A Comparative Analysis Between RIPASA and Alvarado Scoring Systems for the Diagnosis of Acute Appendicitis- A Nepalese Perspective

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ABSTRACT:

Introduction: Various diagnostic criteria have been described for acute appendicitis. For decades the most commonly used one has been Alvarado score. RIPASA scoring system has also been developed for Asian population which has shown highest sensitivity and diagnostic accuracy. This study aimed to compare these two diagnostic criteria in Nepalese population attending a tertiary center. **Methods:** Patients with clinically suspected acute appendicitis were classified according to both Alvarado and RIPASA scoring systems before undergoing surgery. Histopathological examination was taken as the gold standard for diagnosis. Statistical analysis was done using McNemar's test as applicable. **Results:** Ninety nine (90 %) patients had histologically confirmed appendicitis. With the cut-off value greater than 7.5 for RIPASA score; sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy and negative appendectomy rates were 94.5%, 27.27 %, 92.16 %, 37.5 %, 88.18% and 7.84% respectively. With the cut-off value greater than 7 for Alvarado score, sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy and negative appendectomy rates were 71.72%, 72.73 %, 95.95 %, 22.22%, 71.82 %, and 4.05 % respectively. 94.5% of patients were correctly stratified by RIPASA under higher probability group while only 71.8 % were classified by Alvarado (p value= 0.0001). **Conclusion:** RIPASA scoring system showed high sensitivity and diagnostic accuracy in comparison to Alvarado scoring system. So, this method can be applied in Nepalese setting for the diagnosis of acute appendicitis.

Keywords: Acute Appendicitis, Alvarado Score, RIPASA

INTRODUCTION:

With lifetime prevalence of one in seven, acute appendicitis has been one of the most common surgical emergencies worldwide.[1] It is a clinical diagnosis involving clinical history, examination and some laboratory parameters along with radiological examinations whenever required. Of various scoring systems, the most commonly used one for the diagnosis has been Alvarado score for the last two decades. Recently RIPASA (Raja IsteriPengiranAnakSaleha Appendicitis) scoring system has also been employed for Asian population and this has shown the highest sensitivity and diagnostic accuracy in comparison to Alvarado score.[2] Age of the patient, gender and duration of symptoms have not been attributed by Alvarado system which definitely confound the diagnosis of acute appendicitis. RIPASA scoring system, however, incorporates these parameters in the clinical criteria as well. We prospectively compared these two diagnostic criteria in 110 patients with right iliac fossa (RIF) pain and clinically suspected appendicitis.

METHODS:

This was a prospective analytical study conducted at Department of Surgery, Lumbini

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Medical College and Teaching Hospital, Tansen, Nepal from June 2017 to May 2018. Ethical approval was taken from Institutional Review Committee (IRC-LMC 05-E/018). A total of 110 patients presenting with RIF pain and clinically suspected appendicitis were classified according to Alvarado and RIPASA scoring systems. The required laboratory investigations like Complete Blood Count (CBC), Renal Function Test (RFT), routine urine examinations were sent and reports retrieved as mentioned in table 1. Ultrasound (USG) examination was done in every patient by a radiologist and Contrast Enhanced Computed Tomography (CECT) abdomen whenever deemed necessary. The patients were then taken to operation theatre. A proforma was designed and filled up by the surgical residents which included all the variables required.

The gold standard for the diagnosis was positive histopathology findings. Statistical Package for Social Sciences (SPSS™) software version 16 was used for statistical analysis. McNemar's test was applied wherever feasible. Cut-off values for the analysis were 7.5 and 7 for RIPASA and Alvarado scoring systems respectively. RIPASA Scoring system comprises 18 variables and all total score of 17.5. A cut-off value of 7.5 was used which demonstrates the high probability of acute appendicitis. Alvarado scoring system contains eight variables and a score of more than seven demonstrates high probability of acute appendicitis. [3, 4]

The descriptive data were presented as mean ±SD and p value less than 0.05 was considered significant. Receiver operating curve (ROC) was formulated and area under the curve (AUC) was calculated.

RESULT:

A total of 110 patients who underwent surgery were included in the study. The demographics and clinical characteristics of the study population is shown in table 2. The mean age±SD of the patients was 26.84 ± 15.14 years. Ninety percent of the specimens turned out to be appendicitis. Twenty six patients had perforated appendicitis. The mean post-operative hospital stay±SD was 3.97±2.06 days. Thirteen patients developed post-operative complications of which two patients underwent re-exploration for post-operative intestinal obstruction.

