Research Article / Araştırma Makalesi

Effectiveness of Ultrasonography and Computed Tomography in the Diagnosis of Acute Appendicitis

Akut Apandisit Tanısında Ultrasonografi ve Bilgisayarlı Tomografinin Etkinliği

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Abstract

Background: Acute appendicitis is the acute inflammation of the appendix vermiformis and is one of the leading emergency intra-abdominal surgeries. In the study; To investigate the effectiveness of preoperative USG and CT in the diagnosis of acute appendicitis.
Materials and Methods: The records of 332 patients who underwent appendectomy between March 2018 and March 2023 were retrospectively examined. Gender, age, USG and CT reports and pathology results of the patients were recorded. Sensitivity, specificity, positive predictive value and negative predictive values of USG and CT in the diagnosis of acute appendicitis were calculated separately.
Results: The pathology result was reported as acute appendicitis in 312 of the patients, and was evaluated as normal in 20 of them. The pathology result of 254 of 261 patients, whose CT results were evaluated as compatible with acute appendicitis, was reported as acute appendicitis. In 7 patients, it was found to be normal appendicitis. Of 28 patients whose CT results were incompatible with acute appendicitis, the pathology result was positive in 18 and negative in 10. Pathology results of 96 patients whose USG results were compatible with acute appendicitis; Acute appendicitis was found in 90 patients and normal appendix in 6 patients. Pathology results of 41 patients whose USG results were evaluated as negative; It was reported to be compatible with acute appendicitis in 36 cases and normal in 5 cases.
Conclusions: In our study, both the sensitivity and specificity of CT were found to be superior to USG, consistent with the literature. Researching IT effectiveness; We think that prospective studies comparing teleradiology reports and the reports of radiologists working in hospitals would be useful.

Key Words: Acute appendicitis, Computerized tomography, Ultrasonography, Pathology

Öz

Amaç: Akut apandisit, apendiks vermiformisin akut iltihabıdır ve acil batın içi cerrahilerin başında gelir. Çalışmadaki; preoperatif çekilen USG ve BT nin akut apandisit tanısındaki etkinliğini araştırmak.
Materyal ve Metod: Mart 2018- Mart2023 tarihleri arasında apendektomi yapılan 332 hastanın kayıtları retrospektif olarak incelendi. Hastaların cinsiyet, yaş, USG ve BT raporları ve patoloji sonuçları kaydedildi. USG ve BT 'nin akut apandisit tanısında sensitivite(duyarlılığı), spesifite(özgüllüğü), pozitif prediktif değer, negatif prediktif değerleri ayrı ayrı hesaplandı.
Bulgular: Hastaların 312 sinde patoloji sonucu akut apandisit olarak raporlanmış olup 20 sinde ise normal olarak değerlendirilmişti. BT sonucu akut apandisit ile uyumlu olarak değerlendirilen 261 hastanın 254'ünün patoloji sonucu akut apandisit olarak raporlanmıştır.7 hastada ise normal apendiks olarak sonuçlanmıştır.BT sonucu akut apandisit ile uyumsuz olan 28 hastanın 18 inde patoloji sonucu pozitif olup 10 unda ise negatifti. USG sonucu akut apandisit ile uyumlu gelen 96 hastanın patoloji sonuçları; 90 hastada akut apandisit,6 hastada normal apendiks olarak bulundu. USG sonucunun negatif olarak değerlendirilen 41 hastanın patoloji sonuçları; 36' sında akut apandisit ile uyumlu olup 5' inde ise normal olarak raporlanmıştır.
Sonuç: Çalışmamızda literatürle uyumlu olarak BT nin hem duyarlılığı hem özgüllüğü USG'den üstün bulunmuştur. BT etkinliğini araştıran; teleradyoloji raporları ve hastanede çalışan Radyologların raporlarının karşılaştırıldığı prospektif çalışmaların faydalı olacağını düşünmekteyiz.

Anahtar Kelimeler: Akut apandisit, Bilgisayarlı tomogafi, Ultrasonografi, Patoloji

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Introduction

Acute appendicitis is the acute inflammation of the appendix vermiformis and is one of the leading emergency intra-abdominal surgeries. The basis of acute appendicitis is the obstruction of the appendix lumen for various reasons. The lifetime probability of a person suffering from acute appendicitis is 6.7% in women and 8.6% in men (1). Acute appendicitis is most commonly seen between the ages of 10-30, when the increase in lymphoid tissue is high (2).

In the diagnosis of acute appendicitis, detailed history, physical examination and laboratory and imaging techniques are used as auxiliary methods. Despite history, physical examination, laboratory and imaging methods, there are difficulties in making a diagnosis in 20-30% of patients due to atypical clinical presentation (3). For this reason, the search for which of the auxiliary tests used in the diagnosis of acute appendicitis is best remains current.

