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ORIGINAL ARTICLE / ÖZGÜN ARAŞTIRMA MAKALESİ

Computed Tomography In Differential Diagnosis Of Abdominal Pain Among Patients With Suspected Acute Appendicitis

Akut Apandisit Şüphesi Olan Hastaların Karın Ağrısı Ayırıcı Tanısında Bilgisayarlı Tomografinin Yeri

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ÖZET

Amaçlar: Akut apandisit tanısı çoğu zaman klinik değerlendirme ve ultrasonografi (USG) ile koyulur. Karın ağrısı nedenlerini netleştirmek için ileri görüntüleme olarak sıklıkla bilgisayarlı tomografi (BT) tercih edilir. Bu çalışmada akut apandisit şüphesi olan olgularda BT'nin tanısal etkinliği araştırıldı.

Yöntemler: Acil servise karın ağrısı şikayetiyle başvuran, akut apandisit şüphesiyle USG ve BT görüntülemesi yapılan ve bu nedenle opere edilen erişkin hastalara ait veriler retrospektif olarak tarandı. Hastaların demografik özellikleri, görüntüleme sonuçları ve ameliyat sonrası patoloji sonuçları kaydedildi.

Bulgular: Akut apandisit şüphesi olan 1030 vakadan 289'una (% 28) BT incelemesi yapıldığı tespit edildi. Hastaların ortanca yaşı 33'tü (IQR: 24-43) ve bunların% 54'ü erkekti. Akut apandisit tanısında patoloji raporları altın standart olarak kabul edildi. Elde edilen sonuçlara göre, BT görüntülemenin şüpheli vakalarda bile etkili olduğu saptandı ($p < 0.01$). ROC analizinde AUC değeri 0.652 (% 95 CI: 0.546-0.727) idi. Ameliyat sonrası patoloji raporlarında akut apandisit tanısı doğrulanmayan 28 olguda (% 9), mezenterik lenfadenit (n: 16), malignite (n: 6), normal bulgular (n: 3), akut pelvik inflamatuar hastalık (n: 2) ve divertikülit (n: 1) tespit edildi. Bu hastaların 22'si (%78) kadındı.

Sonuç: Bilgisayarlı tomografi, acil servise karın ağrısı sebebiyle başvuran ve akut apandisit şüphesi olan hastaların ayırıcı tanısında etkili bir görüntüleme yöntemidir. Özellikle kadın hastalarda akut apandisit dışında ek ciddi tanılar da tespit edilebilmektedir.

Anahtar kelimeler: Akut apandisit, bilgisayarlı tomografi, ayırıcı tanı

ABSTRACT

Objectives: Acute appendicitis is mostly diagnosed in clinic evaluation and with ultrasonography (USG). Computed tomography (CT) is often preferred as an advanced imaging to clarify the causes of abdominal pain. In this study, the diagnostic effectiveness of CT in cases of suspected acute appendicitis was investigated.

Methods: The data from the adult patients who had applied to the emergency department with abdominal pain, undergone USG and CT imaging with suspected acute appendicitis and operated with that reason were scanned retrospectively. The demographic characteristics, imaging results and post-operative pathology results of the patients were recorded.

Results: It was found that 289 (28%) of the 1030 cases having suspected acute appendicitis had undergone CT imaging. The median age of the patients was 33 years (IQR: 24-43) and 54% of those were male. The pathology reports were accepted to be golden standard for the diagnosis of acute appendicitis. According to the results obtained, CT imaging was found to be effective even in suspected cases ($p<0.01$). In the ROC analysis, the AUC value was 0.652 (95% CI: 0.546-0.727). In 28 cases (9%) for which the diagnosis of acute appendicitis was not verified in the post-operative pathology reports, mesenteric lymphadenitis (n:16), malignity (n:6), normal findings (n:3), acute pelvic inflammatory disease (n:2) and diverticulitis (n:1) were detected. Of those patients, 22 (78%) were females.

Conclusion: Computed tomography is an effective method of imaging in differential diagnosis of patients who apply to the emergency department with abdominal pain and who have suspected acute appendicitis. Especially in female patients, additional serious diagnoses other than acute appendicitis can also be detected.

