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RESEARCH ARTICLE
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The Utility of Alvarado Score, RIPASA Score, NLR, and PLR for Predicting Acute Appendicitis

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Abstract:

Acute appendicitis requires fast and precise diagnosis. Delay in diagnosis will increase the risk of complications, as well as morbidity and mortality. Modalities such as ultrasound or CT scan are not always available. The purpose of this study was to analyze the Alvarado score, RIPASA score, NLR and PLR to predict the diagnosis of acute appendicitis in a type C Hospital. This research is an observational analytic study using a cross-sectional approach, from medical records. The diagnosis is made by surgeon based on clinical, laboratory, imaging findings, then confirmed by surgery and histopathology. From a total of 32 patients, there were 21 patients (66%) with a final diagnosis of acute appendicitis, and 11 patients (34%) with a final diagnosis of non-acute appendicitis. Alvarado score ≥7 has an AUC value of 81.6%, with a sensitivity of 57.14%, a specificity of 81.82%. RIPASA score ≥7.5 has an AUC value of 84.6% with a sensitivity of 80.95%, a specificity of 81.82%. NLR with a cut-off value of >4.49 can be used to detect acute appendicitis, and a cut-off value of >9.13 for perforated appendicitis. PLR with a cut-off value of >172.2 can be used to detect perforated appendicitis.

Keywords: Acute appendicitis; Alvarado Score; Ripasa Score; NLR; PLR

Introduction

Appendicitis is inflammation of the vermiform appendix caused by luminal obstruction. Approximately 7-10% of visits to the Emergency Room (ER) are caused by acute abdominal pain and acute appendicitis is one of the main causes. Acute appendicitis is one of the most common surgical emergencies worldwide.[1,2] The incidence of acute appendicitis is around 5.7-50 patients per 100,000 population per year, with a peak between the ages of 10 and 30.[2] Indonesia has the highest cases of appendicitis in ASEAN with a prevalence of 95 per 1000 population with the number of cases reaching 10 million each year.[3]

Acute appendicitis requires fast and precise diagnosis. Delay in diagnosis will increase the risk of complications, as well as morbidity and mortality.[4] Imaging such as ultrasound or CT-scan can help establish a diagnosis, but these examination modalities are not always available in the emergency department of hospitals in developing countries and the costs are also relatively expensive.[5] Many doctors in the emergency room only depend on the signs and symptoms and simple laboratory tests.[6]

Clinical Prediction Rules (CPR) using a scoring system can be used to predict the diagnosis of acute appendicitis.[7] RIPASA score and Alvarado score have good sensitivity and specificity to help diagnose acute appendicitis.[8] White blood cell count is a simple examination that is cheap and easy to help with diagnosis. The neutrophil-lymphocyte ratio (NLR) is a marker of subclinical inflammation, which can be used with a cut-off value of >4.7 for acute appendicitis and NLR >8.8 for complicated appendicitis.[9] Platelet-lymphocyte ratio (PLR) was also increase significantly in acute appendicitis.[10]

The purpose of this study was to analyze the utility of the Alvarado Score, RIPASA Score, NLR and PLR to predict acute appendicitis in Type C Hospital.

Research Method

This study is an observational analytic study with cross-sectional approach at the Beriman Hospital Balikpapan in September 2022. This study used secondary data from medical records of adult patients over the age of 18 who came to the Emergency Room and hospitalized with a suspected diagnosis of appendicitis, during the period January 2022 to August 2022. Patients with incomplete medical records, patients discharged at their own request, patients with covid-19 coinfection and patients who were referred were excluded from this study.

The diagnosis is made by surgeon based on clinical, laboratory, imaging findings, and confirmed by surgery and histopathology. Patients were grouped based on the final diagnosis into the Acute Appendicitis group and diagnoses other than acute appendicitis were put into the Non-Acute Appendicitis group. Statistical analysis was performed using SPSS Version 25 statistical software.

Results

From January 2022 to August 2022 there were a total of 32 (19 Female, and 13 Male) patients admitted with initial diagnosis of suspected acute appendicitis. In Figure 1, the most common age group was between the ages of 18-25 years, 16 patients (50%). 21 patients (66%) was confirmed acute appendicitis, and 11 patients (34%) was non-acute appendicitis. Patients with acute appendicitis were mostly female, 13 cases (62%), and in the age range of 18-25, 12 cases (57%). 11 patients (52%) had perforated appendicitis. Gynecological mass and gynecological infection were the most common diagnoses in non-appendicitis group in this study.

