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RESEARCH ARTICLE

COMPARISON BETWEEN RIPASA AND ALVARADO SCORE IN THE DIAGNOSIS OF ACUTE APPENDICITES

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ABSTRACT

Acute Appendicitis is one of the most common surgical emergencies. 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. 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. This study was conducted to compare the available scoring system like RIPASA Score's performance and Alvarado Score for the diagnosis of acute appendicitis. The study conducted was a prospective study among 60 suspected patients of appendicitis in the department of Surgery, RIMS during October 2013 to September 2015. Approval from Institutional Ethics Committee and informed consent was taken. Taken were entered in IBM SPSS version 16 and checked for correctness before analysis. Analysis was done using Chi-square test and ANOVA. On histopathological examination appendicitis was confirmed in 86.7% of cases. So this study gives a negativity rate of 13.3%. This gives a sensitivity of 98.1% in RIPASA score and 96.2% in Alvarado score. Specificity was 98.1% and 96.2% by using 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. RIPASA was better in all the parameters compared in this study. So, RIPASA is a better indicator than Alvarado score in diagnosing acute appendicitis.

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INTRODUCTION

Acute Appendicitis is one of the most common surgical emergencies. It becomes increasingly common throughout childhood and reaches its maximum incidence between the age of 10 and 30 years. Among teenagers and young adults, the male/female ratio is about 3:2. After the age of 25 years, the ratio gradually declines until the sex ratio is equal by the mid 30s. (Lews *et al*., 1975) In Western countries nearly 7% of people have appendicitis and the incidence in developing countries which in the past has been quite low has been rising in proportion to economic gain and change of lifestyle. (Doherty, 2010) Appendix is considered as vestigeal organ with no known function in human beings. (Scott, 1980) It is a worm like extension of the caecum and for this reason, has been called vermiform appendix. The appendix can vary in length, from 2cms to 10cms, averaging approximately 9cms. The Appendix develops as an ant mesenteric out pouching from the caecum and is first delineated during the fifth month of gestation. (Matthews and Hodin, 2006) 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" (Fitz, 1886). The first surgeon to correctly diagnose acute appendicitis prior to rupture, perform appendicectomy, have the patient recover and report his experience was Senn in 1889. 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. (Hung, 2002) The etiology of appendicitis remain somewhat unclear. It is a condition characterized by inflammation of appendix. Mortality is high in untreated cases

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because of the risk of rupture leading to peritonitis and shock. In most patients there is probably luminal obstruction due to lymphoid hyperplasia that leads to bacterial overgrowth and increased luminal pressure, leading to obstruction of venous outflow and then arterial inflow resulting in gangrene and eventual perforation. In addition to lymphoid hyperplasia, faecoliths can also lead to appendicitis. In 95% of patients with appendicitis anorexia is the first symptom, followed by abdominal pain which is followed, in turn by vomiting. If vomiting precedes the onset of pain, the diagnosis of appendicitis should be questioned. (Jaffy and Berger, 2010)

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. (Gilmore *et al*., 1975) 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. (Velanovich and Satava, 1992) The opposite is also true, where with reduced diagnostic accuracy, the negative or unnecessary appendicectomy rate is increased, and this is generally reported to be approximately 20%–40%. (Kalan *et al*., 1994) Diagnostic accuracy can be further improved through the use of ultrasonography or computed tomography imaging. (Baidya *et al*., 2007)

However, these modalities are costly and may not be easily available when they are required. Making arrangements for these diagnostic modalities may lead to further delay in diagnosis and surgery. Several scoring systems have been developed to aid in the diagnosis of acute appendicitis. The Alvarado score and the modified Alvarado score are the two most commonly used scoring systems. (Alvarado, 1986) The reported sensitivity and specificity for the Alvarado and the modified Alvarado scores range from 53%–88% and 75%–80%, respectively. However, these scoring systems were developed in western countries, and several studies have reported very low sensitivity and specificity when these scores are applied to a population with a completely different ethnic origin and diet. Thus, the objective of this study was to develop an appendicitis scoring system that is more applicable to the Southeast Asian region. (Al-Hashemy and Saleem, 2004)

