Original Research Article

Role Of RIPASA Scoring System in Diagnosis of Acute Appendicitis

Dr Shailendra Kumar Singh, Assistant Professor[1*], Dr Mahipal, Assistant Professor[2],

Dr Ankit Bhardwaj,Assistant Professor[3], Dr Umesh Kumar PG Student[4]

[1*]Department of General Surgery, UCMS & GTB Hospital, Dilshad Garden, Delhi, India. Email id -- drshailendra.kumar21@gmail.com.

[2]Department of General Surgery, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana, India.

[3]Department of General Surgery, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana, India.

[4]Department of General Surgery, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana, India.

Corresponding Author- Dr Shailendra Kumar Singh, Assistant Professor,

*Department of General Surgery, UCMS & GTB Hospital, Dilshad Garden, Delhi, India.

ABSTRACT:
Background: Acute appendicitis is a commonly encountered surgical emergency it has a lifetime prevalence of 1 in 7. With an incidence of 1.5-1.9 per 1000 in male and female population, and 1.4 times more common in men. The diagnosis is based on a thorough clinical history and examination. It is well supported with efficient laboratory investigations like elevated leucocyte count and ultrasound of the abdomen. Acute appendicitis is a common problem yet a difficult diagnosis at times specially in young and elderly females. Females of reproductive group are more prone for other genitourinary problems that may mimic acute appendicitis. Any delay in performing an appendicectomy to improve its diagnostic accuracy, can increase the risk of complications like appendicular lump, perforation and sepsis, which will in turn increase the morbidity and mortality.

Aims and Objectives: To evaluate the role of RIPASA scoring system in diagnosis of Acute appendicitis.

Material and Methods: The study designed was a prospective, was conducted in the Department of General Surgery, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana, India. 154 patients of either sex, Study duration is from December 2019 to January 2021. Considering 95% confidence interval and 80% power of study for sensitivity to be increased from 53% to 68 % sample size is determined to be 100. For specificity to be increased from 80% to 98% sample size is determined to be 156. So, inclusion of both sensitivities of 68% and specificity of 98% sample size is determined to be 154.
Patients of age group >15 years and <70 years who present with right iliac fossa pain and with a suspicion of acute appendicitis.
RIPASA score for each patient was calculated and diagnosis of acute appendicitis was made. If RIPASA score is <5, then Appendicitis is unlikely, f score is 5.0 to 7.0 then Acute Appendicitis is less likely or can be stated as low probability. If score is 7.5 to 11.5 then, High chances of acute appendicitis.

Score value > 12 suggests definite Acute Appendicitis.

Results and Observations:
Considering a confidence interval of 95%, RIPASA score was correlated with the histopathological diagnosis. The sensitivity of RIPASA score was found to be 94.05% (88.99-99.11%). The specificity of RIPASA score was 42.65% (30.89 - 54.40%). The PPV was found to be 66.95% (58.46-75.44%) and the NPV was found to be 85.29% (73.39-97.20%). The overall accuracy of RIPASA score was found to be 71.05% (63.84- 78.26%).

Conclusion: RIPASA score can be used as a tool to diagnose patients with acute appendicitis but not specific enough to rule out false negatives. RIPASA score looks like a promising scoring system to correctly diagnose cases of acute appendicitis but the accuracy of the same is yet to be analyzed.

Key Words: Acute appendicitis, RIPASA Scoring system, histopathological diagnosis, diagnosis, appendectomy, acute appendicitis management, Sensitivity of RIPASA, Specificity of RIPASA.

