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ORIGINAL RESEARCH

Comparative Evaluation Of Diagnostic Accuracy Of Modified Alvarado And RIPASA Score

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Abstract

Introduction and aim- The importance of early and right diagnosis provides the best and most accurate diagnostic modality for appendicitis. The cheaper, faster, and non-invasive diagnostic tool in diagnosing acute appendicitis is a clinical scoring system. Several clinical scoring systems were developed to reduce the negative appendectomy rate to 5%– 10%. The present study was undertaken in view of the comparison of the RIPASA and the modified Alvarado scoring system in the diagnosis of acute appendicitis among patients.

Material and method- Total 50 patients were included who were admitted to surgical emergency of Govt. Medical College & Rajindra Hospital, Patiala. with acute appendicitis. The patients were selected on the basis of history, examination, laboratory investigations and were also evaluated on the basis of the parameters of RIPASA and Modified Alvarado score.

Observation and results- On analysis of RIPASA score, 38/50 (76%) patients showed High Probability appendicitis with final RIPASA in between 7.5- 12, 7/50(14%) patients had Low Probability appendicitis with final RIPASA score in between 5-7.0, 3/50 (6%) patients were Unlikely to be appendicitis with final RIPASA score <5 and in the remaining 2/50 (4%) patients, RIPASA score predicted Definite appendicitis with final RIPASA score >12. On analysis of Modified Alvarado score, 36/50 (72%) patients showed High Probability appendicitis with final Modified Alvarado score of 7-9. 8/50 (16%) patients had Low Probability appendicitis with final Modified Alvarado score of 5-6. 6/50 (12%) patients were Unlikely to be appendicitis with final Modified Alvarado score of 1-4.

Conclusion- RIPASA score is a better diagnostic tool for the diagnosis of Acute Appendicitis.

Introduction

As quoted by Bailey & Love, "Notwithstanding advances in modern radiographic imaging and diagnostic laboratory investigations, the diagnosis of appendicitis remains essentially clinical, requiring a mixture of observation, clinical acumen, and surgical science".[1] So, it remains an enigmatic challenge and a reminder of the art of surgical diagnosis. Acute appendicitis is the most common cause of surgical emergencies worldwide, with an incidence of 1.17 to 1.9 per 1,000 inhabitants per year and a lifetime

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risk of presenting with it of 8.6% in men and 6.7% in women.[2] Appendicitis, which if caught early and managed appropriately can be the most uneventful surgery, while the other end of the spectrum is also true, that when missed, appendicitis can turn into a disease with great morbidity and mortality.[3] Therefore, the importance of early and right diagnosis provides the best and most accurate diagnostic modality for appendicitis, many clinical scoring systems have been developed over the years.[4] The next problem, of finding the single best scoring system, or the scoring system with the maximum sensitivity and diagnostic accuracy. Multiple studies have been done with randomized controlled trials comparing various scoring systems in different parts of the world. To date, the most commonly used scoring system worldwide is the Alvarado[4] and the Modified Alvarado[5] scoring systems (MASS). Hence, these have almost been considered as the undocumented gold standard scoring system among clinicians worldwide. So much so that any new scoring system that has been developed is usually first compared to this. A negative appendicectomy is taken as a surgery performed for a preoperative diagnosis of appendicitis that resulted in normal histopathology examination. Studies have shown a negative appendicectomy rate of 17% to 36%, when acute appendicitis is diagnosed based on clinical judgment. The gold standard method for confirming the diagnosis is by histopathology.[4]

The cheaper, faster, and non-invasive diagnostic tool in diagnosing acute appendicitis is a clinical scoring system. Several clinical scoring systems were developed to reduce the negative appendectomy rate to 5%– 10%. The most popular scoring system among surgeons is the Alvarado score, which was developed in 1986 as the simple addition of points related to eight clinical parameters.[4] The modified Alvarado score omitted the last point of the original score (shift to the left Neutrophils).[5] Despite its widespread use, sensitivity and specificity for diagnosis of acute appendicitis is low.

The Raja Isteri Pengiran Anak Saleha appendicitis (RIPASA) score was developed in 2010 by Department of Surgery, Raja Isteri Pengiran Anak Saleha Hospital, Brunei Darusslam[6], to find a more favourable scoring system than Alvarado and Modified Alvarado as these were found to have poor sensitivity and specificity in Middle Eastern and Asian population.

