

THE EFFICACY OF THE ALVARADO SCORE IN PEDIATRIC POPULATION OF MUREȘ REGION

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Abstract: Appendicitis diagnosis may be difficult in pediatric population, despite the developed imaging techniques and laboratory tests. Considering this fact, many authors have attempted to develop predictive scores for this pathology. One of the most popular is the Alvarado score, which uses both physical examination and laboratory findings and was quoted by multiple studies as having a great value of sensitivity and specificity. The aim of our study is to check the applicability of the Alvarado score in our pediatric population. Our retrospective study comprised 133 patients aged between 2 and 18 years who had been presented with suspected appendicitis at the Department of Pediatric Surgery and Orthopedics, Emergency Clinical County Hospital of Tîrgu-Mureș between 1st of April 2012 and 30th of July 2014. We found that in different age groups the cut off value and the accuracy of the Alvarado score varied, which leads us to say that the Alvarado score can be of assistance in setting the diagnosis of acute appendicitis, but it cannot be used as an exclusive standard, the final decision being in the hand of the treating surgeon.

INTRODUCTION

Appendicitis is a version of diverticulitis in which the appendix represents a diverticulum with a narrow lumen. Inflammation of the appendix is initiated as the result of an obstructive process within the lumen.(1) The etiology of the obstruction is not always clear. It can be caused by lymphoid hyperplasia as a consequence of bacterial infection or the presence of a fecolith, a calculus, a foreign body (for example fruit seed) in the lumen of the appendix.(2)

Despite the developed imaging techniques and laboratory tests the diagnosis of acute appendicitis is based on the patient's history and the physical examination. The signs and symptoms develop in 24 to 36 hours. The pain classically begins as a poorly defined continuous periumbilical pain that migrates to the right lower quadrant over a period of hours. Other major symptoms which are frequently present in the early stages are fever, anorexia, nausea/vomiting. Physical examination shows localized tenderness to palpation and occasionally rebound pain.

There are some difficulties in diagnosing acute appendicitis in the new-born and the preschooler population. The rate of negative appendectomy in children is in the range of 4-50% in various reports. It gives symptoms similar to other childhood diseases like mesenteric lymphadenitis, pneumonia, gastroenteritis. Infants present only lethargy, irritability, and anorexia in the early stages, but may develop vomiting, fever and pain as the disease progresses. They can present atypical symptoms. Usually the whole abdomen is swollen and painful. The perforation can occur in 6 to 12 hours from the appearance of the first symptoms. If the patient does not speak, we may get the history from the parents, but this can be subjective. Young children have less ability to tell about their developing symptomatology compared to adolescents. Sometimes children may conceal their symptoms because of fear. They might make the physical examination impossible with their behavior. If the presentation is further delayed, the patient may present with a

complication of acute appendicitis, which includes perforation, peritonitis, and abscess. Approximately one-third of children with acute appendicitis have perforation by the time of operation. Complications can exacerbate the patient's status.

Clinical scoring systems can be of assistance in setting the diagnosis of acute appendicitis in time. The Alvarado score, which uses both physical examination and laboratory findings, has a great value of sensitivity and specificity. Many studies have recommended that patients with a score of less than 4 can be discharged, while those with scores between 5 and 7 should be kept under observation, and those with a score greater than 7 should undergo surgery.(3,4,5,6,7)

PURPOSE

The aim of this study is to check the applicability of the Alvarado score in our pediatric population.

MATERIALS AND METHODS

Our retrospective study comprised 133 patients aged between 2 and 18 years who had been presented with suspected appendicitis at the Department of Pediatric Surgery and Orthopedics, Emergency Clinical County Hospital of Tîrgu-Mureș between 1st of April 2012 and 30th of July 2014. The Alvarado score was calculated from variables such as pain in the right lower quadrant, anorexia, nausea or vomiting, tenderness in the right lower quadrant, rebound pain, pyrexia, leukocytosis, and neutrophilic leukocytosis left shift. Patients were divided into three groups according to the Alvarado score: AS<4, AS 5-7, AS 8-10. Another division was made as follows: patients younger than 7 years (preschooler group), aged between 7 and 11 (elementary school group), aged between 12-15 (middle school group) and aged between 16-18 (high school group).

