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Retrospective analysis of clinical and surgical results of 123 patients prediagnosed with acute appendicitis

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ABSTRACT

Introduction: Acute appendicitis is a disease requiring urgent surgical intervention. It is frequently encountered in general surgical clinics. Maintaining a good medical record and physical examination are the first priorities in diagnosing appendicitis. This study aimed to evaluate the clinical and surgical results of patients prediagnosed with acute appendicitis in a Erzurum Oltu State Hospital.

Materials and Methods: The records of the 123 patients [49 (39.8%) female and 74 (60.2%) male], who were diagnosed with acute appendicitis in the hospital between 2015 and 2017, were retrospectively analyzed in terms of age, gender, Alvarado score, and laboratory and radiology findings. Furthermore, surgical methods were examined with regard to the duration of surgery, hospitalization, and complications.

Results: A total of 32 (26%) patients were scanned with ultrasonography (US), 91 (74%) with computed tomography (CT), and 12 (9.7%) with both US and CT. Laparoscopic appendectomy (LA) was performed in 66 (53.6%) patients, and open appendectomy (OA) in 57 patients (46.4%). Further, 71 (57.8%) of the 120 patients with intraoperatively diagnosed appendicitis had suppurative, 38 (30.9%) had catarrhal, 8 (6.5%) had perforated, 3 (2.4%) had gangrenous appendicitis. The histopathological and intraoperatively diagnosis of the remaining 3 (2.4%) patients was normal. Three (2.4%) of the patients who underwent OA developed ileus, and one (0.8%) patient had wound infections. One (0.8%) patient who underwent LA developed ileus.

Conclusion: The effective use of laboratory, scoring, and assisted imaging methods can reduce the rates of negative appendectomy and postoperative complications. Laparoscopic surgery has a positive effect on postoperative pain and quality of life. If laparoscopic equipment and experience with the method are sufficient, the first choice should be laparoscopic surgery for acute appendicitis.

Keywords: Acute appendicitis; histopathological diagnosis; laparoscopic appendectomy; open appendectomy.

Introduction

Acute appendicitis is one of the diseases requiring urgent surgical intervention. It is frequently encountered in general surgical clinics.[1] Maintaining a good medical record and physical examination are the first priorities in diagnosing appendicitis, despite medical innovations and increased experience.[2] The number of unnecessary surgeries and related complications can be reduced using auxiliary methods such as scoring systems (Alvarado), ultrasonography (US), computed tomography (CT), magnetic resonance imaging, and laparoscopy in diagnosing appendicitis.[3]

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Since its introduction into clinical practice in 1983, laparoscopic appendectomy (LA) has proved to be a successful surgical procedure that can be safely performed and is accepted worldwide.[4] The clinical advantages of LA, such as shorter hospitalization, better cosmetic results, faster return to daily activities, fewer wound infections, shorter postoperative ileus, and less postoperative pain, have been demonstrated in many studies and meta-analyses.[5,6] However, some studies who compared open appendectomy (OA) and LA still did not support the application of LA as a "gold standard" for acute appendicitis because of its long surgical time, higher risk for postoperative intra-abdominal abscesses, and higher cost.[7,8]

The aims of this study were to evaluate patients with acute appendicitis in the county state hospital based on the results of the clinical, laboratory, and imaging methods and to compare the duration of the surgeries, hospitalization periods, and the complication rates depending on the surgical methods (LA and OA).