In 2010, a group in Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital, in Brunei, developed a new scoring system called RIPASA score and claimed that it was more suitable for Asian and Middle East populations than Alvarado scoring system. The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score is a simple qualitative scoring system based on 14 fixed clinical parameters (two demographics, five clinical symptoms, five clinical signs and two clinical investigations) and one additional parameter (foreign national Identity card) which is specific to the local population where the system was developed. (Chong *et al*., 2010)

Table. A: Alvarado Score. (Chong *et al*., 2011)

Symptoms	Score
Migratory RIF pain	1
Anorexia	1
Nausea/vomiting	1
Signs	
Tenderness RIF	2
Rebound Tenderness RIF	1
Elevated Temperature	1
Laboratory	
Leucocytosis (>10000/mm3)	2
Shift to the left of neutrophils	1
Total Score	**= 10**

(A score of 7 or more is strongly predictive of acute appendicitis)

Table.B: RIPASA score parameters (Chong *et al*., 2010)

1	Male	1.0
	Female	0.5
2	Age < 39 yrs	1.0
	Age > 40 yrs	0.5
3	RIF pain	0.5
4	Migration of RLQ pain	0.5
5	Anorexia	1.0
6	Nausea and vomiting	1.0
7	Duration of symptoms < 48 hrs	1.0
	Duration of symptoms > 48 hrs	0.5
8	RIF tenderness	1.0
9	RIF guarding	2.0
10	Rebound tenderness	1.0
11	Rovsing sign	2.0
12	Fever	1.0
13	Raised WCC	1.0
14	Negative urinalysis	1.0

(The original score has additional parameter: foreign national record of identity card i.e. NRIC which is specific to the local population where the system was developed.) (Maximum score is 15. A score of 7.5 or more is predictive of acute Appendicitis) So, this study is conducted to compare RIPASA Score's performance with the Alvarado Score for the diagnosis of acute appendicitis.

MATERIALS AND METHODS

Study design

The study was a prospective study.

Study set-up

The study was conducted in the Department of Surgery, Regional Institute of Medical Sciences, Imphal, Manipur.

Study duration

The study was conducted for a period of 2 (two) years from October 2013 to September 2015.

Study population

Patients suspected to have appendicitis attending in the OPD, emergency department and admitted in the surgical ward of Regional Institute of Medical Sciences Hospital, Imphal.

Inclusion criteria

All the patients suspected to have appendicitis attending in the OPD, emergency department and admitted in the surgical ward of Regional Institute of Medical Sciences Hospital, Imphal were included in this study.

Exclusion criteria

Patients who were unwilling to give consent for examination and treatment.

Sample size and sampling

As per previous information the prevalence of appendicitis is 16%. (Chan *et al*., 2001)

$$N = \frac{P\,(100-P)}{e^2}$$

$$= \frac{16\,(100-16)}{5^2}$$

$$= 53.76$$

N= sample size

P= prevalence

e = standard error = 5

So, 60 samples were taken for the study.

Variables

Variables recorded were nausea, vomiting, anorexia, migration of pain to the right iliac fossa, pain in right iliac fossa, rebound tenderness, muscular defense, body temperature, WBC count, proportion of polymorph nuclear leukocytes, and level of C-reactive protein.

Study tools

Alvarado and RIPASA score

(The original score has additional parameter: foreign national record of identity card i.e. NRIC which is specific to the local population where the system was developed) (Maximum score is 15. A score of 7.5 or more is predictive of acute Appendicitis)

Table.A: Alvarado Score. (Chong *et al*., 2011)

Symptoms	Score
Migratory RIF pain	1
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Signs	
Tenderness RIF	2
Rebound Tenderness RIF	1
Elevated Temperature	1
Laboratory	
Leucocytosis (>10000/mm3)	2
Shift to the left of neutrophils	1
Total Score	**= 10**

(A score of 7 or more is strongly predictive of acute appendicitis)

