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Research Article

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Objective Tools for Assessing the Probability of Acute Appendicitis in Domestic Practice

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RELEVANCE In order to objectify the diagnosis of acute appendicitis, a number of scales have been developed, the foreign practice of using which implies performing computed tomography in the case of obtaining intermediate point values corresponding to the average probability of acute appendicitis. This tactical solution, which is still difficult to implement in domestic conditions, limits the use of diagnostic scales and serves as a reason to search for other ways of using them.

AIM OF THE STUDY To evaluate the external validity of the AIRS, Ripasa, AAS and Alvarado scales on the available clinical material and upon obtaining satisfactory results, to determine the applicability of these classifiers in matters of making specific tactical decisions.

MATERIAL AND METHODS The work is based on the analysis of medical records of 293 patients hospitalized with suspected acute appendicitis at the St. Petersburg State Healthcare Institution "Elizavetinskaya Hospital" in the period from 2019 to 2022. Using information on postoperative diagnoses, the values of the AIRS, Ripasa, AAS and Alvarado scores were retrospectively calculated for each of the patients examined, followed by a comparison of the results obtained and the outcomes of hospitalization by conducting a regression analysis.

RESULTS The AIRS, Ripasa, AAS, and Alvarado scales for assessing the probability of acute appendicitis, as applied to the analyzed group of patients, demonstrated external validity due to the preservation of referral threshold values, good description of the studied binary variance (AUC greater than 0.8), and sufficiently high adjusted correlation coefficients (from 0.57 and higher). The final diagnostic accuracy for all analyzed classifiers did not differ statistically significantly and was at acceptable levels of 78.8%, 76.7%, 76.7%, and 75.7% for the AIRS, Ripasa, AAS, and Alvarado scales, respectively (p=0.115). The hypothetical choice of the upper limit of low risk as the threshold value after which all patients are subject to diagnostic laparoscopy may lead to a statistically significant decrease in the number of inpatient observations of patients with acute appendicitis without increasing the frequency of diagnostic laparoscopies in healthy patients.

CONCLUSION The use of the AIRS, Ripasa, AAS and Alvarado assessment scales is advisable both from the standpoint of diagnosing acute appendicitis and for making tactical decisions, provided that patients with intermediate scale values are shifted towards active surgical actions.

Keywords: acute appendicitis, scoring scale, AIRS, Ripasa, AAS, Alvarado

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AUC – area under the curve
CI – confidence interval
cut-off – threshold
r – correlation coefficient

INTRODUCTION

Acute appendicitis is the most common cause of abdominal pain, except in cases where a specific cause has not been identified [1]. Most surgeons at some point in their practice are faced with the important dilemma of performing a negative diagnostic laparoscopy or postponing the necessary intervention in patients with an unclear clinical picture. The symptoms of acute appendicitis, both clinical and laboratory, are well known. At the same time, the prognostic weight of various signs is not the same, and their cumulative assessment can be difficult. In order to objectify such an assessment, a number of dichotomous classifiers or, more simply, scoring scales have been developed to help in matters of diagnosis and determination of treatment tactics. Thus, one of the first and most popular at the moment is the Alvarado scale, which was developed in 1986 by Dr. Alfredo Alvarado [2] and introduced into the practice of assessing the risks of acute appendicitis in pregnant women; later, this classifier was extrapolated to the entire population [3]. Ripasa has its "roots" in the Brunei National Hospital in 2009-2010 and was developed based on the specifics of the South-East Asian region [4]. AIRS was developed to overcome some of the shortcomings of the Alvarado scale in 2008, and the AAS classifier was first used in Finland in 2014 and approved for use in wide clinical practice in 2017 [5]. The last two scales are clinically recommended by the World Society of Emergency Surgery 2020 for the diagnosis and treatment of acute appendicitis [6].

