

Is the appendix length/diameter ratio an early-indicator for the perforation in acute appendicitis?

Ugur Ekici¹, Faik Tatli², Murat Kanlioz³

¹Istanbul Gelişim University, Health Sciences Colleges, Department of Health Administration, Istanbul, Turkey

²Harran University Faculty of Medicine, Department of General Surgery, Sanliurfa, Turkey

³Special Lokman Hekim Hospital, Department of General Surgery, Ankara, Turkey

Copyright © 2018 by authors and Annals of Medical Research Publishing Inc.

Abstract

Aim: Acute appendicitis is the most frequent reason for the stomachaches resulting in the surgery. The acute appendicitis perforation might create complications that are of vital importance. In this study, it is aimed to examine the relationship of appendix length/diameter ratio with acute appendicitis perforation.

Material and Methods: Using the pathology results of appendectomy materials of 144 patients that applied to emergency service between March 2013 and May 2014 and were operated due to the suspicion of acute appendicitis, the length/diameter ratios were calculated. The patients were divided into 2 groups as perforated appendicitis and non-perforated appendicitis. The number of patients and the length/diameter ratios were calculated and recorded for both groups. Pearson's Chi-Square test was used for statistical analysis.

Results: In pathological examination of 144 patients involved in this study, non-complicated acute appendicitis was diagnosed in 123 (85.4%) patients, while 21 (14.6%) patients were found to have perforation. In present study, the results indicating that the length/diameter ratio might be used as early indicator for the perforation were achieved. When the appendix length/diameter ratio declined below 10, then the perforation frequency significantly increased ($p < 0.01$).

Conclusion: Knowing these rate can help the surgeon in early surgical intervention, so the possible complications of perforated appendicitis might be decreased via early surgical intervention.

Keywords: Acute appendicitis; appendix length/diameter ratio; appendicitis perforation.

INTRODUCTION

The acute appendicitis is the most frequent reason for the acute stomachaches resulting in surgery. The perforation of acute appendicitis might cause vitally important complications. The diagnosis of acute appendicitis might be made using history, physical examination findings, and laboratory tests, as well as additional scoring methods and radiological examinations for patients requiring these operations. The latency in diagnosis and treatment increases the risk of perforation. The increase in perforation, on the other hand, increases the postoperative morbidity, mortality, and hospitalization.

The base of appendix is located at the posteromedial of cecum, 2cm below the ileocecal valve. The length of a normal appendix varies between 6 and 9 cm, as well as it might range between 1 and 30 cm (1). The diameter of normal appendix is between 5.6 and 6.6 mm (2). The most frequently seen disease in appendix is the acute

appendicitis. The lifelong possibility of its development is 6-7% (3). As the reason for acute appendicitis, the beginning of obstruction in appendix lumen is considered. This might be caused by lymphoid hyperplasia, hardened feces, parasitic infections, or certain foreign materials. The obstruction of lumen causes the excessive reproduction of bacteria and increase in the mucus secretion. This increases the intraluminal pressure. The increasing intraluminal pressure causes lymphatic and venous obstruction. The excessive reproduction of bacteria constitutes the edema and acute inflammatory response. The appendix becomes edematous and ischemic. Thus, the necrosis developing on the appendix wall causes the bacteria translocation from the ischemic wall. This stage is called gangrenous appendicitis and the appendix perforates unless the surgical intervention is made. Since the diameter of appendix increases with the inflammation but its length doesn't change significantly, the length/diameter ratio is expected to decrease in case of acute

Received: 08.04.2018 Accepted: 24.05.2018 Available online: 28.05.2018

Corresponding Author: Ugur Ekici, Istanbul Gelişim University, Health Sciences Colleges, Department of Health Administration, Istanbul, Turkey, E-mail: opdrugurekici@hotmail.com

appendicitis. The possible complications of perforated appendicitis might be decreased via early diagnosis and early surgical intervention.

In the present study, it was aimed to examine the relationship between appendix length/diameter ratio, which can be easily measured using radiological methods, and acute appendicitis perforation.

MATERIAL and METHODS

The records of 144 patients that applied to emergency service between March 2013 and May 2014 and were operated due to the suspicion of acute appendicitis were retrospectively examined. Using the measurements in pathology reports of patients, the appendix length/diameter ratios were calculated. While calculating and recording these ratios of patients, the normal length and diameter values reported in literature were taken into consideration. The patients were divided into 2 groups as perforated appendicitis and non-perforated appendicitis. The number of patients and the length/diameter ratios were calculated and recorded for both groups. The statistical analysis was performed using SPSS 18.0 software (SPSS Inc., Chicago, IL, USA). Since the numerical variables in both groups didn't meet the normal distribution condition, they were compared using Mann Whitney U test. The rate of categorical variable between the groups was tested using Chi-Square Analysis. Under the conditions that

do not meet the required conditions, the Monte Carlo simulation was applied. The statistical significance was set at $p < 0.05$.