Table 3 presents the distribution of 110 patients in four groups according to RIPASA and Alvarado scores with optimum cut-off values of 7.5 and 7 respectively. Seventy one (71.72 %) patients were correctly placed into higher probability group according to Alvarado score however this number increased to 94 (94.95%) while applying RIPASA score for the clinical diagnosis of acute appendicitis (p=0.0001). Twenty eight patients were missed by Alvarado score and was classified into false negative

Table 1. RIPASA Scoring System

		Score	Patient score
Gender	Male	1	
	Female	0.5	
Age	<40 years	1	
	>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 hours	1.0	
	>48 hours	0.5	
Signs	RIF Tenderness	1.0	
	Guarding	2.0	
	Rebound Tenderness	1.0	
	Rovsing's Sign	2.0	
	Fever >37 <39 ˚C	1.0	
Investigations	Raised WBC	1.0	
	Negative Urinalysis	1.0	
Foreign nationality		1.0	
Total		17.5	

RIF: Right Iliac Fossa, WBC: White Blood Cell

Table 2. Demographic and clinical characteristics of the patients (n = 110)

Variables		Frequency (%)
Gender	Male	59 (53.64%)
	Female	51 (46.36%)
Age in years, mean ±SD		26.84 ± 15.14
USG findings	Positive	99 (90%)
	Negative	11 (10%)
Positive histology for appendicitis		99 (90%)
Negative histology for appendicitis		11 (10%)
Post-operative hospital stay (days), mean ±SD		3.97 ± 2.06
Mean Total hospital stay (days), mean ±SD		4.62± 2.05
Perforated appendicitis		26 (23.63 %)

group while RIPASA classified only five patients in this group. Mean RIPASA score for true positive cases was 10.17±1.5 while true negative cases was 3 ±0.0. Mean RIPASA score for perforated appendicitis was 10.26±1.15. Mean total hospital stay (days) was higher in true positive cases in comparison to true negatives (4.11±2.12 vs 3±0.001).

Table 4 summarizes different variables at optimal cut-off level of >7.5 for RIPASA score and >7 for Alvarado score. The sensitivity for RIPASA was 94.5 % (95 % CI: 88.61%-98.34%) while it was

% (95% CI: 39.03% - 93.98%) respectively (Mc Nemarχ2=39.32, df=1, p value 0.062). Diagnostic accuracies were 88.18% (95% CI: 80.64% - 93.55%) and 71.82% (95% CI:62.4% - 79.98 %) respectively. However, negative appendectomy rate was higher in case of RIPASA scoring system.

ROC Analysis and Optimum Cut-off value

The ROC curves for RIPASA and Alvarado score have been shown in figure 1. This demonstrates the plot of sensitivity versus specificity for these two

Table 3. Patient distribution according to RIPASA and Alvarado scores

Parameters	True Positive		False Positive		True Negative		False Negative	
	Ripasa>7.5	Alvarado>7	Ripasa>7.5	Alvarado>7	Ripasa<7.5	Alvarado<7	Ripasa<7.5	Alvarado<7
Sample Size	94	71	8	3	3	8	5	28
M:F	54:40	40:31	0:8	0:3	0:3	0:8	5:0	19:9
Mean Age± SD (years)	26.8±15.4	28.06±16.4	28.88±18.6	44±1.73	18.67±0.57	19.38±1.68	29.2±19.3	24.04±12.8
Total Score± SD	10.17±1.5	8.31±1.05	10.62±1.4	8±0.001	5±0.001	5±0.926	4.5±1.36	4.83±1.4
Mean Hospital Stay± SD (days)	4.11±2.12	4.1±2.3	3.75±1.90	6.0±0.001	3 ±0.001	2.62±0.51	2.4±0.54	3.8±1.3

71.72 % (95% CI:61.78% - 80.31%) for Alvarado score which was statistically significant (Mc Nemarχ2= 34.08, df= 1, p value 0.0001). Similarly, the specificity for RIPASA and Alvarado scores were 27.27 % (95% CI: 6.07% - 60.97%) and 72.73

diagnostic scoring systems. As evident by the figure, AUC for RIPASA score is 0.93 (p value= 0.0001) which is higher than that of Alvarado scoring system which is 0.74 (p value= 0.011). Coordinates of the curve demonstrate the cut off value of 7.75

Table 4. Comparison between RIPASA and Alvarado scoring systems.