There are a number of works aimed at assessing the external validity of these classifiers, the results of which indicate their high diagnostic value [7–11]. At the same time, foreign practice of using these mathematical tools involves performing computed tomography in the case of obtaining intermediate point values corresponding to the average probability of acute appendicitis [6, 12, 13]. This tactical solution, which is still difficult to implement in domestic conditions, limits the use of diagnostic scales and serves as a reason to search for other ways of using them.

The aim of this work is to evaluate the external validity of the AIRS, Ripasa, AAS and Alvarado scales on the available clinical material and, if satisfactory results are obtained, to determine the applicability of these classifiers in matters of making specific tactical decisions.

RESEARCH MATERIAL

The work is based on the analysis of case histories of 293 patients hospitalized with suspected acute appendicitis at the St. Petersburg State Healthcare Institution "Elizavetinskaya Hospital" in the period from 2019 to 2022. Patients with secondary

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appendicitis against the background of inflammatory diseases of other abdominal organs, as well as patients with widespread peritonitis in the course of destruction of the appendix, were excluded from the study, since in the latter case the tactics were determined primarily by the complication of surgical infection. The average age of the patients examined was 34.9 ± 14.4, ranging from 18 to 86 years with a slight predominance of females 172 (58.7%). All patients upon admission to the hospital received a standard well-known volume of diagnostic measures, ranging from a clinical examination to laboratory and instrumental studies. It should be noted that computed tomography was not included in the examination complex for obvious reasons and was performed for differential diagnostic purposes only in 2 patients due to the presence of absolute contraindications to the creation of tense carboxyperitoneum. After the initial examination, patients were sent to the operating room (if there were no strong doubts about the surgical diagnosis) or hospitalized in the department for further observation. The duration of inpatient treatment until the diagnosis was clarified (including surgically) did not exceed 24 hours in accordance with clinical recommendations and amounted to 6.1 ± 3.0 hours. Among the examined patients, in 81 cases (27.7%) during the observation, the diagnosis of acute appendicitis was excluded, and it was decided to refrain from surgical intervention, these patients were discharged for outpatient treatment with gastroenterological diagnoses. In most cases (212 patients, 72.3%), surgical treatment was undertaken, the scope of which varied from diagnostic laparoscopy to various laparotomic interventions in accordance with intraoperative findings. The decision on the need for surgical intervention was made based on individual clinical judgments of the specialists monitoring the hospitalized patients. The spectrum of surgical interventions performed and postoperative diagnoses is shown in Fig. 1.

Based on the data presented in the figure, in most cases (183 patients, or 86.3% of those operated on), the diagnosis of acute appendicitis was confirmed,

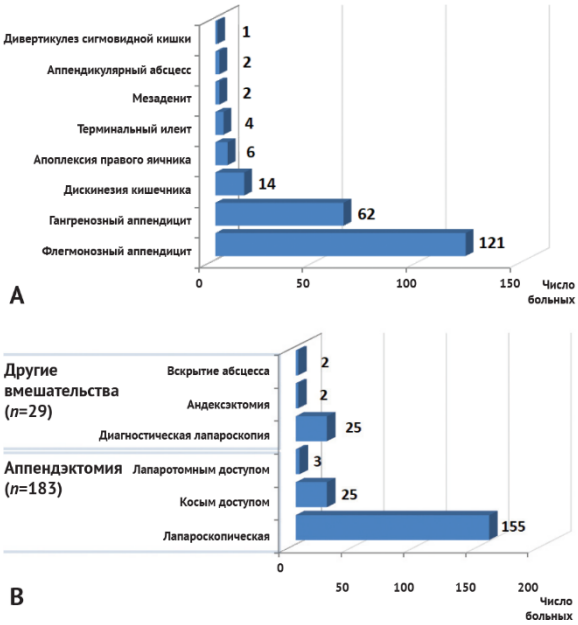

Fig. 1. Postoperative diagnoses (A) and volume of surgical interventions performed (B) in the study group of patients

and the surgical procedure consisted of appendectomy. In 77 of these patients (39.3%), local unconfined peritonitis was detected intraoperatively: in 46 cases, the effusion was serous, in 26 cases, serous-fibrinous, and in another 5 patients, purulent effusion was detected in the right iliac fossa. In 29 patients operated on due to suspected acute appendicitis, the diagnosis was not confirmed, due to which in most cases (25 patients), surgical intervention was limited to diagnostic laparoscopy. All patients were discharged, while the average hospital stay was 4.3±2.0 days.

