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Research Paper

Comparison of RIPASA and Modified Alvarado Scores in the Diagnosis of Acute Appendicitis

Medical Science

KEYWORDS :

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ABSTRACT

Introduction and method - Patients admitted with clinical suspicion of acute appendicitis and being operated with emergency appendectomy were included.150 cases were studied in a prospective comparative design. Detailed history, examination and relevant investigation results were recorded in predesigned case-record forms. The decision for emergency appendectomy or conservative treatment was made on clinical judgment. Operative notes and histopathology reports were reviewed and correlated with the RIPASA and modified Alvarado scores.Parameters of the two scoring systems were compared using ROC curves.Result and Discussion -Data analysis of the 150 patients included with ROC curves and AUC showed statistically significant difference between RIPASA and Alvarado scorings, RIPASA having a better sensitivity and specificity. Difference in the AUC of ROC curves was 13%, representing 19 patients who would have been missed by Alvarado score but were correctly diagnosed by RIPASA. But there was no significant difference in diagnosing correctly the cases of non-appendicitis. Also, had the scores been used to influence the decision for surgery, the negative appendectomy rates would have reduced significantly. Conclusion- Scoring system acts as useful adjunct to clinical diagnosis. The RIPASA, although more extensive, can be preferred over the Alvarado because of its higher accuracy.

INTRODUCTION

Acute appendicitis is one of the most common emergencies in clinical practice [1] and presents with protean manifestations which many busy doctors may miss. The diagnosis of acute appendicitis is mainly a clinical one and no single symptom, sign, diagnostic test or scoring system accurately confirms the diagnosis in all cases. It remains a difficult diagnosis to establish particularly among the very young, the elderly and females of reproductive age in who a host of other conditions present with similar signs and symptoms [2].

Imaging modalities have emerged long since in the form of ultrasound, since the 1980s and CT scan since the mid-1990s. Ultrasound is inexpensive, rapid, non-invasive, has no radiation exposure, has a high sensitivity and specificity (>90%) [3] but the accuracy is limited by various factors as operator variables, patient obesity, appendicitis complicated by abscess/ perforation [4]. Also, CT scan proved to be an extremely accurate diagnostic tool that was less influenced by operator experience or by patient factors. However concerns have been raised about the safety of ionizing radiation, cost and availability of CT facility.

This search for diagnostic modalities has led to renewed interest in clinical scoring systems, which have been shown to increase the diagnostic accuracy in a time- and cost-efficient a manner. Several scoring systems have been developed to aid in the diagnosis of acute appendicitis – The Alvarado score, the Modified Alvarado score, the Samuel score, Kharbanda's low risk score, the Lindberg score, the Ohmann score and the RIPASA score.

The Alvarado and modified Alvarado (which excludes the 'shift to left' criterion of the original score and hence is scored out of 9 instead of 10) were developed in western countries and several studies have reported very low sensitivity and specificity when applied to a population with a completely different ethnic origin and diet [5, 6]. The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score, the newest member, named after its hospital of origin in Brunei [7], is simple, easy to use and was specifically developed for the Asian region. The RIPASA score is more extensive and has more parameters (age, gender, symptom duration) than the Alvarado score, which have been shown to affect the latter's sensitivity and specificity [8]. The RIPASA score has been shown to have significantly higher diagnostic accuracy than the Alvarado score particularly for Asian/ oriental population[9, 10].

This study was undertaken since we deemed that a reliable validated diagnostic score more suited to the local population would help the doctors of government hospitals such as ours to diagnose acute appendicitis in much more accurate and time- and cost- effective manner. We have hereby compared the modified Alvarado and the RIPASA scores, and also analysed the parameters & application of both scores.

MATERIALS AND METHODS

In this prospective study conducted between May 2012 and April 2014, 150 patients of all age groups with right iliac fossa pain suspected to have acute appendicitis and operated with appendectomy were included.

Upon admission, detailed and relevant history and detailed clinical examination findings were noted on predesigned case records. Total leucocyte count and USG of abdomen and pelvis were done on all patients, with other relevant investigation as necessary in every case.

The RIPASA and the modified Alvarado scores were calculated for each case – the scores being as in the tables 1a and 1b:

The decision for emergency appendectomy was made on clinical judgment in each case. The appendix removed in operated cases was analyzed histopathologically at our pathology department and findings were recorded for presence or absence of acute appendicitis.