Statistical data were evaluated with SPSS software to calculate means, frequencies, sensitivity, specificity and the area under the ROC curve.

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CLINICAL ASPECTS

RESULTS

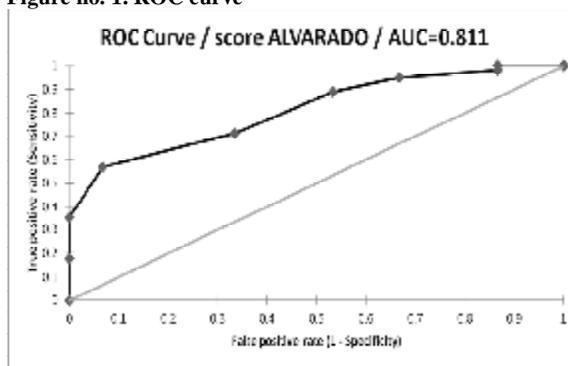
In the study, there were included 78 (58.64%) boys aged between 2 and 17 years (mean age: 10.02) and 55 (47.35%) girls aged between 3 and 17 years (mean age: 11.85). The overall mean Alvarado score was 7.36 ± 1.96 . In 11 cases (8.27%) the score was less than 4. The most frequent symptom in 45.45% of the cases was migration of pain in the right lower quadrant (RLQ). In this group the rate of perforation was low, it occurred in 9.09%. The average of the days spent in the hospital was 4.90.

In 54 cases (40.60%), the score was between 5 and 7, with a rate of perforation of 1.85% and an average hospitalization of 5.16 days. In this group, the most frequent symptoms were migration of pain to the RLQ (87.04%) and tenderness in the RLQ (83.33%).

In 68 cases (51.12%) the score was higher than 7. The most frequent symptoms were the same as in the other group: 95.59% tenderness in the RLQ and leukocytosis with 94.12%. The rate of perforation was higher, with a rate of 18 (26.47%) cases. 12 of the perforated cases came from the rural area and 6 from the urban area.

According to the statistical analyses the cut off value was 7, where the specificity was 93.3% and the sensitivity was 56.8% with a positive predictive value (PPV) of 0.985 and a negative predictive value (NPV) of 0.215. We found a significant correlation at the 0.01 level ($r = -0.909$). The analysis of the ROC curve demonstrated an area under the curve of 81.1% (figure no. 1). We did not find a significant correlation between the Alvarado score and the type of the appendicitis.

Figure no. 1. ROC curve



We found that in different age groups the cut off value and the accuracy of the Alvarado score varied.

In the preschooler group with 6 girls and 14 boys, the mean age was 4.78, and the mean AS was 7.7. The most frequent symptoms were migration of the pain to the RLQ, and nausea or vomiting in 80% of the cases. The specificity was 100% and the sensitivity was 58.8% with a PPV of 1.00 and a NPV of 0.30. In this group we didn't find a correlation between the sensitivity and specificity at the cut off value of 8.

In the elementary schooler's group the mean age was 9.05 with 17 girls and 38 boys. They have been presented most frequently with migration of the pain to the RLQ in 89.09% of the cases, tenderness, and nausea/vomiting in 85.45%. We found at the cut off value of 5 a specificity of 66.7% and sensitivity of 98.1% with a PPV of 0.981 and NPV of 0.667. The correlation between specificity and sensitivity was significant at 0.05 level ($r = 0.021$). The accuracy in this case was 96.5%.

In 21 girls and 20 boys with a mean age of 13.51 were included in the middle scholar group with a mean of AS 7.17. In this group the most frequent symptom was also the migration of the pain and tenderness in the RLQ, both with 87.80%. The

specificity was 100% and the sensitivity was 61.1% at a cut off value of 8. A PPV of 1.00 and a NPV of 0.263 showed an accuracy of 65.9%. The correlation between the specificity and sensitivity was significant at 0.05 level ($r = 0.011$).

