ARAŞTIRMA MAKALESİ
RESEARCH ARTICLE

Evaluation of the Efficiency of Four Different Scoring Systems in the Diagnosis of Acute Appendicitis

Akut Apandisit Tanısında Dört Farklı Skorlama Sisteminin Etkinliğinin Değerlendirilmesi

Mustafa Yılmaz[1], Alper Aytekin[2*], Latif Yılmaz[2], Aziz Bulut[2]

[1]Nizip State Hospital, General Surgery Clinic, Gaziantep, Turkey.
[2]Department of General Surgery, Faculty of Medicine, Gaziantep UniversityGaziantep, Turkey

e-mail: dktrmstfylmz@gmail.com, aytekinalper83@hotmail.com, klorpromazin@hotmail.com, drazizbulut@yahoo.com
ORCID :0000-0001-5455-3258
ORCID :0000-0003-2872-5276
ORCID :0000-0003-2528-9691
ORCID :0000-0001-6613-3082

*Sorumlu Yazar / Corresponding Author: Alper Aytekin

Öz

Amaç: Bu çalışmada akut apandisit nedeniyle opere edilecek hastalarda dört ayrı skorlama sisteminin (Alvarado, Lintula, RIPASA, Tzanakis) akut apandisit tanısında etkinliğini araştırmayı hedefledik.

Materyal ve Metod: Skorlama sistemlerinin sonuçları ve etkinliği histopatolojik olarak akut apandisit net tanısı alan hastaların sonuçları ile karşılaştırıldı.

Bulgular: 115 hasta ameliyat edildi. 62'si erkek, 53'ü kadındı. Alvarado, Lintula, RİPASA ve Tzanakis skorlama sistemleri için sensitivite sırasıyla %93,6, %91,4, %93,6, %55,3, spesifite sırasıyla %71,4, %90,4, %81, %76, Pozitif Prediktif Değer (PPD) sırasıyla %93,6, %97,7, %95,7 %91,2, Negatif Prediktif Değer (NPD) sırasıyla %71,4, %70,3, %74, %27,6 bulundu.

Sonuç: Skorlama sistemleri içerisinde Alvarado, Lintula ve RIPASA skorlama sistemlerinin akut apandisit tanısı koymada daha etkili olduğu ve Tzanakis skorlama sistemi için ise tanı koyma etkinliğinin düşük olduğunu saptadık. Ultrasonografi bulgularının skorlamada etkisi yüksek olduğu için deneyimli bir radyoloji kliniği ile beraber çalışıldığında Tzanakis skorlama sisteminin de tanı aşamasında güçlü bir skorlama sistemi olabileceği düşünülmektedir. Akut apandisit tanısında %100 tahmin etme görüsü olan herhangi bir yöntem olmadığı ve tüm skorlama sistemlerinin eksiklerinin olduğu görülmektedir. Yine de en önemli kriterlerin hastanın kliniği, muayene bulguları ve klinisyenin deneyimi olduğunu ve ek tanısal yöntemlerin tanıyı destekleyici ve klinisyeni yönlendirici araçlar olduğunu düşünmekteyiz.

Anahtar kelimeler: Akut Apandisit, Skorlama sistemleri, Alvarado, Lintula, Ripasa, Tzanakis

Abstrac

Objective: The aim of this study was to investigate the effectiveness of four commonly used scoring systems (Alvarado, Lintula, RIPASA, Tzanakis) in the diagnosis of acute appendicitis in patients to be operated for acute appendicitis.

Materials and Methods: We compared the results and efficacy of the scoring systems with the results of patients with an accurate histopathologic diagnosis of acute appendicitis.

Results: A total number of 115 patients were included in the study (62 male and 53 female). For Alvarado, Lintula, RIPASA and Tzanakis scoring systems, sensitivity was 93.6%, 91.4%, 93.6%, 55.3%, specificity was 71.4%, 90.4%, 81%, 76%, Positive Predictive Value (PPV) was 93.6%, 97.7%, 95.7%, 91.2%, Negative Predictive Value (NPV) was 71.4%, 70.3%, 74%, 27.6%, respectively.