STATISTICAL ANALYSIS

The data was analysed using the SPSS 21.0 and Medcalc for Windows. The results for all of the items were expressed as the mean +/_ SD, assessed within a 95% confidence interval and at a significance level of $P<0.05$. Sensitivity, Specificity, PPV, NPV and negative appendectomy rate of both the scoring systems were calculated using cross tabulations and receiver operating characteristic (ROC) curves. Mean, SD and other statistics were used to describe various parameters. Chi square test was used to compare categorical data while independent sample T-test was used to compare means. ROC curves were plotted for both scores and the Area Under Curves (AUC) for the two scores were compared. Parameters of the two scoring systems were also compared using ROC Curves.

RESULTS

Of the 150 patients included, 111 (82%) were histopathologically

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diagnosed with acute appendicitis, 39 (18%) patients did not have appendicitis.

The results of RIPASA and Alvarado scores calculated for the 150 patients are as follows:

A RIPASA score of 7.5 or above was classified as high-risk and those below 7.5 as low-risk. For Alvarado score, similar cut-off taken was 7.

The RIPASA score classified 110 patients as high-risk of which 100 were true positives. Among the 40 patients classified as low-risk, 29 were true negatives.

The patients who had acute appendicitis had a mean RIPASA score of 9.9 (SD = 2.10), those with perforated appendix 11.64 (SD = 1.95) while those without had a mean score of 6.3 (SD = 1.25). This difference was statistically significant. (Tables 2, 3. Fig 1)

Table -1 – Area Under the ROC curve (AUC) for the RIPASA score

Parameter	Value
AUC	0.93
Standard error	0.019
95% confidence interval	0.87 to 0.96
Z statistic	22.36
P value/ significance level (Area = 0.5)	<0.0001

Table-2 – Parameters of the RIPASA Score derived from the ROC curve

Parameter	Value	95% CI
Sensitivity	90.09 %	83.0 – 94.9
Specificity	74.36 %	57.9 – 87.0
Positive likelihood ratio	3.51	2.1 – 6.0
Negative likelihood ratio	0.13	.07 – 0.2

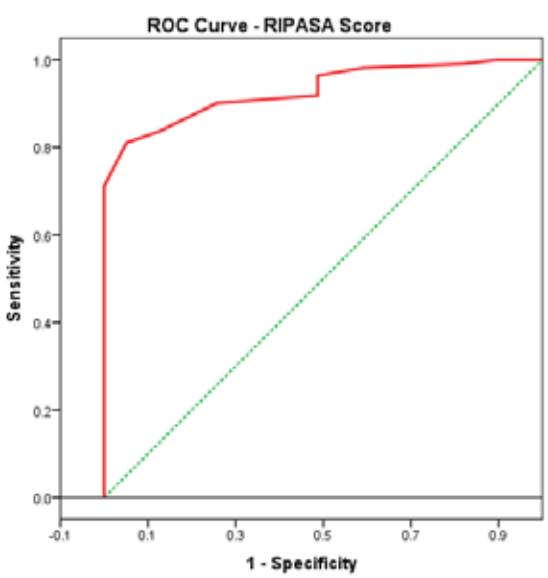

Fig. 1 ROC curve of RIPASA score

The Alvarado score classified 80 patients as high-risk of which 71 were true positives. Among the 70 patients classified as low-risk, 30 were true negatives.

The patients who had acute appendicitis had a mean Alvarado score of 6.5 (SD = 1.47), those with perforated appendix 7.58 (SD = 1.17) while those without had a mean score of 4.6 (SD = 1.58). This difference was statistically significant.

(Tables 3, 4. Fig. 2)

Table -3 – Area Under the ROC curve (AUC) for the Alvarado score

Parameter	Value
AUC	0.80
Standard error	0.039
95% confidence interval	0.72 to 0.86
Z statistic	7.69
P value/ significance level (Area = 0.5)	<0.0001

Table-4 – Parameters of the Alvarado Score derived from the ROC curve

Parameter	Value	95% CI
Sensitivity	64.86 %	55.2 – 73.7
Specificity	76.92 %	60.7 – 88.9
Positive likelihood ratio	2.81	1.6 – 5.1
Negative likelihood ratio	0.46	0.3 – 0.6

