

Accuracy in The Diagnosis of Acute Appendicitis: Physical Examination Versus Ultrasonographic Evaluation

Akut Apandisit Tanısında Doğruluk: Fizik Muayene İle Görüntüleme Yöntemlerinin Karşılaştırılması

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Abstract

Introduction

Acute appendicitis is one of the most common causes of acute abdomen. In case of delay in the diagnosis process, perforation develops and the patient's morbidity and mortality increase. In our study, we evaluated the effectiveness of laboratory, radiological and physical examination findings in the diagnosis of acute appendicitis

Materials and Methods

A total of 488 patients hospitalized with a prediagnosis of acute appendicitis were included in the study. 162 patients constituted the unoperated and 326 patients constituted the operated group (Groups 1 and 2). The two groups were compared in terms of age, gender, and ultrasonographic findings, as well as Alvarado score parameters.

Results

In logistic regression analysis, which included only Alvarado parameters, anorexia was the most valuable parameter in predicting surgery (p=0.000). The Alvarado score was found to be the most useful parameter in making the surgery decision (p<0.001). In the regression model in which only Alvarado parameters were included, the most critical parameters in predicting acute appendicitis were fever (p<0.001), leukocytosis (p=0.001), rebound (p=0.016) and migration of pain to the right lower quadrant (p=0.04). When the Alvarado score was compared with other parameters in group 2, ultrasonographic positivity was at least as predictive as Alvarado positivity. While 87% of operated women had appendicitis, 94.3% of men had appendicitis (Chi-square p=0.02).

Conclusion

The clinic of the patient is more important than leukocytosis and ultrasonographic findings in making the surgery decision in patients consulted with a preliminary diagnosis of acute appendicitis. Using the Alvarado scoring system at this stage will reduce negative appendectomy rates.

Keywords

Acute appendicitis, Alvarado score, ultrasonography, physical examination

Özet

Amaç

Cerrahi müdahale gerektiren akut abdomen sebepleri arasında akut apandisit önemli bir konuma sahiptir. Tanı sürecinin uzaması ile perforasyon, batın içi apse ve sepsis gibi komplikasyonlar gelişebilmekte, morbidite ve mortalite oranları artmakta, hastanede kalış süresi uzamakta, maliyetler yükselmektedir. Günümüz koşullarında kolaylıkla tedavi edilebilmesi, erken ve doğru teşhis edilmesine bağlıdır. Bu gerçek doğrultusunda teşhis sürecinde başvurulan yöntemlerin etkinliğini değerlendirmeyi amaçladık.

Gereç ve Yöntemler

2016-2022 yılları arasında akut apandisit ön tanısı değerlendirilen 488 hastanın muayene laboratuvar ve görüntüleme sonuçları analiz edildi. En az 48 saattir devam eden karın ağrısı tüm hastaların ortak özelliği idi. Dahil edilme kriterlerinde başka bir merkezde görüntüleme yapılmamış ve medikal tedavi başlanmamış olması vardı. Hariç tutulma kriterleri ise sırasıyla: 15 yaşından küçük olmak, bilinen malignite, ailevi akdeniz ateşi, pelvik inflamatuvar hastalık, sistit ve gebelik ile geçirilmiş batın cerrahisi idi. İlk muayene sonrası takip kararı alınan 162 hasta (Non-surgery group) ile cerrahi müdahale kararı verilen 326 hasta (Surgery group) iki ayrı grupta irdelendi. Yaş, cinsiyet ve ultrasonografi ile iştahsızlık, ateş, ağrının lokalizasyonu, ağrının migrasyonu, rebound bulgusu, bulantı-kusma, lökositoz, akut faz yanıtında sola kayma gibi Alvarado parametreleri yönünden karşılaştırıldı. Opere edilen hastaların final patolojileri kendi içinde değerlendirildi.

