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ARAŞTIRMA / RESEARCH

Comparison of efficiency of Alvarado score and ultrasonography in acute appendicitis diagnosis

Akut apandisit tanısında Alvarado skoru ve ultrasonografinin etkinliğinin karşılaştırılması

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Abstract

Purpose: The aim of this study is to compare the efficiencies of Alvarado score and ultrasonography in diagnosis of acute appendicitis

Material and Methods: Two hundred and eleven patients who applied to emergency service with complaint of right lower quadrant pain between January 2013 and February 2015, were retrospectively examined. Twenty two patients, where the pathologies other than appendicitis were determined and no ultrasonography was applied, were excluded from the study. The Alvarado scores of the patients were calculated and recorded. They were divided into 2 groups by the Alvarado score; the scores <7 and those ≥7.

Results: Of 189 patients involved in this study, 157 patients (83%) had acute appendicitis and 32 (17%) had normal appendix. There were 68 patients (35.9%) having Alvarado score <7 and 121 patients (64.1%) having Alvarado score ≥7. Specificity of Alvarado score was calculated to be 90.6%, sensitivity to be 75.1%, positive predictive value to be 97.5%, negative predictive value to be 18.4%, and accuracy rate to be 77.7%. The specificity of ultrasonography was calculated to be 62.5%, sensitivity to be 74.5%, positive predictive value to be 90.6%, negative predictive value to be 12.7%, and accuracy rate to be 72.4%.

Conclusion: Alvarado scoring system and ultrasonography are the effective tools that can be used in diagnosis of acute appendicitis. But, however, Alvarado system come to the forefront as a more sensitive system. Among the patients having Alvarado score ≥7 and ultrasonographically diagnosed to have appendicitis, it would be better to use these methods together.

Key words: Acute appendicitis, Alvarado score, ultrasonography.

Öz

Amaç: Bu çalışmanın amacı Alvarado skoru ile ultrasonografinin akut apandisit tanısındaki etkinliğini karşılaştırmaktır.

Gereç ve Yöntem: Ocak 2013-Şubat 2015 tarihleri arasında sağ alt kadran ağrısı ile acil servise başvuran 211 hasta geriye dönük olarak incelendi. Apandisit dışında patolojiler tesbit edilen ve ultrasonografi yapılamayan 22 hasta çalışma dışı bırakıldı. Hastaların Alvarado skorları hesaplandı ve kaydedildi. Alvarado skoruna göre <7 ve ≥7 olarak 2 gruba ayrıldı. Tüm hastaların preoperatif ultrasonografi ve postoperatif histopatolojik sonuçları kaydedildi.

Bulgular: Çalışmaya dahil edilen 189 hastadan 157(%83) hastada akut appandisit ve 32(%17) hastada normal appendiks mevcuttu. Alvarado skoru <7 olan 68 (%35.9) ve ≥7 olan 121(%64.1) hasta mevcuttu. Alvarado skorunun spesifitesi %90.6, sensivitesi %75.1, pozitif prediktif değeri %97.5,negatif prediktif değeri %18.4 ve doğruluk oranı %77.7 olarak hesaplandı. Preoperatif 129 (%68.2) hastada ultrasonografi akut appandisit olarak rapor edildi. Bu hastaların, 117 (%61.9) tanesinde patoloji sonucu akut apandisit, 12 (%6.3) tanesinin ise patolojisi normaldi. Ultrasonografinin spesifitesi %62.5, sensivitesi %74.5, pozitif prediktif değeri %90.6, negatif prediktif değeri %12.7 ve doğruluk oranı %72.4 olarak hesaplandı.

Sonuç: Alvarado skorlama sistemi ve ultrasonografi akut apandisitin tanısında kullanılabilecek etkili araçlardır. Ancak Alvarado skorlama sistemi, daha duyarlı bir yöntem olarak ön plana çıkmaktadır. Alvarado skorunun ≥7 olduğu ve ultrasonografik olarak apandisitin tesbit edildiği hastalarda bu iki yöntemin birlikte kullanılması daha değerli bulunmuştur.

Anahtar kelimeler: Akut apandisit, Alvarado skoru, ultrasonografi.