Table. B: RIPASA score parameters. (Chong *et al*., 2010)

1	Male	1.0
	Female	0.5
2	Age < 39 yrs	1.0
	Age > 40 yrs	0.5
3	RIF pain	0.5
4	Migration of RLQ pain	0.5
5	Anorexia	1.0
6	Nausea and vomiting	1.0
7	Duration of symptoms < 48 hrs	1.0
	Duration of symptoms > 48 hrs	0.5
8	RIF tenderness	1.0
9	RIF guarding	2.0
10	Rebound tenderness	1.0
11	Rovsing sign	2.0
12	Fever	1.0
13	Raised WCC	1.0
14	Negative urinalysis	1.0

Procedure

A total of sixty cases of appendicitis fulfilling the inclusion criteria were studied and recorded in the prescribed proforma. Prior written consent from the patients in case of adults and parents or guardians in case of minor was taken.

Methods

1. A detailed history of 60 patients was taken and detailed physical examination was undertaken and relevant laboratory investigations were performed during the initial clinical encounter.
2. Patient was scored in the emergency department or OPD by RIPASA score and Alvarado score.
3. All necessary investigations like CBC, Urine RE, Blood Sugar, LFT, KFT, BT, CT, C-reactive protein, Ultrasonography and X-ray was done.

Statistics

Statistical analysis was carried out using SPSS statistical software. Data were described using mean and percentages. Analysis were done using Fisher exact test.

Ethics issue

The study was carried out only after obtaining approval from the Institutional Ethics Committee (IEC), Regional Institute of Medical Sciences, Imphal. Written informed consent taken from all the patients. Confidentiality was maintained as name of patients was not recorded.

Conflict of interest

None.

RESULTS AND OBSERVATION

The study was conducted among 60 suspected cases of suspected appendicitis attending OPD, emergency department and admitted in the surgical ward of Regional Institute of Medical Sciences Hospital, Imphal. Majority of the respondents were from age group 21-30 years which constituted 26.7% of the cases followed by age group 41-50 years (21.7%) and 11-20 years (16.6%). Mean age was 28.18 years with a standard deviation of 12.34 years. Majority of appendicitis case in this study were female (61.7%).

Distribution of respondents by symptoms

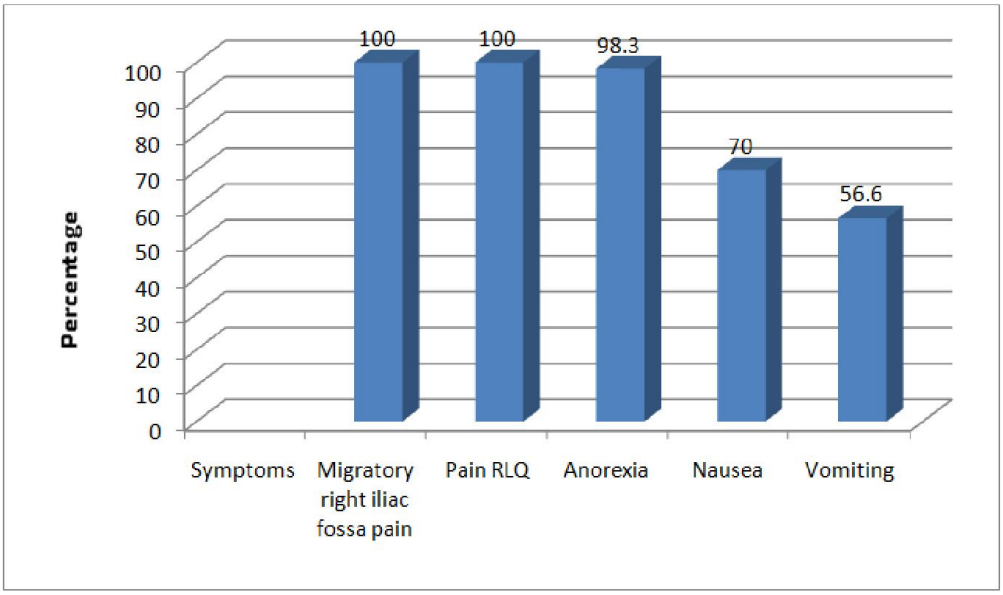

Figure 1. Bar diagram showing distribution of the respondents by presence of symptoms

All the respondents had right Iliac fossa pain and migratory right iliac fossa pain. Anorexia, nausea and vomiting were present in 98.3%, 70% and 56.6% respectively.