INTRODUCTION:
Acute appendicitis is the most common cause of an acute abdomen requiring surgery, with a lifetime risk of about 7%. [1] The clinical presentation is typical in 50% of the cases, but the decision to explore the patient can sometimes be challenging and tests the clinical acumen of the surgeon, particularly in young, elderly, and females of reproductive age group. [2] The diagnosis and management of acute abdominal pain remains one of the last bastions of clinical medicine, which remains to be conquered. There is no common situation where clinical feature, accurate diagnosis, and immediate decision are of utmost importance. [3] The diagnosis is based on history, clinical examination, and few laboratory investigations. In addition, a negative appendicectomy rate of 20- 40% has been documented, and many surgeons would accept a rate of 30% as inevitable. Acute appendicitis is a commonly encountered surgical emergency it has a lifetime prevalence of 1 in 7.[4]With an incidence of 1.5-1.9 per 1000 in male and female population, it is found to be 1.4 times more common in men.[5] The diagnosis is based on a thorough clinical history and examination. It is well supported with efficient laboratory investigations like elevated leucocyte count and ultrasound of the abdomen. Acute appendicitis is a common problem yet a difficult diagnosis at times specially in young and elderly females. Females of reproductive group are more prone for other genitourinary problems that may mimic acute appendicitis [6] Any delay in performing an appendicectomy to improve its diagnostic accuracy, will increase the risk of appendicular perforation and sepsis, which will in turn increase the morbidity and mortality. [7] Due to difficulty in diagnosis, unwanted appendicectomy rate has increased and it is reported to be around 20-40%. [8] Numerous scores have been developed in the past for facilitating diagnosis of acute appendicitis. These scores are the Alvarado and modified Alvarado scores. Their sensitivity and specificity range from 53-88% and 75-80% respectively. [8, 9] Computerized tomography and Ultrasonography can improvise on accuracy of diagnosis of acute appendicitis These modalities are costly and may not be easily available when in dire emergency. Making arrangements for these is cumbersome and we lose a lot of time. This leads to a delay in emergency appendicectomy. Timely intervention of acute appendicitis among the young, elderly, and females of the reproductive age group is essential to avoid complications. To help the surgeon make diagnosis with certainty and reduce negative laparotomy rate, a number of clinical scoring systems are in vogue. All these scoring systems have been developed for the Western Population. Studies have shown that these scores have a low sensitivity and specificity when it was applied to a population of different ethnicity. In 2010, The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) scoring system was developed for Southeast Asian region. It was containing 15 diagnostic parameters to diagnose the cases of acute appendicitis.[10] The aim of the current study is to evaluate the role of RIPASA scoring system in diagnosis of Acute appendicitis.

MATERIAL AND METHODS:
The study designed was a prospective, was conducted in the Department of General Surgery, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana, India. 154 patients of either sex, Study duration is from December 2019 to January 2021. Considering 95% confidence interval and 80% power of study for sensitivity to be increased from 53% to 68 %

sample size is determined to be 100. For specificity to be increased from 80% to 98% sample size is determined to be 156. So, inclusion of both sensitivities of 68% and specificity of 98% sample size is determined to be 154.

Patients of age group >15 years and <70 years who present with right iliac fossa pain and with a suspicion of acute appendicitis. RIPASA Score for each patient was calculated based on the 15 parameters of the scoring system and interpretation was made and patients were managed accordingly.

Having RIPASA score of >= 7.5 is considered to be of a high possibility of acute Appendicitis. If RIPASA score is <5, then Appendicitis is unlikely, keep the patients for an hour or two and re-analyze if score is same or marginally up or down, then 95% chances no appendicitis is there, if score is 5.0 to 7.0 then Acute Appendicitis is less likely or can be stated as low probability. Patient should be observed for 1 or 2 hours and do an USG abdomen and other relevant investigations, if score is 7.5 to 11.5 then, High chances of acute appendicitis. Repeat the score after 1 hour, if still high, prepare the patient for appendectomy. If score is > 12 suggest definite diagnosis of acute appendicitis.