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INTRODUCTION

Acute appendicitis is the most frequent cause of the abdominal pain resulting in surgery. The risk of experiencing it in entire life is approx. 75[1]. History, physical examination, and laboratory tests are still the most frequently used methods of diagnosing[2]. If the process of deciding an operation is based only on the physical examinations and symptoms of patients, the negative appendectomy rates vary between 15 and 30%[3,4]. Final diagnosis is possible only with the histopathological analysis of peroperative findings and specimen[5]. When necessary for the diagnosis, the additional scoring methods, ultrasonography (USG), tomography (CT), magnetic resonance (MRI), and laparoscopy can be used[6].

Alvarado scoring system is one of these auxiliary systems. Basically, it relies upon the history, physical examination, and some laboratory tests. Migration of abdominal pain, anorexia, nausea, defense, rebound, fever, leukocytosis, and neutrophilia are assessed and scored over 10 points[7]. While the patients with scores between 7 and 10 are recommended to be operated, those having 5-6 points are recommended to be examined via CT[8]. USG is another method that can be used in diagnosis of acute appendicitis in first step. Despite that it is a method depending on the person, it also has some advantages such as ease of access, cheapness, ease of use, and not exposing the patients to radiation. Most of the abdominal pain patients are examined by emergency physicians or different branches physicians before examined general surgeon. Thus diagnose acute appendicitis with simply laboratory tests and physical examination is important for early intervention.

In our study, we aimed to compare the diagnostic values of Alvarado score and USG in diagnosis of acute appendicitis when used separately and together.

MATERIAL AND METHODS

211 patients, who applied to Malatya State Hospital emergency service with complaint of right lower quadrant pain between January 2013 and February 2015, were retrospectively examined. The study was conducted according to Helsinki declaration criters. Among these patients, 1 patient diagnosed for Meckel diverticulum, 2 patients having ovarian cyst, 2 patients having appendix tumor, and 17 patients that were not received preoperative USG, totally 22 patients were excluded from the study. Alvarado scores of resting 189 patients were calculated. USG results and histopathological results were recorded. In our study, Alvarado score among the clinic scoring systems was utilized (Table 1).

Table 1. Alvarado scoring system

Clinic Finding	Score
Migration of pain	1
Vomiting	1
Anorexia	1
Defense	2
Rebound	1
High fever	1
Leukocytosis	2
Neutrophilia	1

Patients were divided into 2 groups by the Alvarado score; the scores <7 and those ≥7. While scoring, leucocyte >10,000/mm3, neutrophil percentage >75%, and fever >37.5°C were considered positive. Toshiba SSA-660A device was used in USG. USG was performed by on-call radiologist. Surficial USG was used for scanning the patients for appendix. In USG, the tubular at right lower quadrant wider than 6mm, non-compressed, and ending with dead end were considered positive for acute appendicitis. All of the patients were undergone appendectomy surgery. Specimens were sent to laboratory for histopathology analysis. The Alvarado scores and USG findings of patients were compared to pathology results. In order to use Alvarado score and USG together, a third group was established from patients having Alvarado score ≥7 and with appendicitis in USG.

Statistical analysis

All of the patient's groups specificity, sensitivity, positive predictive value, negative predictive value, and accuracy rate (test reliability) were calculated by using SPSS statistical software (SPSS 18.0 for Windows, Inc., Chicago, IL, USA).

RESULTS

Of 189 patients involved in this study, 105(55.5%) were male and 84(44.5%) were female. Mean age was 26.38 years, while median age was 24 (10-80) years. Of 189 patients operated with acute appendicitis pre-diagnosis, pathology of 157 (83%) was acute appendicitis, and those of 32 (17%) were

normal. In 129 (68.2%) preoperative patients, ultrasonography was reported as acute appendicitis. Of these patients, the pathology results of 117 (90.7%) patients were acute appendicitis, while those of 12 (9.3%) patients were normal. The preoperative ultrasonography results of resting 60 (31.8%) patients were reported to be normal. Of these patients, pathology results of 40 (66.6%) patients were acute appendicitis, while those of 20 (33.3%) patients were normal appendix (Table 2).