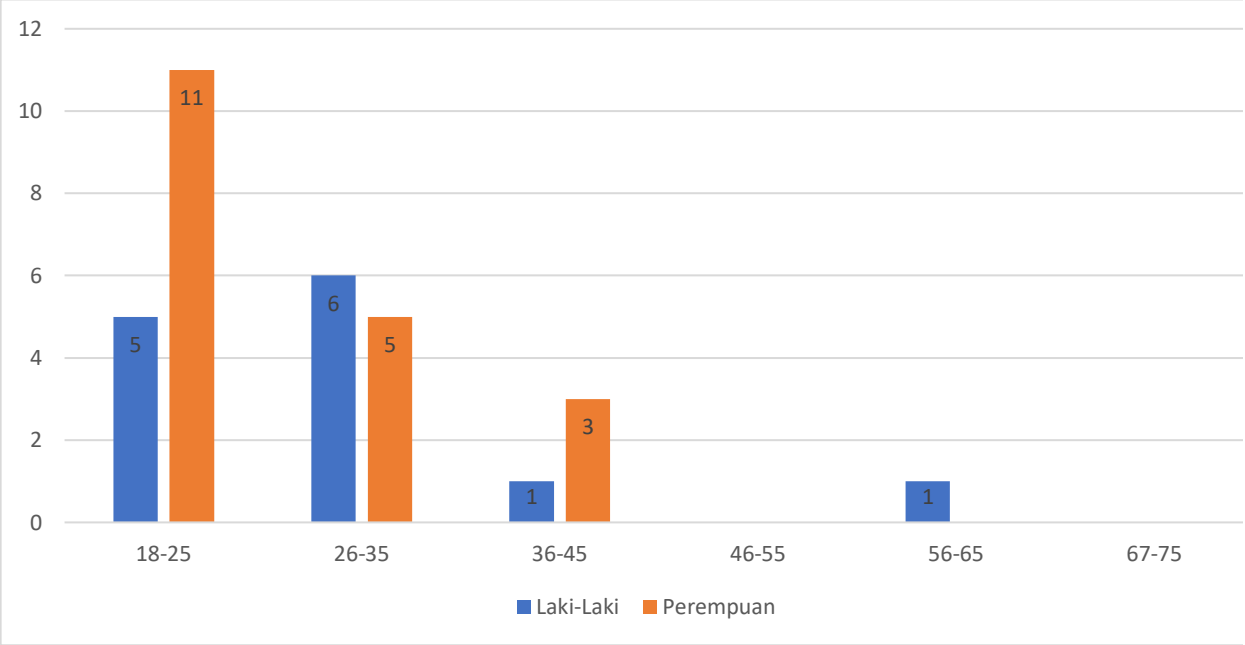


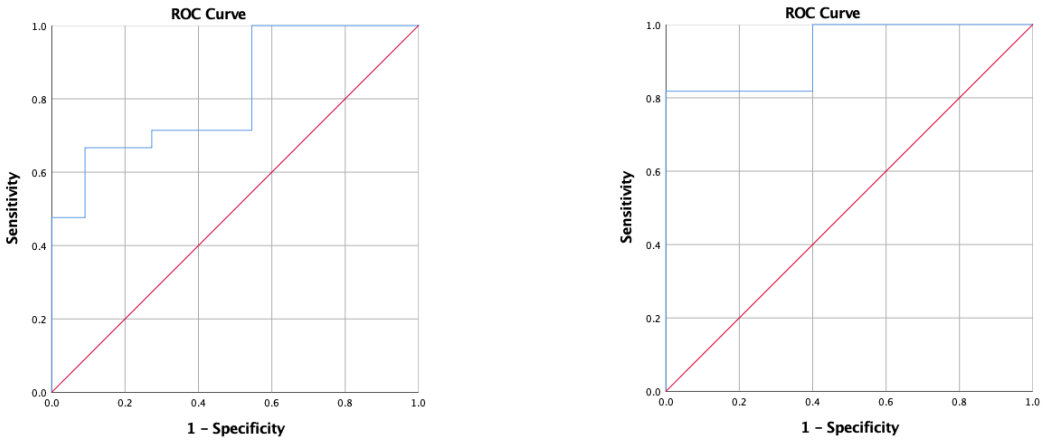
Figure 1 Subject Characteristics Diagram