Table 1:

RIPASA SCORING SYSTEM	
Parameters	**Score**
Age	1 if <40 years and 0.5 if >40 years
Sex	1 if Male and 0.5 if Female
RIF pain	0.5
Migration to RIF	0.5
Nausea/Vomiting	1
Anorexia	1
Duration of Symptoms	1 if < 48 hours or 0.5 if >48 hours
RIF Tenderness	1
RIF Rebound Tenderness	1
RIF guarding	2
Rovsing's sign	2
Fever	1
Raised WBC Count	1
Negative Urinalysis	1
Maximum score/ Minimum Score	**15/2**

Table 2:

INTERPRETATION OF RIPASA SCORING SYSTEM	
Total Score	**Interpretation**
<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

Statistical analysis: Validity of RIPASA score as a diagnostic test for appendicitis was established by calculating its sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) along with 95% confidence interval (CI), using operative diagnosis confirmed by

histopathology as gold standard. The cut-off value for RIPASA score was determined by receiver operating characteristic (ROC) curve. ANOVA was applied to explore whether there was any significant age difference in RIPASA scores. Data is tabulated using Microsoft excel 2010 software (Microsoft office 2010 v14.0) and analyzed with SPSS 22.0 (SPSS Inc. Chicago. Il, USA). Correlation coefficient between 2 scores is determined and analysis is done by calculating sensitivity, specificity and roc curve to find an appropriate cut off value.

OBSERVATIONS AND RESULTS:

Observations and results drawn from the study are given below **(Table 3 to 11 and Figure 1 to 6)**

Table 3: Distribution of Patients with their Age, Frequency and %.
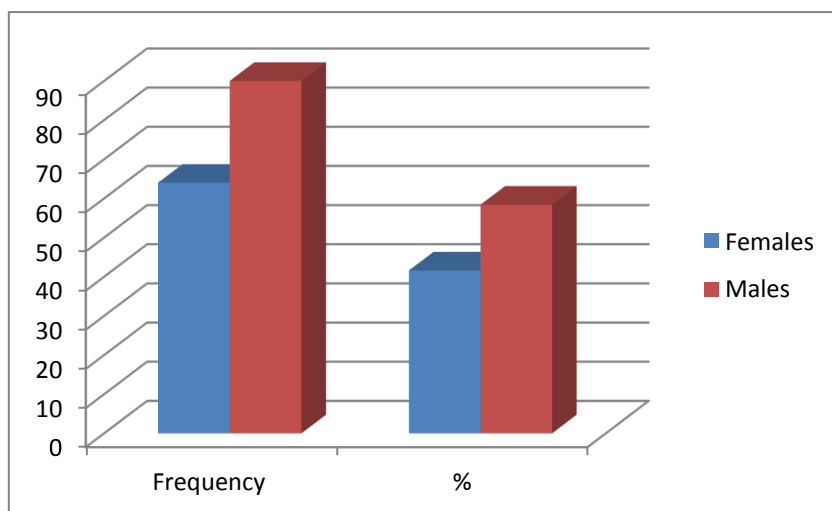
Age (Years)	No. Of Patients (Frequency)	%
15-20	66	42.9
21-25	25	16.2
26-30	19	12.3
31-40	25	16.2
41-50	12	7.8
>50	7	4.5
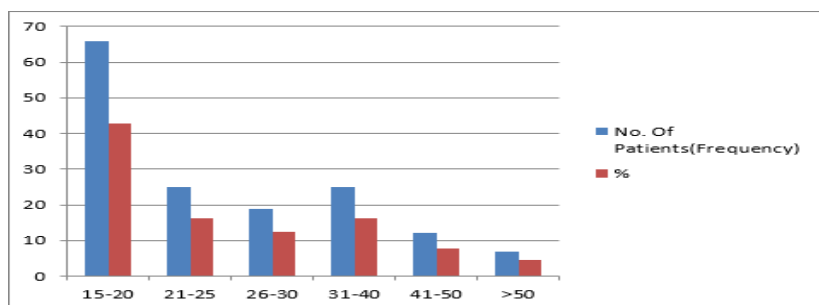
Figure 1: Distribution of Patients with their Age, Frequency and %.
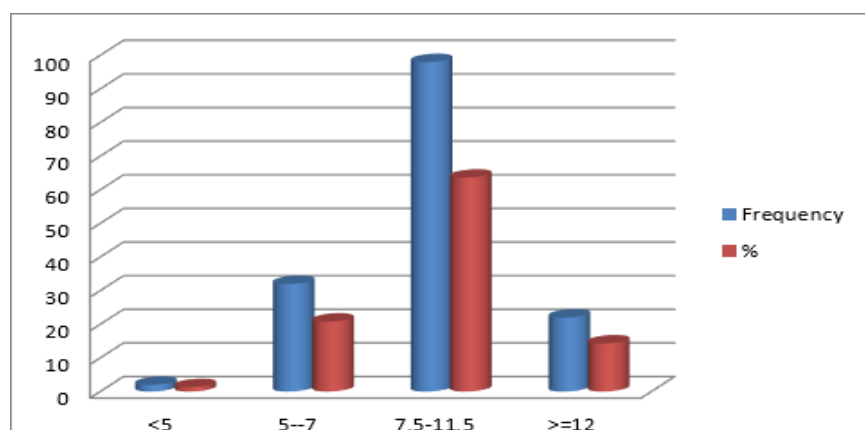
Table 4: Sex distribution