AIRS, Ripasa, AAS and Alvarado point scales were retrospectively calculated for each of the examined patients, followed by a comparison of the obtained results and the outcomes of hospitalization by means of regression analysis. The Chaddock scale was used to assess the strength of the relationship of the correlation coefficients: from 0 to 0.3 - very weak; from 0.3 to 0.5 - weak; from 0.5 to 0.7 - average; from 0.7 to 0.9 - high; from 0.9 to 1 - very high. Considering that the practical application of these scales implies a three-stage starting of patients in accordance with the degree of probability of acute appendicitis, the examined patients were also

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divided into high, medium and low risk subgroups. The results of the retrospective calculation of the point scale values in them are presented in Table 1.

Table 1

Values of the scoring scales in the examined group of patients and the corresponding outcomes

Scale	Risk (score range)	Number patients	The diagnosis has been ruled out	Appendicitis confirmed	
				Phlegmonous	Gangrenous
AIRS	Low (<5) Average (5–8) High (>8)	98 154 41	73 35 2	22 75 25	3 44 14
Ripasa	Low (<7.5) Average (7.5–11.5) High (>11.5)	128 162 3	85 25 0	38 82 2	5 55 1
AAS	Low (<11) Average (11–15) High (>15)	76 123 94	68 36 6	8 60 54	0 27 34
Alvarado	Low (<4) Average (4–6) High (>6)	141 135 17	90 20 0	42 73 7	9 42 10

RESULTS

Before assessing the potential clinical utility of any binary classifier, it is necessary to conduct its external validation by repeating the statistical procedures on the basis of which these scales were constructed. Given the fact that the threshold value of any classifier obtained by conducting Roc analysis ultimately depends on the properties of the sample on the basis of which this scale was developed, sensitivity and specificity curves were constructed for the studied scales for the purpose of external validation (Fig. 2).

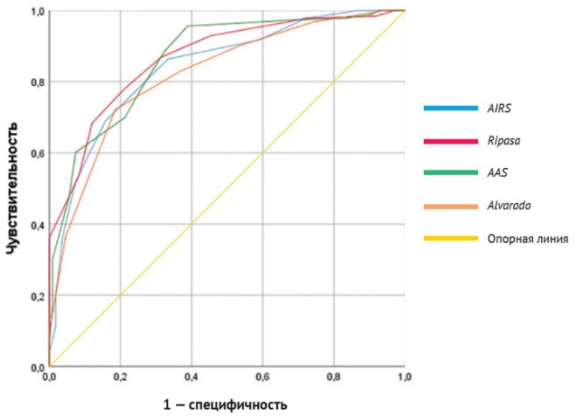

Fig. 2. ROC-curves of the studied scales

According to Youden's statistics, the resulting threshold values of the analyzed scales were 5, 7.25, 10.75 and 4.25 points for the AIRS, Ripasa, AAS and Alvarado scales, respectively. The given values were practically no different from those recommended in foreign literature, which testifies in favor of the external validity of the compared scales. A preliminary analysis of the prognostic significance of each of the analyzed binary systems did not reveal any advantages: the area under the curve did not differ significantly within the compared scales (Table 2).