Distribution of respondents by RIF rebound tenderness

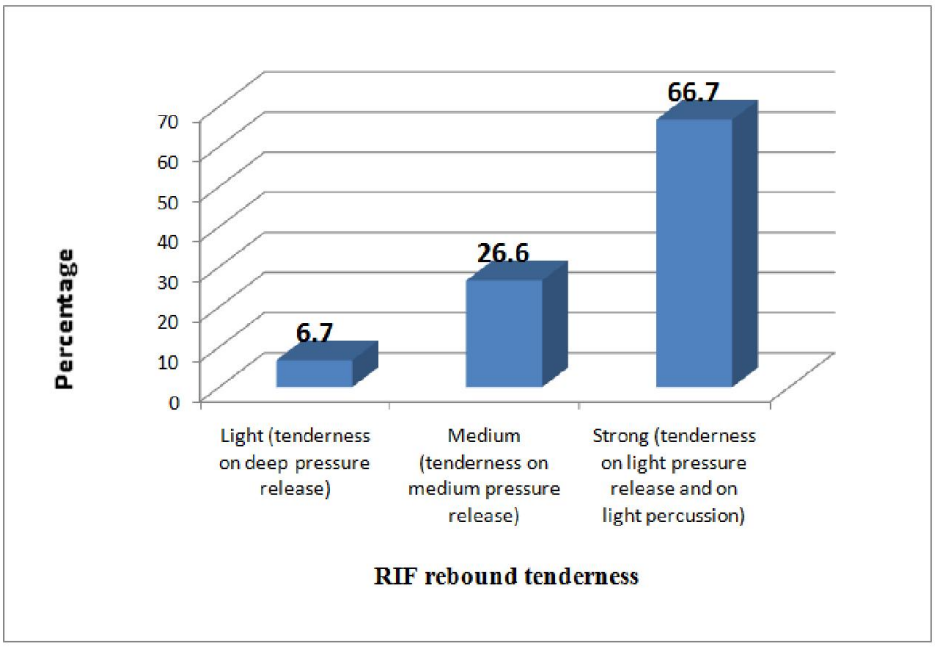

Figure 2. Bar diagram showing distribution of the respondents by presence of symptoms