RESULTS

Of 144 patients involved in present study, 77(53.4%) were males and 67(46.7%) were females. Mean age was 27.48(10-80) years, while the median age was found to be 25 years. According to the histopathological results, non-complicated acute appendicitis was found in 123 (85.4%) patients, while 21 (14.6%) of the patients were found to have perforation. Appendix perforation was found in 19 (13.1%) of patients with appendix length/diameter ratio ≤ 10 . Of these patients, 9 (47.3%) were female and 10 (52.7%) were male. Among the patients with appendix length/diameter ratio > 10 , only 2 (1.3%) appendix perforations were found, and both of these patients were male. The distribution of appendix length/diameter ratios of patients by the type of appendicitis is presented in Table 1.

As a result of the statistical analyses, the significant results indicating that the length/diameter ratio might be used as early indicator for the perforation were obtained (Table 2). When the appendix length/diameter ratio declined below 10, then the perforation frequency significantly increased ($p < 0.01$)

Table 1. Patient distribution by length/diameter ratio

Appendicitis Type	Length/Diameter				Total
	0-5	5-10	10-15	>15	
Perforated (n:21)	10 (3.65±0.72)	9 (5.94±0.58)	2 (10.4±0,14)	0	21
Nonperforated(n:123)	9 (4.02±0.52)	71 (7.98±0.97)	39 (12.82±1,07)	4 (15.68±0,44)	123
Total	19	80	41	4	144

n: number

Table 2. Comparison of tumor localizations between groups

Appendicitis type	0-5	Length/Diameter			Total
		5-10	10-15	>15	
Perforated (n:21)					
Male	5	4	0	0	9
Female	5	5	2	0	12
Total	10	9	2	0	21
Nonperforated (n:123)					
Male	4	31	20	3	58
Female	5	40	19	1	65
Total	9	71	39	4	123
P Value	0.01	0.01	0.651		

DISCUSSION

The most important step in treatment process of patients, for whom the acute appendicitis is suspected, is to determine the surgical intervention and its timing. Thus, the rates of negative laparotomy and complicated appendicitis might be reduced (4). The diagnosis of appendicitis is a clinical diagnosis, in which the inflammatory indicators expected to increase are used in making decision. Complicated appendicitis may occur more in patients with atypical symptoms (epigastric pain, diarrhea, malaise, lack of anorexia, and history of chronic right abdominal quadran pain), those who are older, married, without higher education or with a longer interval from the onset of symptoms to admission. Patients with these factors and suspicion for appendicitis should be evaluated, advised and followed-up in a vigorous way not to be overlooked (5). Nowadays, the methods such

as ultrasonography, computed tomography, magnetic resonance imaging, and laparoscopy are used for preventing the patient from unnecessary interventions and to support the diagnostic process. But Alvarado scoring system is found to be a more sensitive method for diagnosis of acute appendicitis (6,7). Despite the physical examination, laboratory findings, and assistive methods, the rates of negative laparotomy vary between 9% and 20% (8,9). The number of patient, for whom the negative laparotomy was performed, was 15 (9.4%). 9 (60%) of them were females, and 6 (40%) were males.

If the progression towards the perforation can be detected and treated in early stage by using radiological and laboratory tests in diagnosis and treatment period, the mortality and morbidity might be declined. The rate of negative laparotomy and complication is still high despite the history of patient, examination results, and examinations. In study of Richard Nshuti et al., they reported the perforation rate to be 29% (10), while the same rate was reported to be 15.3% by Taylan O. et al. (11). In present study, the number of patient diagnosed for perforated appendicitis was found to be 21 (14.5%).

The most frequent symptom of acute appendicitis is the stomachache around the belly and changing its location 4-6 hours later. Another symptom that is seen in almost any patient is the inappetency. Vomiting and nausea are seen in 75% of patients. The most important symptoms in physical examination are the defense and rebound. The body temperature rarely exceeds beyond 38 °C. The body temperature is normal in 25-50% of the patients. The number of leucocyte is generally between 10,000 and 18,000. Shift to the left in number of neutrophil is another laboratory finding (12). In the present study, inappetence is seen in 115 (79.8%) patients, defense in 129 (89.5%) patients, and leukocytosis in 98 (68%) patients.