Table 2

Parameters of external validity of diagnostic scales calculated on the basis of the analyzed sample

Analyzed scales	AUC	95% CI limits		Calculated cut-off level	Recommended cut-off level	r
		Lower	Upper			
AIRS	0,840	0.793	0.887	5	5	0.57
Ripasa	0.866	0.825	0.907	7.25	7.5	0.61
AAS	0.863	0.820	0.906	10.75	11	0.63
Alvarado	0.820	0.771	0,870	4.25	4	0.55

Notes: CI — confidence interval; AUC — area under the curve; r — correlation coefficient

Isolated univariate analysis of all parameters included in the analyzed scales also did not reveal any signs that would have greater prognostic significance compared to the adjusted correlation coefficient of the whole scale: the symptom of pain in the right iliac region had the greatest predictive value, but even its coefficient was only 0.34. The obtained cut-off values, close to the reference ones, sufficiently large areas under the curves, in all cases exceeding 0.8, and adjusted correlation coefficients of whole scales exceeding the coefficients of their individual components, these facts indicate an acceptable quality of the considered classifiers, which justifies the advisability of further evaluation of their clinical effectiveness.

The generally accepted interpretation of the indices of the studied scales involves the use of high-tech imaging techniques to obtain intermediate score values corresponding to the average risk of acute appendicitis. Without going into a discussion of the clinical (taking into account the radiation

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load) and economic feasibility of such an approach and in order to simplify further interpretation of the results, the sum of points corresponding to the upper limit of low risk was taken as the threshold value. In other words, the sum of points in the low-risk range was interpreted as a negative test result (no appendicitis), and all other values of the above were considered as a positive result and an indication of the presence of the disease. Thus, these threshold values were 5, 7.5, 11 and 4 points for the AIRS, Ripasa, AAS and Alvarado scales, respectively. Based on the indicated interpretation, the main parameters of the diagnostic value of the scales in question were calculated in the context of the group of patients under consideration – the results are summarized in Fig. 3.

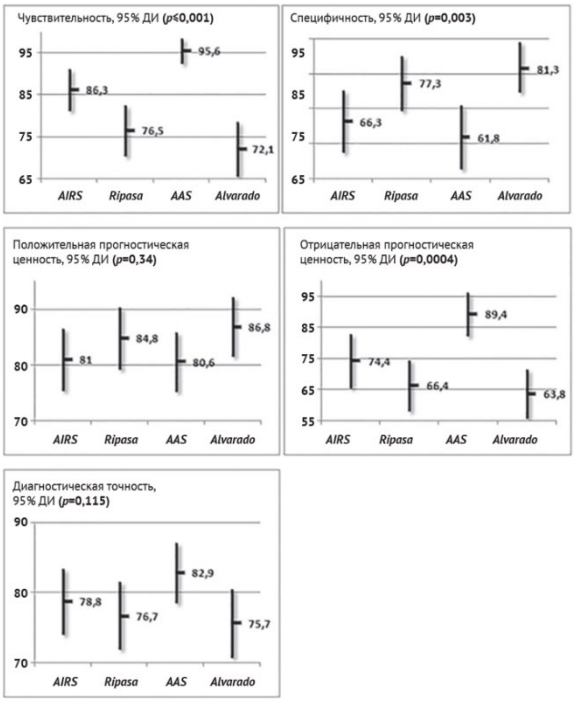

Fig. 3. Diagnostic indicators of the studied scales
Note: CI – confidence interval

According to the obtained data, the AAS scale had the best sensitivity: out of 183 patients with appendicitis, the scale values exceeding the threshold were obtained in 175 cases (95.6%), which indicates a significant prognostic significance of this scale in terms of identifying true positive results. At the same time, the sensitivity of the other studied classifiers was statistically significantly lower than that of the AAS scale ($p << 0.001$). On the other hand, the specificity index in this case was the lowest among other scales and amounted to 61.8% - out of 110 people without acute appendicitis, the diagnosis was correctly rejected in only 68 cases. On the contrary, the ratio of the analyzed diagnostic parameters was the opposite in relation to the Alvarado scale - it was characterized by maximum specificity values (81.3%) and minimum sensitivity level (72.1%), which indicated a low frequency of underdiagnosis of acute appendicitis when using this classifier. A similar tendency was observed when comparing the negative and positive prognostic values — the AAS and Alvarado scales had oppositely directed extreme values of these parameters, while the characteristics of AIRS and Ripasa were more balanced. However, prognostic scales similar to those analyzed are inherently always characterized by some negative feedback between sensitivity and specificity — the desire to minimize the frequency of type I errors by overestimating the threshold value naturally leads to an increase in the number of type II errors. In view of this, the final diagnostic accuracy of the scales under consideration did not differ significantly from each other, with the exception of a statistically insignificantly higher value of this parameter for the AAS scale (82.9%), which, by the way, was also characterized by a slightly better correlation coefficient (0.63, $p << 0.001$, Table 1).