The RIPASA score has been shown to have significantly higher sensitivity, specificity and diagnostic accuracy compared to Modified Alvarado Score[6,7]. There are very few studies conducted on comparison of RIPASA score and Modified Alvarado score in global context. Hence the present study was undertaken in view of the comparison of the RIPASA and the modified Alvarado scoring system in the diagnosis of acute appendicitis among patients admitted in general surgery wards in Government Medical College and Rajindra Hospital, Patiala.

Clinical scoring systems modified alvarado scoring system (MASS)[5]

Symptoms	**Score**
Migratory RIF pain	1
Nausea/Vomiting	1
Anorexia	1
Signs	
Tenderness in RIF	2
Rebound tenderness in RIF	1
Elevated temperature	1
Laboratory findings	
Leucocytosis	2
TOTAL	**9**

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Score <5 – Unlikely to be appendicitis 5-6 – Low Probability to be appendicitis 7-9 – High Probability to be appendicitis

Ripasa scoring system[6,7]

Patient's demographic	Score
Female	0.5
Male	1.0
Age< 39.9 years	1.0
Age> 40 years	0.5
Symptoms	
RIF pain	0.5
Pain migration to RIF	0.5
Anorexia	1.0
Nausea & vomiting	1.0
Duration of symptoms < 48 hrs	1.0
Duration of symptoms > 48 hrs	0.5
Signs	
RIF tenderness	1.0
Guarding	2.0
Patient's demographic	**Score**
Rebound tenderness	1.0
Rovsing's sign	2.0
Fever>37^0C , <39^0C	1.0
Investigations	
Raised WBC count	1.0
Negative urinalysis	1.0
Additional scores	
Foreign NRIC (National Registration Identity Card)	1.0

- Score <5 – Unlikely to be appendicitis
- 5-7.5 – Low Probability to be appendicitis
- 7.5-12 – High Probability to be appendicitis
- >12 – Definite appendicitis

Material and methods

This prospective study was conducted in the Department of General Surgery, Govt. Medical College & Rajindra Hospital, Patiala. Total 50 patients were included who were admitted to surgical emergency with acute appendicitis. The patients were selected on the basis of history, examination, laboratory investigations and were also evaluated on the basis of the parameters of RIPASA and Modified Alvarado score. All the patients underwent appendicectomy and confirmation of diagnosis was done by histopathological examination.Data for this prospective Study was sourced from patients admitted with clinical suspicion of acute appendicitis in Govt. Medical College & Rajindra Hospital, Patiala. All patients irrespective of gender with classical signs and symptoms of acute appendicitis: Peri-umbilical colic, Pain shifting to the right iliac fossa, Anorexia, Nausea, Pyrexia, Localized tenderness in right iliac fossa, Muscle guarding were included in the study. Patient with distension of abdomen, Pregnant females, with previous history of any pelvic inflammatory disease, Patient not willing for surgery were excluded from the study.

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Observations and results

The present study conducted to compare the RIPASA scoring and Modified Alvarado scoring in the diagnosis of acute appendicitis on 50 patients admitted to Surgical Emergency with acute abdominal pain, suspected to be having acute appendicitis. Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. Results on continuous measurements were presented as Mean ± SD (Min-Max) & categorical as Frequency (Percentage). The contingency coefficient is computed as the square root of chi-square divided by chi-square plus n, the sample size. Sensitivity (true positive rate), specificity (test result will be negative when the disease is not present), PPV (the probability that the disease is present), Negative Predictive Value (disease is not present when the test is negative) of the scoring system will be estimated by comparing the threshold level of the score with surgical findings and histopathology findings.