40 patients (66.7%) had strong RIF rebound tenderness

Distribution of respondents by Alvarado score

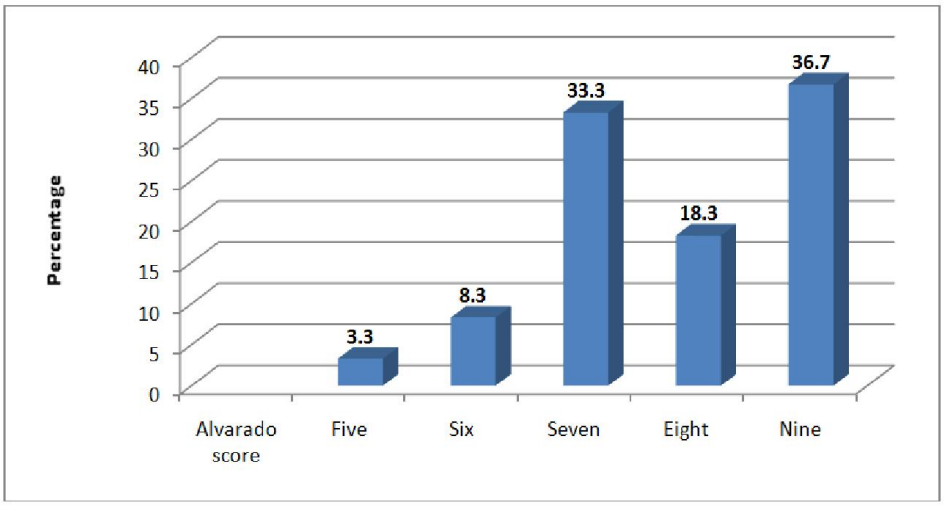

Figure 3. Bar diagram showing distribution of the respondents by Alvarado score

Majority of the patients had Alvarado score of 9 (36.7%) followed by Alvarado score of 7 (33.3%) and 8 (18.3%) as shown in Table 12 and Figure 3. Median score was 8. Minimum score was 5 and maximum score was 9. Alvarado score ≥ 7 was found in 53 patients accounting 88.3% of cases

Distribution of respondents by RIPASA score

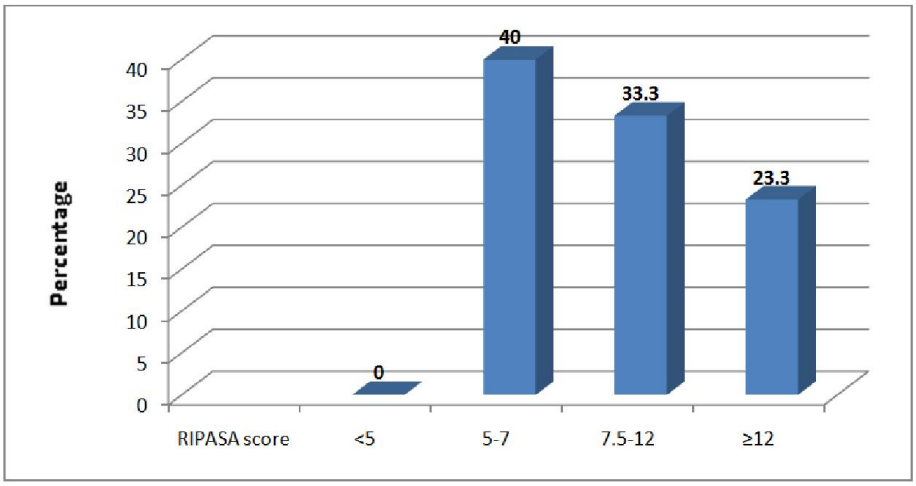

Figure 4. Bar diagram showing distribution of the respondents by RIPASA score

Table 14 and Figure 4 show that majority of the patients had RIPASA score of 5-7 followed by RIPASA score of 7.5-12. Mean RIPASA score was 10.28 with a standard deviation of 2.90.

Distribution of patients based on operative finding

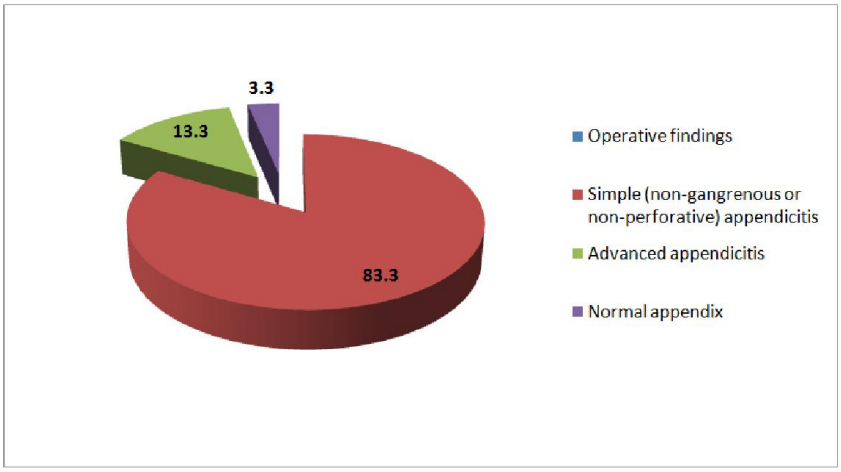

Figure 5. Pie chart showing distribution of the respondents by operative findings

Out of 60 operation, simple (non-grangrenous or non-perforated) appendicitis was found in 50 (83.3%) cases, advanced appendicitis in 8 (13.3%) cases and normal appendix in 3.3% of cases.