Keywords: Acute appendicitis, computed tomography, differential diagnosis

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Introduction

Acute appendicitis is the most frequent reason of acute abdominal pain requiring surgical intervention. It is often observed in 20 to 30 years of age and it makes a peak in 22 years of age (1). Although diagnosis can be done with clinic findings and laboratory results for many of the patients, imaging techniques are appealed in suspected cases (2). In recent years, the utilisation of advanced techniques such as computed tomography (CT) together with ultrasonography (USG) has increased in diagnosis of acute appendicitis (3).

The most important disadvantage of ultrasonography is that it is applicant dependant. It becomes harder to image the appendicitis with USG especially in anatomically retrocecal appendicitis, in obese patients, in patents who have developed perforations and who had undergone abdominal surgery. If clinic suspicion is pending, the observation of the patient must be continued, or CT must be performed (4).

CT is a more effective method in diagnosis of acute appendicitis. The inflamed appendix seems dilated in CT and it has thickening in its wall. In general, inflammation images such as dirty lipidosis and thickening in mesoappendix, phlegmon and appendicolite can be seen (5).

The definitive therapy in acute appendicitis is appendectomy. In case of development of perforation morbidity is 100 times more compared to simple appendicitis. While mortality is 0,1% in simple appendicitis, it reaches up to 10% in perforation, in turn. Hence, early diagnosis and early surgical intervention is essential (6). In this study, it was targeted to investigate the effectiveness of computed tomography in differential diagnosis of abdominal pain among patients with suspected acute appendicitis.

Material and Methods

The research was performed in the emergency department (ED) of an education and research hospital after receiving approval from the board of ethics. The data from the patients were scanned retrospectively through the hospital automatization system.

The 18 years old and older patients applied to the ED between the dates of January 1st, 2013 and December 30th, 2015, who were operated with the diagnosis of acute appendicitis and whose abdominal USG and contrast enhanced abdominal CT inspections had been completed previously. Only the inspections performed by injecting contrast substance from the intravenous tract have been taken into consideration. The patients who did not satisfy these conditions and whose data could not be reached were excluded from the study.

Imaging results of the patients were recorded together with their ages and genders. The USG inspections were performed with Toshiba Istyle Nemio XG (2006, Japan) device using 3.75 mHz convex probe. The diameter width greater than 6mm measured with USG from the proximal of the appendix and the existence of appendicolite image were accepted as appendicitis.

The abdominal BT imaging inspections were carried out with Siemens Definition AS device by taking intersections in 5mm intervals. Having a diameter width of 7 mm or above, having inflammation on peri-appendicular adipose tissue, distension in appendix and observation of wall thickening have been accepted to be acute appendicitis. All the BT imaging inspections were assessed and reported by senior radiologists. The post-operative pathology reports were accepted to be golden standard for the final diagnoses.

Statistical analysis

The SPSS 22 (version 22.0.0.0) software was used in the data evaluation. The qualitative data were expressed with number of observations and percentages and the quantitative data with interquartile range (IQR), minimum (min) and maximum (max) values. The chi-square test was used in the analysis of categorical variables. The effectiveness of abdominal CT in diagnosis of acute appendicitis was evaluated with the ROC (Receiver Operating Characteristic) analysis. All the analyses were performed in 95% confidence interval and $p<0.05$ was accepted to be statistically significant.

Results

The data from a total of 1030 patients were analysed in the study. Patients who had USG results but had not undergone CT inspection, constituting a total of 715, and 26 patients whose data were deficient were excluded from the study. At the end, 289 (28%) patients were included in the study. Accordingly, it was determined that contrast enhanced abdominal CT inspection was carried out for about one third of the patients having suspected acute appendicitis. The median age of the patients was 33 years (IQR:24-43, min:18, max:92) and 156 (54%) of them were male.

It was determined that 146 of the 247 patients whose USG results were reported to be normal appendix but had undergone CT upon clinic suspicion were reported to have acute appendicitis. For 139 of those, the diagnosis of acute appendicitis was verified with a post-operative pathology report.

In 28 cases (9%) for which the diagnosis of acute appendicitis was not verified in the pathology reports, mesenteric lymphadenitis (n:16), malignity (n:6), normal findings (n:3), acute pelvic inflammatory disease (n:2) and diverticulitis (n:1) were detected. Of those patients, 22 (78%) were females.

