Diagnostic Accuracy of the RIPASA Score in Suspected Acute Appendicitis in Adults: A Cross-sectional Study Comparing it with Histopathological Findings from Bagalkot, India

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ABSTRACT

Introduction: Acute appendicitis remains the most commonly occurring surgical emergency, with a prevalence rate of approximately 8% among individuals aged 10-30 years [1]. According to a study conducted by Singh A et al., the prevalence of acute appendicitis is also approximately 8% in the Indian population [2]. The overall prevalence of acute appendicitis was reported as 44.27% (95% CI: 38.366, 50.180; [2=93.9%]) [3]. Subgroup analysis revealed that the prevalence of acute appendicitis in Ethiopia was 36.81% in Amhara, 53.20% in Tigra, 41.30% in Addis Ababa, and 46.54% in Oromia [5].

Leonardo da Vinci depicted the appendix in his anatomical drawings, making him the first person to do so [4]. The appendix develops as an outpouching from the caecal bud during the descent of the colon around the sixth week of gestation [4,5]. It can have various positions, including retrocaecal, retrocolic, pelvic, subcaecal, pre-ileal, and post-ileal, with retrocaecal, retrocolic, and pelvic being the most common [6,7].

The classic Alvarado total score is 10 and includes the left shift of neutrophil maturation (score 1). However, in 1994, Kalan excluded this left shift and created a modified score known as MAS (Modified Alvarado scoring), which is a simple aid for the diagnosis of acute appendicitis [8]. In 2010, a novel scoring system called RIPASA was developed specifically for the diagnosis of acute appendicitis in the Asian population [9]. Anwer M et al., formulated this scoring system to provide an efficient, simple, and reliable diagnostic tool with high accuracy. They also found that ultrasonography is ineffective in ruling out negative appendicitis [10].

Chong CF et al., described a set of 15 parameters, and a score of 7.5 or higher is considered as the cut-off value for diagnosing acute appendicitis that requires surgery [11]. This scoring system also reduces the rate of unnecessary appendicectomies. The RIPASA system was found to be the most suitable score for pregnant patients [12].

The RIPASA test demonstrated higher sensitivity than the Alvarado test, while the Alvarado test showed greater specificity. RIPASA also exhibited a larger Area Under the ROC Curve (AUC) compared to Alvarado. The diagnostic odds ratio was higher for RIPASA than for Alvarado [13]. Other scoring systems for acute appendicitis include Izbicki, Ohman, Tzanaki, Lintula, Eskelinen, Fenyo-Lindberg, Pediatric Appendicitis Score, and Appendicitis Inflammatory Response scoring systems [14,15]. Tzanakis’s score is more sensitive and specific than the scores of Alvarado, RIPASA, Eskelinen, and Ohmann in diagnosing Acute Appendicitis (AA). Based on the AUC, Tzanakis’s score outperformed Ohmann’s and Alvarado’s scores in diagnosing AA. Tzanakis’s scoring system is useful for screening purposes. The Ohmann score is a simple test that can aid in diagnosing AA, while the Eskelinen score is helpful in ruling out AA. Erdem et al., found that the sensitivity and specificity of the Ohmann and Eskelinen scores were 96% and 42%, and 100% and 44%, respectively. Ohmann and Eskelinen’s scores demonstrated sufficient specificity. However, the Eskelinen score has the disadvantage of involving decimal calculations, which may make it less practical. It may also require additional diagnostic methods such as laboratory testing or ultrasonography [16].

Keywords: Acute appendicectomy, Sensitivity, Specificity, Symptoms, Tenderness, Validity

INTRODUCTION

Acute appendicitis remains the most commonly occurring surgical emergency, with a prevalence rate of approximately 8% among individuals aged 10 to 30 years [1]. According to a study conducted by Singh A et al., the prevalence of acute appendicitis in Ethiopia was 36.81% in Amhara, 53.20% in Tigra, 41.30% in Addis Ababa, and 46.54% in Oromia [5].

Leonardo da Vinci depicted the appendix in his anatomical drawings, making him the first person to do so [4]. The appendix develops as an outpouching from the caecal bud during the descent of the colon around the sixth week of gestation [4,5]. It can have various positions, including retrocaecal, retrocolic, pelvic, subcaecal, pre-ileal, and post-ileal, with retrocaecal, retrocolic, and pelvic being the most common [6,7].