Table 1 - Frequency And Percentage Distribution Of Patients On The Basis Of RIPASA Symptoms And Signs Parameter

Symptoms	Score	Frequency(N)	Percentage(%)
RIF PAIN	0.5	50	100
Pain migration to RIF	0	20	40.0
	0.5	30	60.0
Anorexia	0	20	40.0
	1	30	60.0
Nausea & vomiting	0	22	44.0
	1	28	56.0
f symptoms > 48hours	0.5	32	64.0
f symptoms < 48hours	1	18	36.0

Signs	Score	Frequency (N)	%Age
RIF tenderness	0	3	6.0
	1	47	94.0
Guarding	0	33	66.0
	2	17	34.0
Rebound tenderness	0	28	56.0
	1	22	44.0
Rovsing's Sign	0	46	92.0
	2	4	8.0
Fever >37° C,< 39^0 C	0	12	24.0
	1	38	76.0

Out of total 50 patients, all the 50/50 (100%) patients presented with RIF pain with a RIPASA score of 0.5. Out of 50 patients, 20/50 (40%) patients had no migration of pain to RIF with RIPASA score of 0 and in 30/50 (60%) patients, migration of pain to RIF was present with RIPASA score of 0.5, only 30/50 (60%) patients had anorexia as a symptom of acute appendicitis with a RIPASA score of 1 and in 20/50 (40%) patients, anorexia was absent with a RIPASA score of 0. The results also showed that, 28/50 (56%) patients had nausea and vomiting as a symptom of acute appendicitis with a RIPASA score of 1 and 22/50 (44%) patients had no nausea and vomiting with a RIPASA score of 0. The duration of symptoms was > 48 hours in 32/50 (64%) patients with a RIPASA score of 0.5 and the duration of symptoms was < 48 hours in 18/50 (36%) patients with a RIPASA score of 1. 47/50 (94%) patients presented with RIF

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tenderness as a sign of acute appendicitis with a RIPASA score of 1 and 3/50 (6%) patients had no sign of RIF tenderness with a RIPASA score of 0. Out of 50 patients, 17/50 (34%) patients had guarding as a sign of acute appendicitis with a RIPASA score of 2 and 33/50 (66%) patients did not have guarding as a sign of acute appendicitis with a RIPASA score of 0. Out of 50 patients, 22/50 (44%) patients had rebound tenderness as a sign of acute appendicitis with a RIPASA score of 1 and 28/50 (56%) patients did not have rebound tenderness as a sign of acute appendicitis with a RIPASA score of 0. Out of 50 patients, 4/50 (8%) patients showed Rovsing's sign as a sign of acute appendicitis with a RIPASA score of 2 and 46/50 (92%) patients did notshow Rovsing's sign of acute appendicitis with a RIPASA score of 0. Out of 50 patients, 38/50 (76%) patients had fever as a sign of acute appendicitis with a RIPASA score of 1 and 12/50 (24%) patients did nothave fever as a sign of acute appendicitis with a RIPASA score of 0.

Table 2 Frequency and percentage distribution of patients on thebasis of Modified Alvarado Symptoms and sign parameter

Symptoms	Score	Frequency(N)	Percentage(%)
Pain migration to RIF	0	20	40.0
	1	30	60.0
Anorexia	0	20	40.0
	1	30	60.0
Nausea & vomiting	0	22	44.0
	1	28	56.0

Signs	Score	Frequency (N)	Percentage (%)
RIF tenderness	0	3	6.0
	2	47	94.0
Rebound tenderness	0	27	54.0
	1	23	46.0
Fever >37^0C, < 39^0C	0	12	24.0
	1	38	76.0

Table 3: Correlation of RIPASA score, Modified Alvarado score

	RIPASA score	Modified Alvarado score
True positive (TP)	39	34
False positive (FP)	1	2
True negative (TN)	7	6
False negative (FN)	3	8

Table 4: RIPASA Scoring (Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and DiagnosticAccuracy)

Sensitivity (%) [TP/(TP+FN)] ×100	Specificity (%) [TN/(TN+FP)] ×100	Positive Predictive Value (%) [TP/(TP+FP)]×100	Negative Predictive Value (%) [TN/(TN+FN)] ×100	Diagnostic Accuracy (%)
92.86	87.50	97.50	70.00	92.00

RIPASA score had a Sensitivity of 92.86% [(39/42)×100], Specificity of 87.50% [(7/8)×100], Positive Predictive Value 97.50% [(39/40)×100],Negative Predictive Value of 70.00% [(7/10)×100] and Diagnostic Accuracy of 92.00%