The effectiveness of abdominal CT on diagnosis of acute appendicitis in cases whose diagnosis cannot be finalised with clinic findings and USG is shown on Table 1 and Table 2. In the ROC analysis in which the effectiveness of CT was evaluated, the AUC value was calculated to be 0.652 (95% CI:

0.546-0.757). This value was found to be statistically meaningful (p<0.01). In these analyzes, pathology reports were accepted as the gold standard for the diagnosis of acute appendicitis.

	Pathology report		
	(+)	**(-)**	**Total**
CT (+)	163 (56.4%)	9 (3.1%)	172 (60%)
CT (-)	98 (33.9%)	19 (6.5%)	117 (40%)
Total	261 (90%)	28 (10%)	289 (100%)

CT: Computed Tomography

Table 1. Computed tomography and pathology results

Discussion

USG and CT are the preferred methods for the differential diagnosis of acute appendicitis (7). The superiorities of USG over BT are its low cost and that it can be repeated easily, also it does not require contrast substance and it does not possess risk of radiation. But USG is applicant dependant and it is sometimes insufficient for diagnosis (8).

Performing CT inspection in cases in which acute appendicitis findings cannot be detected with USG is quite effective for diagnosis and for reducing the ratios of negative appendectomies (9). Furthermore, CT is also a more effective method for identifying the other intra-abdominal pathologies (9,10). The results of our study have been found to be in accordance with that.

Acute appendicitis and other additional diagnosis have frequently been encountered at the operations performed upon pending clinic suspicion despite the USG and CT inspections. Therefore, it can be said that anamnesis and physical examination are the most important steps guiding physicians to diagnosis.

CT is not a hundred percent reliable technique for the diagnosis of appendicitis. It has been reported that appendix could not have been imaged in 10 to 15 percent of CT imaging inspections (10). In the literature, the sensitivity of CT for the diagnosis of acute appendicitis has been determined to be 76% to 96% and its specificity to be 75% to 95% (11-13). The result that these ratios have been measured to be lower in our research can be explained by the fact that not all the patients applied with suspected acute appendicitis were included in the study. About one third of the patients with suspicion of acute appendicitis had been subjected to CT inspection and only the data from those patients were taken into consideration.

The other diagnosis detected in the patients operated with suspected acute appendicitis have been reported by 75% to be acute mesenteric lymphadenitis, not organic pathologic case, acute pelvic inflammatory disease, ovarian cyst torsion, graafian follicle rupture and acute gastroenteritis (3). The results of our study are in consistence with that and furthermore malignancies related with gynaecologic or gastrointestinal system have been detected in 21% of the patients.

		95% CI
Sensitivity	62.4	56.2 - 68.2
Specificity	67.8	47.5 - 83.4
+LR	1.94	1.12 - 3.35
-LR	0.55	0.45 - 0.66
+PV	94.7	89.9 - 81.6
-PV	16.2	10.3 - 24.4
Area Under the ROC Curve	0.652	0.546 - 0.757
Significance level / p (Area=0.5)	< 0.01	

LR: Likelihood Ratio, PV: Predictive Value CI: Confidence Interval

Table 2. The effectiveness of computed tomography in diagnosis of acute appendicitis

Female gender constitutes most of the patients operated with suspected acute appendicitis but who have not been detected to have organic pathology or who have received additional diagnosis (3,14). In consistence with that, 78% of the negative appendectomy cases were females in our study.

Limitations

The main limitations of the study are that it is single-centred and that it was carried out with a limited patient group for which both CT and USG techniques had been applied and who had had operation at the end.

Conclusions

Abdominal CT imaging is effective in the differential diagnosis of patients with suspected acute appendicitis and whose diagnosis cannot be clarified with USG. In complicated cases, especially in female patients, additional serious diagnoses other than acute appendicitis can be detected by CT imaging.

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Author contribution statement: Conceived and designed the experiments (MY, TI, TYK), data collection (HCA, HI, TYK), analyzed and interpreted the data (MY, HI), contributed reagents, materials, analysis tools or data (HCA, MY, TI) wrote the paper (HCA, HI, TYK). All authors reviewed and edited the manuscript and approved the final version.

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