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The RIPASA test demonstrated higher sensitivity than the Alvarado test, while the Alvarado test showed greater specificity. RIPASA also exhibited a larger Area Under the ROC Curve (AUC) compared to Alvarado. The diagnostic odds ratio was higher for RIPASA than for Alvarado [13]. Other scoring systems for acute appendicitis include Izbicki, Ohman, Tzanaki, Lintula, Eskelinen, Fenyo-Lindberg, Pediatric Appendicitis Score, and Appendicitis Inflammatory Response scoring systems [14,15]. Tzanakis’s score is more sensitive and specific than the scores of Alvarado, RIPASA, Eskelinen, and Ohmann in diagnosing Acute Appendicitis (AA). Based on the AUC, Tzanakis’s score outperformed Ohmann’s and Alvarado’s scores in diagnosing AA. Tzanakis’s scoring system is useful for screening purposes. The Ohmann score is a simple test that can aid in diagnosing AA, while the Eskelinen score is helpful in ruling out AA. Erdem et al., found that the sensitivity and specificity of the Ohmann and Eskelinen scores were 96% and 42%, and 100% and 44%, respectively. Ohmann and Eskelinen’s scores demonstrated sufficient specificity. However, the Eskelinen score has the disadvantage of involving decimal calculations, which may make it less practical. It may also require additional diagnostic methods such as laboratory testing or ultrasonography [16].
The aim of the study is to determine the validity and diagnostic efficiency of the RIPASA scoring system for acute appendicitis and compare it with histopathology, which is an innovative aspect of this study.

**MATERIALS AND METHODS**
A cross-sectional study was conducted at Shri Hangal Kumareswara Hospital and Nijalingappa Medical College, Bagalkot, Karnataka, India, from January 2020 to June 2021. Ethical committee clearance was obtained from the institution (IEC approval number: SNMC/IECHSR/2019-20/A-18/1.2), and informed consent was obtained from the participants.

**Inclusion criteria:** Patients of both genders, aged 18 to 60 years, presenting with right iliac fossa pain were included in the study.

**Exclusion criteria:** Patients with a right iliac fossa mass, pregnant women, and those with a previous history of urolithiasis or pelvic inflammatory disease were excluded.

**Sample size calculation:** According to the study conducted by Singh A et al., the diagnostic accuracy of the RIPASA scoring system was reported as 90.5% [2]. Therefore, with a 95% confidence level and 80% power of the study, the sample size was determined to be 90.

**Procedure**
Data were collected from patients admitted with pain in the appendicular area and meeting the inclusion criteria. Detailed history was obtained, and a thorough clinical examination was conducted. Appropriate investigations were performed, and the RIPASA score was calculated [Table/Fig-1] [9]. Appendicectomy was performed based solely on clinical judgment, taking into consideration the RIPASA score. The resected appendix was subjected to histopathological examination.

**Results**
Histopathological findings of the resected appendix revealed areas of hyperemia, congestion, and inflammation with an average increase in diameter of up to 1 cm. Some cases showed pockets of abscess in the mesoappendix and periappendiceal areas in recurrent cases. In chronic cases, few showed gangrenous necrosis.

**Discussion**
Acute appendicitis is a significant surgical emergency worldwide and is often misdiagnosed among all abdominal emergencies. Prompt intervention is required for acute appendicitis [2]. The most characteristic and common symptom is pain that ranges from the umbilical area to the right iliac fossa. Additional symptoms may include fever, abdominal pain, guarding, and anorexia [17]. Approximately 50% of acute appendicitis cases present with imprecise and uncommon symptoms, which hinders accurate diagnosis, even in the modern era [18]. According to a study by Singh TB et al., the diagnostic accuracy of the RIPASA scoring system was reported as 90.5% [2]. Therefore, with a 95% confidence level and 80% power of the study, the sample size was determined to be 90.

**STATISTICAL ANALYSIS**
Categorical data were represented using frequency and percentage. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated to test the validity of the tool. An ROC curve was plotted to assess the area under the curve. A p-value of <0.05 was considered significant. IBM SPSS Version 28.0 for windows was used for statistical analysis.

### RESULTS
The age distribution showed a similar pattern in both sexes, with a peak incidence in the third decade and a mean age of 39.9±6.8 years [Table/Fig-2].