Although the rate of patients with no acute appendicitis detected in pathological examination (negative appendectomy) in patients who underwent appendectomy varies between studies, this rate has decreased over time with the use of auxiliary tests in the diagnosis of acute appendicitis (4-6). Imaging methods are frequently used in practical applications to minimize negative appendectomy rates as much as possible. USG and CT are generally used as auxiliary imaging methods. Although USG has a high level of accuracy, it can give false negative results due to reasons such as individual dependency, appendix location, and obesity (7). CT is frequently used in differential diagnosis, especially to reduce negative appendectomy rates. CT is recommended for definitive diagnosis in patients with negative USG but clinically suspected acute appendicitis, and in older and obese patients.

Our aim in this study is; to compare preoperative USG and CT scans with pathology results; To investigate the effectiveness of USG and CT in the diagnosis of acute appendicitis.

Materials and Methods

Ethical approval was received for this study by the decision of Harran University Clinical Research Ethics Committee dated 07/08/2023.

Our study is multicenter. The records of 357 patients who were operated for appendectomy in the 4 centers where our study was performed were retrospectively reviewed. Gender, age, USG and CT reports and pathology results of the patients were recorded. 25 patients who did not have both USG and CT imaging methods, whose pathology report was not available, and who underwent appendectomy in addition to other surgeries were excluded from the study. 332 patients were included in the study. On USG, "a non-compressible tubular structure in the right lower quadrant, ending in a blunt end, with a diameter greater than 6 mm" was accepted as positive for acute appendicitis. Acute appendicitis was considered negative in patients whose USG was interpreted as "the appendix could not be visualized" or "a normal appendix was observed". CT was performed in cases where USG was negative but clinically suspicious. CT positive in patients whose CT reports are interpreted as acute appendicitis or suspected acute appendicitis; In patients whose appendix was normal or the appendix could not be visualized, CT was considered negative. All patients were taken into surgery and the appendectomy material was sent to pathology for examination. In patients whose pathology evaluations were interpreted as acute appendicitis, perforated appendicitis, or phlegmenous appendicitis, the pathology was positive; In patients interpreted as lymphoid hyperplasia in the appendix and normal appendix, the pathology was considered negative.

Sensitivity, specificity, positive predictive value and negative predictive values of USG and CT in the diagnosis of acute appendicitis were calculated separately.

Results

Of the 332 patients included in the study, 203 (61.1%) were male and 129 (38.9%) were female. The average age of the patients was 30.1 (14-79), the average age of men was 29.8 (15-79), and the average age of women was 30.4 (14-70).

When the pathology results of the patients included in the study were examined, it was reported as acute appendicitis in 312 (94%) patients and normal appendix in 20 (6%) patients.

Of the 289 patients who underwent CT, 261 were considered compatible with acute appendicitis, while 28 patients were evaluated as incompatible with appendicitis. The pathology results of 261 patients whose CT results were compatible with acute appendicitis were reported as acute appendicitis in 254 patients and as normal appendicitis in 7 patients. Of the 28 patients whose CT results were interpreted as negative for appendicitis, 18 of the pathology results were compatible with acute appendicitis and 10 were negative.

Table 1. CT and USG Diagnostic Correlation

	CT	CT	USG	USG	Pathology	Pathology	Total
Female	98	15	45	14	120	9	129
Male	163	13	51	27	192	11	203
Total	261	28	96	41	312	20	332

Table 2. Diagnostic Correlation with CT

	Pathology Positive	Pathology Negative	Total
CT Positive	254	7	261
CT Negative	18	10	28
Total	272	17	289

Of the 137 patients who underwent USG, 96 were reported as compatible with acute appendicitis, while 41 were evaluated as negative. While the pathology results of 90 of 96 patients whose USG results were compatible with acute appendicitis were reported as positive, the results of 6 patients were reported as negative. Of the 41 patients whose USG showed no appearance compatible with acute appendicitis, the pathology result was reported as positive in 36 and negative in 5.

In our study, the sensitivity of CT was calculated as 93.4%, specificity as 58.8%, positive predictive value as 97.3% and negative predictive value as 3.7%. The sensitivity of USG was calculated as 71.4%, specificity as 45.4%, positive predictive value as 93.8% and negative predictive value as 3.9%.

