

ORIGINAL ARTICLE**A Prospective Comparative Analysis of the Pediatric Appendicitis Score and Alvarado Score for Clinical Diagnosis of Acute Appendicitis in Children**¹Himanshu Tyagi, ²Ram Niwas Dhukiya¹Assistant Professor, Department of Pediatrics, Rajshree Medical Research Institute, Bareilly, Uttar Pradesh, India;²Assistant Professor, Department of General Surgery, Rajshree Medical Research Institute, Bareilly, Uttar Pradesh, India**ABSTRACT:**

Background: The Alvarado score and pediatric appendicitis scoring systems establish a threshold score that guides decision-making. Above this score, surgery is typically recommended, while below it, observation suffices. This study was conducted among pediatric patients presenting in a surgical emergency setting with right lower abdominal pain and exhibiting signs and symptoms suggestive of acute appendicitis. **Methods:** This study was carried out on children who presented in a surgical emergency setting with right lower abdominal pain and displayed signs and symptoms indicative of acute appendicitis. Each patient enrolled in the study was assigned clinical scores using both the Alvarado scoring system and the pediatric appendicitis scoring system. Statistical analyses were performed for both scoring systems with a focus on the cutoff score of 7. **Results:** The study included a total of 200 patients, comprising 140 males and 60 females. Among these, 94 patients were categorized as part of the operated group (scoring seven or more on the PAS/Alvarado systems), and 106 patients were part of the observational group (scoring less than seven). Within the observational group, 78 patients (73.58%) experienced a successful resolution of symptoms during observation, without any complications, while 28 patients (26.41%) required surgery due to an increase in their PAS/Alvarado scores during the observational period. Out of the total 200 patients, 122 underwent surgery, with 94 in the "seven or more than seven" group and 28 in the "less than seven" group. Among these operated patients, the histopathology reports confirmed acute appendicitis in 100 cases and ruled out appendicitis in 22 cases. Using the Alvarado scoring system, 86 patients fell into the "seven or more than seven" group, while 36 patients were classified as "less than seven." At the cutoff value of 7, the Alvarado score achieved 78 accurate diagnoses of appendicitis and 8 cases of unnecessary appendectomies. **Conclusion:** The diagnostic accuracy values indicate that the pediatric appendicitis score (PAS) outperformed the Alvarado score in diagnosing acute appendicitis in the pediatric population.

Keywords: Pediatric appendicitis, Alvarado score, Pediatric appendicitis score

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INTRODUCTION

Acute appendicitis is a prevalent intra-abdominal surgical emergency, and the surgical removal of the appendix (appendectomy) ranks among the most frequently performed procedures in abdominal surgery¹. Approximately 1 to 10% of children seen in surgical emergency departments with acute abdominal symptoms are diagnosed with acute appendicitis. The early and accurate diagnosis of this condition holds the potential to reduce the rate of appendiceal perforation and its associated complications.

Swift and precise diagnoses, classifying patients as either having or not having appendicitis, based on a pediatric appendicitis score, have the potential to streamline the use of resources and reduce emergency department time, as well as avoid the subsequent costs and risks of further². The primary scoring systems used for this purpose include the Heidelberg Appendicitis Score (HAS), the Pediatric Appendicitis Score (PAS), the Alvarado Score, and the Tzanakis Score. While both the HAS and PAS are tailored for

use in pediatric patients, the Alvarado and Tzanakis Scores were originally developed for a more general patient population. The Alvarado score is a widely used scoring system primarily designed for diagnosing acute appendicitis in adults³. However, recent research has extended its application to the pediatric population. In addition, a pediatric-specific scoring system called the Pediatric Appendicitis Score (PAS) was introduced by Samuel in 2002. Both these scoring systems assign scores based on clinical signs, symptoms, and laboratory findings, helping healthcare providers assess the likelihood of acute appendicitis. In these scoring systems, there is a predetermined reference score above which the recommendation is to proceed with surgery (appendectomy) to treat appendicitis⁴. Conversely, when a patient's total score falls below a certain threshold, it is generally considered appropriate to observe the patient rather than opting for immediate surgery. The present study was conducted over the course of one year and focused on children who presented in a surgical

emergency setting with symptoms such as right lower abdominal pain and clinical indications suggestive of acute appendicitis. The study aimed to assess the effectiveness of these scoring systems in accurately identifying cases where surgical intervention was warranted based on the assigned scores⁵. By implementing these scoring systems, healthcare providers can make more informed decisions regarding the need for surgery, optimizing patient care and treatment outcomes.