Sex	Frequency	%
Females	64	41.6
Males	90	58.4
Total	154	100

Figure 2: sex distribution

Table 5: RIPASA Score vs our patients status.

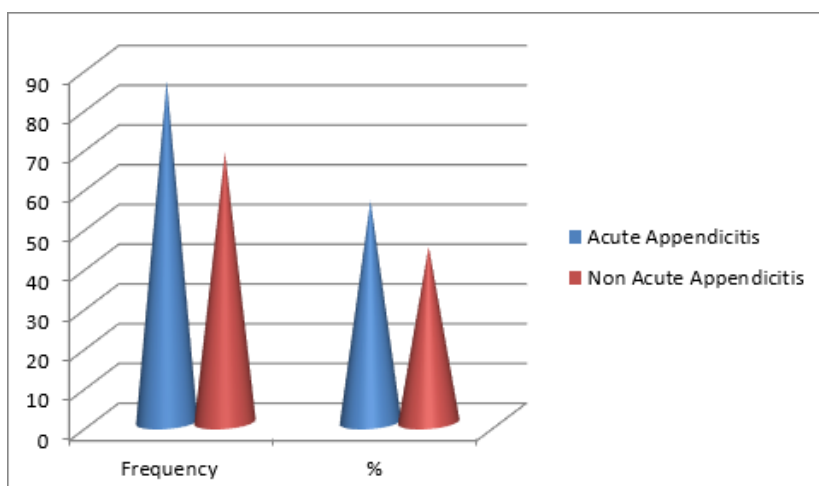| Score	Frequency	%
<5	2	1.3
5-7	32	20.8
7.5-11.5	98	63.6
>=12	22	14.3
Total	154	100

Figure 3: RIPASA Score vs our patients status.

**Table 6:** Acute and Non Acute Appendicitis as per the Histopathology Report.

Diagnosis	Frequency	%
Acute Appendicitis	86	55.8
Non Acute Appendicitis	68	44.2
Total	154	100

Figure 4: Acute Vs Non Acute Appendicitis.

Table 7: Correlation of RIPASA Score with Histopathology Report (HPR).