Bulgular

Surgery Group(SG) ta kadınların %87'si, erkeklerin %94,3'ü apandisit idi (p=0.02). Alvarado sisteminde, ameliyat kararını ön gördüren en önemli parametre anoreksi olarak tespit edildi (p<0.001). Alvarado skoru, yaş, cinsiyet ve ultrasonografi sonuçlarının dahil edildiği regresyon analizinde, ultrasonografinin ameliyatı ön gördürmede istatistiksel olarak anlamlı olmadığı (p=0.6), Alvarado skorunun ise bu bakımdan değerli olduğu gözlemlendi (p<0.001). SG'nin regresyon analizinde, ateş (p<0.001), lökositoz (p=0.001), ve rebound (p=0.016) akut apandisit ön gördürmede önemliydi. Bu grupta ultrasonografi de benzer etkinliğe sahipti. Ultrasonografinin akut apandisit desteklemesi, kati patoloji sonucunun apandisit olarak raporlanması ihtimalini 1,9 kat arttırmaktaydı

Sonuç

Akut apandisit ön tanısı ile konsülte edilen hastalarda ameliyat kararı üzerinde fizik muayene bulguları önemlidir. Bu amaçla erkeklerde daha güvenli olan Alvarado skorlama sisteminin kullanılması negatif apendektomi oranlarını azaltmakta, tanıda gecikme ihtimalini düşürmektedir.

Anahtar Kelimeler Akut apandisit, Alvarado skoru, Ultrasonografi, Fizik muayene

INTRODUCTION

Acute appendicitis is the most common surgical disease among the causes of acute abdomen. The lifetime incidence of appendicitis is 8.6% in men and 6.7% in women. The highest incidence occurs in the second and third decade of life and remains an important public health problem (1). In developed countries, the rate of appendectomy has been decreasing over the years (2). While lumen obstruction resulting from lymphoid hyperplasia is often the cause in the pediatric population; in adults, it is caused by stool, fibrosis, foreign bodies (food, parasites, stones) or neoplasia (3-5). Late diagnosis and perforation are observed more frequently in children and the elderly. Negative appendectomy (NE) rate is higher in female patients. As a result of early diagnosis, the clinical picture improves in a short time with appendectomy, while the process becomes complicated in case of late diagnosis, and morbidity and mortality increase (6). Ultrasonography, computed tomography, magnetic resonance and diagnostic laparoscopy are used together with physical examination findings for diagnosis. Similarly, various scoring systems aid diagnosis (7,8). The current effective treatment of acute appendicitis is appendectomy. Normal appendix is seen in 15-30% of laparotomies performed (9). With radiological diagnostic methods, this rate can be reduced and unnecessary laparotomy can be prevented. Since there are no auxiliary radiological diagnostic devices in every health facility or there are no physicians who will use these devices, these devices do not help in diagnosis. In such a case, the physician has to make a decision based on the physical examination findings and laboratory results. The Alvarado scoring system, which is frequently used today, is a diagnostic method with high predictive value developed according to the clinical and laboratory results of the patient (10). It consists of eight parameters: right localization of pain (migration), right lower quadrant pain, fever, leukocytosis, nausea-vomiting, left shift in acute phase response, rebound sign, and loss of appetite. Right lower quadrant pain 2 points, leukocytosis 2 points, other parameters 1 point, a total of 10 points are evaluated (10). The accuracy of diagnosis of acute appendicitis increases and the rate of NE decreases in patients with a score of seven

and above (Table 1). In our study, we aimed to compare the reliability of physical examination, laboratory and imaging in the diagnosis of acute appendicitis.

