

Comparative Evaluation of RIPASA and Paediatric Appendicitis Score in Children with Acute Appendicitis

Sana Viqar, Muhammad Amjad Chaudhary

Abstract

Objective: To evaluate the diagnostic accuracy of Raja Isteri Pengiran Anak Saleha Appendicitis in children with acute appendicitis, and comparing its accuracy with Paediatric Alvarado score.

Method: The prospective, observational study was conducted at the Paediatric Surgery Department, Children's Hospital, Pakistan Institute of Medical Sciences, Islamabad, Pakistan, from January 2024 to May 2025. Raja Isteri Pengiran Anak Saleha Appendicitis score and Paediatric Alvarado score were calculated in children presenting with right iliac fossa pain. Sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy and area under receiver operating characteristic curve were obtained for both scores, and compared with the gold standard of histopathological findings. Data was analysed using SPSS 27.

Results: Of the 120 children with mean age 8.30 ± 2.7 years, 87(72.5%) were boys and 33(27.5%) were girls. Negative appendectomy was noted in 12(10%) patients. Of them, 9(75%) patients had both low Raja Isteri Pengiran Anak Saleha Appendicitis and Paediatric Alvarado scores ($p < 0.001$). Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of Raja Isteri Pengiran Anak Saleha Appendicitis score were 86.1%, 75.0%, 96.9%, 37.5% and 85%, respectively. The corresponding values for Paediatric Alvarado score were 68.5%, 91.7%, 98.7%, 24.4% and 70.8%, respectively. For Raja Isteri Pengiran Anak Saleha Appendicitis score, the area under the receiver operating characteristic curve was 0.92. There was a significant association of Raja Isteri Pengiran Anak Saleha Appendicitis score with perforated appendicitis ($p < 0.05$).

Conclusion: Raja Isteri Pengiran Anak Saleha Appendicitis was found to have a greater sensitivity and accuracy in diagnosing acute appendicitis in children, while Paediatric Alvarado score was more specific. With the help of Raja Isteri Pengiran Anak Saleha Appendicitis score, negative appendectomies in children may be avoided.

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Introduction

Acute appendicitis is one of the most common surgical emergencies in both adults and children. Children may present with vague symptoms, leading to a delay in diagnosis, and, hence, a higher rate of perforation in the appendix.¹ Diagnosis of acute appendicitis in children may be challenging which causes difficulty in deciding the course of management. Various scoring systems have been proposed to accurately diagnose acute appendicitis. The Alvarado score and the Paediatric Alvarado score (PAS) have been commonly used in paediatric population.² However, their sensitivity (Sn), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV) results have not been satisfactory.³ The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score is a new diagnostic scoring system developed at the Department of Surgery, Raja Isteri Pengiran Anak Saleha Hospital, Darussalam,

Brunei.⁴ This scoring system was initially designed for use in Asian population. It consists of 15 parameters, including some parameters missing in the Alvarado score, such as age, gender and duration of symptoms prior to presentation, which were shown to affect the Sn and Sp of the Alvarado scoring system in diagnosing acute appendicitis.⁴ Initial results of RIPASA in the adult population were found to be promising, with high sensitivity and specificity. RIPASA scoring was also studied in non-Asian countries, and showed similarly high Sn, Sp, PPV and NPV values.⁵ Although the RIPASA score was initially conceived for adult population, studies have evaluated its predictive value in the paediatric population, and reported a high Sn, Sp and accuracy as well as superior results compared to Alvarado and PAS scores in acute appendicitis in children.^{6,7} All the parameters in RIPASA score are simple, quick and easy to obtain without needing any costly investigation. The current study was planned to evaluate the predictive value of RIPASA score in children with acute appendicitis by comparing the score with gold standard histopathological findings, and by comparing RIPASA score's diagnostic performance with PAS.

Department of Paediatric Surgery, The Children's Hospital, Pakistan Institute of Medical Sciences, Islamabad, Pakistan.