Conclusion: Our findings show that among the four scoring systems, Alvarado, Lintula and RIPASA scoring systems are more effective scoring systems in diagnosing acute appendicitis whereas Tzanakis scoring system had a low diagnostic efficiency. Since ultrasonography findings have a high impact on Tzanakis scoring system, by working with an experienced radiology clinic, Tzanakis scoring system could be also a powerful scoring system at the diagnostic stage. None of the four scoring systems has 100% predictive accuracy in the diagnosis of acute appendicitis and all scoring systems have some shortcomings. Nevertheless, we believe that the most important criteria in the diagnostic process are the clinic where the patients are admitted, the examination findings and the experience of the clinician. Scoring systems seem to support the diagnosis and guide the clinician.

1.Introduction

Acute appendicitis (AA) is one of the most common health problems, accounting for about 5% of all emergency department admissions in patients under the age of 21, and accounting for 30% of acute abdominal surgical emergencies under the age of 50 [1]. The lifetime risk of appendicitis in the society is around 7-8%, and this prevalence by gender is 6.7% for women and 8.6% for men. While the lifetime risk of appendectomy is 12% in men, the risk for women is 23.1%. The incidence of appendicitis is most common between the ages of 10 and 19 [2]. Early diagnosis and a rapid early surgical intervention following the diagnosis are crucial in AA while a delayed diagnosis or treatment increases the risk of complications-related to AA. The probability of perforation of the appendix in the first 36 hours after the onset of symptoms was reported between 16% and 36%, and this rate increases as this duration increases [3]. Especially, perforation may lead to peritonitis or abscess formation, resulting in an increase in the morbidity and mortality rates. Therefore, to date, different scoring systems/methods have been developed for the diagnosis of AA, and these scoring systems are based on different approaches such as anamnesis, clinical signs and symptoms, and inflammatory parameters [4]. For example, the Alvarado scoring system is the first scoring system for diagnosing AA [5]. Moreover, the Lintula scoring system [6] was later developed for pediatric patients while the RIPASA scoring system [7] was developed for Asian patients. In recent years, the Tzanakis scoring system, which merges both radiological (ultrasonography) and clinical/laboratory findings, has also been developed [8]. While there are several scoring systems, the ultimate aim of all these scoring systems is to reduce the negative appendectomy rate and complicated appendicitis, and also to reduce mortality and morbidity.

The aim of this study was to compare the sensitivity, specificity, negative and positive predictive values (PPV) of Alvarado, Lintula, RIPASA and Tzanakis scores with histopathological diagnosis of patients who applied to the emergency department and underwent appendectomy due to an initial/preliminary diagnosis of AA.

2.Material and Method

Following the ethical approval of Gaziantep University Ethics Committee with the decision number 2022/88 dated 06.04.2022, the current study was designed as a single-center, prospective, single-blind study with the patients who were operated with the preliminary diagnosis of AA between April and June 2022. The participants of this study consisted of all patients over the age of 18 who had a preliminary diagnosis of AA in the General Surgery Clinic at Gaziantep University-Sahinbey Research and Application Hospital. After obtaining an informed consent form from all patients, a total number of 115 patients were included in the study. We examined demographic data, overall physical examination findings, laboratory tests and ultrasonography imaging of the patients, clinical scores of Alvarado, Lintula, RIPASA and Tzanakis, and pathology reports of histopathological evaluation. Among the patients included in the study, those who were ≥ 6 scores for The Alvarado, ≥ 21 scores for Lintula, ≥ 8 for Tzanakis, and ≥ 7.5 for RIPASA were classified as the high-risk group for AA, while patients with the values below these scores were classified as the low-risk group. The surgeons decided whether they performed a surgery based on clinical, laboratory and imaging methods without knowing the scoring results of the patients. In our study, the histopathological diagnosis of the patients was accepted as the gold standard, and we compared the clinical scores at the time of admission with each other. For this purpose, we calculated sensitivity, specificity, positive and negative predictive values to evaluate the diagnostic efficiency. We used SPSS for Windows version24.0 package program for all statistical analysis. As descriptive statistics, numbers and % values were reported for categorical variables. Pearson Chi-Square analyzes were used in the analysis of the cross tables.