Thus, the scales under consideration were reproducible in the conditions of the studied sample (retaining the referral threshold values) and demonstrated a fairly high diagnostic value. However, good statistical parameters do not yet indicate that such an approach is more effective than the traditional intuitive choice of treatment tactics for a patient with suspected acute appendicitis. After all, these mathematical tools were developed to reduce the duration of inpatient observation of patients with acute appendicitis and the number of diagnostic laparoscopies in healthy patients (which will provide an economic effect without a significant negative impact due to hypo-/hyperdiagnosis). The practical application of these scales, described in foreign studies, implies a differentiated approach

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depending on the score and the corresponding probability of the disease: low risk is associated with outpatient observation, medium risk - with low-dose computed tomography, high risk is associated with diagnostic laparoscopy. At first glance and at all subsequent glances, such an approach, when applied to domestic practice, seems difficult to implement: if the treatment tactics in a group of high-risk patients are understandable and feasible, then low-risk patients require close outpatient attention, and average-risk patients require a large volume of radiation studies.

The interpretation of these scales can be modified to meet the needs of domestic practice in various ways. Patients with a low probability of acute appendicitis obviously require dynamic observation and are likely to avoid diagnostic laparoscopy, while high-risk patients can be referred to the said invasive examination without unnecessary preoperative hospital stay. As for patients with an intermediate (medium) risk of acute appendicitis, they can be interpreted in two ways - either in favor of dynamic observation or more active surgical tactics. The decision taken will determine the ratio of cases of "hypodiagnostics" (inpatient observation of patients in whom acute appendicitis will ultimately be confirmed) and "hyperdiagnosis" (laparoscopies that were exclusively diagnostic in nature). Leaving this controversial subgroup of patients with the formulation “the decision in each specific case should be made individually” means depriving the use of the binary scales under consideration of any meaning and taking a step towards the traditional conventional approach to diagnostics, which has been practiced since the description of acute appendicitis as an independent disease. In view of this, it makes sense to consider two extreme options, when all patients of average risk are unambiguously determined in favor of dynamic observation or immediate diagnostic laparoscopy. The results that could have been obtained in the analyzed group of 293 patients with such alternative interpretations of the scales under consideration are presented in Fig. 4, where the frequency of “hypo-” and “hyperdiagnosis” with the traditional intuitive approach is also given for comparison.

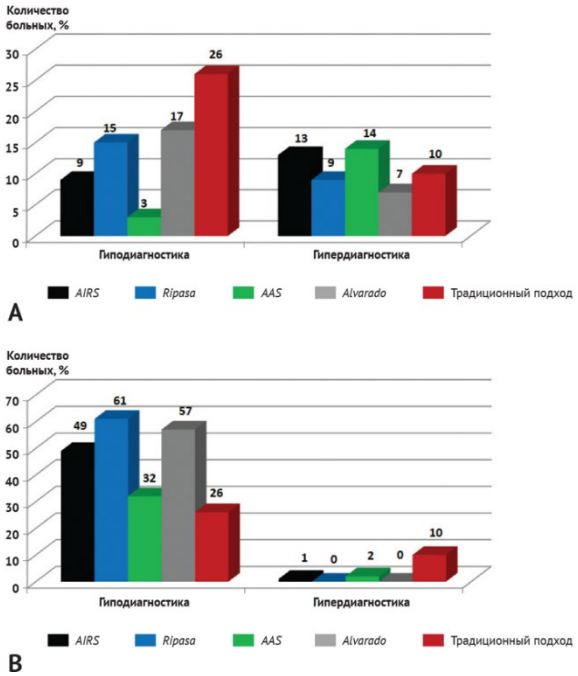

Fig. 4. Potential results of alternative methods of interpreting the scales for diagnosing acute appendicitis in the study group of patients. Alternative methods: all patients with low risk are subject to observation, moderate and high risk - diagnostic laparoscopy (A); all patients with low and moderate risk are subject to observation, high risk — diagnostic laparoscopy (B)

