



# BRITISH

# MEDICAL JOURNAL



**British Medical Journal**

**Volume 2, No 4., 2022**

**Internet address:** <http://ejournals.id/index.php/bmj>

**E-mail:** [info@ejournals.id](mailto:info@ejournals.id)

Published by British Medical Journal

Issued Bimonthly

3 knoll drive. London. N14 5LU United Kingdom

+44 7542 987055

Chief Editor

**Dr. Fiona Egea**

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**British Medical Journal** Volume-2, No 4

## THE ROLE OF THE ALVARADO INTEGRAL SCALE IN THE DIAGNOSIS OF ATYPICAL AND RARE FORMS OF ACUTE APPENDICITIS (Literature review)

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**Abstract:** The traditional diagnostics of acute appendicitis (AA) leads to an increased number of "negative" appendectomies (35-40%) or delayed operations (25-30%), as there are no strictly specific symptoms and laboratory tests for AA. The presence of inflammation in the appendix in atypical and rare forms of AA (up to 30%), in children, in women of fertile age, and in pregnant women in the 2nd or 3rd trimester, or the elderly (over 60 years of age) develop a variety of clinical variants of the disease course, which often do not require surgical intervention. In these cases, the use of diagnostic scales of acute appendicitis helps to improve diagnosis of AA. Their meaning lies in the selection of the most objective and informative parameters, each of them being assigned a certain number of points; the question about the tactics of management of a patient with a suspected AA is decided on the basis of the sum of the points. A. Alvarado diagnostic score (1986) is the most informative among them, easy to use, and does not require special equipment. When AA is suspected, it can be applied equally successfully in any in-patient emergency medical services.

**Keywords:** acute atypical appendicitis, diagnostic scales of acute appendicitis, Alvarado diagnostic scale.

According to Kolesov A.A. (1972) 95% of the right iliac region pain cases are caused by acute appendicitis (AA) [1]. Detection of this pathology does not cause difficulties with the classical symptoms and signs when the appendix is located in the right iliac region on its own mesentery (70% of patients). However, in atypical and rare forms of AA (up to 30%), in children, in women of fertile age, and pregnant in the 2-3 trimester, the elderly over 60 years of age, the clinical picture of the disease is variable and is a "risk factor"[2]. Due to "contact inflammation" of the organs to

which it adjoins, atypical and rare forms of acute appendicitis simulate a large number of diseases, which mostly not requiring surgical intervention (acute gastroenterocolitis, infectious hepatitis, pyelonephritis, etc.) [3]. Often in these cases establishing the presence of AA is a diagnostic problem [4]. The laboratory diagnosis of AA in general has an auxiliary character, since there are no strictly specific laboratory tests for acute appendicitis [5]. Thus, according to Kasimov R.R. (2012, 2013) the level of leukocytes in non-destructive appendicitis was within normal values in 32.6% number of cases, and 22,8% in destructive forms of AA, and 37,5% of patients did not have any laboratory inflammatory changes [6].

Statistical data of some authors shows that among patients admitted to infectious diseases hospitals with suspected infectious diseases, almost 16% of cases are caused by acute destructive appendicitis [7]. Other somatic diseases (acute myocardial infarction, follicular angina, etc.) simulated acute appendicitis in 11.9% number of cases [8]. Therefore, there is a need for expansion of diagnostic measures with the use of additional clinical symptoms (Kaup, Obratsov, Promtov, etc.) and the results of rectovaginal, urological, radiological examination methods. Also the consultation of related specialists is of great importance [9].

Thus, at the present time, absolutely specific methods of atypical and rare forms of acute appendicitis do not exist [10,11]. Common diagnostics of AA leads to the increased number of "negative" appendectomies (NA) (35-40%) or delayed operations (25-30%) [12,13,14].

The use of diagnostic scales of acute appendicitis (DSAA) improves the diagnostics of AA. Their meaning lies in the selection of the most objective and informative parameters, each has a certain number of points assigned; based on the sum of the points the question of the management tactics of a patient with suspected AA is decided on [15].

The first DSAA was created by I.Ticher in 1983. Its application allowed to reduce the proportion of NA from 38% to 14% [16].

Based on a retrospective study of 305 patients, A.Alvarado created his DSAA in 1986. It includes three clinical syndromes, three physical and two laboratory indicators. Each indicator is assigned 1-2 points, which are summed up. The total score of 0-4 is considered unlikely, a score of 5-6 raises suspicion of AA, with a score 7-8 the diagnosis of AA is probable, 9-10 points means AA is very probable. According to the author's data the sensitivity was 89.7% and specificity 76.3% [17].

TABLE 1. Alvarado score

<b>Alvarado diagnostic scale</b>	
<b>Indicator</b>	<b>Score</b>
<i>Clinical syndromes</i>	
Right iliac region pain migration	1
Anorexia	1
Nausea	1
<i>Physical signs</i>	
Tenderness in the right lower quadrant	2
Rebound pain	1
Elevated temperature	1
<i>Laboratory</i>	

Leukocytosis $>10,0 \times 10^9$	2
Neutrophils $>75\%$ (shift to the left)	1
<b>Total score</b>	<b>10</b>

Studies have been conducted at various centers, clarifying the sensitivity, specificity of Alvarado scale (AS), taking into account age and sex of patients, and the results were used to determine indications for ultrasound, CT scan and diagnostic laparoscopy [18].