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>21-30</td>
<td>8</td>
<td>4</td>
<td>12</td>
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<tr>
<td>31-40</td>
<td>18</td>
<td>23</td>
<td>41</td>
</tr>
<tr>
<td>41-50</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>&gt;50</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>46</td>
<td>90</td>
</tr>
</tbody>
</table>

**Table/Fig-2**: Age-wise and gender-wise distribution of subjects.

### DISCUSSION
Acute appendicitis is a significant surgical emergency worldwide and is often misdiagnosed among all abdominal emergencies. Prompt intervention is required for acute appendicitis [2]. The most characteristic and common symptom is pain that ranges from the umbilical area to the right iliac fossa. Additional symptoms may include fever, abdominal pain, guarding, and anorexia [17]. Approximately 50% of acute appendicitis cases present with imprecise and uncommon symptoms, which hinders accurate diagnosis, even in the modern era [18]. According to a study by Singh TB et al.,
appendicitis affects both sexes with a male preponderance and most commonly occurs in the second and third decades of life [19]. Murmz H et al., found a sensitivity of 88% and specificity of 67% for the RIPASA score compared to the Alvarado score, which had a specificity of 23% and sensitivity of 59% in the Asian population [20]. Many studies have compared the RIPASA score to the Alvarado score [8,9,13,16,19,21,22]. However, this study did not compare the RIPASA score to the Alvarado score; instead, the authors assessed the diagnostic accuracy of the RIPASA score and compared it to histopathology.

Another study by Karami MY et al., showed that the sensitivity and specificity of the RIPASA scoring system were higher than those of the Alvarado system, i.e., 93.18% and 91.67% compared to 78.4% and 100%, respectively [21]. Nanjundaiah N et al., also demonstrated that the sensitivity of the RIPASA scoring system was higher than that of the Alvarado scoring system for the diagnosis of acute appendicitis, i.e., 96.2% and 58.9%, respectively [22]. According to Karapolat B, the RIPASA scoring system can accurately diagnose acute appendicitis, including the pathological stage, without the use of computed tomography [23]. Bhatnagar SP and Chavan S proved that RIPASA is more efficient [24]. Even in the present study, ultrasonography did not play a significant role.

The diagnostic accuracy of RIPASA for acute appendicitis was 93.18% according to a study conducted by Barman MK et al., [25]. In a study by Singh A et al., the RIPASA sensitivity was 95.89% and specificity was 75.92%, with a diagnostic accuracy of 90.5% [2]. The positive predictive value (PPV) was 91.50% and negative predictive value (NPV) was 87.23%. The mean duration of hospital stay was 4.7 days, and the negative appendectomy rate was 12.35% (22 total cases). According to the RIPASA scoring system, the expected rate of negative appendectomy was 8.5%, resulting in a reduction of the negative appendectomy rate by 3.85%. The study concluded that in an Indian scenario where the majority of the population is rural and middle-class, the RIPASA score is an easy, better, safe, and non-invasive diagnostic tool for acute appendicitis, considering availability and affordability, thereby reducing healthcare costs [2]. Due to the same geographic location, the present study was compared with study by Singh A et al., [2]. Apart from the NPV, the authors obtained very good results and reached the same conclusion.

Validating RIPASA by comparing it with histopathological examination, the authors found a sensitivity of 82%, specificity of 100%, PPV of 100%, and NPV of 16%, with a diagnostic accuracy of 82%. A ROC curve was also plotted, showing an area under the curve of 0.908. According to the study conducted by Chong CF et al., the negative appendectomy rate was 6.9% with a p-value of 0.0007. The cut-off threshold score from the ROC curve was 7.5, with a sensitivity of 88%, specificity of 67%, PPV of 93%, and NPV of 53% [11].

According to the study conducted by Pasumarthi V and Madhu CP, the diagnostic accuracy of the RIPASA score was 73.28%, with a difference of 16.38% compared to the Alvarado scoring system. Both the RIPASA and Alvarado scores had a significant area under the curve (AUC). Out of 116 patients, 17.2% were diagnosed with negative appendicitis and 82.8% were positive for appendicitis. There was a 7% difference between ultrasonography and histopathology, but it was not considered significant [26]. In comparison, the present study showed an AUC of 0.908. After appendicectomy, 87 (97%) cases showed a positive result for appendicitis, with 46 (51.1%) being diagnosed as acute appendicitis. The negative appendectomy rate in the present study was 3%. The RIPASA scoring system demonstrated an accurate diagnosis of acute appendicitis, including the pathological stage [Table/Fig-6].

**References**

C Shobha et al., Accuracy of RIPASA in Acute Appendicitis and Histopathology

• For any images presented appropriate consent has been obtained from the subjects. NA

• Was informed consent obtained from the subjects involved in the study? Yes

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• Financial or other competing interests: None

• Was ethics committee approval obtained for this study? Yes

• Was informed consent obtained from the subjects involved in the study? Yes

• For any images presented appropriate consent has been obtained from the subjects. NA

Plagiarism checking methods:

• Plagiarism-X-Checker: May 06, 2023

• Thenticate Software: Aug 07, 2023 (21%)

Eymology: Author origin

Emendations: 8

Date of submission: May 03, 2023

Date of peer review: Jun 15, 2023

Date of acceptance: Aug 08, 2023

Date of publishing: Sep 01, 2023