Table 1. HPE report of the patients

According to HPE report 8 cases (13.3%) were found to be negative for appendicitis as shown in Table 1.

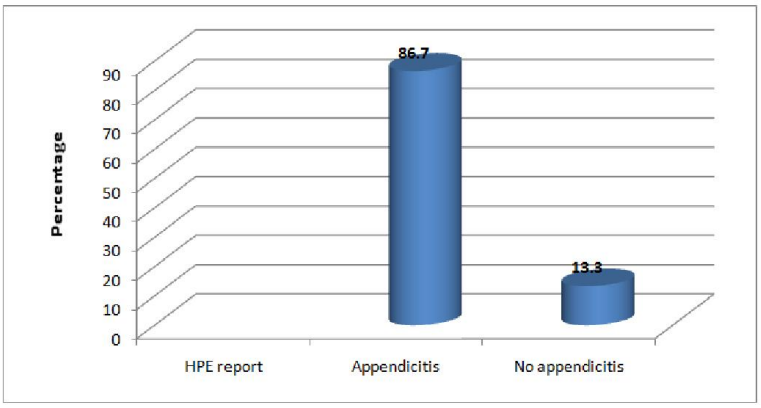

Figure 5. Bar diagram showing HPE report of the patients

Table 2. Final diagnosis of the patients

Final diagnosis	Number	Percentage
Acute appendicitis	52	86.7
Pelvic Inflammatory Disease	3	5.0
UTI	3	5.0
Renal Calculi	1	1.6
Ovulation bleeding	1	1.6
Total	60	100.0

Other diagnoses other than acute appendicitis were PID (5%), UTI (5%), renal calculi (1.6%) and ovulating bleeding (1.6%).

Table 3. Relation between Alvarado score and HPE report

Alvarado score	HPE report		Total	Fisher exact test
	Appendicitis	Not appendicitis		
≥7	50 (94.3)	3 (5.7)	53 (100.0)	Value=23.15
<7	2 (28.6)	5 (71.4)	7 (100.0)	p-0.000
Total	52 (86.7)	8 (13.3)	100.0	

Table 3 shows that among patients with Alvarado score of ≥7 there was more appendicitis (94.3%) then Alvarado score of <7 (28.6). This finding is found to be statistically significant ($p<0.05$).

So,

Sensitivity of Alvarado score= 50/(50+2)=50/52=96.2%

Specificity Alvarado score= 5/(5+3)=5/8=62.5%

Positive predictive value=50/(50+3)=50/53=94.3%

Negative predictive value=5/(5+2)=5/7=71.4%

Accuracy of Alvarado score=(55+5)/(55+3+2+5)=91.6

Table 4. Relation between RIPASA score and HPE report

RIPASA score	HPE report		Total	Fisher exact test
	Appendicitis	Not appendicitis		
≥7.5	51 (98.1)	1 (1.9)	52 (100.0)	Value=43.94
<7.5	1 (12.5)	7 (87.5)	8 (100.0)	p-value=0.000
Total	52 (86.7)	8 (13.3)	60 (100.0)	

Table 4 shows that among patients with RIPASA score of ≥7.5 there was more appendicitis (98.1%) than RIPASA score of <7.5 (12.5).

So,

Sensitivity of RIPASA score= 51/(51+1)=51/52=98.1%

Specificity of RIPASA score = 7/ (7+1)=7/8=87.5%

Positive predictive value=51/(51+1)=98.1%

Negative predictive value=7/ (7+1)=7/8=87.5%

Accuracy of RIPASA score =(51+7)/(51+1+1+7)=96.6%

Table 5. Comparison of diagnostic characteristics between of RIPASA score and Alvarado score

Diagnostic value	RIPASA score	Alvarado score
Sensitivity	98.1%	96.2%
Specificity	87.5%	62.5%
Positive Predictive Value	98.1%	94.3%
Negative Predictive Value	87.5%	71.4%
Accuracy	96.6%	91.6%

Table 5 shows that all the diagnostic parameters were higher in RIPASA score than Alvarado score.