Correspondence: Sana Viqar. e-mail: sana.viqar27@gmail.com

ORCID ID: 0000-0001-7747-208X

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Patients and Methods

The prospective, observational study was conducted at the Paediatric Surgery Department, Children's Hospital, Pakistan Institute of Medical Sciences (PIMS), Islamabad, Pakistan, from January 2024 to May 2025. After approval from the institutional ethics review committee, the sample size was calculated using the World Health Organisation (WHO) calculator⁸ with 95% confidence interval (CI) and 10% precision based on Sn (82.75% and Sp (90%) taken from a reference study⁷ and disease prevalence (d) from another study.⁶

$$n = \frac{Z^2 \times Sn \times (1 - Sn)}{d^2 \times P} \quad n = \frac{Z^2 \times Sp \times (1 - Sp)}{d^2 \times (1 - P)}$$

The sample size was inflated by about 50%. The sample was raised using non-probability consecutive sampling technique. All patients aged up to 12 years presenting with complaints of right iliac fossa (RIF) pain and in whom acute appendicitis was suspected were included. All those outside the age range, those with history of appendectomy, and those previously conservatively managed for right lower pain were excluded. The patients were evaluated by paediatric surgeons in the emergency room (ER), and the checklist included RIPASA and PAS parameters.^{2,4} The scoring of the parameters were kept confidential to avoid bias. The questionnaire also included demographic details, duration of symptoms and ultrasound findings. The patients were admitted to the surgical floor, and decision to proceed with surgery was taken by the registrar on call. The questionnaire data was compared with intraoperative findings. Histopathology report, length of hospital stay (LOS) and postoperative complications, if any, were also noted. The cut-off value for RIPASA score was 7.5 and for PAS it was 7. The RIPASA score was further divided into low (<7.5), intermediate high (7.5-12) and very high (>12) categories. The PAS score was categorised as low (<4), moderate (5-6) and high (>equal 7).^{2,4}

Data was analysed using SPSS 27. Categorical variables were expressed as frequencies and percentages. Numerical variables were expressed as mean±standard deviation. One-way analysis of variance (ANOVA) was not used for analysis of the three RIPASA/PAS subgroups. Histopathological findings were used as the gold standard to determine the positive and negative appendectomy. The diagnostic performance of RIPASA and PAS scores were tested against this gold standard, and Sn, Sp, PPV, NPV, accuracy (validity parameter) and area under the receiver operating characteristic (ROC) curve (C-statistic) were obtained for both the scores. Using a 2×2 contingency

table, true positive (TP), true negative (TN), false positive (FP) and false negative (FN) values were used and Sn was defined as TP/(TP + FN), Sp as TN/(TN + FP), PPV as TP/(TP + FP), NPV as TN/(TN + FN), and overall diagnostic accuracy as (TP + TN)/(TP + FP + FN). Independent sample t-test was used to see the association of negative appendectomy (independent variable) with mean RIPASA and PAS scores (dependent variables). Chi square test was used to assess the association between categorical variables, including negative appendectomy and perforation of appendix with RIPASA score ≥7.5 or <7.5, and PAS ≥7 and <7. P<0.05 was considered statistically significant.

Results

Of the 120 patients, 87(72.5%) were males and 33(27.5%) were females. The overall mean age was 8.30±2.7 years (range: 1.5-12 years). The mean duration of symptoms was 2.87±2.3 days (range: 1-14 days) and mean LOS was 3.3±1.8 days (range: 1-16 days). Appendectomy was performed in all 120(100%) patients. While a simple Lanz incision was utilised in 105(87.5%) patients, 15(12.5%) required explorative laparotomy approach when intraoperative difficulty necessitated a wider surgical access. Ultrasound was able to visualise the appendix in 55(48.7%) cases. Intraoperative findings of the appendix were noted (Figure 1). Appendicolith was noted in 13(10.8%) patients, and, of them, 8(61.5%) were found in perforated appendix. No complications were seen in 109(90.8%) patients, while 7(5.8%) developed wound infection, and 1(0.8%) each had incisional hernia and paralytic ileus, and 2(1.7%) had adhesive obstruction. Overall, 4(3.3%) patients were readmitted and 2(1.7%) underwent exploration for adhesive obstruction. Out of the total sample, 12(10%) cases had normal appendix, or negative appendectomy. On histopathology, 63(52.5%) cases had acute appendicitis and 45(37.5%) had perforated appendix.

Mean RIPASA score was 8.90±1.82 (range: 5.0-13.0) with mode value 10.5. Mean PAS score was 6.51±1.82 (range 2.0-10.0), with mode value 8.0. Frequency of patients with low, intermediate and very high RIPASA score was 25(20.8%),

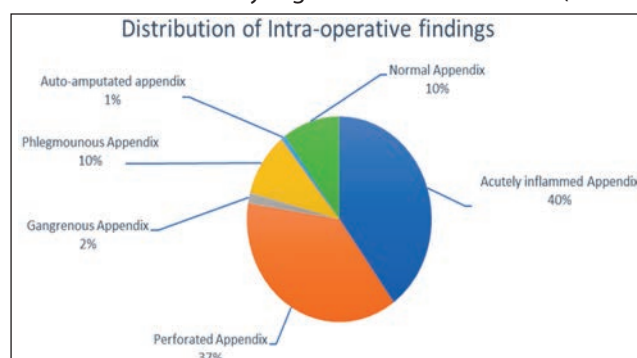


Figure-1: Distribution of intraoperative findings.

