Original Research Article

Comparison of RIPASA and Alvarado score in diagnosing acute appendicitis

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ABSTRACT

Background: Acute appendicitis is a common cause of abdominal pain and can be difficult to diagnose, especially during its early stages. The diagnosis of acute appendicitis is based on clinical history, examination combined with investigations. The purpose of this study is to compare between the RIPASA score and Alvarado score in the diagnosis of acute appendicitis. The aim of the present study was to compare the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of Alvarado and RIPASA score.

Methods: The cases for the study will be sourced from cases admitted in SVMCH and RC, Puducherry during the period of November 2016 to June 2018.

Results: Out of the 144 patients in our study 133 patients were diagnosed with acute appendicitis as per HPE report. As per our study, sensitivity, specificity, PPV, NPV of RIPASA and Alvarado scoring system is 96.2%, 57.1%, 97.7% and 44.4%; 81.9%,85.7%, 95.1% and 20% respectively. The diagnostic accuracy of RIPASA score is 94.3 as compared to 82.1 of Alvarado score.

Conclusions: The RIPASA scoring system is a promising and has good sensitivity, specificity and diagnostic accuracy when compared to Alvarado scoring for Asian Population.

RIPASA scoring system is an easy and reliable, cost effective diagnostic tool which reduce negative appendicectomy rates and the expensive radiological investigations for the diagnosis of acute appendicitis.

Keywords: Alvarado, Acute appendicitis, Asian population, Diagnostic accuracy, Negative appendicectomy, RIPASA score

INTRODUCTION

The vermiform appendix has been a mysterious organ in the Pandora's Box. Its importance in surgery results only from its propensity for inflammation, which results in the clinical syndrome known as 'acute appendicitis'. Appendicectomy is one of the commonest surgeries conducted in any hospital. Despite modern advances, the diagnosis of appendicitis remains essentially clinical, requiring a mixture of observation clinical acumen and surgical science and as such it remains an enigmatic challenge and a reminder of the art of surgical diagnosis. Approximately 7 percent of the population will have appendicitis in their life time.[1] The incidence is 1.5 to 1.9 per 1000 in the population, with a male preponderance of 1.4, and is one of the most common surgical emergencies and one of the most common indicators of emergency.[2]

The decision of performing an appendectomy is largely based on history, clinical examination and investigations. A delay in performing an appendicectomy runs the risk of appendicular perforation and sepsis, which in turn

increases morbidity, hospital stay and mortality. A reasonable degree of diagnostic accuracy would result in low negative exploration rates thereby reducing the financial burden and morbidity. Diagnostic accuracy can be further improved through the use of ultrasonography or computed tomography imaging. However, these modalities are costly and may not be easily available when they are required.

A number of scoring systems have been employed for aiding in diagnosis of acute appendicitis and its prompt management. These scores make use of clinical history, physical examination and laboratory findings. The Raja Isteri Pengirm Anak Saleha Appendicitis (RIPASA) score is a new diagnostic of acute appendicitis and has been shown to have significantly higher sensitivity, specificity and diagnostic accuracy compared to Alvarado scoring system, particularly when applied to the Asian population. Although, RIPASA score is more extensive than the Alvarado score, the latter did not contain certain parameters such as age, gender, duration of symptoms prior to presentation. These parameters are shown to affect sensitivity and specificity of Alvarado scoring system in the diagnosis of acute appendicitis.

The Alvarado score was assessed as to its accuracy in the preoperative diagnostic of acute appendicitis by Kalan M et al.[3] Chong CF et al, did a prospective study on patients presenting to the Emergency department or the surgical wards in RIPAS National Hospital at Brunei, with right iliac fossa pain.[4] They concluded that RIPAS score is a more suitable appendicitis scoring system developed for local settings that is in south-east Asia and has high sensitivity, specificity and diagnosis accuracy. Hence, author prospectively compared Alvarado and RIPAS score by applying them to the patients with right iliac fossa pain during the period November 2016 to June 2018.

METHODS

Author compared prospectively RIPASA and Alvarado scoring system by applying them to 144 patients who presented with right iliac fossa pain during the study period (November 2016 to June 2018). Depending on clinical judgment and other investigations appendicectomy was done. Intra-operative findings and post-operative histopathology report were correlated with the scores. A score of 7.5 is the optimal cut off threshold for RIPASA and 7 for Alvarado The percentage distribution of patients with respect to scoring system. Sensitivity, specificity, positive predictive value (PPV) and negative predictive (NPV) for RIPASA and Alvarado system were calculated and compared.