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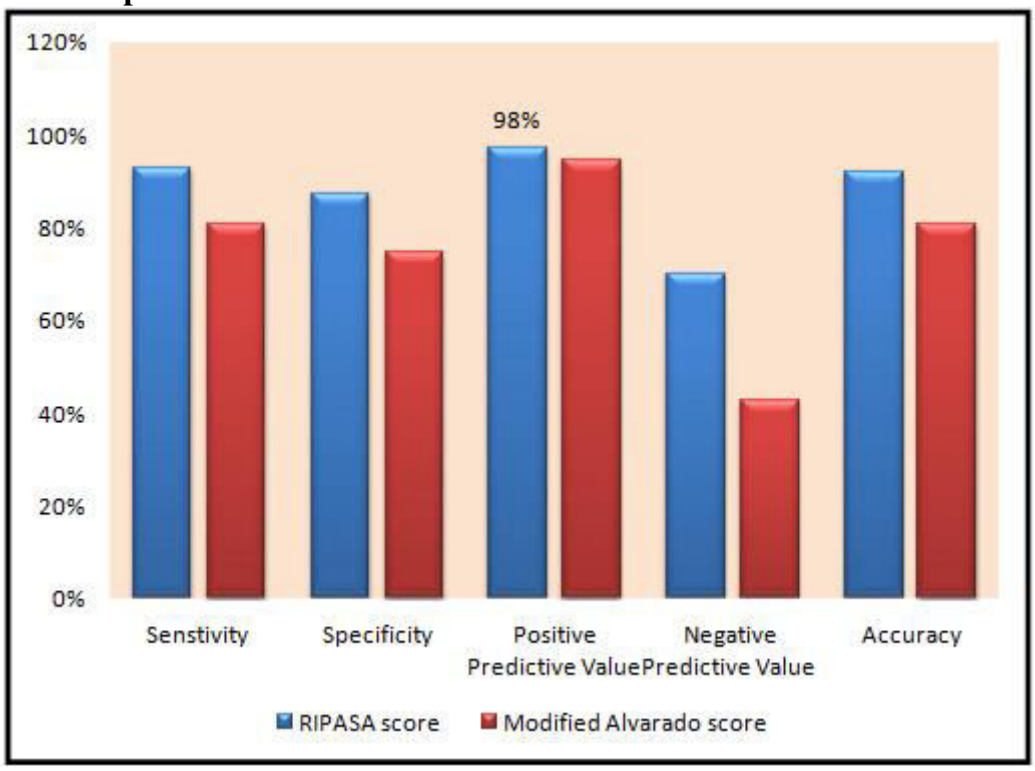
Table 5: Modified Alvarado Score (Sensitivity, Specificity, PositivePredictive Value, Negative Predictive Value and Diagnostic Accuracy)

Sensitivity (%) [TP/(TP+FN)] ×100	Specificity (%) [TN/(TN+FP)] ×100	Positive Predictive Value (%) [TP/(TP+FP)] ×100	Negative Predictive Value (%) [TN/(TN+FN)] ×100	Diagnostic Accuracy (%)
80.95	75.00	94.44	42.86	80.95

Whereas the Modified Alvarado score had a Sensitivity of 80.95% [(34/42)×100], Specificity of 75.00% [(6/8)×100], Positive Predictive Value of 94.44% [(34/36)×100], Negative Predictive Value of 42.86% [(6/14)×100], Diagnostic Accuracy of 80.95%

Figure 1: Comparison of RIPASA and Modified Alvarado score



Discussion

The concept of clinical scoring systems have beenintroduced, multiple studies have been done in search of the most sensitive, specific and diagnostically accurate clinical score to aid in the diagnosis of acute appendicitis Alvarado is one of the most well-known and studied scores for acute appendicitis. Its modification, Modified Alvarado Scoring System (MASS) has been equally in common use. As this is the most popular and commonly used scoring system, we planned to compare the newer scoring system (RIPASA) with it, and study its efficacy in terms of sensitivity, specificity and diagnostic accuracy among other factors.