93(77.5%) and 2(1.7%), respectively. Low, moderate and high PAS scores were noted in 23(19.2%), 23(19.2%) and 74(61.7%) patients, respectively. Of the 12(10%) patients with negative appendectomy, 9(75%) had both low RIPASA and low PAS scores ($p<0.001$). The distribution of RIPASA and PAS scores with histopathological findings of appendix were noted (Table).

Sn, Sp, PPV and NPV of RIPASA score was 86.1%, 75.0%, 96.9%, 37.5%, respectively. The corresponding values for PAS scores were 68.5%, 91.7%, 98.7% and 24.4%, respectively. The accuracy of RIPASA and PAS scores was 85% and 70.8%, respectively. All these values were statistically significant ($p<0.05$). Both RIPASA and PAS scores were positively correlated (0.782, $p<0.001$). Using ROC for RIPASA score, the area under the curve (AUC) was 0.919 (95%CI: 0.86-0.98) and for PAS score the AUC was 0.905 (95%CI: 0.82-0.98) (Figure 2). The difference between the AUCs for the two scores was not significant ($p>0.05$).

Out of the 45(37.5%) perforated appendix, 44(97.8%) had RIPASA score >7.5 ($p<0.001$) and 36(80%) had a PAS score >7 ($p<0.003$). Perforated appendix was more common in patients having younger age ($p<0.001$) and longer LOS ($p<0.001$) compared to the non-perforated group. RIPASA and PAS scores were both higher in perforated appendix group compared to non-perforated group; 9.86 ± 1.25 vs 8.33 ± 1.88 for RIPASA, and 7.29 ± 1.41 vs 6.05 ± 1.89 for PAS ($p<0.001$).

Table: Relation of RIPASA and PAS score with histopathological findings [n (%)].

	Appendicitis	Negative Appendectomy
RIPASA Score		
≥ 7.5	93 (86.1)	3(25)
< 7.5	15(13.9)	9 (75)
PAS Score		
≥ 7	74 (68.5)	1 (8.3)
< 7	34 (31.5)	11 (91.7)

RIPASA: Raja Isteri Pengiran Anak Saleha Appendicitis, PAS: Paediatric Alvarado score.

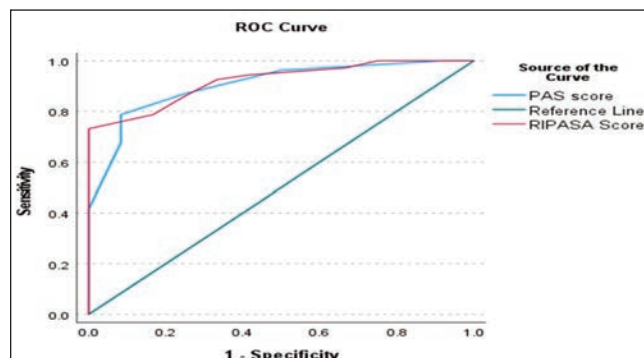


Figure-2: Area under the receiver operating characteristic (ROC) curve for RIPASA and PAS scores.

RIPASA: Raja Isteri Pengiran Anak Saleha Appendicitis, PAS: Paediatric Alvarado score.

Discussion

Acute appendicitis is a common emergency in children. In view of the limited history given by the patients and atypical symptoms of the condition, the diagnosis of acute appendicitis can be challenging. RIPASA score is a new scoring system that has shown to have a high Sn, PPV and accuracy.⁹ It was specifically designed for the Asian population in whom the Alvarado score had low accuracy.¹⁰ Sn and Sp of RIPASA in diagnosing acute appendicitis in adults have been shown up to 98% and 75-76%, respectively, with PPV up to 97% and NPV 68-84.7%.^{11,12}