Inclusion criteria

- Both male and female patient >10 years age.
- Patients presenting with c/o pain in right iliac region.

- Patients willing to give consent for surgery and study.

Exclusion criteria

- Patient coming to hospital with pain abdomen along with distension of Abdomen
- Pregnant females
- Any mass per abdomen
- Patient with previous history of any pelvic inflammatory disease
- Patient not willing for surgery
- Patients <10 years of age

The master chart is arranged accordingly showing age in years, sex, date of admission, date of surgery, date of discharge, RIPASA score, USG, CT scan, histopathology examination report.

Statistical analysis

Following statistical methods are applied in the present study.

- Descriptive and inferencial statistical analysis
- Student 't' test (two tailed, independent)
- Levens test
- Chi square test / Fischer Exact test

Sensitivity, specificity, PPV, NPV, ACCURACY are computed to find the diagnostic properties of RIPASA Score and Alvarado score correlating to HPE reports.

Statistical software

The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

In the present study 144 patients attending the hospital were applied RIPASA and Alvarado score. The data collected have been statistically analysed and discussed. The total of 144 patients are arranged and grouped into age subgroups.

The percentage of age groups <20, 20-30, 30-40, 40-50, 50-60, 60-70, >70 years are 31.3%,3 2.6%, 20.8%, 7.6%, 4.2%, 2.1%, 1.4% respectively.

The percentage distribution of patients with respect to gender is shown in Table 2. Out of 144 patients 84 were male attributing to 58% and 60 were female attributing to 42%.

Table 1: The percentage distribution of the patients with respect of age group.

Age in years	No. of patients	Percentage
10-20	45	31.3%
21-30	47	32.6%
31-40	30	20.8%
41-50	11	7.6%
51-60	6	4.2%
61-70	3	2.1%
>70	2	1.4%
Total	144	100%

Table 2: The percentage distribution of the patients with respect to gender.

Gender	No. of patients	Percentage
Male	84	58%
Female	60	42%
Total	144	100%

The percentage distribution of patients with respect to USG Report is shown in Table 3. Out of 144 patients 15 patients did not undergo USG scanning due to non availability/affordability, 112 patients were positive for appendicitis by USG accounting for 77.8% and 17 patients were negative for appendicitis accounting for 11.8%.

Table 3: The percentage distribution of the patients with respect to USG report.

USG report	No. of patients	Percentage
Positive	112	77.8%
Negative	27	11.8%
Not done	15	10.4%
Total	144	100.00%

Table 4: The percentage distribution of the patients with respect to histopathology report.

HPE report	No. of patients	Percentage
Positive	133	95%
Negative	7	5%
Total	140*	100%

*4 patients had appendicular abscess/ appendicular mass and hence appendix was not excised.

The percentage distribution of patients with respect to histopathology report is shown in Table 4. Out of 144 patients 133 had positive Histopathology report for appendicitis that accounts to 95% and 7 patients had negative histopathology report that accounts to 5%.

Of the 140 patients who underwent appendicectomy, 134 patients showed RIPASA score >7.5 suggesting probability of acute appendicitis. 6 patients showed RIPASA score <7.5 suggesting low probability of acute

appendicitis. Hence according to the Table 7 sensitivity of RIPASA score = 96.2%, specificity = 57.1%, positive predictive value = 97.7%, negative predictive value = 44.4%.

Table 5: The RIPASA score with respect to histopathology report.

RIPASA	HPE		Total
	Negative	Positive	
<5	0 (0%)	1 (0.8%)	1 (0.7%)
5-7	3 (42.9%)	2 (1.5%)	5 (3.6%)
7.5-11.5	4 (57.1%)	90 (67.7%)	94 (67.1%)
≥12	0 (0%)	40 (30.1%)	40 (28.6%)
Total	7 (100%)	133 (100%)	140 (100%)

P<0.001**: Significant, Fisher Exact test

Table 6: The Alvarado score with respect to histopathology report.