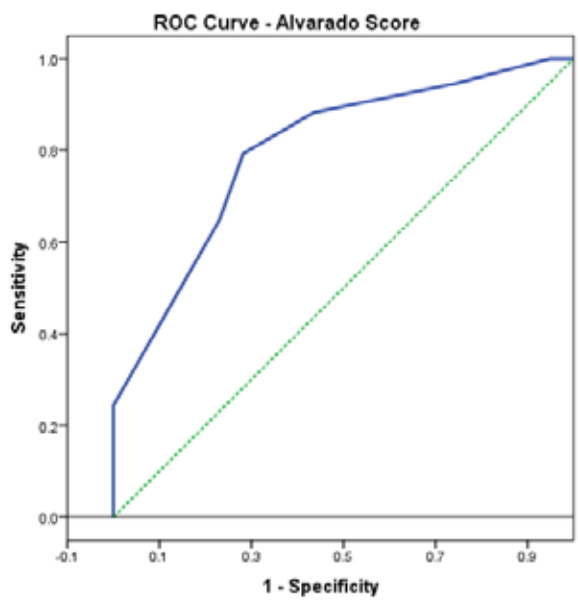

Fig 2: ROC of Alvarado score

The two scores were compared using cross-tabulation and their ROC curves (table 5). While the RIPASA score had higher sensitivity, negative predictive value and diagnostic accuracy as compared with the Alvarado score, there was no significant difference in the Specificity and positive predictive value.

Table-5 – Comparison of parameters of the RIPASA and the Alvarado scores

Parameter	RIPASA Score	Alvarado Score	Statistical Significance (P value)
Sensitivity	90.1 %	64.0 %	<0.001
Specificity	74.4 %	76.9 %	1.00
Positive predictive value	90.9 %	88.8 %	0.414

Parameter	RIPASA Score	Alvarado Score	Statistical Significance (P value)
Negative predictive value	72.5 %	42.9 %	<0.001
Positive likelihood ratio	3.51	2.77	
Negative likelihood ratio	0.13	0.46	
Diagnostic accuracy	86 %	74 %	<0.001
Negative appendectomy rate	9.1 %	11.2 %	0.414

DISCUSSION

Analysis of parameters included in both scores two demographic parameters, age and sex, were similar in both appendicitis and non-appendicitis group. The differences in signs, symptoms and lab studies except for fever

Sensitivity and specificity

The sensitivity of a test is the ability of the test to correctly classify an individual as *diseased* and specificity, to classify as *disease-free.*

The RIPASA score was derived from a retrograde study on 400 patients. It was further evaluated by the creators in a prospective study on 144 patients and was later compared to the Alvarado score by them. In all the three studies, the RIPASA score had a higher sensitivity and specificity than the Alvarado score. In studies conducted by Alnjadat et al, the RIPASA score had a higher sensitivity and similar specificity as the Alvarado score, like in the present study. Study by Erdem et al showed a higher sensitivity but lower specificity for the RIPASA score.

Predictive values

Positive predictive value (PPV) is the percentage of patients with a positive test/score who actually have the disease & negative predictive value (NPV) is the percentage of patients with negative test/ score who do not have the disease. Both together describe the performance of a diagnostic test and a high result can be interpreted as indicating the accuracy of the test.

In this study, the RIPASA score had a similar PPV as the Alvarado score but a higher NPV which means that the RIPASA score had a higher accuracy than the Alvarado score in identifying those *without acute appendicitis* and had similar accuracy in identifying those *with acute appendicitis.*

Likelihood ratios

Likelihood ratios are alternative statistics for summarizing diagnostic accuracy, which have several powerful properties that make them more useful clinically than other statistics. Each test result has its own likelihood ratio which summarizes how many times more (or less) likely patients with the disease are to have that particular result than patients without the disease. More formally, it is the ratio of the probability of the specific test result in people who do have the disease to the probability in people who do not.

A likelihood ratio greater than 1 indicates that the test result is associated with the presence of the disease whereas a likelihood ratio less than 1 indicates that the test result is associated with absence of the disease. The further the likelihood ratios are from 1 (especially if and when above 10 or below 0.1), the stronger the evidence for the presence or absence of disease. When test report results as being either positive or negative, the two likelihood ratios are called positive likelihood ratio (PLR) and negative likelihood ratio (NLR) respectively.

In studies conducted by Alnjadat et al and Reyes-Garcia et al, the RIPASA score had better PLR & NLR than the Alvarado score, as in the present study. Thus acute appendicitis is more likely to be present in a patient with positive RIPASA score than the one with positive Alvarado score. Similarly, acute appendicitis can be ruled out with more confidence in a patient with negative RIPASA score than in a patient with a negative Alvarado score.