Scoring systems are shown in the tables (Table 1, 2, 3, 4).

Table 1: Alvarado Scoring System

Symptoms	Score
Migration of pain to the right lower quadrant	1
Loss of appetite/Anorexia	1
Nausea or vomiting	1
Findings	
Tenderness in right lower quadrant	2
Rebound pain	1
Elevated Temperature	1
Laboratory	
WBC increase/Leukocytosis	2
Shift of the white blood cell count to the left	1
WBC: white blood cell	

Table 2: Lintula Scoring System

Diagnostic Criteria		Puan
Gender	Male	2
	Female	0
Intensity of Pain	Severe	2
	Mild to moderate	0
Relocation of Pain	Yes	4
	No	0
Vomiting	Yes	2
	No	0
Pain in the RLQ	Yes	4
	No	0
Fever ≥37.5	Yes	3
	No	0
Guarding	Yes	4
	No	0
Bowel Sounds	Absent, tinkling, high-pitched	4
	Normal	0
Rebound Tenderness	Yes	7
	No	0
Total Score		32
RLQ: right lower quadrant		

Table 3: Ripasa Scoring System

Scoring Parameter	Score
Gender	Male:1
	Female: 0.5
Age (Year)	<40 yr: 1
	40< yr: 0.5
Pain in the RLQ	0.5
Migration pain to RLQ	0.5
Anorexia	1
Nausea or Vomiting	1
Duration of symptoms	<48 hrs:1
	>48 hrs:0.5
RLQ tenderness	1
Guarding	2
Rebound tenderness	1
Rovsing sign	2
39 °C > Fever >37 °C	1
Raised WBC count	1
Negative urine analysis	1
Non-Asian Background	1
Total Score	17.5
RLQ: right lower quadrant, WBC: White blood cell, yr: years, hrs:hours	

Table 4: Tzakanis Scoring System

Diagnostic Criteria	Puan
RLQ tenderness	4
Rebound tenderness	3
WBC> 12000	2
Positive Ultrasound scan findings	6
Total Score	15
RLQ: right lower quadrant, WBC: White blood cell	

3.Results

A total number of 115 patients were included, and 62 of the patients (53.9%) were male while 53 (46.1%) were female. The mean age of these patients was 32.6 (between 18 and 77 years old). According to the histopathological results of the patients after an appendectomy, we found that 83 out of 115 patients (72.1%) were non-complicated appendicitis, 21 of them (18.3%) were reactive lymphoid hyperplasia, along with 11 of them (9.6%) were complicated-perforated appendicitis (Table 5).

Table 5: Pathology Results

	Pathology	n	%
Group	Non - Complicated Appendicitis	83	72.1
	Complicated-Perforated Appendicitis	11	9.6
	Not Appendicitis	21	18.3

Based on the Alvarado score, 94 patients (81.7%) were determined in the high-risk appendicitis group (Alvarado Score ≥ 6) while 21 (18.3%) patients were determined in the low-risk group (Alvarado Score <6). However, based on the pathology results of 94 patients who were considered in the high-risk group, 88 out of 94 patients (93.6%) were in fact determined as AA, while 6 of them (6.4%) had normal appendicitis. On the other hand, in the pathology results of 21 patients who were considered in the low-risk group, 6 out of 21 patients (28.6%) were determined as AA, while 15 patients (71.4%) had normal appendicitis. Therefore, when cumulatively considering the Alvarado score, we calculated that the sensitivity was 93.6%, the specificity was 71.4%, the positive predictive value (PPV) was 93.6%, and the negative predictive value (NPV) was 71.4% (Table 6).