The high-schooler's group was formed by 12 girls and 5 boys with a mean age of 16.47, and a mean of AS of 6.29. In 94.12%, they have presented migration of the pain and tenderness in the RLQ. The specificity was 100% and the sensitivity was 50% at a cut off value of 7. A PPV of 1.00 and a NPV of 0.300 showed an accuracy of 58.8%. The correlation between the specificity and sensitivity was significant at 0.01 level ($r = 0.003$).

DISCUSSIONS

Acute appendicitis is a common cause of abdominal pain and can be difficult to diagnose, especially during the early stages. There is still appreciable morbidity and occasionally mortality which may be related to failure of making an early diagnosis. Clinical scoring systems were developed in order to sustain the clinical diagnosis. The Alvarado scoring system was developed in 1986. Alvarado conducted a retrospective study on 305 patients admitted for suspected appendicitis and he evaluated common clinical and laboratory findings in relation to pathologically proven acute appendicitis. The initial study included adults and children, with an age range of 4 to 80 years. An Alvarado score above 7 was considered high risk for appendicitis with a sensitivity of 81% and a specificity of 74%.

Yildirim(8) et al. performed surgery on 14 patients with AS<4, and detected AA in 13 (92.8%) cases. Yücel et al.(7) found 13 (56.5%) AA cases out of 23. Winn et al.(9) discharged 12 patients, but 4 were re-admitted and 2 of them underwent surgery, but appendicitis was not found. In our study, 11 patients underwent surgery with an AS<4 and AA was found in 6 cases (54.5%). According to these results, patients with a score less than 4 should be reexamined if the pain increases. A low Alvarado score does not exclude a possible acute appendicitis. Reexamination can prevent the complications of appendicitis.

AS between 5 and 7 was calculated in 54 cases in our study and AA was found in 45 (83.3%) cases. Yücel et al(7) detected AA in 75.9%, and Yildirim et al.(8) in 84.2% of their patients. Patients with AS between 5 and 7 should be monitored and AS should be calculated at certain intervals.

Yildirim et al.(8) detected AA in 91% of the patients with a score between 8 and 10. We found AA in 67 (98.5%) out of 68 cases. Patients who belong to this group should undergo surgery without the need of other examination in order to prevent the complications.

Bond et al.(10) found that AS to be least accurate in preschool children. In our study were included 20 patients from this age group and in 17 cases (85%) had AA. In this group of patients we can consider a lower AS as a cut off value because the data obtained from the anamnesis can be false negative. If the AA is not treated in time the appendix can perforate. The general perforation rate of AA was 20% according to Mentés et al.(11) The prevalence of perforation increases as the AS increases. Yücel et al (7) found perforation in 7.7% of the cases in the AS<4 group, 27% in the AS 5-7 group, and 27% in the AS 8-10 group. In our study, the perforation occurred in one case (9.09%) in AS<4 group, one case (1.85%) in AS 5-7 group, and 26.47% in AS 8-10 group. Douglas et al.(12)suggested that surgery is not necessary if the Alvarado score is less than 4. Our study and the data from literature (ex. Yücel et al(7)) showed that perforation cannot be correlated with the Alvarado score, the risk of perforation is there even when the AS is low. However, it is more likely in patients with high AS. When there is a chance of perforation we suggest reevaluation of the case,

CLINICAL ASPECTS

since the perforation may not be determined based on the AS. Sometimes, from the clinical signs and laboratory findings we can suspect acute appendicitis, but as a result we have negative appendectomy. In the literature, the negative appendectomy rate is between 15 and 40%, in our study we found 11%.

No study has investigated the efficacy of the Alvarado score just in the pediatric population. In comparison to the data from the literature, we have achieved better results. We can use the Alvarado score in predicting acute appendicitis in pediatric population with a higher confidence.

CONCLUSIONS

The Alvarado score can be of assistance in setting the diagnosis of acute appendicitis, but it cannot be used as an exclusive standard. It can be used with a higher confidence in pediatric population. However, a low score does not exclude the possibility of a perforated appendix. The perforation may not be determined based on this score. As a clinical scoring system it can be repeated during active observation and influence the decision to operate. It can also be used by general practitioners; they could estimate the surgical indication. The final decision has to be based on the surgeon's opinion.

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