Table 2. Distribution by ultrasonography

Ultrasonography	Acute Appendicitis	Normal	Total
Acute Appendicitis	117	12	129
Normal	40	20	60
Total	157	32	189

There were 68 (36%) patients having Alvarado score <7. Acute appendicitis was histopathologically detected in 39 (57.4%) of them, while normal appendix was found in 29 29 (42.6%) of these patients. Of 121 patients (64%) having score ≥ 7, 188 (97.5%) were histopathologically diagnosed for acute appendicitis, while 3 (2.5%) were found to be normal (Table 3).

In patient group having Alvarado score ≥ 7 and diagnosed for appendicitis in ultrasonography, there were 88 (46.5%) patients. Of these patients, 86 (97.7%) were histopathologically diagnosed for acute appendicitis, while 2 (2.3%) were not (Table 5). Specificity of Alvarado score was calculated to be 90.6%, sensitivity to be 75.1%, positive predictive value to be 97.5%, negative predictive value to be 18.4%, and diagnosis accuracy rate to be 77.7% (Table 6). The specificity of ultrasonography was calculated to be 62.5%, sensitivity to be 74.5%, positive predictive value to be 90.6%, negative predictive value to be 12.7%, and diagnosis accuracy rate to be 72.4% (Table 6).

Of the group having Alvarado score ≥ 7 and acute appendicitis in ultrasonography, specificity was calculated to be 87.5%, sensitivity to be 89.5%, positive predictive value to be 97.7% negative predictive value to be 14.5%, and diagnosis accuracy rate to be 89.2% (Table 6).

Table 3. Patient distribution by the scores

Alvarado score	Sex	Appendicitis	Normal	Total
<7	Female	18	17	35 (18.7 %)
	Male	21	12	33 (17.4 %)
	Total	39	29	68 (36.1 %)
≥7	Female	47	2	49 (25.9 %)
	Male	71	1	72 (38. 0 %)
	Total	118	3	121 (64,9 %)

Table 4. Patient distribution by parameters

Parameter	+ n (%)	n (%)
Migration of the pain	114 (60.3 %)	75 (39.7 %)
Vomiting	151 (79.8 %)	38 (20.2 %)
Anorexia	125 (66.1 %)	64 (33.9 %)
Defense	169 (89.4 %)	20 (10.6 %)
Rebound	157 (83 %)	32 (17 %)
Temperature (>37.5 ^{0} C)	57 (30 %)	132 (70 %)
Leukocyte (>10000/mm^3)	129 (68.2 %)	60 (31.8 %)
Neutrophlia (> %75)	81 (42.8 %)	108 (57.2 %)

+ : Parameter is available: Parameter is unavailable n: number

Table 5. Distribution by Alvarado score, USG and histopathological state

Alvarado score		Appendicitis	Normal	Total
≥ 7	USG +	86	2	88
	USG -	32	1	33
	Total	118	3	121
< 7	USG+	31	10	41
	USG -	8	19	27
	Total	39	29	68

USG +: Acute appendicitis in ultrasonography USG - : Normal Ultrasonography

Table 6. Comparison of the groups' diagnostic value

Statistical Results	USG	Alvarado score	Alvarado ≥ 7 and USG+
Sensitivity	74.5 %	75.1 %	89.5 %
Specificity	62.5 %	90.6 %	87.5 %
Positive Predictive Value	90.6 %	97.5 %	97.7 %
Negative Predictive Value	12.7 %	18.4 %	14.5 %
Accuracy Test	72.4 %	77.7 %	89.2 %

DISCUSSION

Even though the appendicitis is the most frequently seen disease and it requires emergency surgery, it is not always possible to make accurate and on-time diagnosis. Making accurate and on-time diagnosis is the most important point in treatment of acute appendicitis. A careful history and a detailed physical examination are the most important tools in diagnosis. But, it might not be sufficient to evaluate the patients only through clinic and laboratory examinations. It is confused with other diseases, especially gynecological ones, despite all the laboratory findings, imaging examinations, and physical examination. This increases the rates of negative laparotomy. Because of these difficulties, even in best series, it has been reported that 11.9-13% of the patients, who have been undergone surgery with suspicion of acute appendicitis, have been unnecessarily operated[9]. In our study, the histopathological analysis reports of the appendix materials of 32 patients (16.9%) were found to be normal (negative laparotomy). Of these patients, 19 (10.1%) were female, and 12 6.8%) were male. While 29 of them had Alvarado score <7 (17 females, 12 males), 3 had Alvarado score ≥7 (2 females, 1 male). While ultrasonography imaging of 12 (7 females, 5 males) patients indicated appendicitis, those of 20 (12 females, 8 males) were normal.