MATERIAL and METHODS

i- Ethical Approval

This study was approved by Tekirdag Namik Kemal University Ethics Committee approval was obtained (Approval number 2022.209.11.11) in line with the ethical standards of the institutional/national research committee and the 1964 Helsinki Declaration. All patients who agreed to participate in the study were informed about the contents and informed consents were obtained.

ii- Data Sources

The study was carried out in Tekirdag Namik Kemal University General Surgery Clinic. The study was conducted by retrospectively examining the files of 488 patients hospitalized with a prediagnosis of acute appendicitis between 2016-2022. The data were obtained from Tekirdag Namik Kemal University hospital information management system.

iii- Patient population

Patients; it was divided into two as non-operated (Group 1) and operated (Group 2). The two groups were compared according to age, gender, anorexia, migration of pain, vomiting, right lower quadrant pain, leukocytosis, rebound, fever, left shift in acute phase response (Alvarado score parameters) and ultrasonographic examination (Table 1). In addition, the operation group was analyzed in itself according to the final pathology report. Patients younger than 15 years of age, pregnant patients, patients with a diagnosis of appendicitis complicated by perforation or plastron, patients with incidental appendicitis, patients undergoing abdominal surgery, patients with rheumatological diagnosis such as known familial Mediterranean fever, patients receiving oncological treatment, and patients taking nonsteroidal anti-inflammatory drugs was not included in the study. Those who had recently been treated for urinary tract infection or pelvic inflammatory disease were also excluded from the study. The study group consists of patients aged sixteen years and over, who were considered for a pre-diagnosis of

appendicitis in the emergency outpatient clinic and were taken to clinical observation. Those with an Alvarado score of seven and above were considered positive for the diagnosis of acute appendicitis, and those below seven were considered negative.

STATISTICAL EVALUATION

The mean and median values of the frequencies of the independent variables were calculated. Shapiro-Wilk test was used for distribution of Likert scales.

Predictive values of independent variables were calculated by logistic regression method, The distribution differences of non-parametric data between different groups were tested with the Kruskal-Wallis method. The chi-square method was used to examine the relationship between two different categorical parameters. All statistical analyzes were performed with SPSS ver 22 for windows.

Table 1: Demographic and clinical information of surgical and nonsurgical group participants

	Surgical n:326			Non-surgical n:162	Total n:488
	Appendicitis n:299	Normal n:27	Overall		
Age (mean)	25.7(15-58)	30.1(17-50)	26(15-58)	25(15-46)	25.7(15-58)
Gender					
Male	199(66.6%)	12(44.4%)	211(64.7%)	70(43.2%)	281(57.6%)
Female	100(33.4%)	15(55.6%)	115(35.3%)	92(56.8%)	207(42.4%)
Lower quadrant pain	291(97.3%)	27(100%)	318(97.5%)	156(96.3%)	474(97.1%)
Migration of pain	173(57.9%)	9 (33.3%)	182(55.8%)	118(72.8%)	300(61.5%)
Rebound	209(69.9%)	13(48.1%)	222(68.1%)	110(67.9%)	332(68%)
Fever	190(63.5%)	1(%3.7)	191(58.6%)	94(58%)	285(58.4%)
Nausea-vomiting	235(78.6%)	22(81.5)	257(78.8%)	106(65.4%)	363(74.4%)
Anorexia	280(93.6%)	25(92.6)	305(93.6%)	126(77.8%)	431(88.3%)
Ultrasonographic positivity	250(83.6)	16(59.3)	266(81.6%)	135(83.3%)	401(82.2%)
Leukocytosis	260(87%)	20(74.1%)	280(85.9%)	119(73.5%)	399(81.8%)
Left shift	215(71.9%)	17(63%)	232(71.2%)	87(53.7%)	319(65.4%)
Alvarado positivity	276(92.3%)	19(70.4%)	295(90.5%)	112(69.1%)	407(83.4%)

RESULTS

In Group 1, there were 70 (43.2%) men and 92 (56.79%) women. In Group 2, there were 115 (35.3%) women and 211 (64.7%) men. The mean age was 25 (15-46) in group 1 and 26 (15-58) in group 2. The mean age of all patients was 25.7. Demographic and clinical characteristics of the groups are summarized in Table 1. Age and leukocyte values of the patients show non-homogeneous distribution. It was observed that leukocyte values decreased with increasing age (Spearman'sRhop=0.01). In the logistic regression analysis (Table 2) in which only Alvarado parameters were included, pain anorexia was the most valuable parameter in predicting the surgery, followed by a left shift in the hemogram and nausea-vomiting. Migration of pain to the right lower quadrant was negatively predictive, contrary to expectations. In the analysis that included Alvarado score, age, gender and ultrasonography result, it

was seen that ultrasonography had no statistical effect on predicting the operation (p=0.6). While the decision for surgery was mostly taken for male patients, almost half of the female patients were followed up without surgery (p<0.001). Again, the Alvarado score was found to be the most valuable parameter in making the surgery decision (p<0.001).