Diagnostic accuracy

Diagnostic accuracy relates to the ability of a test to discriminate between the target condition/ disease and health.

In the present study, like most other studies except one, the RIPASA score had a higher diagnostic accuracy than the Alvarado score.

Negative appendectomy rate

Although the negative appendectomy rate reported by surgeons advocating early surgical intervention in suspected acute appendicitis cases to prevent perforation varies between 20% and 40%, the generally accepted range is 15-20 %.

In the present study, it was 17.7%. Had the scores been used, the rate would have reduced to 9.1 % with RIPASA score and 11.2% with Alvarado scoring. This difference between the negative appendectomy rates in reality and the score-determined ones (both RIPASA and Alvarado) was statistically significant. But the difference in negative appendectomy *between the two scores* was not statistically significant.

Receiver Operating Characteristic curves

The ROC curve is a plot of the true positive rate against the false positive rate for different possible cutoff-points of a diagnostic test/ score. It shows the tradeoff between sensitivity and specificity (any increase in sensitivity will be accompanied by a decrease in specificity).

AUC is a combined measure of sensitivity and specificity and is interpreted as the average value of sensitivity for all possible values of specificity. It can take on any value between 0 and 1, since both x and y axes have values ranging from 0 to 1. The closer AUC is to 1, the better the overall diagnostic performance of the test, and a test with an AUC value of 1 is one that is perfectly accurate; and the practical lower limit is 0.5. The ROC curves plotted in various studies, as in the present study, showed AUC being greater for RIPASA score than for Alvarado score. The difference in the area under the ROC curves of13% represented 19 patients who would have been missed by the Alvarado score but correctly diagnosed by the RIPASA as having acute appendicitis.

CONCLUSION

Although the RIPASA scoring is more extensive than the Alvarado score, it is simple to apply and has a few parameters like age, gender and duration of symptoms prior to presentation. The score also is able to perform better on an Asian population where it was developed and aimed for primary use. It can thus be used with ease and without any subjective values affecting the final score. In a setup like the hospital where the present study was conducted, where ultrasound is not of high quality and CT-scan facilities are scarcely available and expensive, scoring systems need to be used so as to reduce the negative appendectomy rates, and to reduce the financial burden on patients who might otherwise be undergoing expensive investigation(s).

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REFERENCE

1. Stephens PL, Mazzucco JJ, Comparison of ultrasound and the Alvarado score for the diagnosis of acute appendicitis. Conn Med. 1999 Mar; 63(3): 137-40. | 2. Gilmore OJ, Browett JP, Griffin PH, Ross IK, Brodribb AJ, Cooke TJ et al, Appendicitis and mimicking conditions - a prospective study. Lancet. 1975 Sep 6;2(7932):421-4 | 3. Lee J-H, Jeong YK, Hwang JC, Ham SY, Yang S-O. Graded compression sonography with adjuvant use of a posterior manual compression technique in the sonographic diagnosis of acute appendicitis. AJR Am J Roentgenol. 2002 Apr; 178 (4):863-8 | 4. Hormann M, Scharitzer M, Stadler A, Pokieser P, Puig S, Helbich T. Ultrasound of the appendix in children: is the child too obese? Eur Radiol. 2003 Jun;13(6)1428-31 | 5. Al-Hashemy AM, Seleem MI. Appraisal of the modified Alvarado score for acute appendicitis in adults. Saudi Med J. 2004 Sep;25(9): 1229-31 | 6. Khan I, UR Rehman A. Application of Alvarado scoring system in diagnosis of acute appendicitis. J Ayub Med Coll Abbottabad JAMC, 2005 Sep; 17(3):41-4 | 7. Chong CF, Adi MIW, Thien A, Suyoi A, Mackie AJ, Tin AS et al. Development of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. Singapore Med J. 2010 Mar; 51(3): 220-5. | 8. M Wani, M yousaf, M Khan, A Baba Abdul, M Durrani, M Shafi. Usefulness of the Alvarado scoring system with respect to age, sex and time of presentation with regression analysis of individual parameters. Internat J surg. 2006; 11(2) | 9. Ching CF, Telisinghe PU, Ang SH, Tan C, Mat Daud F, Tan LT et al. Evaluation of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. Brunei Int Med J. 2010; 6(1): 17-26 | 10. Chong CF, Thien A, Suyoi A, Mackie AJ, Tin AS et al. Development of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. Singapore Med J. 2010 Mar; 51(3): 220-5. |