The difficulties in diagnosis lead to latencies among some of the patients suspected of acute appendicitis. Accurate and on-time diagnosis is the most important point in treatment of acute appendicitis. The latencies in diagnosis increase the perforation rates in acute appendicitis. In literature, the frequency of perforated appendicitis has been reported to vary between 12.5% and 21%[10]. In our study, however, perforation was detected in 26 (12.3%) patients. Of these patients, 14 (53.8%) were male, and 12 (46.2%) were female. Of these patients, 3 had Alvarado score <7, and 23 patients had score ≥ 7. Of these patients, 15 had positive preoperative ultrasonography and 11 had negative preoperative ultrasonography.

It has been projected that the rates of the laparotomy and perforation would be decreased using imaging and scoring methods. Even though tomography is a method that offers more accurate results in diagnosis of acute appendicitis, it has some disadvantages such as expensiveness, difficulty of access, and radiation exposure[11]. Ultrasonography is the radiologic method, which will be preferred primarily because of its ease of access, cheapness, and ease of use, despite the fact that it is a person-dependent method. Since its first use by Puylaert in diagnosis of acute appendicitis in year 1986, the sensitivity of ultrasonography has been reported to vary between 44-98%, specificity between 47-95%, positive predictive value between 84-96%, and negative predictive value between 76-97%[12,13,14,15]. In their meta-analysis, Terasawa et al. have reported the ultrasonography as a diagnostic tool to have sensitivity of 86% and specificity of 81%[16]. In our study, sensitivity was determined to be 74.5%, specificity to be 62.5%, positive predictive value to be 90.6%, and negative predictive value to be 12.7%. The predictive value was found to be low in our study; we believe that this is probably because the real negative value is low.

The most frequent symptom of acute appendicitis is the abdominal pain that is initially located around the belly button and moving after 4-6 hours. Another symptom that is seen in almost any patient is the anorexia. Vomiting and nausea are observed in 75% of the patients. Important findings of physical examination are defense and rebound. Fever rarely exceeds beyond 38^0 C. in 25-50% of patients, the body temperature is within normal range. Leukocyte level generally is between 10,000 and 18,000. Shift to the left in number of neutrophil is another laboratory finding [17]. In our study, anorexia was observed in 151(79.8%) patients, defense in 169 (89.4%) patients, and leukocytosis in 129 (68.2%) patients (Table 4).

Use of multiple parameters may be further useful in early and accurate diagnosis of disease. Thus, the rates of perforation and negative appendectomy might be decreased. For this purpose, the Alvarado scoring, which includes the most frequent symptoms, physical examination findings, and laboratory analyses, can be used. Since Alvarado has described it, many studies have been carried out in order to evaluate its usability and reliability. Its sensitivity has been reported to vary between 54-96.2% and specificity between 54-74.39% [18.19]. In our study, its specificity was found to be 90.6%, sensitivity to be 75.1%, positive predictive value to be 97.5%, negative predictive value to be 18.4%, and diagnosis accuracy test to be 77.7%.

There are publications recommending the execution of emergency surgery in patients having Alvarado score ≥ 7 and appendicitis in ultrasonography when ultrasonography and Alvarado score are used together [20]. In our study, the specificity for this group of patients was found to be 87.5%, sensitivity to be 89.5%, positive predictive value to be 97.7%, negative predictive value to be 14.5%, and diagnosis accuracy test to be 89.1%.

In conclusion, USG performed by different radyologist is the basic limiting factor in this study. However, both of Alvarado scoring and ultrasonography seem to be methods that can be used in diagnosis of acute appendicitis. Following the physical examination, the radiological test to be preferred primarily is the ultrasonography. Alvarado score, which is the combination of physical examination, patient's complaints, and laboratory findings, was found to be a sensitive method for making an operation decision more than ultrasonography is. But, in in patients, who have Alvarado score ≥ 7 and where the appendicitis is detected in ultrasonography, together use of these 2 methods was determined to be more useful.

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