Materials and Methods

The records of the 123 patients, who were diagnosed with acute appendicitis in the hospital between 2015 and 2017, were retrospectively examined. The clinical diagnosis was made according to medical history, physical examination, complete blood count, and radiological (US and CT) findings. The final diagnosis was made based on the histopathological examination results. Laboratory tests were made after admission to the hospital, and the number of leukocytes and neutrophil percentages were recorded. A leukocyte count greater than 10×10^9/L was regarded as leukocytosis, and a neutrophil percentage greater than 74% was regarded as neutrophilia. US showed a noncompressible tubular structure without luminal gas in the right iliac fossa, and CT showed appendiceal wall thickening and contrast enhancement. These findings were accepted as signs of appendicitis. In both examinations, an appendix diameter of 6 mm or above was evaluated as significant.[9,10] Cases in which the appendices were never seen or seen normally were reported as negative. Cases with free fluid in the pericecal region, edematous appearance of the wall of the caecum, and mesenteric lymph nodes were reported as suspicious. In the present study, the Alvarado score was used for clinical scoring. It was preferred because it was a scoring system including symptoms, findings, and laboratory evaluations with a total of 10 points. Also, the reporting accuracy rate was 78%–82% for acute appendicitis. According to this scoring system, it is recommended that the patients who have 7 or more points should be operated and those who have less than 7 points should be followed up.[11] For LA, pneumoperitoneum was formed with CO_2 by penetrating Veress needle under the belly. One 10-mm trocar was inserted from the middle line under the belly, one 10-mm trocar from the suprapubic area, and one 5 mm trocar from the left paramedian line. 2/0 PDS were was used for suturing at the site of fusion, where the root of the appendix and caecum were ligated intracorporeally, and the appendix was resected. The appendix was removed from the 10-mm trocar in the suprapubic area with an endobag or sterile glove. A McBurney's incision (approximately 4–5 cm) was made during OA. The appendix stump was found, the mesoappendix was dissected with monopolar cautery, and the stump was tied two times and cut with a 2/0 Vicryl suture. Drains were used only in perforated cases. All OA and LA surgeries were performed by a single general surgeon in the hospital.

The patients who were diagnosed with appendicitis according to the histopathological findings were classified into four groups: catarrhal, suppurative, gangrenous, and perforated appendicitis. Groups were evaluated in terms of age, sex, Alvarado score, and laboratory and radiology findings. The surgical methods (OA/LA) were evaluated in terms of the duration of surgery, duration of hospitalization, additional surgical findings, and complications.

Statistical Analysis

Descriptive statistics were calculated as number (percentage), mean (±standard deviation), and median (least–largest). The chi-square test was used for variables with normal distribution. The Mann–Whitney U test was used for the original variables and the numerical variables not fitting the normal distribution. A P value <0.05 indicated statistical significance. SPSS 23.0 (IBM, Armonk, NY, USA) software was used for statistical analysis.

Results

A total of 123 patients who underwent appendectomy between 2015 and 2017 in the hospital were included in the study. Of these, 74 (60.2%) were male and 49 (39.8%) were female. The median age of patients was 27 years (range: 8–76 years). The median duration of symptoms was 2 days (range: 1–9). The median value of Alvarado scores was 8 (range: 5–10). In 110 (89.4%) patients, neutrophils were shifted to the left, and in 13 (10.6%) patients, no neu-

trophil shift was observed. US was performed in 33 patients (26.9%). Further, 19 patients (15.5%) were reported as compatible with acute appendicitis, 8 (6.5%) as suspicious, and 6 (4.9%) as normal. The results of patients scanned with CT showed that 90 (73.2%) had acute appendicitis, 7 (5.6%) had perforated appendicitis, 1 (0.8%) had plastron appendicitis, whereas 5 (4.1%) were reported as normal (Table 1).

Three patients with a suspicious intraoperative diagnosis were reported as normal, whereas 120 patients with an intraoperative diagnosis of acute appendicitis was reported as acute appendicitis. Moreover, 71 (57.8%) patients were histopathologically diagnosed with suppurative appendicitis, 38 (30.9%) with catarrhal appendicitis, 8 (6.5%) with perforated appendicitis, and 3 (2.4%) with gangrenous appendicitis.

The median value of symptom durations was 3 (range: 2–7) in 71 patients with suppurative appendicitis, 1 (range: 1–3) in 38 patients with catarrhal appendicitis, 7 (range: 3–9) in 8 patients with perforated appendicitis, 6 (range: 5–8) in 3 patients with gangrenous appendicitis, and 5 (range: 4–7) in 3 patients with normal histopathological diagnosis. The symptom duration was significantly higher in the suppurative appendicitis group than in the catarrhal appendicitis group (p=0.013).