Table 6: Comparison of current study with other studies (Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic accuracy of RIPASA score)

STUDY	SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
Chong CF et al (2010)[7]	98%	81.3%	85.3%	97.4%	91.8%
Nanjundaiah N et al (2012)[8]	96.2%	90.5%	98.9%	73.1%	91.8%

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Alnjadat I etAl (2013)[9]	93.2%	61.8%	92.2%	64.9%	91.5%
Singla S et al(2016)[10]	95.6%	80%	-	-	94.67%
Shuaib A et al(2017)[11]	94.5%	56%	97.2%	78.5%	-
Karami MY et al(2017)[12]	93.18%	91.67%	-	-	-
Damburaci et al(2018)[13]	94%	88%	-	-	85.2%
Rao KD et al (2021)[14]	91.04%	71.42%	96.82%	45.45%	89.14%
Pachya U et al (2021)[15]	98.71%	80%	87.46%	88.89%	96.6%
PRESENT STUDY	**92.86%**	**87.50%**	**97.50%**	**70.00%**	**92%**

In our study, a cut off of 7.5 was used for RIPASA scoring, which revealed a high Sensitivity of 92.86% which was almost comparable to other studies like those done by Chong CF et al[7] (2010) with 98%, Nanjundaiah N et al[8] (2012) 96.2%, Alnjadat I et al[9] (2013)93.2%, Singh S et al[10] (2016) 95.6%, Shuaib et al[11] (2017) 9\ Karami MY et a[12] (2017) 93.18%, Damburaci et al[13] (2018) 94%, 98.4%, Rao KD et al[14] (2021) 91.04% and Pachya U et al[15] (2021) 98.71%. The Specificity of RIPASA score in our study was found to be 87.50% which was almost comparable to studies done by Chong CF etal[7] (2010) with the value of 81.3%, Singla S et al[10] (2016) 80%, Damburaci et al[13] (2018) 88%, Pachya U et al[15] 2021) 80%. Our study had better values when compared with other studies like those done by Alnjadat I et al[9] (2013) with a value of 61.8%, Shuaib et al[11] (2017) 56%, Rao KD et al[14] (2021) 71.42%. Our study had lower values as when compared with other studies like thosedone by Nanjundaiah N et al[8] (2012) 90.5% and Karami MY et al[12] (2017) 91.67%.

Our study had Positive Predictive Value of 97.50% which was almost comparable to other studies which had 98.9% in Nanjundaiah Net al[8] (2012), 92.2% in Alnjadat I et al[9] (2013), 97.2% in Shuaib et al[11] (2017), 96.82% in Rao KD et al[14] (2021). Our study had better values when compared with other studies like those done by Chong et al[7] (2010) with a value of 85.3% and Pachya Uet al[15] (2021) with 87.46%.

Our study had Negative Predictive Value of 70.00% which was almost comparable to other studies like those done by Nanjundaiah N et al[8] (2012) with the value of 73.15%, Shuaib et al[11] (2017) with 78.5%. Our study had better valueswhen compared with other studies like those done by Alnjadat I et al[9] (2013) with the value of 64.9%, Rao KD et al[14] (2021) 45.45%. Our study had lower values as when compared with other studies like thosedone by Chong CF et al[7] (2010) with a value of 97.4% and Pachya U etal[15] (2021) with 88.89%.

The Diagnostic Accuracy of our study was 92.00% which was almost comparable with other studies done by Chong CF et al[7] (2010) with the value of 91.8%, Nanjundaiah N et al[8] (2012) 91.8%, Alnjadat[9] (2013) 91.5%, Singla S et al[10] (2016) 94.67, Damburaci et al[13] (2018) 85.2%, 92%, Rao KD et al[14] (2021) 89.14% and Pachya U et al[15] (2021) 96.6%.

Table 7 Comparison of present study with other studies (Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Diagnostic accuracy of Modified Alvaradoscore)

STUDY	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Accuracy (%)
Singla A et al(2016)[10]	53%	100%	-	-	-
Shuaib A et al(2017)[11]	82.8%	56%	89.3%	42.4%	74.3%
Peyvasteh M etal(2017)[16]	91.3%	38.4%	87.7%	51.2%	-
Damburacı et al(2018)[13]	88%	69%	-	-	-

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Rao KD et al(2021)[14]	85.07%	57.14%	95%	28.57%	82.44%
PRESENT	**80.95%**	**75.00%**	**94.44%**	**42.86%**	**80.95%**

Analyzing both RIPASA and Modified Alvarado score, it was found that both RIPASA and Modified Alvarado score were easy to perform as they mainly relied upon clinical symptoms and signs, along with basic laboratory investigations, and they did not need elaborate investigations. As RIPASA had more number of parameters compared with Modified Alvarado score, subjectively it felt like it summarized the patient's clinical condition better.