		Confidence interval	
		Lower	Upper
Sensitivity	94.05	88.99	99.11
Specificity	42.65	30.89	54.40
Ppv	66.95	58.46	75.44
Npv	85.29	73.39	97.20
Overall accuracy	71.05	63.84	78.26
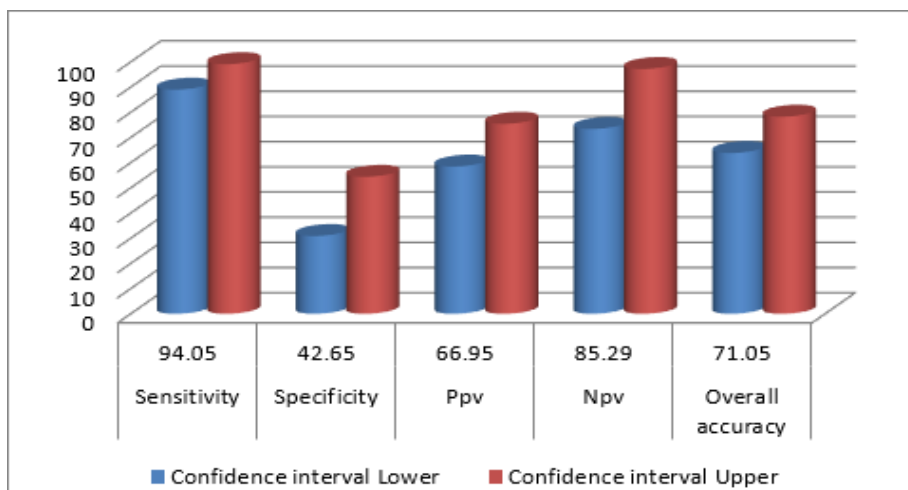
Figure 5: RIPASA Vs HPR.

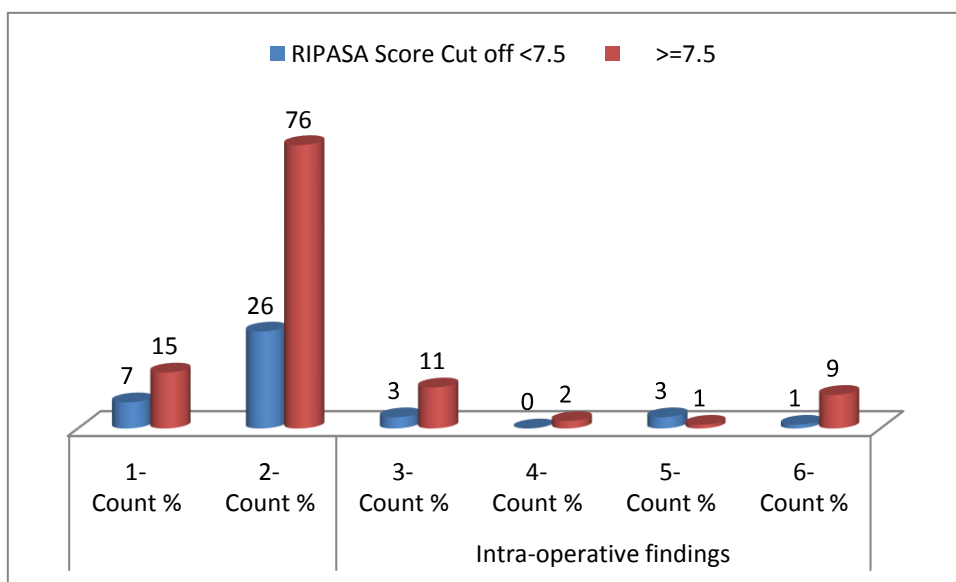**Table 8**: Association of RIPASA Score with Histopathology Report (HPR).

			RIPASA Score Cut off <7.5	>=7.5	Total	Odds ratio	P value
Histopathology	1-	Count %	9(22.5%)	77(67.5%)	86(55.8%)		
	2-	Count %	31(77.5%)	37(32.5%)	68(44.2%)	0.143	0.001

*p value <0.05 is significant.

Table 9: Association of RIPASA Score with Intra-operative findings.