Table 3. Diagnostic Correlation with USG

	Pathology Positive	Pathology Negative	Total
USG Positive	90	6	96
USG Negative	36	5	41
Total	126	11	137

Discussion

Acute appendicitis is one of the most common causes of emergency abdominal surgery. It occurs as a result of blockage of the appendix lumen for various reasons and is most common between the ages of 10-30. The diagnosis of acute appendicitis is made by the patient's medical history and physical examination. Today, in parallel with medical developments, laboratory and imaging techniques are frequently used as auxiliary techniques in the diagnosis of acute appendicitis. Although USG is the first imaging technique recommended, CT and magnetic resonance (MRI) imaging are also used for differential diagnosis (7). Despite detailed medical history, physical examination and auxiliary techniques, difficulties are sometimes experienced in the diagnosis of acute appendicitis due to the atypical clinical presentation. These difficulties in diagnosis also bring about negative appendectomies. Over time, negative appendectomy rates have decreased significantly due to medical advances.

The diagnosis of acute appendicitis can be confused with many diseases, especially gynecological diseases, despite laboratory tests, physical examination and imaging techniques. This situation increases the rate of negative appendectomy. In the study conducted by Henna et al. (8), the negative appendectomy rate was 18.2%, while Taylan et al. reported it as 15.3% (9). In our study, the negative appendectomy rate was found to be 6%, which can be considered low compared to the literature. We think that one of the reasons for our low negative appendectomy rate is that clinically suspicious patients are hospitalized with medical treatment and followed up with close clinical monitoring. There are studies in the literature on medical treatment in the early stages of acute appendicitis and in uncomplicated acute appendicitis (10,11). We think that not performing an appendectomy on patients whose general condition is good but who have clinically suspected abdominal pain is followed up with medical treatment, resulting in the recovery of acute appendicitis or nonspecific abdominal pain in the early stages, reduces our negative appendectomy rate. Since USG was used in the diagnosis of acute appendicitis by Puylaert in 1986, it was reported that its sensitivity was 44-98%, its specificity was 47-95%, its positive predictive value was 84-96%, and its negative predictive value was 76-97% (12). In our study, the sensitivity of USG was calculated as 71.4%, specificity as 45.4%, positive predictive value as 93.8% and negative predictive value as 3.9%. Most studies report that USG is highly effective in diagnosing acute appendicitis(7). When there is doubt in the definitive diagnosis, it is recommended that US be used
as an imaging test first, as this technique is easily accessible, has low cost, and is easy to use. However, the clinical approach must be used together with the tests used in diagnosis.

In patients presenting with a typical history of acute appendicitis, the diagnosis can be easily made with a clinical approach. However, it is often difficult to diagnose a history of atypical acute appendicitis. US may not be sufficient in obese, elderly, comorbid, atypical appendix and uncooperative patients. Richard Nshuti found that only 31% of patients admitted to the hospital had a typical history of acute appendicitis(13). The first imaging test for patients in this group is USG. However, in patients with a history of atypical acute appendicitis, CT and MRI are required for diagnosis. Today, the sensitivity and specificity of CT are 87-100% and 89-99%, respectively(14). This increases the use of CT in patients with suspected acute appendicitis. In our study, the sensitivity of CT was found to be 93.4% and the specificity was 58.8%.

Although the sensitivity of CT is compatible with the literature, its specificity was found to be low (15). This may be due to data limitations such as the fact that our study is retrospective and patients with negative CT results and who did not undergo surgery could not be included in the study, teleradiology, which has become widespread recently and the radiology specialist's interpretation over the internet from another center, the physician examining the patient and the radiologist interpreting the CT not being able to communicate directly, and the situation of incomplete clinical information. We think it depends. It would be useful to examine this situation with prospective studies. It was thought that the reason why USG has low sensitivity and

specificity is because USG depends on the person using it. We consider the limitations of our study to be that it is retrospective, that patients with negative imaging and who did not undergo surgery but recovered with medical treatment were not included, and that both imaging methods were not applied to all patients.

Conclusion

Although anamnesis and physical examination are very important in the diagnosis of acute appendicitis, additional radiological examinations are often required. Although negative appendectomy rates have decreased today compared to the past, problems such as the fact that it is not always possible to perform USG before CT and evaluation of CT with teleradiology method contribute to the current negative appendectomy rates. It should not be forgotten that USG is person-dependent in clinical applications. In our study, consistent with the literature, both the sensitivity and specificity of CT were found to be superior to USG. Researching IT effectiveness; We think that prospective studies comparing teleradiology reports and the reports of radiologists working in hospitals would be useful.

Ethical Approval: Ethical approval was received for this study by the decision of Harran University Clinical Research Ethics Committee dated 07/08/2023.

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Data acquisition: M.G., F.E., E.K., R.Ç.
Analysis and interpretation: M.G., F.E., E.K., R.Ç.
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