An obstruction occurring in proximal segment of appendix lumen in development period of acute appendicitis makes the appendix a closed space. Because of the normally continuing secretion of appendix mucosa, the rapid effusion and distention develop in this closed space. While the capacity of normal appendix is approx. 1ml, even low level of secretion such as 0.5 ml easily increases the pressure in lumen within the appendix, which turns into a closed space, up to 60 cm water. The appendix mucosa continues secretion while the pressure within the lumen is high, and then the appendix firstly becomes gangrened and then perforated. Although this process varies between the individuals, the risk of perforation, which is 20% in first 24 hours, might increase to 65% after 48th hour (13). The mean duration to surgery for perforated cases in present study was 54 (18-90) hours.

For the patients, for whom acute appendicitis is suspected, the appendix diameter higher than 6 mm is generally accepted to be possible appendicitis, while diameters higher than 10 mm are considered strongly possible appendicitis (14). Considering the changes in size of organ due to the advancement in inflammation process,

which point indicates the critical perforation stage in pressure increase is very important. In present study, this critical point is thought to be the sizes with length/diameter ratio lower than 10. When compared to group of patients with length/diameter ratio higher than 10, the number of patients, who diagnosed for acute appendicitis, in patient group with length/diameter ratio of 10 increased approximately 2 times (45 and 95, respectively), the perforation frequency increased approximately 9 times (2 and 9, respectively).

Study Limitations; although the present study was carried out by analyzing the pathology specimens, the length and diameter of appendix are the parameters that can be measured using radiological methods before operation. Thus, for the patients, for whom surgery is planned due to suspicion of acute appendicitis, the radiologist should be asked to measure the length and diameter during the preoperative imaging procedures. So, the early diagnosis can be made and negative consequences can be reduced.

CONCLUSION

In conclusion, the statistically significant results indicating that the length/diameter ratio might be used as early indicator for the perforation were achieved. When the appendix length/diameter ratio declined below 10, then the perforation frequency significantly increased ($p < 0.01$). Knowing these rates can help the surgeon in early surgical intervention, so the possible complications of perforated appendicitis might be decreased via early surgical intervention.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports .

Ethical approval: This work has been approved by the Institutional Review Board.

REFERENCES

1. Jaffe BM, Berger DH. The Appendix. In: Schwartz SI, Brunicaudi CF eds. Schwartz Principles of Surgery, 4th edition. New York: McGraw-Hill Health Pub. Division; 2005. p. 1325-46.
2. Willekns I, Peeters E, Maesener MD, de Mey J. The normal appendix on CT: does size matter? PLoS One 2014;9(5):e96476
3. Primates P, Goldacre MJ. Appendicectomy for acute appendicitis and for other conditions: an epidemiological study. Int J Epidemiol 1994;23(1):155-60.
4. Vaughan-Shaw PG, Rees JR, Bell E, Hamdan M, Platt T. Normal inflammatory markers in appendicitis: evidence from two independent cohort studies. JRSM Short Rep 2011;2(5):43.
5. Naderan M, Babaki AES, Shoar S, Mahmoodzadeh H, Nasiri S, Khorgami Z. Risk factors for the development of complicated appendicitis in adults. Turk J Surg 2016;32(1):37-42.
6. Ekici U, Kanlıöz M. Comparison of efficiency of Alvarado score and ultrasonography in acute appendicitis diagnosis. Cukurova Medical Journal 2017;42(2):351-6
7. Özsoy Z, Yenidoğan E. Evaluation of the Alvarado scoring system in the management of acute appendicitis. Turk J Surg 2017;33(3):200-4.

8. Colson M, Skinner KA, Dunnignton G. High negative appendectomy rates are no longer acceptable. *Am J Surg* 1997;174(6):723-6.
9. Fingerhut A, Yahchouchy-Chouillard E, Etrenne JC, Ghiles E. Appendicitis or nonspecific pain in the right iliac fossa. *RevProt* 2001;51(15):1654-6.
10. Nshuti R, KrugerD, Luvhengo TE. Clinical presentation of acute appendicitis in adults at the Chris Hani Baragwanath academic hospital. *Int J Emerg Med* 2014;7(1):12.
11. Sezer TO, Gulece B, Zalluhoglu N, Gorgun M, Dogan S. Diagnostic value of ultrasonography in appendicitis. *AdvClinExpMed* 2012;21(5):633-6.
12. Coşkun T, Kaya Y. Akut Apandisit. In: Sayek İ eds. *Sayek Temel Cerrahi*. 5th edition. Ankara: Güneş Tıp Kitabevi; 2013. p. 1342-3
13. Arnbjörnsson E, Bengmark S. Role of obstruction in the pathogenesis of acute appendicitis. *Am J Surg* 1984;147(3):390-2.
14. Tamburrini S, Brunetti A, Brown M, Sirlin CB, Casola G. CT appearance of the normal appendix in adults. *EurRadiol* 2005;15(10):2096–103.