Alvarado	HPE		Total
	Negative	Positive	
0-4	0 (0%)	1 (0.8%)	1 (0.7%)
5-6	6 (85.7%)	24 (18%)	30 (21.4%)
7-8	1 (14.3%)	70 (52.6%)	71 (50.7%)
≥9	0 (0%)	38 (28.6%)	38 (27.1%)
Total	7 (100%)	133 (100%)	140 (100%)

P=0.001**, Significant, Fisher Exact test

Table 7: Comparison between Alvarado vs RIPASA scoring with HPE reports.

	RIPASA	Alvarado
Sensitivity	96.2%	81.9%
Specificity	57.1%	85.7%
Positive predictive value	97.7%	95.1%
Negative predictive value	44.4%	20.0%

Sensitivity, specificitiy, positive predictive value, negative predictive value of RIPASA and Alvarado scoring when applied to 140 patients in our study were 96.2%, 57.1%, 97.7%, 44.4% and 81.9%, 85.7%, 97.7%, 20% respectively (Table 7).

Of all patients, 25% patients had appendicular perforation, 10% patients had gangrenous appendix and 65% had only inflamed appendix (Table 8).

Table 8: Perforated and gangrenous appendix vs inflamed appendix.

Intra-op finding	No. of patients	Percentage
Perforated appendix	36	25%
Gangrenous appendix	14	10%
Inflamed appendix	94	65%

Of total 144 patients, 42 had either perforated appendix or gangrenous appendix. Out of this 42, 22 patients had Alvarado score 9-10 and 17 patients had score of 7-8, indicating complicated appendix have relatively more score compared to only inflamed appendix (Table 9).

Table 9: Alvarado score in relation to perforated vs non-perforated inflammed appendix.

Intra-op finding	Alvarado score			Total
	<7	7-8	9-10	
Perforated or gangrenous appendix	3	17	22	42
Non-perforated appendix	30	56	16	102
Total	33	73	38	144

Of total 144, 40 patients had RIPASA score between >=12 in which 33 patients had perforated or gangrenous appendix and only 7 patients with non-perforated appendix.

This is indicating that as chances of complications increases RIPASA score is increasing because patients may have guarding which carries 2 points and elevated temperature which carries 1 point (Table 10).

Diagnostic accuracy of RIPASA and Alvarado score is 94.3 and 82.1 respectively (Table 11).

Table 10: RIPASA score in relation to perforated vs non-perforated inflammed appendix.

Intra-op finding	RIPASA score			Total
	<7.5	7.5-11.5	>=12	
Perforated appendix	1	18	33	52
Non-perforated appendix	5	80	7	92
Total	6	98	40	144

Table 11: Comparision of RIPASA score and Alvarado score.

	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
RIPASA	96.2	57.1	97.7	44.4	94.3	<0.001**
Alavarado	81.9	85.7	95.1	20	82.1	<0.001**

DISCUSSION

Acute appendicitis is one of the most common surgical emergencies, with a lifetime prevalence rate of approximately one in seven.[2] Despite being a common Problem, Acute appendicitis remains a difficult diagnosis to establish, particularly among the young, the elderly and females of reproductive age, where a host of other genitourinary and gynaecological inflammatory conditions can present with signs and symptoms that are similar to those of acute appendictis. The differential diagnosis of acute appendicitis being Crohn's disease, ulcerative colitis, renal colic, perforated peptic ulcer, pancreatitis, rectus sheath hematoma, diverticulitis, intestinal obstruction, colonic carcinoma, mesenteric ischaemia in general, Ectopic pregnancy, dysmenorrhea, pelvic inflammatory disease, endometriosis in females and testicular torsion in males.

It becomes increasingly common throughout childhood and reaches its maximum incidence between the age of 20 and 30 years.

Appendix is a worm like extension of the caecum and for this reason, has been called vermiform appendix. The appendix can vary in length, from 20ms to 10cms, averaging approximately 9cms. The disease was first coined as Appendicitis by Professor Reginald Fitz in 1886, in his historic paper entitled "Perforating inflammation of the vermiform appendix: with special reference to its early diagnosis and treatment".[5]

Mc Burney described the clinical findings of acute appendicitis prior to rupture, including the description of the point of maximum abdominal tenderness that now bears his name and the technique of appendicectomy that has become gold standard for appendicectomy throughout the 20th century.[6] Appendicitis is a condition characterized by inflammation of appendix. Mortality is high in untreated cases leading to risk of rupture leading to peritonitis and shock.