MATERIALS AND METHODS

The present study was conducted among children who presented in a surgical emergency setting with symptoms of right lower abdominal pain, indicative of acute appendicitis. Prior to their inclusion in the study, written informed consent was obtained from the parents or legal guardians of the children. The study focused on children aged between 4 and 12 years who had a history of symptoms lasting less than 72 hours⁶. The study had specific exclusion criteria, which included children with co-morbidities, complicated appendicitis cases, and those exhibiting an appendicular mass upon clinical examination or initial ultrasonography at the time of presentation. Each enrolled patient underwent a clinical assessment and was assigned scores based on both the Alvarado scoring system and the Pediatric Appendicitis Score (PAS). The patients were then divided into two groups based on a predetermined cutoff value of 7 for both scoring systems^{7,8}. Patients who scored 7 or higher in both scoring systems were categorized as the "seven or more than seven group." These patients underwent appendectomy, and the histopathology reports from the surgery were reviewed. Patients who scored 7 in one system and less than 7 in the other, or scored less than 7 in both systems, were categorized as the "less than seven group." These patients were admitted to the ward for further evaluation and observation⁹. They were allowed to consume clear liquids orally without the prescription of antibiotics. Data was collected, including the patients' medical history and the use of laboratory samples. Additionally, ultrasonography was performed by a radiologist in the emergency room for each patient to rule out the presence of an appendicular mass or complicated appendicitis. The study aimed to assess the effectiveness of these scoring systems in distinguishing between patients requiring immediate surgery and those who could be observed further without surgery, improving diagnostic and treatment strategies for pediatric appendicitis.

The study involved obtaining samples of the appendix from patients who underwent surgery for histopathological examination. The reports from the Pathology department were reviewed, with the pathologist examining the samples without prior knowledge of the patient's clinical information. Patients who fell into the "less than seven group" based on the scoring systems were admitted to the

ward. Their clinical progress was closely observed¹⁰. During this observation period, the scoring systems were reviewed periodically. Patients who showed improvement and resolution of their symptoms during observation were discharged from the hospital.

For patients in the "less than seven group" whose scoring systems indicated worsening or an increase in their scores during the observation phase, surgical intervention was deemed necessary. These patients then underwent surgery, and their appendix samples were collected and sent for histopathological examination¹¹. The statistical values for the two scoring systems, Alvarado and Pediatric Appendicitis Score (PAS), at the cutoff score of 7, were calculated. These calculations were aimed at assessing the diagnostic accuracy and predictive value of the scoring systems for identifying cases of pediatric appendicitis requiring surgical intervention and those that could be managed conservatively.

RESULTS

This study included a total of 200 patients, comprising 140 males and 60 females. Among them, 94 patients were placed in the operated group ("seven or more than seven group"), and 106 patients were categorized as the observational group ("less than seven group"). In the observational group, 78 patients (73.58%) showed improvement and were successfully managed conservatively, while 28 patients (26.41%) had to undergo surgery due to an increase in their scoring system values (either PAS or Alvarado) during the observation period¹².

Out of the 200 patients, 122 underwent surgery. Specifically, 94 patients were in the operated group (considered "seven or more than seven group"), while 28 patients from the observational group ("less than seven group") required surgery. Among those who underwent surgery, 100 patients were confirmed to have acute appendicitis based on histopathology reports, whereas 22 patients had negative appendectomies, indicating that their appendices were found to be free from inflammation.