In most studies investigating scoring systems in diagnosing acute appendicitis, there has been, like the current study, a male preponderance (61-76%)^{6,13,14} and a mean age of 8-11 years.^{6,12} The current study had a negative appendectomy rate of 10% which was comparable to the incidence cited in other studies ranging 4.8-11.4%.^{6,14} In literature, the rate of perforation in appendicitis in children has been reported up to 38.9%, comparable to the current results.¹⁵ The institution at which the current study was conducted is the main tertiary hospital of the federal capital with large number of referrals. This may explain the high number of perforated appendicitis in the study population. In 48.7% of the current cases, appendix was visualised on ultrasound. Detection of appendicitis on ultrasonography has been reported between 2% and 82%, highlighting the operator-dependence nature of such assessment.¹⁶

A study reported Sn, Sp and accuracy of RIPASA as 76.9%, 87.1% and 84.4%, respectively.⁶ This is slightly in contrast to the current study's higher Sn (86%) and lower Sp (75%). Accuracy was comparable. A few other studies have also reported RIPASA to have higher Sn and lower Sp.^{10,17} A study in children reported PA Sn 74.8%, Sp 80%, PPV 98.67%, NPV 13.79% and accuracy 75% with a cut-off value of 6.14. Another study reported PAS Sn 86%, Sp 50% and PPV 90.1% with cut-off value 7.¹⁸ In the current study, PAS Sn was lower with a higher Sp.

A few studies have compared RIPASA with PAS in children with acute appendicitis. Similar to the current study, one earlier study reported higher sensitivity of RIPASA compared to PAS (97% vs 95%) and lower Sp (75% vs 80%).¹² In the earlier study, PPV was high up to 97%, while NPV was 75%. There was no significant difference in accuracy. The mean RIPASA score in that study was 9.4 (8-15) and mean PAS was 8.2 (6-9)¹² both higher than the mean scores in the current study.¹² Another study reported a higher Sn and Sp of RIPASA compared to PAS (96.7% vs 70% and 84.4% vs 75%, respectively).¹⁹ The previous study

reported a higher accuracy for RIPASA compared to the current study, and concluded that patients with RIPASA score >7.5 were 5.8 times likely to have acute appendicitis, while for PAS the likelihood was 2.6 times. Similarly, a RIPASA score <7.5 had a likelihood ratio of 0.04.19 In the current study, 75% of the negative appendectomies had low RIPASA and PAS scores. This may suggest that patients with either low RIPASA score or low PAS score must be kept under observation as a conservative approach in order to reduce the likelihood of a negative appendectomy.

In the current study, there was a significant association of RIPASA score ≥ 7.5 with the incidence of perforated appendicitis. This corroborates with the finding reported by an earlier study of a strong correlation between RIPASA score and pathological stage of appendicitis.²⁰

RIPASA score clearly looks like a more accurate tool in diagnosing acute appendicitis than PAS. While values of Sn, Sp, PPV and NPV for different scores have varied in literature due to different cut-off values, RIPASA scores have been mostly reported with a higher Sn and accuracy. The accuracy of RIPASA score in adults has echoed in paediatric population as well.

The current study has limitations of a small sample size, but it does provide valuable evidence in support of the use of RIPASA score in children, and thereby having the potential to reduce the rate of negative appendectomies. Furthermore, is the current study, to the best of our knowledge, is the first in Pakistan to evaluate RIPASA score in children with acute appendicitis and directly comparing it with PAS.

Conclusion

RIPASA score was found to have a higher Sn and accuracy in diagnosing acute appendicitis in children compared to PAS score, which had higher Sp than RIPASA score. A higher RIPASA score may also predict a perforated appendicitis in children. Similarly, a low RIPASA score can predict a negative appendectomy, warranting a watchful period of conservative management for patients with low RIPASA score.

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Conflict of Interest: None.