Alvarado Score

At the optimal threshold value ≥7 [11], Alvarado scoring system had a sensitivity of 57.14%, a specificity of 81.82%, a positive predictive value of 85.71%, negative predictive value of 81.82%. Using the ROC curve, the AUC value is 81.6% with a CI of 95% (66.5%-96.7%).

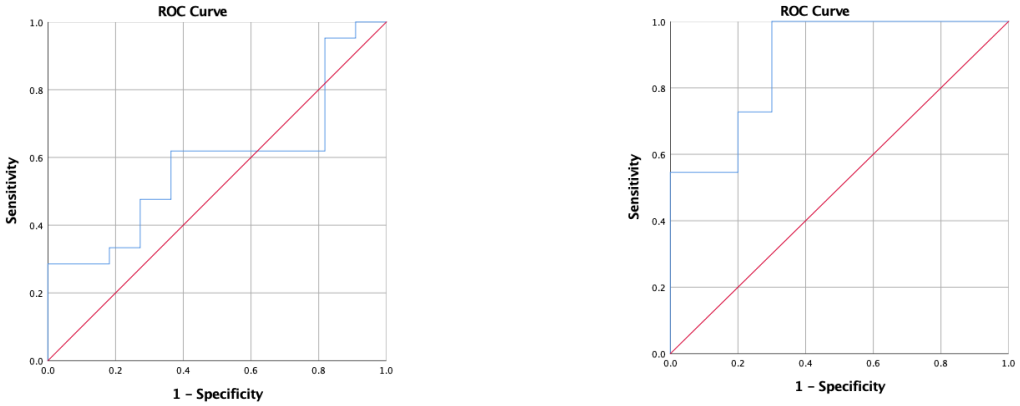
Ripasa Score

At the optimal threshold value ≥7.5 [11], RIPASA scoring system had a sensitivity of 80.95%, a specificity of 81.82%, a positive predictive value of 89.47%, negative predictive value of 69.23%. Using the ROC curve, the AUC value is 84.6% with a CI of 95% (69.8%-99.5%).



(a) (b)

Figure 2 ROC Curve Analysis on NLR: (a) Appendicitis or Non-Appendicitis; and (b) Perforated Appendicitis or Non-Perforated Appendicitis



(a) (b)

Figure 3 ROC Curve Analysis on PLR: (a) Appendicitis or Non-Appendicitis; and (b) Perforated Appendicitis or Non-Perforated Appendicitis

NLR

From a total of 32 samples, there were 11 samples of non-appendicitis, 10 samples of non-perforated appendicitis, and 11 samples of perforated appendicitis with mean values (NLR 3.57), (NLR 5.10), and (NLR 13.14). There was significant difference in NLR values between each group ($p<0.05$).

With a cut-off point NLR > 4.49, it has a sensitivity of 71.43%, a specificity of 72.73%, to differentiate acute and non-acute appendicitis; AUC value of 81.4% with a CI of 95% (66.3% - 96.4%). With a cut-off point NLR > 9.13, it has a sensitivity of 82%, a specificity of 100%, to differentiate perforated and non-perforated acute appendicitis; AUC value of 92.7% with a CI of 95% (81.5% - 100%).

PLR

From a total of 32 samples, there were 11 samples of non-appendicitis, 10 samples of non-perforated appendicitis, and 11 samples of perforated appendicitis with mean values (PLR 160.92), (PLR 132.51), and (PLR 285.32). There was significant difference in NLR values between each group ($p<0.05$).

With a cut-off point PLR > 146.8 it has a sensitivity of 61.90%, a specificity of 63.64%, to differentiate acute and non-acute appendicitis; AUC value of 58.4% with a CI of 95% (38.1% - 78.8%). With a cut-off point PLR > 172.2, it has a sensitivity of 82%, a specificity of 100%, to differentiate perforated and non-perforated acute appendicitis; AUC value of 92.7% with a CI of 95% (81.5% - 100%).