Table 6: Comparison between Alvarado Score and Pathology

		Group			
		Appendicitis (n=94)		Not Appendicitis (n:21)	
		n	%	n	%
Alvarado Score	High Risk Total: 94 % 81.7	88	93.6	6	6.4
	Low risk Total: 21 % 18,3	6	28.6	15	71.4
n: number of patients					

Considering the Lintula score, 88 (76.5%) patients were classified in the high-risk appendicitis group (Lintula Score ≥21), while 27 (23.5%) patients were in the low-risk group (Lintula Score <21). However, 86 (97.7%) of the 88 patients classified as high risk had AA in the pathology results, while 2 patients (2.3%) had normal appendicitis. Of the 27 patients classified as low risk, 8 (29.6%) had AA in the pathology results, while 19 (70.4%) had normal appendicitis. According to these results, the Lintula score had a sensitivity of 91.4%, specificity of 90.4%, PPV of 97.7% and NPV of 70.4% (Table 7).

Table 7: Comparison between Lintula Score and Pathology

		Group			
		Appendicitis (n=94)		Not Appendicitis (n:21)	
		n	%	n	%
Lintula Score	High Risk Total: 88 % 76.5	86	97.7	2	2.3
	Low risk Total: 27 % 23.5	8	29.6	19	70.4
n: number of patients					

Based on the RIPASA score, 92 out of 94 (80%) patients were defined as high-risk appendicitis (RIPASA score ≥ 7.5), while 23 (20%) patients were considered low-risk (RIPASA score <7.5). However, 88 (95.7%) of the 92 patients who were considered high risk were identified as AA by pathology, while 4 (4.3%) had a normal appendix. On the other hand, among the 23 patients who were considered low risk, 6 (26%) had AA on pathology results, while 17 (74%) had a normal appendix. As a result of these results, the sensitivity of the RIPASA score was 93.6%, specificity 81%, PPV 95.7% and NPV 74% (Table 8).

Table 8: Comparison between RIPASA Score and Pathology

		Group			
		Appendicitis (n=94)		Not Appendicitis (n:21)	
		n	%	n	%
RIPASA Score	High Risk Total: 92 % 80	88	95.7	4	4.3
	Low Risk Total: 23 % 20	6	26	17	74
n: number of patients					

According to the Tzanakis score, 57 out of 94 patients (49.6%) were found to have high-risk appendicitis (Tzanakis score ≥8), while 58 patients (50.4%) were found to have low-risk appendicitis (Tzanakis score <8). Of the 57 patients who were evaluated as high-risk, 52 patients (91.2%) had AA in the pathology results, while 5 patients (8.8%) had normal appendicitis. Of the 58 patients considered as low risk, 42 patients (72.4%) had AA in the pathology results, while 16 (27.6%) had normal appendicitis. For the Tzanakis score, sensitivity was 55.3%, specificity 76%, PPV 91.2%, NPV 27.6% (Table 9).

Table 9: Comparison between Tzanakis Score and Pathology

		Group			
		Appendicitis (n=94)		Not Appendicitis (n:21)	
		n	%	n	%
Tzanakis Score	High Risk Total: 57 % 49.6	52	91.2	5	8.8
	Low Risk Total: 58 % 50.4	42	72.4	16	27.6
n: number of patients					

Comparison of scoring systems is reported in the Table 10.

Table 10: Comparison among scoring systems

	Alvarado	Lintula	RİPASA	Tzanakis
Sensitivity	%93.6	%91.4	%93.6	%55.3
Specificity	%71.4	%90.4	%81	%76
PPV	%93.6	%97.7	%95.7	%91.2
NPV	%71.4	%70.3	%74	%27.6

4.Discussion

Regardless of age group, AA is the most common form of acute abdomen and requires urgent surgery. Despite all the technological advances over the past three decades (laboratory tests, ultrasonography, computed tomography, and magnetic resonance imaging), the diagnosis of AA is still a serious challenge. Difficulties in diagnosis result in 20% perforation, 15-30% negative laparotomy, as well as post-operative complications [9, 10]. Moreover, removal of healthy appendicitis has been associated with a greater risk of abdominal adhesions compared to AA and puts a healthy patient at the risk for operative complications [11, 12].