			RIPASA Score Cut off <7.5	>=7.5	Total	P value
	1-	Count %	7(17.5%)	15(13.2%)	22(14.3%)	
	2-	Count %	26(65%)	76(66.7%)	102(66.2%)	
Intra-operative findings	3-	Count %	3(7.5%)	11(9.6%)	14(9%)	0.186
	4-	Count %	0	2(1.8%)	2(1.3%)	
	5-	Count %	3(7.5%)	1(.9%)	4(2.6%)	
	6-	Count %	1(2.5%)	9(7.9%)	10(6.5%)	

*p value <0.05 is significant.

Figure 6: Association of RIPASA Score with Intra-operative findings.

These findings were -
1: Normal Looking Appendix With No Free Fluid Or Adhesions 2: Inflamed Appendix With Minimal Adhesions 3: inflamed Appendix +/- Dense Adhesions +/- Free Fluid In Peritoneal Cavity 4: Appendicular Abscess 5: Early Mass Formation; Appendicular Mass 6: Ruptured Appendix; Perforated Appendix; Fecolith RIPASA score was correlated with intraoperative finding and the association between them was calculated using odds ratio. A p value of <0.05 was considered to be significant. In this study p value was found to be 0.183 which shows no statistically significant correlation between RIPASA score and intraoperative findings. (As in Figure 6 and Table 7).

Table 10: Test result variable for Area under Curve

Area	Std. Error(a)	Asymptotic sig.(b)	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
.791	036	0.000	.719	.862

Table 11: Results variables: RIPASA.

Positive if >= to(a)	Sensitivity	1 – specificity
3.500	1.000	1.000
4.750	1.000	.971
5.250	1.000	.941
5.750	.988	.868
6.250	.964	.750
6.750	.964	.662
7.250	.940	.574
7.750	.893	.544
8.250	.857	.426
8.750	.714	.309
9.250	.619	.221
9.750	.476	.118
10.250	.405	.074
10.750	.369	.074
11.250	.321	.044
11.750	.238	.029
12.250	.155	.015
12.750	.095	.015
13.250	.048	.015
13.250	.036	.000
15.000	.000	.000

As per the ROC curve analysis, from the above figure the area under the curve is 0.791, which shows moderate discriminatory ability of RIPASA score. However, a cut off value for the determination of Acute Appendicitis using the RIPASA score could not be arrived at without significant compromise of specificity.

DISCUSSION:
Acute appendicitis is one of the most common surgical emergencies encountered, especially by junior doctors during on-call duties with emergency appendicectomy making up 10% of all emergency abdominal surgeries.[11] The evaluation is mainly based on history and clinical findings, which is an important parameter in reaching a diagnosis of acute appendicitis.[12] Acute appendicitis is a common surgical crisis encountered by the surgeons. They represent one in ten of all abdominal surgeries. A rapid and correct diagnosis of appendicitis that leads to appendectomy is needed to prevent complications like perforation. This is a challenging job for most surgeons. CT scan has been shown to have a high sensitivity and high specificity (94% and 95% respectively) to make an accurate diagnosis of acute appendicitis. A routine practice of doing a CT will swell the expenses of the patient towards healthcare. Arranging CT scans may induce a further delay in surgery. A recent study also showed that CT when used indiscriminately will lead to detection of early acute appendicitis and contribute even more towards needless appendectomy. These needless surgeries could be well treated conservatively with a course of antibiotic therapy. Alvarado score was developed in the year 1986 which was a simple system for diagnosis of acute appendicitis.[13] When this score was applied in Western population, it was proven to have a very good sensitivity and specificity but when applied to the Asian population, it showed its limitations.[14-17] Hence the RIPASA score was developed which was extensive but a simple additive score that will yield well for diagnosis of acute appendicitis. It consisted of 15 parameters including an extra parameter called the NRIC. All the parameters were obtained with a thorough clinical history, examination and investigations. In this study we applied the