Discussion

Acute abdominal pain is one of the most common complaints in the Emergency Room.[12] Acute appendicitis is one of the most common causes of right lower abdominal pain, with a lifetime prevalence rate of approximately one in seven.[11]

Despite the large number of cases, acute appendicitis remains a difficult diagnosis to make, especially among the young, the elderly and women of reproductive age groups, where a number of other genitourinary and Gynecological inflammatory conditions may present with signs and symptoms similar to those of acute appendicitis. [11] In our study Gynecological masses and Gynecological infections were the most common diagnosis in non-appendicitis group.

Patients with a final diagnosis of appendicitis were mostly female (62%), and in the age range of 18-25 (57%). Appendicitis often occurs in adolescents and young adults, starting from the first to second decades. Women suffer from appendicitis more,

although this finding is still controversial because it contradicts the results of other studies.[13] Research at a provincial referral hospital in Indonesia also states that the 20-29 age group is the most common group suffering from acute appendicitis. [14]

Ultrasonography (USG) and Computed Tomography (CT) scans can increase the accuracy of diagnosis by >90%, but not all hospital have them, and these examinations are expensive. The Alvarado score was introduced in 1986. It assesses 8 parameters.[7] In 2010 a new scoring system called the Raja Istri Pengiran Anak Saleha score (RIPASA) was developed by Chong CF, et al. This score was created to assist the diagnosis of acute appendicitis, especially in the Asian population. This score assesses 15 parameters including age, sex, symptom onset, urinalysis and population race.[16]

RIPASA score can detect 84.6% of acute appendicitis, better than Alvarado (81.6%). In addition, the RIPASA score has a higher sensitivity than Alvarado (80.95% vs 57.14%). This finding is consistent with a meta-analysis study with a larger scale (2161 samples) which states that the RIPASA score has a very high sensitivity (94%) and the Alvarado score presents a lower sensitivity (69%), but higher specificity (77% vs. 55%). In addition, RIPASA has a higher diagnostic Chance Ratio and a larger AUC.[7]

Laboratory examination by examining leukocyte count is one of the blood tests that is routinely carried out in patients with suspected of appendicitis. Inflammatory index such as neutrophil to lymphocyte ratio (NLR) and platelet to lymphocyte ratio (PLR) can be used as biomarkers to diagnose and assess the severity of acute appendicitis.[10]

These findings indicate that the NLR value is significantly higher in individuals with acute appendicitis compared to non-appendicitis. During the inflammatory response, the ratio of leukocytes in the circulatory system changes, which is accompanied by relative lymphopenia. The increase in neutrophils occurs as a result of a physiological response to stressful conditions, so it is hypothesized that the more severe the inflammation that occurs, the higher the neutrophil lymphocyte ratio. NLR with a cut-off value of >4.49 has a sensitivity of 71.43%, a specificity of 72.73% to differentiating non-acute appendicitis and acute appendicitis. Research by Kahramanca et al, 2014. shows that NLR with a cut-off value of 4.68 can significantly differentiate a normal appendix and an inflammatory appendix.[17] Research in Indonesia by Christian et al, 2017. NLR with a cut-off value > 5.00 has a higher sensitivity (85.3%).[18] Research by Hajibandeh et al, 2018. showed that NLR can be used as a predictor of perforated acute appendicitis with a cut-off value > 8.8.[9] In this study the NLR value > 9.13 had a sensitivity of 82%, a specificity of 100% in differentiating non-perforated and perforated acute appendicitis.

The PLR value based on this study is not good at differentiating Non-appendicitis and acute appendicitis. However, it can be used in detecting perforated appendicitis. In study by Pehlivanli, 2019. the platelet count did not differ significantly between non-perforated and perforated acute appendicitis, an increase in the PLR value could be associated with a decrease in the number of lymphocytes in the perforation group.[19]

Conclusions

Alvarado Score, RIPASA Score, NLR and PLR can be used to predict the diagnosis of Acute Appendicitis in Type C Hospital settings with fairly good sensitivity and specificity. The RIPASA score has better sensitivity than Alvarado Score. NLR and PLR can be used to predict perforated appendicitis.

Study with a larger number of samples and more complex exclusion criteria is needed to support the research hypothesis.

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