Jose et al. reported the perforation rate in their study as 10.3% [13], while Farooqu et al. reported the rate as 18.8% [14]. The perforation rate in our study was found to be 9.6%.

Negative appendectomy rate has been reported in the range of 15-19% in previous studies. For example, Ma et al. reported 18.2% [15], Awayshih et al. reported 20% [16], Yoldaş et al. reported 15.4% [17] and Şenocak et al. reported 15.8% [18]. In our study, this rate was found to be 18.3% and is compatible with the literature.

Previously, in a study where the Alvarado scoring performance was examined on 206 patients, Kundiona et al. reported that the sensitivity and PPV for the Alvarado scoring system were 95.3% and 90.3%, respectively [19]. Similarly, Bouali et al. showed that the sensitivity and specificity of the Alvarado scoring system were 94.9%

and 72.7%, while PPV and NPV were 98.4% and 44.4%, respectively [20]. In another study, Noor et al. found that the sensitivity and specificity of the Alvarado scoring system were 90% and 80%, respectively and PPV and NPV were 97.6% and 21.8%, respectively [21]. In our study, the sensitivity was 93.6%, specificity was 71.4%, while PPV was 93.6% and NPV was 71.4% when the Alvarado score was ≥ 6, which is consistent with the literature.

Yoldas et al. reported a sensitivity of 88.1%, specificity of 91.6%, PPV of 97.8% and NPV of 64.7% for the Lintula scoring system in a study conducted on 156 Turkish patients in 2010 [22]. In addition, Konan et al. reported a PPV of 87.2% and NPV of 87.8% for the Lintula scoring system in a geriatric patient group [23]. Similarly, we found the sensitivity and specificity of the Lintula scoring system to be 91.4% and 90.4%, respectively. We also found the PPV to be 97.7% and NPV to be 70.3%, which is consistent with the literature.

Khan et al. reported 98.4% sensitivity, 87% specificity, 97% PPV and 77% NPV for the RIPASA score in a study conducted in 2020 [24]. Furthermore, in a study by Nanjundaiah et al. including 206 patients and comparing Alvarado and RIPASA scores, the sensitivity and specificity of the RIPASA score were found to be 96.2% and 90.5%, respectively [25]. Similarly, in our study, the sensitivity and specificity of the RIPASA scoring system were found to be 93.6% and 81%, respectively. In our study, PPV and NPV were 95.6% and 73.9%, respectively, which is in line with the literature.

Tzanakis et al., reported that the sensitivity and specificity were 95.4% and 97.4%, respectively in a study on 303 patients in 2005 [26]. In a study conducted by Korkut et al. On 74 Turkish patients, the sensitivity and specificity of the Tzanakis scoring system were found to be 84.4% and 99.8%, respectively [27]. In contrast to the previous studies in the literature, the sensitivity, specificity, PPV and NPV for the Tzanakis scoring system in our study were 55.3%, 76%, 91.2% and 27.6%, respectively. These low rates compared to the previous studies may be due to the low sensitivity of ultrasound imaging (USI) used and the different experience levels of the USI operators/sonographers.

5.Conclusion

Taking all into consideration, our findings suggest that Alvarado, Lintula and RIPASA scoring systems are more effective in the diagnosis of acute appendicitis, whereas Tzanakis scoring system has low diagnostic efficiency. Due to the high contribution of ultrasound findings to the scoring, it is thought that the Tzanakis scoring system can also be a powerful scoring system in the diagnostic phase when working with an experienced radiology clinic. In addition, there is no single method that provides 100% prediction in the diagnosis of AA and all scoring systems have some shortcomings. However, we think that the most important criteria in making the correct diagnosis of AA are the clinic where the patients are admitted, clinical and examination findings and the experience of the clinician, and that additional diagnostic methods are only tools that support the diagnosis and guide the clinician.

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