The diagnosis of acute appendicitis is based purely on clinical history and examination combined with laboratory investigations such as elevated white cell count. Despite being a common problem, acute appendicitis remains a difficult diagnosis to establish, particularly among the young, the elderly and females of reproductive age, where a host of other genitourinary and gynaecological inflammatory conditions can present with signs and symptoms that are similar to those of acute appendicitis.

The removal of a healthy appendix is associated with a greater risk of abdominal adhesions as compared to acute appendicitis.[7] The contrasts with an increasing rate of appendiceal perforations associated with delayed surgical interventions for the purpose of increasing diagnostic accuracy at the opposite end of spectrum.[2]

It should be stressed of course that the physical signs of acute appendicitis are not specific, but merely those produced by the local peritoneal irritation in the right iliac fossa (RIF), the most common cause of which is acute appendicitis. Timely intervention of acute appendicitis among the young, elderly, and females of the reproductive age group is essential to avoid complications.[4]

Diagnostic accuracy can be further improved through the use of ultrasonography or computed tomography imaging. Although ultrasonography has some limitations such as, it does not reveal any abnormalities despite the presence of appendicitis especially in early appendicitis before the appendix has become significantly distended in adults where larger amounts of fat and bowel gas make visualization of appendix actually difficult.

CT has drawbacks, especially in resource-poor settings such as ours, as far as cost and availability are concerned, and it requires 2 hours to visualize oral contrast and during this time the appendix has a high chance to perforate. However, these modalities are costly and may not be easily available when they are required.

The Alvarado score and the modified Alvarado score are the two most commonly used scoring systems. The reported sensitivity and specificity for the Alvarado and the modified Alvarado scores range from 53%-88 and 75%-80% respectively.

In 2010, a group in Raja Isteri Pengiran Anak Saleha (RIPAS) hospital, in Brunei, developed a new scoring system called RIPASA score.[4] The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) is a new scoring system, which has been developed for a better diagnosis of acute appendicitis: this score includes 14 clinical parameters, which have higher sensitivity, specificity, and diagnostic accuracy than Alvarado scoring, especially in the Asian population.[4]

The evaluation is mainly based on history and clinical findings, which is an important parameter in reaching a diagnosis of acute appendicitis. The RIPASA score is simple and easy to use as a quantitative scoring system and most of the parameters are easily obtained from a good clinical history and examination. This also includes urinalysis, which can be easily performed. Hence, a score can be obtained quickly, and a rapid diagnosis can be made without having to wait for the full investigations.[4]

Such scoring systems also provide guidelines to help junior doctors to select patients for either emergency appendicectomy or conservative management with further radiological investigations, if required.[4]

The Alvarado score has more emphasis on tenderness in RIF, which has given a higher score than that of rebound tenderness, whereas rebound tenderness is a clinical parameter, which is more important in reaching a diagnosis of acute appendicitis as RIF tenderness can be present as a different pathological condition.

The data collected include the patients demographics (age and gender), the presenting symptoms (RIF pain, the migration of pain to the RIF, nausea and vomiting, anorexia, and the duration of symptoms), clinical signs (RIF tenderness, guarding, rebound tenderness, Rovsing's sign, and fever), and laboratory investigations (elevated white cell count and negative urinalysis). The inclusion of these 14 parameters was agreed upon by a panel of general surgeons at RIPAS hospital. These 14 parameters formed the basis of the new appendicitis scoring system. The probability of each parameter was calculated and scores of 0.5, 1.0, or 2.0 points were allocated to each parameter based on its probability, with extra weightage provided to two clinical signs; guarding and Rovsing's signs.[4]

Author prospectively compared the two scoring systems for diagnosing acute appendicitis in 144 patents presenting with right iliac fossa pain. The RIPASA score correctly classified 130 patients with histologically confirmed acute appendicitis compared to 108 patients with Alvarado score with total 133 HPE positive cases(four cases in which appendix was not excised and only drain was kept) indicating the RIPASA score is more superior to Alvarado score in our clinical settings.

This prospective evaluation of RIPASA score in present study had a Positive predictive value of 97.7% (score >7.5) and a negative predictive value of 44.4% (score <7.5), prospective evaluation of Alvarado score in our study had a positive predictive value of 95.1% (score >7) and an Negative predictive value of 20% (score <7). Thus, RIPASA scores clearly outperformed the Alvarado scores.