Based on the presented data, universal diagnostic laparoscopy in the most controversial subgroup of patients with average risk (Fig. 4A) would lead to a statistically significant reduction in the frequency of inpatient observations of patients with acute appendicitis (from 26% to 3–17% depending on the scale under consideration, $p < 0.05$) without a significant increase in the number of diagnostic laparoscopies compared with the traditional approach. Moreover, the use of the Ripasa and Alvarado scales could contribute to a statistically insignificant reduction in the number of diagnostic interventions in healthy patients from 10% to 9% and 7%, respectively ($p > 0.05$). As for the second possible method of interpretation (Fig. 4B), its practice would lead, on the one hand, to a minimization of the total number of laparoscopies that ultimately did not reveal pathological changes, due to more stringent indications, and on the other hand, to a sharp increase in the frequency of inpatient observation of patients who would ultimately be diagnosed with acute appendicitis (up to 61%).

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Thus, the presented simplified methods of interpreting the results of the studied scales of acute appendicitis are not without meaning. The choice in favor of primarily active surgical tactics in patients with medium and high risks may lead to a statistically significant decrease in the frequency of inpatient observations of patients with acute appendicitis (true for all scales) and an insignificant decrease in the number of diagnostic laparoscopies in healthy patients (when using the Ripasa and Alvarado scales). On the contrary, a shift in emphasis towards conservative therapy in patients with low and medium risks may minimize the frequency of diagnostic laparoscopies, although at the cost of expanding the indications for inpatient observation.

CONCLUSION

The scales for assessing the probability of acute appendicitis AIRS, Ripasa, AAS and Alvarado, when applied to the analyzed group of patients, demonstrated external validity due to the preservation of referral threshold values, good description of the studied binary variance (AUC more than 0.8) and sufficiently high adjusted correlation coefficients (from 0.57 and higher). In other words, their use is justified not only in relation to the samples on the basis of which these scales were developed, but also in the conditions of wide clinical practice. In addition, the final diagnostic accuracy for all analyzed classifiers did not differ statistically significantly and was at acceptable levels of 78.8%, 76.7%, 76.7% and 75.7% for the AIRS, Ripasa, AAS and Alvarado scales, respectively (p = 0.115), which allows us to recommend these tools for the diagnosis of acute appendicitis without any preferences towards a specific scale. When it comes to making specific tactical decisions, the classical interpretation of the results of these scales in domestic practice may be difficult at the moment. However, an alternative to such an approach may be the choice of the upper limit of low risk as a threshold value after which all patients are subject to diagnostic laparoscopy - such an interpretation may lead to a statistically significant decrease in the number of inpatient observations of patients with acute appendicitis without increasing the frequency of diagnostic laparoscopies in healthy patients.

CONCLUSIONS

1. The threshold values of the analyzed scales, obtained on the basis of processing our own clinical material, were 5, 7.25, 10.75 and 4.25 points for the AIRS, Ripasa, AAS and Alvarado scales, respectively, which corresponds to those recommended in the original sources and testifies in favor of the external validity of the compared scales.

2. The final diagnostic accuracy of the scales under consideration did not differ significantly from each other, with the exception of a statistically insignificantly higher value of the specified parameter for the AAS scale (82.9%), which was also characterized by a slightly better correlation coefficient with the probability of acute appendicitis (0.63, p ⩽0.001).

