <5	Not sure
Score between 5-6	Compatible
Score between 6-9	Probable
Score >9	Confirmed

A score of 7 is taken as high probability of acute appendicitis for Alvarado scoring system.

The aim of this study is to compare RIPASA SCORE and ALVARADO SCORE in the diagnosis of acute appendicitis.

METHODS

A prospective analysis of 116 cases admitted with RIF pain during a 2 years period was performed. Patients between 15-60 years were scored as per Alvarado and RIPASA scoring system. Histopathological reports of the cases were collected and compared with the scores. ROC curve area analysis was performed to examine diagnostic accuracy of RIPASA and ALVARADO scores.

Alvarado score contained 8 parameters, whereas RIPASA score contained 18 parameters. The score for the parameters ranged from 0.5 to 2 for RIPASA and 1 to 2 for Alvarado as shown above.

A score of 7 is taken as high probability of acute appendicitis for Alvarado scoring system and a score of 7.5 for RIPASA scoring system. The decision on appendicectomy was solely based on surgeon's clinical judgment after taking into consideration all the findings of clinical, laboratory and radiological investigation.

Histopathology findings of the operated case will be followed and correlated with either score. Scores will be tabulated and compared by applying Chi-square test. All the measurements are done using SPSS version 21.0 and open epi software 3.01 $P<0.05$ is considered as statistically significant.

RESULTS

The mean age among the patients is 34.4 years and the mean TLC count is 10550 cells/cumm. There is no significant difference in age among the patients with appendicitis and no appendicitis.

There is significant difference in the mean TLC count among the patients with appendicitis and no appendicitis.

Table 5: ALVARADO scoring among the cases.

ALVARADO	Count	Column N %
Not sure	32	27.6%
compatible	30	25.9%
Probable	47	40.5%
Confirmed	7	6.0%

Table 6: ALVARADO scoring groups among the patients.

ALVARADO	Count	Column N %
No appendicitis	62	53.4%
Appendicitis	54	46.6%

Table 7: RIPASA scoring among the patients.

RIPASA	Count	Column N %
Appendicitis unlikely	4	3.4%
Low probability appendicitis	33	28.4%
High probability appendicitis	59	50.9%
Confirmed appendicitis	20	17.2%

Table 8: RIPASA score groups among the patients.

RIPASA	Count	Column N %
No appendicitis	37	31.9%
Appendicitis	79	68.1%

Table 9: Mean ALVARADO and RIPASA score difference between histopathology groups.

	Histopathology			
	No appendicitis		Appendicitis	
	Mean	SD	Mean	SD
ALVARADO	4.75	1.25	6.54	1.95
RIPASA	6.65	2.06	9.55	2.60

P<0.0001

Table 10: Comparison between ALVARDO scoring and histopathological reports among the patients.

ALVARDO	Histopathology			
	Appendicitis		No appendicitis	
	Count	Table N %	Count	Table N %
Appendicitis	50	43.1%	4	3.4%
No appendiciti	46	39.7%	16	13.8%

There is significant difference between the mean score in ALVARADO and RIPASA in patients with scores suggestive of appendicitis and no appendicitis (Table 9).

Table 11: Sensitivity, specificity, PPV, NPV, diagnostic accuracy of ALVARADO score.

Parameter	Estimate	Lower-upper 95% CIs
Sensitivity	52.08	(42.2, 61.8)
Specificity	80	(58.4, 91.93)
Positive predictive value	92.59	(82.45, 97.08)
Negative predictive value	25.81	(16.55, 37.88)
Diagnostic accuracy	56.9	(47.81, 65.54)

Table 12: Comparison between RIPASA score and histopathological reports among patients.

RIPASA	Histopathology			
	Appendicitis		No appendicitis	
	Count	Table N %	Count	Table N %
Appendicitis	72	62.1%	7	6.0%
No appendicitis	24	20.7%	13	11.2%

Table 13: Sensitivity, specificity, PPV, NPV, diagnostic accuracy of RIPASA score.

Parameter	Estimate	Lower-upper 95% CIs
Sensitivity	75	(65.49, 82.59)
Specificity	65	(43.29, 81.88)
Positive predictive value	91.14	(82.82, 95.64)
Negative predictive value	35.14	(21.83, 51.24)
Diagnostic accuracy	73.28	(64.57, 80.49)

Table 14: Comparison between ALVARADO and RIPASA scoring system among two groups.

RIPASA	ALVARADO			
	Appendicitis		No appendicitis	
	Count	Table N %	Count	Table N %
Appendicitis	49	42.2	30	25.9
No appendicitis	5	4.3	32	27.6

Kappa=0.411, p<0.0001

There is a significant statistical difference between ALVARDO and RIPASA scoring system with a p value of <0.0001 and Kappa value of 0.411.

Out of 116 subjects who were diagnosed as appendicitis under ALVARDO scoring system 42.2% where shown positive for appendicitis with RIPASA scoring system whereas 4.3% where negative for appendicitis under RIPASA scoring system.