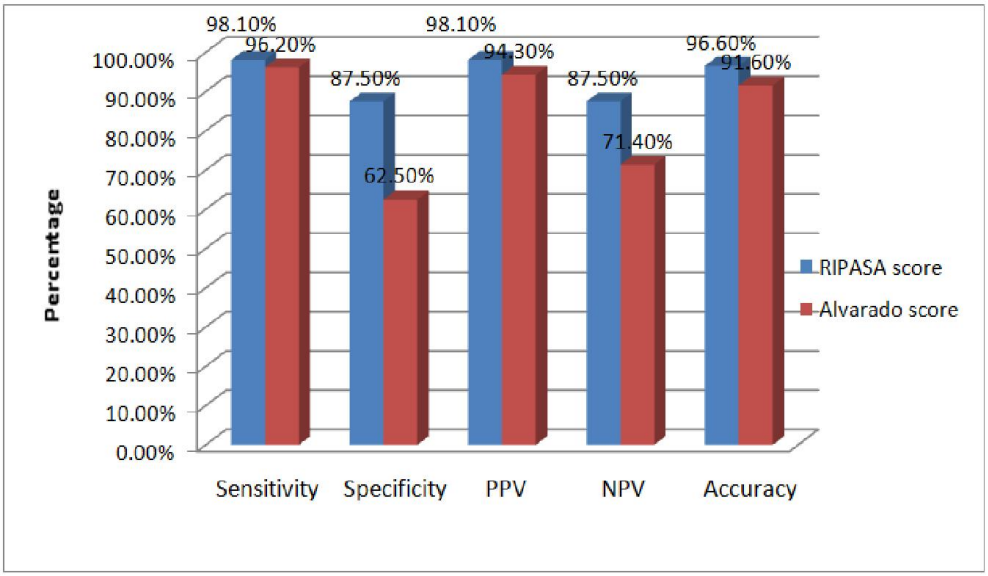

Figure 6. Bar diagram showing diagnostic characteristics between of RIPASA score and Alvarado score

Table: Showing sensitivity and specificity of Alvarado score

Studies	Alvarado score Sensitivity	Alvarado score specificity
Limpawattanasiri (2011)	87.14%	74.34%
Alnjadatin *et al*. (2013)	73.7%	68.6%
Jalil *et al*. (2011)	66.0%	81.0%
Tamanna *et al*. (2012)	59.5%	85.13%
Chong *et al*. (2011)	68.3%	87.9%
Schneider *et al*. (2007)	72%	81%

Majority of the respondents were Hindus (73%) followed by Christian (22%) and Muslim (5%). Majority of the respondents were from low socio economic status which constituted 60% of the respondents.

Distribution of respondents by symptoms

All the respondents had right Iliac fossa pain and migratory right iliac fossa pain. Anorexia, nausea and vomiting were present in 98.3%, 70% and 56.6% respectively.

Distribution of patients based on operative finding

Out of 60 operation, simple (non-grangrenous or non-perforated) appendicitis was found in 50 (83.3%) cases, advanced appendicitis in 8 (13.3%) cases and normal appendix in 3.3% of cases.

The study was conducted among 60 suspected cases of suspected appendicitis attending OPD, emergency department and admitted in the surgical ward of Regional Institute of Medical Sciences Hospital, Imphal.