According to many researchers, the sensitivity of AS at 7 points or higher for adult men ranges from 92.6-95.8%, and the specificity is 92.8%. In women of reproductive age - 76.7-88% and 75-89.7% respectively, in children - 76.3%-92% and 78.8 - 82%, in the elderly these indicators were 85,7 and 80% [Baidya G. 2007; Shreef K.S 2010; Di Saverio et al 2020].

In a large cohort study by Coleman J.J. et al. in 2018 it has been found that AS is not specific enough to diagnose AA, a threshold score of  $<5$  is sensitive enough to exclude AA in men (sensitivity 99%), the probability of AA is 0%. In females, 5% of cases were intraoperatively diagnosed with AA. In contrast, 100% of men with an Alvarado score of 9 or higher and 100% of women with an Alvarado score of 10 had AA confirmed by surgery. Of course, with a score of 1-4 patients can be discharged for outpatient follow-up after 24 hours, observation and CT is not indicated for them [Coleman J.J. 2018]. Nevertheless, according to Dubrovsky A.S. (2013) in women of fertile age, when the risk of AA remains at 5%, they require in-patient observation and re-calculation of Alvarado score and ultrasound examination [19].

A patient with a score of 9 or more according to AS is indicated for emergency surgery. At the same time, a false-negative ultrasound result can affect the management tactics of patients and delay surgical treatment, thereby increasing the risk of perforation. Therefore, ultrasound is not recommended to perform in this group of patients[20,18].

Meanwhile, according to specialists, in atypical and rare forms of AA, in children, in women of fertile age and pregnant in the 2-3 trimester, the elderly over 60 years of age, the clinical picture AA has a large number of different variants and the individual features. Alvarado scale does not allow to score the required number of points. In this case, the sum of the points, which is 5 - 6 (suspected AA) and 7- 8 (AA probable) does not allow us to confidently state that a patient has an AA. At the same time, due to the low sensitivity and specificity of the method (73-75% and 75-78%)[21, 22, 23, 24] in a number of cases, correct and timely diagnosis of AA becomes very difficult. In the literature, this score interval some authors refer to as the "gray" or "intermediate" zone, where it is recommended to include in the diagnostic search additional noninvasive (ultrasound, CT, MRI) and invasive diagnostic (diagnostic laparoscopy) methods [15,25,26].

There are many variations of the diagnostic scales of AA. The Lintula score (2005) takes into account only clinical and anamnestic findings. In Lodewijk's randomized study, the Lintula scale's sensitivity was 87%, specificity 59% and accuracy 74% [27]. Turkish researchers have shown a high informative value of the Lintula DSAA in patients over 65 years of age [28].

Nevertheless, other DSAA (RIPASA C.F., 2010) also use such parameters like: Rovsing's symptom, gender, age and urinalysis [29,30]. At the same time, the sensitivity, specificity, and accuracy of these scales do not exceed the informative value of Alvarado score [31,32].

Lisunov A.Yu. (2008) created a mathematical diagnostic table based on the difference in axillary and rectal temperature and anatomical abdomen region, where the pain originated. In addition to this, 10 other clinical and laboratory signs are examined. A score of 41 or more indicates a destructive form of AA, 35-41 "gray area," where probability of destructive appendicitis is about 95-96%, which indicates surgical treatment. The disadvantage of the method is laboriousness[33].

On the basis of meta-analysis C.W.Yuetal (2013) studied the diagnostic value of procalcitonin (PCT), C-reactive protein (CRP) and the number of WBC in uncomplicated or complicated AA. It turned out that CRP level is the most informative in diagnosing AA, while PCT count is the most informative in diagnosing complicated forms of AA, with a sensitivity of 62% and specificity of 94% [34].

Subsequently, the CRP values were included in the Acute Appendicitis Scale by R.R. Kasimov (2013) AIRS-Appendicitis Inflammatory Response Score and AAS - Adult Appendicitis Assessment Scale [35]. These scales slightly improved the accuracy of diagnosis of AA compared with the Alvarado score [18]. Kasimov's DSAA improved the overall accuracy of AA diagnosis by 97%, the sensitivity of the scale was 94.1% and the specificity 100% [6]. At a low risk score on the AAS scale, AA was detected in 7% during the surgery, also the number of negative appendectomies decreased from 18.2% to 8.7% [35].

In 2019, researchers from the United Kingdom studied 5,345 patients in 154 hospitals with right iliac pain and compared informativeness of the AAS and AIRS. In this study, the AAS showed the best results for women, whereas the AIRS performed best in men (2019).

Many Russian-speaking and foreign experts, in order to improve the accuracy of AA diagnosing and its various forms, consider it expedient not only the combined use of clinical data and ultrasound, but also their complex use in combination with Alvarado score. [18].

Thus, A.G. Natroshvili and Tzanakis added the data of ultrasound examination of the appendix into the Alvarado scale. The sensitivity, specificity, and accuracy results were 87.0 and 95.4%, 96.7 and 97.4%, 94.0 and 96.5% respectively[36]. The authors managed to reduce the number of unwarranted surgical interventions in patients with suspected AA by 12.3%.

## Conclusion.

Thus, the Alvarado DS enables the clinician to reduce the inpatient period, the number of "negative" appendectomies, AA complications, perform immediate appendectomy. Also optimize the use of diagnostic imaging techniques in indeterminate cases. It has found the greatest practical application compared with other diagnostic scales in the most informative, simple, inexpensive ways, which

does not require special equipment. It may be applied with equal success in terms of district medical associations, as well as in multidisciplinary specialized medical institutions.

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