RIPASA scoring system to the patients admitted with abdominal pain suspicious of acute appendicitis

in our hospital to assess the accuracy and to establish, if this scoring system can be used to diagnose cases of acute appendicitis to save time for unwanted investigations so that the patient can be taken up for emergency appendectomy at the earliest. A total of 154 patients were included in our study and it was found that 64 out of 154 patients (42.1%) who presented with pain abdomen suspicious of acuteappendicitis were in the age group of 15-20 years and 88(57.8%) patients were males while 64 (42.1%) were females. The diagnosis of acute appendicitis was confirmed only on histopathological report. Patients found to be suspicious of acute appendicitis were assessed based on RIPASA score and an ultrasonography was done to correlate the clinical diagnosis. Based on RIPASA score as shown in table 5, out of 154 patients; 98 patients (63.2%) had a score between 7.5-11.5 while 22 patients had a score of >=12. Chong CF et al in 2010 studied that the recently developed scoring system of acute appendicitis was promising and showed a higher sensitivity and specificity compared to the Alvarado score when specifically applied to Asian population. In this study RIPASA score could correctly classify 98% of patients a with histologically proven diagnosis of acute appendicitis to high probability group (score>7.5) In our study 120 out of 154 (77.63%) patients diagnosed with acute appendicitis had a score of >7.5 which is in contrast to the study done by Chong CF et al . In another study in 2011 of 200 patients, Mackie A J A et al analyzed that RIPASA score correctly identified 98% of all patients who had a histological diagnosis of acute appendicitis on HPE. It accurately classifiedall these patients to high probability group with a score >7 [18]. RIPASA score was further correlated with the histopathological diagnosis. Considering a confidence interval of 95% applied to the RIPASA score; sensitivity (94.05%), specificity (42.65%), PPV (66.95%), NPV (85.29%), and the accuracy (71.05%) was calculated. In a study done by Nanjundaiah and Ashfaque Mohammed et al [19] on 206patients in 2012, at optimal cut off threshold of >7.5. In our study , we found that the sensitivity of RIPASA score was 94.05% (88.99-99.11%). The specificity of RIPASA score was 42.65%(30.89- 54.40%). The PPV was found to be 66.95%(58.46-75.44%) and the NPV was found to be 85.29%(73.39-97.20%). The overall accuracy of RIPASA score was found to be 71.05% (63.84- 78.26%).In another study done by Muhammad Usman Malik et al [20] in April 2017 in a group of 208 patients; they found that 64.9% of the patients diagnosed with acute appendicitis on histology had a score of >7.5. They also demonstrated that the RIPASA score had a sensitivity of 85.39%, specificityof 69.86%, PPV of 84.06% and an overall accuracy of 80%. The RIPASA score is simple and easy touse as a quantitative scoring system and as shown in Appendix, most of these 14 clinical parameters are easily obtained from a good clinical history and examination. This also includes a urinalysis, which can be easily performed on the spot. Hence, a score can be obtained quickly and a rapid diagnosis can be made without having to wait for the full investigations to be available.[21] The number of patients in our study had males more than females, which is similar to a study done by Canavosso et al. in which the incidence of acute appendicitis was more in males than in females.[22]

CONCLUSION.

The RIPASA score is a simple scoring system with high sensitivity and specificity for the diagnosis of acute appendicitis. The 14 clinical parameters are all present in a good clinical history and examination and can be easily and quickly applied. Therefore, a decision on the management can be made early Acute appendicitis is more commonly seen in younger individuals predominantly in males. RIPASA score can be used as a tool to diagnose patients with acute appendicitis but not specific enough to rule out true negatives. RIPASA score looks like a promising scoring system to correctly diagnose cases of acute appendicitis but the accuracy of the same is yet to be analyzed. RIPASA vs HPR: showed a high sensitivity but poor specificity. On applying odds ratio, it was found that, there is statistically significant association between RIPASA score and HPR but there was no significant association between RIPASA score and the intraoperative findings.

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Conflict of Interest: None

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