When patients showing no appendicitis under ALVARADO scoring where analyzed about 25.9% showed appendicitis on RIPASA scoring system which is nearly 1/4th of the total expected positive on

ALVARADO. Equally 27.6% of them showed no appendicitis on RIPASA scoring also.

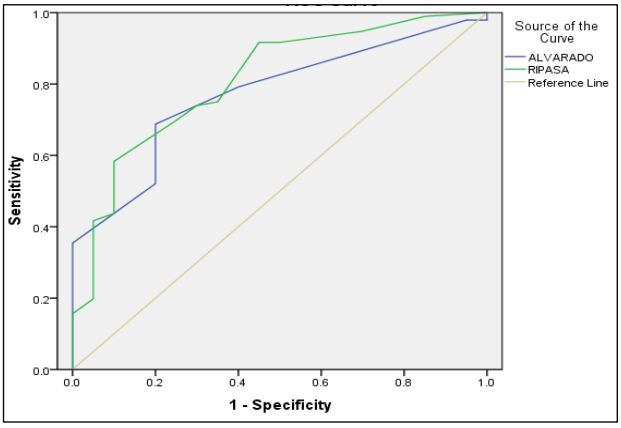

Figure 1: ROC curve receiver operating characteristic curves with corresponding AUC for ALVARADO and RIPASA scoring system in predicting acute appendicitis.

Table 15: AUC for ALVARADO and RIPASA scoring system in predicting acute appendicitis.

Test result variable(s)	Area	P	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
ALVARADO	0.771	0.00	0.673	0.870
RIPASA	0.810	0.00	0.706	0.913

When the ROC curve was observed the area under the curve is high for both RIPASA and ALVARADO scoring but it is higher for RIPASA scoring system.

The AUC is significant for both ALVARADO and RIPASA scoring system.

DISCUSSION

In the present study out of 116 patients the predominant age group among the patients is 21-30 years.

Table 16: Age group distribution among the patients in Zulfiqur study.[9]

Age distribution (years)	N	%
<20	29	12.0
21-40	139	55.0
41-60	77	31.0
>60	5	2.0
Mean±SD		35.27±12.57

In a prospective study done by Nunjhandaiah et al, in patients admitted with right iliac fossa pain among 206 patients the mean age in their study group that consisted of 61.6% male patients and 38.4% female patients were 27.82±9.262 years.[11] In a cross-sectional study done on 250 patients who were having acute appendicitis by Zulfiquar et al the mean age was 35.17±9.13 and 184 (74%) were males and 66 (26%) were females with a male to female ratio 1.92:1.[9]

The mean age when compared between patients with appendicitis and with no appendicitis did not show any significant difference (p=0.3). The proportion of females and males in present study is 51.7% and 48.3% respectively. Though females are the majority numerically it is not significantly high.

In study done by Nunjhandaih et al males were majority constituting 61.6% of the total subjects which is higher than present study population males.[11] Even in the study done by Zulfiqur et al males were majority about 74% when compared to females of 26%.[9]

In the present study on 116 subjects of suspected acute appendicitis, histopathological reports showed several features of acute appendicitis. About 82.8% had report positive for acute appendicitis where as 17.2% were given No appendicitis.

A difference of 7% was observed between ultrasonography and histopathology in diagnosing acute appendicitis which is not significant in present study. When the total leucocyte count (TLC) was compared between the patients with appendicitis and no appendicitis there is a significant difference with a p value of 0.03. When patients were scored for ALVARADO in present study a score of 6 is taken as cut off for high probability of acute appendicitis. In their study out of 236 patients 92% showed score above 6 showing high probability of appendicitis where as 8% showed lower probability. The mean score was 8.18.[10] These results are far above the scores. They are not comparable to present study.

In present study when RIPASA score was applied about 50.9% showed high probability and 17.2% had a score of confirmed appendicitis. 31.9% had a score of low probability and appendicitis unlikely. When the present study was compared with study done by Nanjundaiah et al, their study showed, and the result were different from present study.

Table 17: RIPASA score among cases in Nunjundaiah study.[11]

RIPASA Score	No. of cases	Percentage
<5	0	0
5-7	26	12.6%
>7	180	11.1%
Total	206	100.00

There is significant difference between mean ALVARDO and RIPASA score between two histopathological groups

as seen in Table-12 with a p value of <0.0001. When the ALVARDO score was compared with the histopathological findings, the results are as seen (Table 10).