Conclusion

So, we finally conclude that the results of RIPASA scoring system in comparison to Modified Alvarado scoring system in terms of Sensitivity, Specificity, PPV, NPV, Diagnostic accuracy and NAR are better in our study. Though Modified Alvarado score is a routinely used scoring system for the diagnosis of Acute Appendicitis worldwide, it has found to be lacking in its Sensitivity, Specificity, PPV, NPV, Diagnostic accuracy and NAR as compared to RIPASA score in our study. So, RIPASA score is a better diagnostic tool for the diagnosis of Acute Appendicitis.

References

1. Hamilton Bailey's "Emergency Surgeries", 12th Ed, 1995; 438- 51.
2. Cervellin G, Mora R, Ticinesi A, Meschi T, Comelli I, Catena F et al. Epidemiology and outcomes of acute abdominal pain in a large urban Emergency Department: retrospective analysis of 5,340 cases. Ann Transl Med. 2016 Oct;4(19):362-70.
3. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem sguidelines. World J EmergSurg. 2020 April;15(1): 27-49.
4. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med. 1986 May;15(5):557–64.
5. Kalan M, Talbot D, Cunliffe WJ, Rich AJ. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study. Ann R Coll Surg Engl. 1994 Nov;76(6):418- 9.
6. 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 J2010 March;51(3):220-5.
7. Chong CF, Thien A, Mackie AJA, Tin AS, Tripathi S, Ahmad MAA et al. Evaluation of the RIPASA Score: a new appendicitis scoring system for the diagnosis of acute appendicitis. Brunei IntMed J 2010 June;6(1):17-26
8. Nanjundaiah N, Mohammed A, Shanbhag V, Ashfaque M and Priya SA. A comparative study of RIPASA score and ALVARADO score in the diagnosis of Acute Appendicitis. Journal of Clinical and Diagnostic Research. 2014 Nov;8(11): NC03-NC05.
9. Alnjadat I, Abdallah B. Alvarado versus RIPASA score in diagnosing acute appendicitis. Rawal Medical Journal. 2013 April-June;38(2):147-51.
10. Singla S, Singh M, Singla D. A comparison between modified Alvarado score and RIPASA score in the diagnosis of acute appendicitis. Updates Surg. 2016 Dec; 68(4):351-5.
11. Shuaib A, Shuaib A, Fakhra Z, Marafi B, Alsharaf K, Behbehani. A Evaluation of modified Alvarado scoring system and RIPASA scoring system as diagnostic tools of acute appendicitis. World JEmerg Med. 2017 July;8(4):276-80.
12. Karami MY, Niakan H, Zadebagheri N, Mardani P, Shayan Z, Deilami I. Which One

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is Better? Comparison of the Acute Inflammatory Response, Raja Isteri Pengiran Anak Saleha Appendicitis and Alvarado Scoring Systems. Ann Coloproctol. 2017 Dec;33(6):227-31.
13. Damburaci N, Sevinç B, Güner M, Karahan Ö. Comparison of Raja Isteri Pengiran Anak Saleha Appendicitis and modified Alvarado scoring systems in the diagnosis of acute appendicitis.ANZ Journal of Surgery. 2020 April;90(4):521-4.
14. Rao KD, Harika NS, Narayana SV, Kumar V, Kumar Yadav CP, Kiran SHU et al. A comparative study on RIPASA and modified Alvarado score in the diagnosis of acute appendicitis in tertiary care hospital. International Surgery Journal. 2021March:8(3); 944-8
15. Pachya U, Shrestha SR, Pokharel YR, Thapa A. A Comparative Study of Raja Isteri Pengiran Anak Saleha and Alvarado Scoresto Diagnose Acute Appendicitis. J Nepal Health Res Counc. 2021 Apr 23;19(1):111-4.
16. Peyvasteh M, Askarpour S, Javaherizadeh H, Besharati S. Modified alvarado score in children with diagnosis of appendicitis. Arq Bras Cir Dig. 2017 Jan-Mar;30(1):51-2.