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References

- Pogorelić Z, Domjanović J, Jukić M, Poklepović Peričić T. Acute appendicitis in children younger than five years of age: diagnostic challenge for pediatric surgeons. *Surg Infect (Larchmt)*. 2020;21:239-45. doi:10.1089/sur.2019.175.
- Goldman RD, Carter S, Stephens D, Antoon R, Mounstephen W, Langer JC. Prospective validation of the pediatric appendicitis score. *J Pediatr*. 2008;153:278-82. doi:10.1016/j.jpeds.2008.01.033.
- Badebarin D, Parsay S, Aslanabadi S. Alvarado vs. Pediatric Appendicitis Score (PAS) in acute appendicitis of children. *Iran J Pediatr Surg*. 2020;6:1-9. doi:10.22037/irjps.v6i1.28077.
- Chong CF, Adi MI, Thien A, Suyoi A, Mackie AJ, Tin AS, et al. Development of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. *Singapore Med J*. 2010;51:220-5.
- Malik MU, Connelly TM, Awan F, Pretorius F, Fiuza-Castineira C, El Faedy O, et al. The RIPASA score is sensitive and specific for the diagnosis of acute appendicitis in a western population. *Int J Colorectal Dis*. 2017;32:491-7. doi:10.1007/s00384-016-2713-4.
- Öztaş T, Asena M. RIPASA versus Alvarado score in the assessment of suspected appendicitis in children: a prospective study. *Ann Pediatr Surg*. 2021;17:65. doi:10.1186/s43159-021-00132-5.
- Roby M, Dastamuar S, Saksono S, Bahar E. Accuracy score on Raja Isteri Pengiran Anak Saleha (RIPASA) and Pediatric Appendicitis (PAS) for diagnosing acute appendicitis in children. *Sriwijaya J Surg*. 2020;3:96-105. doi:10.37275/sjs.v2i2.32.
- Lwanga SK, Lemeshow S. Sample size determination in health studies: a practical manual. Geneva: World Health Organization, 1991; pp-80.
- Thompson G. Clinical scoring systems in the management of suspected appendicitis in children. In: Lander A, editor. *Appendicitis: a collection of essays from around the world*. IntechOpen; 2012. doi:10.5772/25485.
- Nanjundaiah N, Mohammed A, Shanbhag V, Ashfaq K, Priya SA. A comparative study of RIPASA score and ALVARADO score in the diagnosis of acute appendicitis. *J Clin Diagn Res*. 2014;8:NC03-5. doi:10.7860/JCDR/2014/9055.5170.
- Akbar I, Shehzad JA, Ali S. Diagnostic accuracy of RIPASA score. *J Ayub Med Coll Abbottabad*. 2019;31:411-4.
- Abourizk MI, Abd El Hafez EM, Abdelrahman EM, El Hantery MM, Waly MA. Accuracy and sensitivity of RIPASA score in diagnosis of acute appendicitis. *Benha Med J*. 2024. doi:10.21608/bmfj.2024.249337.1953.
- Abo El-Ela MM, Ibrahim SG, Ramadan ME. RIPASA score versus Pediatric Appendicitis Score in diagnosis of acute appendicitis in pediatric patients. *Egypt J Hosp Med*. 2024;97:3410-4. doi:10.21608/ejhm.2024.384063.
- Salahuddin SM, Ayaz O, Jaffer M, Naeem R, Tikmani SS, Mian AI. Pediatric Appendicitis Score for identifying acute appendicitis in children presenting with acute abdominal pain to the emergency department. *Indian Pediatr*. 2022;59:774-7. doi:10.1007/s13312-022-2620-4.
- Meier DE, Guzzetta PC, Barber RG, Hynan LS, Seetharamaiah R. Perforated appendicitis in children: is there a best treatment? *J Pediatr Surg*. 2003;38:1520-4. doi:10.1016/S0022-3468(03)00549-9.
- Douglas CD, Macpherson NE, Davidson PM, Gani JS. Randomised controlled trial of ultrasonography in diagnosis of acute appendicitis, incorporating the Alvarado score. *BMJ*. 2000;321:919-22. doi:10.1136/bmj.321.7266.919.
- Madhushankar L, Rai R, Anirudh V, Krishna AV. Comparison of modified Alvarado and RIPASA scoring systems correlated with intra-operative findings in predicting acute appendicitis. *Int Surg J*. 2021;8:2662-8. doi:10.18203/2349-2902.isj20213593.
- Pogorelić Z, Rak S, Mrklić I, Jurić I. Prospective validation of Alvarado score and Pediatric Appendicitis Score for the diagnosis of acute appendicitis in children. *Pediatr Emerg Care*. 2015;31:164-8. doi:10.1097/PEC.0000000000000375.

19. Chong WCF, Ahmad M, Chong VH. Comparisons of the RIPASA score with the ALVARADO and Paediatric Appendicitis Scores for the diagnosis of acute appendicitis in paediatric patients. *Brunei Int Med J.* 2016;12:10-7.
20. Nanjundaiah N, Mohammed A, Shanbhag V, Ashfaque K, Priya SA. A comparative study of RIPASA score and ALVARADO score in the diagnosis of acute appendicitis. *J Clin Diagn Res.* 2014;8:NC03-5. doi:10.7860/JCDR/2014/9055.5170.

Author Contribution:

SV: Data acquisition, writing, literature review and agreement to be accountable for all aspects of the work.

MAC: Supervision, review and final approval.