Table 18: Comparison between ALVARDO scoring and histopathological reports among the patients in Kothari D study.[12]

ALVARADO	Histopathology			
	Appendicitis		No appendicitis	
	Count	Table N %	Count	Table N %
Appendicitis >7	52	65%	4	5%
No appendicitis <7	17	21.2%	7	8%

About 43.1% of the cases where diagnosed through ALVARADO score in present study which is low when compared to study done by Kothari D et al as 65% of cases where diagnosed through ALVARADO scoring.[12]

However about 13.8% of cases where ruled out through ALVARADO scoring in present study which is slightly higher compared to study done by Kothari D et al.[12]

The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of ALVARADO scoring is as seen (Table 11). In a study done by Nanjundaiah et al, at optimal cutoff threshold of >7 the sensitivity and specificity of the Alvarado scoring system were 58.9% and 85.7% respectively which is very much comparable with present study.[11] The positive predictive value and negative predictive value of Alvarado score is 97.3% and 19.1% respectively which are similar to present study.

In a study done by Chong CF et al, the cut-off threshold score of 7.0 for the Alvarado score, the sensitivity, specificity, PPV, NPV and diagnostic accuracy were 68.3 percent, 87.9 percent, 86.3 percent, 71.4 percent and 86.5 percent, respectively.[13]

When RIPASA score and histopathological reports were compared the results are as seen (Table 12).

In a study done by Nanjundaiah et al using the RIPASA score, 96.2% of patients who actually had acute appendicitis were correctly diagnosed and placed in the high probability group (RIPASA score >7.5), compared to only 58.9% when using the ALVARADO score on the same population sample.[11]

In a study done by Chong CF et al the RIPASA score correctly classified 98 percent of all patients confirmed with histological acute appendicitis to the high-probability group (RIPASA score greater than 7.5) compared with 68.3 percent with the Alvarado score (Alvarado score greater than 7.0; p-value less than 0.0001).[13]

The sensitivity, specificity, PPV NPV, Diagnostic accuracy of RIPASA score are as seen (Table 13).

In a similar study done by Nanjundaiah et al, at optimal cutoff threshold of >7.5, the sensitivity and specificity of the RIPASA scoring system were 96.2% and 90.5% respectively.[11] The positive predictive value and negative predictive value of RIPASA score is 98.9% and 73.1% respectively.

In a study done by Chong CF et al, at the optimal cut-off threshold score of 7.5 derived from the ROC, the sensitivity, specificity, PPV, NPV and diagnostic accuracy of the RIPASA score were 98.0 percent, 81.3 percent, 85.3 percent, 97.4 percent and 91.8 percent, respectively.[13]

The difference in the diagnostic accuracy between ALVARADO and RIPASA scoring system is 16.38% in present study which is different to study done by Nanjundaiah et al which showed a difference of 33.93%.[11]

However, p value is significant <0.0001 in both studies indicating the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis.

Present study is comparable with the study done by Chong CF et al also.[13]

In present study when ROC is plotted the following curves are as seen (Figure 1). When the ROC curve was observed the area under the curve is high for both RIPASA and ALVARADO scoring but it is higher for RIPASA scoring system. The AUC area under the curve is significant for both ALVARADO and RIPASA scoring system. In a study done by Nanjundaiah et al the difference in the area under the curves of 13.4% is significant between two scoring systems (p<0.0001), which equates to 30 (13.4 %) patients with acute appendicitis who were misdiagnosed using the Alvarado score compared to the RIPASA score.[11]

In a study done by Chong CF et al, area under curve (diagnostic accuracy) for the RIPASA score is 0.9183 (91.83%), which is greater than that for the Alvarado score, which is 0.8651 (86.51%).[13] The difference in the area (shaded) under the curve of 0.0532 (5.32%) is significant between the two scoring systems (p <0.0001), which equates to 30 (15.6%) patients with acute appendicitis who were misdiagnosed using the Alvarado score compared to the RIPASA score. The results are very close to this study.

CONCLUSION

There is significant difference between the mean score in ALVARADO and RIPASA in patients with scores suggestive of appendicitis and no appendicitis. The sensitivity of ALVARDO score is estimated to be 52.08

with 95% Confidence interval being 42.2 to 61.8 for a cut off of 6. The specificity is 80% with a 95% CI 58.4 to 91.93, positive predictive value is 92.59 with 95%CI 82.45 to 97.08, negative predictive value is 25.81 with 95%CI 16.55 to 37.88. The Diagnostic accuracy of ALVARADO scoring is found to be 56.9 with 95% confidence interval being 47.8-65.54.

The sensitivity, specificity, positive predictive value and negative predictive values of RIPASA scoring system are 75%(95% CI 65.49-82.59), 65%(95% CI 43.29-81.88), 91.14% (95%CI 82.82-95.64), 35.14% (95%CI 21.83-51.24). The diagnostic accuracy of RIPASA score is 73.28 with 95% confidence interval 64.57 to 80.49. The difference in the diagnostic accuracy between ALVARADO and RIPASA scoring system is 16.38% in present study. However, p value is significant <0.0001 in both studies indicating the RIPASA score is a much better diagnostic tool for the diagnosis of acute appendicitis. When the ROC curve was observed the area under the curve is high for both RIPASA and ALVARADO scoring but it is higher for RIPASA scoring system. The AUC is significant for both ALVARADO and RIPASA scoring system.

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