3. Conducting diagnostic laparoscopies in the subgroup of patients with average risk according to the studied scales would lead to a statistically significant reduction in the frequency of inpatient observations of patients with acute appendicitis (from 26% to 3–17%, p <0.05) without a significant increase in the number of diagnostic laparoscopies compared to the traditional approach.

REFERENCES

1. Cervellin G, Mora R, Ticinesi A, Meschi T, Comelli I, Catena F, et al. Epidemiology and outcomes of acute abdominal pain in a large urban Emergency Department: retrospective analysis of 5,340 cases. Ann Transl Med. 2016;4(19):362. PMID: 27826565 https://doi.org/10.21037/atm.2016.09.10
2. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med. 1986;15:557–564. PMID: 3963537 https://doi.org/10.1016/s0196-0644(86)80993-3
3. Kollar D, McCartan DP, Bourke M, Cross KS, Dowdall J. Predicting acute appendicitis? A comparison of the Alvarado score, the Appendicitis Inflammatory Response Score and clinical assessment. World J Surg. 2015;39:104–109. PMID: 25245432 https://doi.org/10.1007/s00268-014-2794-6
4. Chong CF, Adi MI, Thien A, Suyoi A, Mackie AJ, Tin AS, et al. Development of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. Singapore Med J. 2010;51(3):220–225. PMID: 20428744

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5. Sammalkorpi HE, Mentula P, Savolainen H, Leppäniemi A. The Introduction of Adult Appendicitis Score Reduced Negative Appendectomy Rate. Scand J Surg . 2017;106(3):196–201. PMID: 28737110 https://doi.org/10.1177/1457496916683099
6. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2020;15(1):27. PMID: 32295644 https://doi.org/10.1186/s13017-020-00306-3
7. Frountzas M, Stergios K, Kopsini D, Schizas D, Kontzoglou K, Toutouzas K. Alvarado or RIPASA score for diagnosis of acute appendicitis? A meta-analysis of randomized trials. Int J Surg. 2018;56:307–314. PMID: 30017607 https://doi.org/10.1016/j.ijsu.2018.07.003
8. Favara G, Maugeri A, Barchitta M, Ventura A, Basile G, Agodi A. Comparison of RIPASA and ALVARADO scores for risk assessment of acute appendicitis: A systematic review and meta-analysis. PLoS One. 2022;17(9):e0275427. PMID: 36178953 https://doi.org/10.1371/journal.pone.0275427
9. Elsherbiny MW, Emile SH, Abdelnaby M, Khafagy W, Elshobaky A. Assessment of the Diagnostic Accuracy of Alvarado Scoring System Combined with Focused Ultrasound in the Diagnosis of Acute Appendicitis. Br J Surg. 2020;107(12):e594–e595. PMID: 32898282 https://doi.org/10.1002/bjs.12037
10. Kaminsky MN, Vavrinchuk SA. Kaminsky MN. Comparative Analysis of Clinical – sonoscopic Scale of Acute Destructive Appendicitis and Alvarado Diagnostic Score. Far Eastern medical journal. 2022;(1):19–22. (in Russ.) http://dx.doi.org/10.35177/1994-5191-2022-1-3
11. Malgazhdarov MS, Amantaeva KK, Turbekova MN. The Application of the Alvarado Scale in the Diagnosis of Acute Appendicitis. Farmatsiya Kazakhstana. 2020;(5):36–39. (In Russ.)
12. Gorter RR, Eker HH, Gorter-Stam MA, Abis GS, Acharya A, Ankersmit M, et al. Diagnosis and management of acute appendicitis. EAES consensus development conference 2015. Surg Endosc . 2016;30(11):4668–4690. PMID: 27660247 https://doi.org/10.1007/s00464-016-5245-7
13. Podda M, Pisanu A, Sartelli M, Coccolini F, Damaskos D, Augustin G, et al. Diagnosis of acute appendicitis based on clinical scores: is it a myth or reality? Acta Biomed. 2021;92(4):e2021231. PMID: 34487066 https://doi.org/10.23750/abm.v92i4.11666

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