In the regression model in which only Alvarado parameters were included in group 2 patients, fever (p<0.001), leukocytosis (p=0.001), rebound (p=0.016) and pain migration to the right lower quadrant (p=0.04) were the most important parameters in predicting appendicitis. Anorexia, nausea-vomiting, and left shift in hemogram were insufficient to predict appendicitis. Right lower quadrant pain was positive in all negative appendectomies (Table 2).

Table-2 The importance of Alvarado parameters in the prediction of surgery

Parameters	B	P value	Exp(B)
Lower quadrant pain	0.644	0.28	0.5
Migration of pain	-0.767	0.001	2.1
Rebound	0.134	0.55	0.8
Fever	0.075	0.73	0.9
Nausea-vomiting	0.471	0.04	0.6
Anorexia	1.255	0.000	0.2
Leukocytosis	0.021	0.94	0.9
Left shift	0.678	0.01	0.5
Logistic regression model			

Again, when Alvarado score was compared with other parameters in Group 2 (Table 3), ultrasonographic positivity was at least as predictive as Alvarado positivity. In this group, positive ultrasonography increased the probability of appendicitis 1,9 times. While 87% of operated women had appendicitis, 94.3% of men had appendicitis (Chi square p=0.02). This situation justified the surgical decision to be at

the forefront in men.

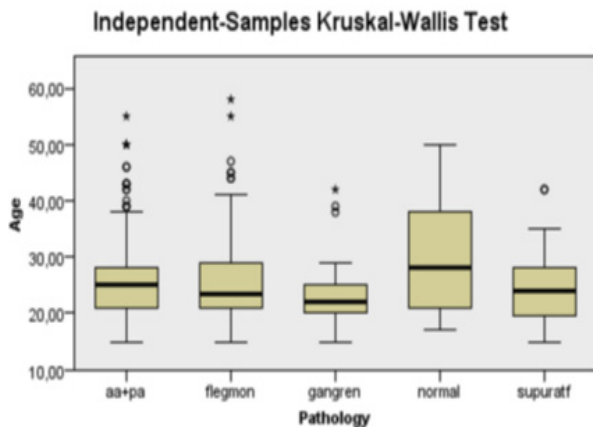
Although the mean age of the operated patients who were reported as appendicitis in the final pathology was smaller (Mann-Whitney U p=0.03), it was seen that age was not as statistically significant as other parameters in predicting appendicitis in the logistic regression model (p=0.07).

Table-3 The importance of parameters in the prediction of appendicitis

Parameters	B	P value	Exp(B)
Age	0.047	0.070	0.95
Gender	0.890	0.039	2.43
Alvarado	1.911	0.001	0.14
Ultrasonographic positivity	1.861	0.000	0.15

Logistic regression model

Considering the age distribution of the pathology results in the operated patients, the mean age of the normal group was higher. Gangrenous appendicitis was seen in younger patients ($p=0.04$) (Figure 1).



DISCUSSION

Inadequate access to imaging methods in primary healthcare institutions creates a disadvantage in the evaluation of acute abdomen patients. Especially, delay in the diagnosis of acute appendicitis leads to many complications. In our study, the predictive value of the Alvarado score, which consists of physical examination and laboratory values, in the diagnosis of acute appendicitis was 90.5% in accordance with the literature. Its sensitivity is 90% and specificity is 30% (7). Our negative appendectomy rate was 8.3%, lower than the literature⁹. Our study has shown that the Alvarado scoring system is sufficient in the diagnosis of acute appendicitis without the need for an auxiliary diagnostic method.