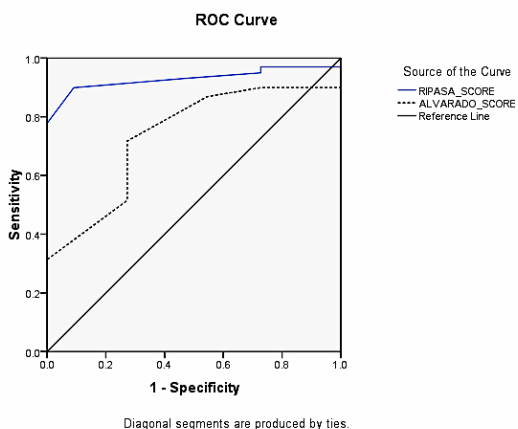| Variable	RIPASA>7.5 (95% CI)	Alvarado >7 (95 % CI)	p value
Sensitivity	94.5 % (88.61-98.34)	71.72% (61.78-80.31)	0.0001 *
Specificity	27.27 % (6.07- 60.97)	72.73% (39.03-93.98)	0.062 *
Positive Predictive Value	92.16% (89.08- 94.42)	95.95% (89.95-98.43)	
Negative Predictive Value	37.5% (14.19-68.52)	22.22% (15.04-31.56)	
Diagnostic Accuracy	88.18% (80.64-93.55)	71.82% (62.4- 79.98)	
Negative Appendectomy Rate	7.84%	4.05 %	

*Mc Nemar's Test

Figure 1. ROC plots for RIPASA and Alvarado scoring systems.

for RIPASA score which nearly corresponds to 7.5 which is the standard cut off value as given for the Asian population.

DISCUSSION:

Acute appendicitis is one of the most common surgical emergencies for all age groups with a life time prevalence of 7-8 %.[1, 5] The diagnosis of acute appendicitis is primarily based on clinical findings and laboratory examinations. Radiological examinations like USG and CECT have been used as adjuncts for the diagnosis and to look for the differentials. However use of these modalities have cost implications and requirement of experts for prompt diagnosis.[6]

Various scoring systems have been proposed for early diagnosis of acute appendicitis and Alvarado scoring system is the widely used.[7] However, owing to lack of high sensitivity and specificity which is as low as 59% and 23% respectively in Asian population, RIPASA scoring system has been developed which has been shown to achieve better sensitivity (88%) and specificity(67%).[3]

So, we intended to apply RIPASA scoring system in the diagnosis of acute appendicitis at one of the tertiary centres in western Nepal and look for the sensitivity, specificity and diagnostic accuracy comparing with Alvarado scoring system.

A study by Singh A et al.[8] conducted on Indian population showed sensitivity of 95.89% and diagnostic accuracy of 90.5% for RIPASA which is comparable to our study (sensitivity 94.5% and diagnostic accuracy 88.18%). This could be due to similar geography, shared lifestyles and exposure to similar risk factors for developing acute appendicitis. Another study by Singla A et

al.[9] showed sensitivity of 95.6% and diagnostic accuracy of 81%. Diagnostic accuracy for RIPASA was 80.50 % in a study by Chong CF et al.[3] but study by Klabtawee W et al.[10] showed low accuracy of RIPASA in comparison to Alvarado.

However, specificity or true negative rate for RIPASA was quite low in our context (27.27 %) which did not corroborate to any other findings or studies. A study by Arroyo-Rangel C et al.[11]on Mexican population showed specificity as low as 71.4 % while Karami MY et al.[12] showed as high as 91.67 % in Iranian population. In Indian population, specificity for RIPASA was 80%.[9]The reason behind low specificity in our study could be due to less number of cohorts who fall under this category.

Alvarado score showed sensitivity of 71.72 % which is comparable to a study by Jalil A et al.[4] which showed it to be 66%. Similarly, true positive rate was 92.7% in a study by Xingye W et al.[13]in China.

Eleven patients who fell under true negative groups were operated either owing to USG / CECT findings despite clinical suspicion while some of these group of population underwent diagnostic laparoscopy and appendix was removed as benefit of doubt in absence of other findings.

There are some limitations in our study. The sample size might be small for validation of the scoring system. It definitely requires a larger cohort to carry out the comparative analysis of two scoring systems. A single institution based study might not include the aspects of the whole population of the country.

CONCLUSION:

RIPASA scoring system at a cut-off value of 7.5 is a better diagnostic tool for the diagnosis of acute appendicitis where other radiological diagnostic modalities are not feasible, especially in peripheral settings of the country. Higher sensitivity and diagnostic accuracy in comparison to Alvarado scoring system make RIPASA scoring system a better alternative for the diagnosis of acute appendicitis.

Conflict of interest:
The authors declare that no competing interests exist.

Source of funds:
No funds were available.

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