In this study the commonest age group for appendicitis is 21-30 years. This finding is consistent with study by Soride (1984) and Naveen *et al*. where the commonest age was 15-24 years and 16-30 years respectively. But occurrence of appendicitis is the highest in the 11-20 years age group which constituted 44.6% in a study by Lohar *et al*. followed by 21-30 years age group, which constituted 36.1%. Mean age is 28.18 years. Females constituted majority of the patients, nearly two third. This finding is supported by Naveen *et al*. and other studies (Alnjadat and Abdallah, 2013). In most age group female predominance is seen. Patients from Hindu religion form majority of the patients. This may be because of Hindu dominant society. Socio economic status of most of the patients is low and few of them have high socio economic status. In all the patients pain in right iliac fossa and migratory right iliac fossa pain were present. Nausea and vomiting were present in 70% and 56.6% respectively. Strong right iliac fossa rebound tenderness was present in two third of the patients. Body temperature was elevated (>37.5 -38.5°C**)** in three fourth of the patients. Majority of the patients had neutrophilia and neutrophil shift to the left. CRP was raised in around one third of the cases. Out of 60 patients operated, simple (non-grangrenous or non-perforated) appendicitis was found in 50 (83.3%) cases, advanced appendicitis in 8 (13.3%) cases and normal appendix in 2(3.3%) cases. According to HPE report 8 cases (13.3%) were found to be negative for appendicitis. Majority of the patients have Alvarado score of 9 (36.7%) followed by Alvarado score of 7 (33.3%) and 8 (18.3%). Median Alvarado score is 8. Alvarado score of ≥ 7 was found in 94.3% of cases. In this study Alvardo score gives a sensitivity of 96.2% and specificity of 62.5%. Similar finding is observed by Kanumba *et al*. (2011) where sensitivity was 94.1% but in that study specificity was higher compared to this study. In a study by Srivastava *et al*. (2004) sensitivity was 92.0%. Positive predictive value and negative predictive value

were 94.3% and 71.4% respectively and this finding is almost similar with Kanumba *et al*. (2011) (positive predictive value and negative predictive value were 95.2 and 88.4% respectively). False negative was present in 5.7% of the cases. False negative rate with Alvarado score was 12.5% in a study by Qahtami *et al*. (2004) which was higher than this study. Some studies sensitivity and specificity of Alvarado score is given below:

Accuracy of Alvarado score in this study is 91.6% when cut off level is at 7. This finding is consistent with the study by Jang *et al*. (2008) where accuracy was 90%. Other studies like Tamanna *et al*. (2012), Chong *et al*. (2011) and Alnjadatin *et al*. (2013) had an accuracy of 75%, 86.5% and 74.3% respectively. So compared to other studies in this study Alvarado score was better in all aspects. Majority of the patients had RIPASA score of 5-7 followed by RIPASA score of 7.5-12. Mean RIPASA score is 10.28 with a standard deviation of 2.90. In this study RIPASA score's sensitivity and specificity are 98.1% and 87% respectively when cut off level is at 7.5. This finding is supported by Chong *et al*. (2010) where sensitivity was 97.5% when the cut off level was at 7.5.But compared to this study specificity was on the lower side (81.8%) In another study by Chong *et al*. (2010) the calculated sensitivity and specificity were 88.46% and 66.67% respectively and same finding in Khalil (2013). This is lower than this study Sensitivity was higher in RIPASA score (98.1%) than Alvarado score (96.2%). RIPASA score had specificity of 87.5% and Alvarado score had only 62.5% specificity. RIPASA score gave an accuracy of 96.6% and Alvarado 91.6%. And also NPV and PPV also better in RIPSA score. So, RIPASA scoring is better than Alvarado scoring. This finding is also supported by many studies. (Chong *et al*., 2010; Chong *et al*., 2011; Alnjadat *et al*., 2013)

Conclusion

This study was conducted in the department of Surgery, RIMS, Imphal among 60 suspected case of appendicitis. Most of the respondents were from the age group 21-30 years followed by 41-50 years and female's predominance was seen in this study. On histopathological examination appendicitis was confirmed in 86.7% of cases. This gives a sensitivity of 98.1% in RIPASA score and 96.2% in Alvarado score. Specificity was 98.1% and 96.2% by using 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. RIPASA is better in all the parameters compared in this study. So, RIPASA score is a better indicator than Alvarado score in diagnosing acute appendicitis.

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