With respect to the Alvarado scoring system, 86 patients were in the "seven or more than seven" group, while 36 patients were in the "less than seven" group. When compared to the histopathology results using a cutoff score of 7, the Alvarado score correctly diagnosed appendicitis in 78 cases and resulted in 8 innocent appendectomies (cases where surgery was performed, but no appendicitis was found). Using the pediatric appendicitis scoring system, 94 patients were classified in the "seven or more than seven" group, while 28 patients were placed in the "less than seven" group. At the histopathology cutoff value of 7, the pediatric appendicitis score yielded 86 accurate diagnoses of appendicitis and led to 4 innocent appendectomies (cases where surgery was performed, but no appendicitis was found).

Table 1: Distribution of operated patients according to groups by both scoring systems and type of histopathology

Scoring system	Groups	Histopathology		Total	Grandtotal
		Inflamed	Normal		
Pediatric appendicitis score	Seven and more than seven	86	8	94	122
	Less than seven	14	14	28	
Alvarado score	Seven and more than seven	78	8	86	122
	Less than seven	22	14	36	

DISCUSSION

Abdominal pain is a frequently reported symptom that prompts individuals to seek medical care. Among the various potential causes of acute abdominal pain, acute appendicitis stands out as one of the most prevalent and significant. However, accurately distinguishing appendicitis from other abdominal disorders can be challenging, especially in young children who are not yet able to communicate effectively due to their age or lack of verbal skills. The study included 200 patients, with 140 being male and 60 female participants¹³. Out of these, 94 patients fell into the "operated group," which consisted of individuals scoring seven or more on either the PAS or Alvarado scoring systems, while 106 patients belonged to the "observational group," with scores of less than seven on both scoring systems. Among the observational group, 78 patients (73.58%) improved during observation without any complications, while 28 patients (26.41%) required surgery due to an increase in their PAS or Alvarado scores¹⁴.

Out of the total 200 patients, 122 underwent surgery, with 94 of them in the operated group and 28 in the observational group¹⁵. According to histopathology reports, 100 cases were confirmed as acute appendicitis, while 22 cases were considered negative appendectomies. When evaluating the Alvarado scoring system, 86 patients scored seven or more and 36 patients scored less than seven. Using a cutoff value of 7, the Alvarado score correctly identified 78 cases of appendicitis and resulted in 4 cases of unnecessary appendectomies. In the case of the pediatric appendicitis scoring system, 94 patients scored seven or more, while 28 patients scored less than seven¹⁶. At a histopathology cutoff value of 7, the pediatric appendicitis score accurately diagnosed 86 cases of appendicitis and led to 8 unnecessary appendectomies.

A retrospective comparison of appendectomies for appendicitis versus non-inflamed appendix indicates that the utilization of a scoring system could have led to a reduction in the rate of negative appendectomies by one third¹⁷. This finding underscores the potential benefit of employing a scoring system, such as the Alvarado or pediatric appendicitis scoring system, to enhance the accuracy of diagnosing appendicitis, thus avoiding unnecessary surgeries and the associated risks and costs. Scoring systems can aid in distinguishing between cases that require surgical intervention and those that can be managed

conservatively, ultimately improving patient care and resource allocation.

Samuel developed the Pediatric Appendicitis Score (PAS) in 2002 based on a cohort of 1170 children aged 4 to 15 years. When the PAS was tested on the same population, it demonstrated promising diagnostic performance. The sensitivity of the PAS was 100%, meaning it accurately identified all cases of appendicitis. The specificity was 92%, indicating that it was effective in correctly identifying cases without appendicitis^{18,19}. The positive predictive value (PPV) was 96%, implying that a high percentage of patients with a PAS score of 6 or higher indeed had appendicitis. The negative predictive value (NPV) was 99%, suggesting that a PAS score of 5 or less was highly predictive of the absence of appendicitis. In conclusion, Samuel's study found that patients with a PAS score of 5 or lower were unlikely to have appendicitis, while a score of 6 or higher was strongly associated with appendicitis. The PAS has since become a valuable tool for clinicians in diagnosing appendicitis in pediatric patients.

CONCLUSION

The study's findings indicate that the Pediatric Appendicitis Score (PAS) outperformed the Alvarado score in diagnosing acute appendicitis in the pediatric population, as evidenced by higher values of diagnostic accuracy. This suggests that the PAS may be a more reliable and effective tool for assessing appendicitis in children compared to the Alvarado score.

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