In present study RIPASA score's sensitivity is 96.2% when cut off level is at 7.5. This finding is supported by Chong et al, where sensitivity was 97.5% when the cut off level was at 7.5.[4]

Sensitivity, specificity of present study was almost similar with results of Chong et al.[4] The sensitivity of the Alvarado score achieved when applied in an oriental population, at the suggested cut-off threshold of 7.0, was also low at 50.6%, but achieved a high specificity of 94.5%. However, this improved when the cut-off threshold was lowered to 6.0, with a sensitivity and specificity of 88.3% and 94.5%, respectively suggesting a definite ethnic difference with regard to the Alvarado score.

Iqbal J et al, evaluated the efficacy of Alvarado score in the diagnosis of acute appendicitis.[8] They found a positive predictive value of 82% and negative appendicectomy rate of 16% which is comparable with our study 95% and 20% respectively.

In a study done by Bhabatosh, D et al, a sensitivity of 98.1% in RIPASA score and 96.2% in Alvarado score and Specificity of 98.1% and 96.2% by using RIPASA score and Alvarado score respectively were seen.[9] RIPASA was better in all the parameters compared in this study. So, RIPASA is a better indicator than Alvarado score in diagnosing acute appendicitis which is similar to present study.

Chong CF et al, in 2010 did a prospective study on patients presenting to the accident and emergency department or the surgical wards with right iliac fossa pain.[4] The data showed a sensitivity of 98%, specificity at 81.3% comparable to our study 98.61% and 83.33% respectively, a diagnostic accuracy of 91.8%.

Gender wise diagnostic accuracy was significantly higher in both the gender using RIPASA score when it was compared with Alvarado score.

The RIPASA score is a useful tool for diagnosis of acute appendicitis, as it contains simple parameters that include Clinical history, examination and two simple blood investigations. Thus, the operating surgeon can make a quick decision upon seeing patients with right iliac fossa pain, by RIPASA scoring system with a score >7.5 to be operated, while patients with a RIPASA score <7.0 can either be observed in the unit's day ward or discharged with an early clinic review appointment. Unnecessary and expensive radiological investigations can be avoided by using RIPASA score and thus reducing health care expenditure.

In present study sensitivity was higher in RIPASA score (96.2%) than Alvarado score (81.9%). RIPASA score had specificity of 57.1% and Alvarado score had 85.7% specificity and negative predictive value and POSITIVE predictive value of RIPASA score are 44.4% and 97.7% respectively and negative predictive value and positive predictive value of Alvarado scores are 20% and 95.1% respectively. These parameters indicate that RIPASA score is better in clinical diagnosis of acute appendicitis than Alvarado score.

This present study suggests that RIPASA score can be considered a superior score than the commonly used Alvarado score in terms of higher sensitivity and specificity in diagnosing acute appendicitis, both the RIPASA and Alvarado scoring systems could significantly lower negative appendicectomy rate; however, RIPASA could identify a significant proportion of patients who could be otherwise missed by Alvarado score. Of all patients, 25% patients had appendicular perforation, 10% patients had gangrenous appendix and 65% had only inflamed appendix.

Appendiceal perforations and gangrenous appendix were seen in our study due to delayed presentation referral in some cases and to lesser extent due to delayed diagnosis.

Of total 144 patients 42 had either perforated appendix or gangrenous appendix. Out of this 42, 22 patients had Alvarado Score of 9.10 and 17 patients had score of 7,8 Indicating complicated appendix have relatively more score compared to only inflamed appendix.

Of all patients with complicated appendix, 40 patients had RIPASA Score between >=12 whereas only 7 patients with inflamed appendix had score between >=12. This is indicating that as chances of complications increases RIPASA score is increasing because patients may have guarding which carries 2 points and elevated temperature which carries 1 point.

When considering the approaches to appendectomy, 93 patients (64.6%) were operated by laparoscopy, 51 patients (35.4%) underwent open appendectomies. Patients treated with a laparoscopic appendectomy have significantly fewer wound infections. Less pain, and a shorter duration of hospital stay, but due to non-availability of lap in emergency most underwent open surgeries with high incidence of wound infections and increased hospital stay.

The RIPASA score was specifically developed for our Asian population, the 14 fixed clinical parameters are common to all the worldwide population and hence the RIPASA score can be applied in any country. The additional parameter of foreign NR can be included to the score in countries where there is a large foreign work-force who have to pay for any healthcare treatment.

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