In recent years, various scoring systems have been developed to assist in the diagnosis of acute appendicitis⁸. However, these scoring systems are complex and not

suitable for clinical use. The Alvarado scoring system, on the other hand, can be easily applied both in the clinic and in the emergency department, as it is cost-effective and practical (6).

Parameters and auxiliary diagnostic methods to be used in the diagnosis of acute appendicitis should be both sensitive and specific. In our study, the sensitivity of the Alvarado score was found to be high, and the specificity was low, in line with the literature (7). The reason for this is that gynecological and urological pathologies cause similar complaints. The positive predictive value of the Alvarado score was found to be 90% and was consistent with the literature (11,12). In our study, the accuracy rate of the Alvarado score in the diagnosis of acute appendicitis was statistically significant in both groups ($p<0.001$). Ultrasonography is the first preferred and frequently used tool among the auxiliary diagnostic methods. Some studies in the literature report the sensitivity and specificity as 80-88% and 60-70%, respectively (13,14). In our study, the diagnostic sensitivity of ultrasonography was 83%. When the two groups were evaluated together, ultrasonography was not found to be statistically effective in making the decision for surgery ($p=0.637$). However, it was found to be statistically significant in the diagnosis of appendicitis in the surgery group ($p=0.002$).

The rate of Ne reported in the literature is approximately 15-30% (9). This rate is higher in women. The reason why it is higher in women is that gynecological pathologies cause similar complaints (15). In our study, while the rate of NA was higher in females (13%), this ratio was 5.7% in males and it was statistically significant ($p=0.021$).

Acute appendicitis is often seen in the first three decades of

life. Perforated appendicitis rate is higher in children and elderly patients. The possible reason for this is the inability of children to express their complaints and localize the pain. In the elderly, the pain threshold is high and they delay hospital admission for various reasons (16-19). Gangrenous appendicitis was more common in the younger age group.

In our study, high leukocyte count, presence of rebound and tenderness findings and migration of pain were more important among alvarado score parameters ($p=0.001$, $p=0.016$, $p=0.04$).

The fact that the Alvarado score is objective makes it more reliable. When used by different physicians, the result does not change. In a study, no significant difference was found in the diagnosis of acute appendicitis in the evaluation of the Alvarado score made by physicians from different departments. In this study, the sensitivity of the Alvarado score was found to be 95.4% and the specificity as 45.7% (20). For this reason, it seems appropriate to use the scoring system especially for non-surgeons working in primary health care institutions. As shown in our study, the Alvarado scoring system alone can be used reliably in the diagnosis of acute appendicitis.

Especially in cases where ultrasonography is not available, it helps to make decisions about the follow-up of the patient by scoring and prevents unnecessary referrals. The results of studies on ultrasonography contradict each other. Although some studies claim that ultrasonography provides early diagnosis and reduces what rate (21-23), there are also publications stating that perforation and complication rates do not decrease and the length of stay is not shortened by ultrasonography (24,25).

The limitation of our study is that it is retrospective and scoring is done according to the findings of the first examination. The results of our study, which we believe will support prospective randomized studies, studies in large series and in multiple centers, are compatible with the literature.

CONCLUSION

Our study showed that the number of monocytes is The Alvarado scoring system can be used safely in the diagnosis of acute appendicitis, a disease in which the definitive diagnosis can only be made by histopathology as the gold standard. Because it is cost effective, it offers repeatable and rapid evaluation. It reduces the dependency on ultrasonography. Obtaining similar results as a result of its interdisciplinary use provides an advantage for physicians.

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Ethical Declerations

The approval for this study was obtained from Tekirdağ Namık Ke- mal University Health Research Ethics Committee (Protocol no: 2022.209.11.11).

Informed Consent:

An informed consent was obtained from the patient for surgical intervention. This manuscript has not been presented orally or as a poster in any congress..

Conflict of Interest Statement:

The authors have no conflicts of interest to declare.

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Author Contributions:

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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