Table 1. Sociodemographic, clinical, laboratory, and radiological characteristics of all patients

Age	27 (8–76)
Gender	
Female	49 (39.8%)
Male	74 (60.2%)
Symptom duration	2 (1–9)
Alvarado score	8 (5–10)
White blood cell count	17.024 (±17.208)
Neutrophil left shift	
Yes	110 (89.4%)
No	13 (10.6%)
Ultrasonography	
Not performed	90 (73.1%)
Normal	6 (4.9%)
Suspicious	8 (6.5%)
Acute appendicitis	19 (15.5%)
Computed tomography	
Not performed	20 (16.3%)
Normal	5 (4.1%)
Acute appendicitis	90 (73.2%)
Perforated appendicitis	7 (5.6%)
Plastron appendicitis	1 (0.8%)

The median values of the Alvarado scores was 8 (range: 6–10) in patients with suppurative appendicitis, 7 (range: 5–9) in patients with catarrhal appendicitis, 9 (range: 8–10) in patients with perforated appendicitis, 6 (range: 7–9) in patients with gangrenous appendicitis, and 8 (range: 8–9) in patients with normal histopathological diagnosis. The Alvarado scores were significantly higher in the suppurative appendicitis group than in the catarrhal appendicitis group (p<0.001).

The mean white blood cell counts, was 18.897 (±2289) in patients with suppurative appendicitis, 13.446 (±3078) in patients with catarrh appendicitis, 19.261 (±4365) in patients with perforated appendicitis, 13.833 (2685) in patients with gangrenous appendicitis, and 12.066 (±5153) in patients with a normal histopathologic diagnosis. The white cell counts were significantly higher in the suppurative appendicitis group than in the catarrhal appendicitis group (p<0.001).

A neutrophil shift to the left was observed in 66 (93%) of the 71 patients with suppurative appendicitis, 30 (78.9%) of the 38 patients with catarrhal appendicitis, all of the 8 patients with perforated appendicitis, 3 patients with gangrenous appendicitis, and 3 with a histopathologically normal diagnosis. No significant difference in the neutrophil shift to the left was found between the suppurative and catarrhal appendicitis groups.

The results of the US evaluation in the preoperative period showed that US was performed in 33 patients diagnosed with appendicitis histopathologically, and 19 (57.5%) were found to have appendicitis. US was not performed in three patients with no acute appendicitis.

The findings of the CT evaluation in the preoperative period showed that CT was performed in 90 patients diagnosed with appendicitis histopathologically, and 85 (94.5%) were found to have appendicitis. CT was performed in three patients with no acute appendicitis in the preoperative period and positive results were obtained (2.5%).

The clinical and laboratory findings according to histopathological characteristics and radiological examination accuracy rates of patients with acute appendicitis are given in Table 2.

Table 2. Distribution of sociodemographic, clinical, laboratory, and radiological findings according to histopathological diagnosis

Feature	Normal	Catarrhal	Suppurative	Gangrenous	Perforated
Age	36 (21–50)	27 (10–67)	25 (8–76)	42 (15–73)	28.5 (14–72)
Gender					
Male	1 (33.3%)	17 (44.7%)	28 (39.4%)	0 (0.0%)	4 (50%)
Female	2 (66.7%)	21 (55.3%)	43 (60.6%)	3 (100.0%)	4 (50%)
Symptom duration	5 (4–7)	1 (1–3)	3 (2–7)	6 (5–8)	7 (3–9)
		p=0.013			
Alvarado score	8 (8–9)	7 (5–9)	8 (6–10)	8 (7–9)	9 (8–10)
		p<0.001			
White blood cell count	12.066 (±5153)	13.446 (±3078)	18.897 (±2289)	13.833 (±2685)	19.261 (±4365)
		p<0.001			
Neutrophil left shift					
Yes	3 (100%)	30 (78.9%)	66 (93%)	3 (100%)	8 (100%)
No	0 (0.0%)	8 (21.1%)	5 (7%)	0 (0.0%)	0 (0.0%)
Ultrasonography					
Not performed	3 (100%)	24 (63.2%)	56 (78.9%)	3 (100%)	3 (42.8%)
Normal	0 (0.0%)	1 (2.6%)	4 (5.6%)	0 (0.0%)	1 (14.3%)
Suspicious	0 (0.0%)	2 (5.3%)	4 (5.6%)	0 (0.0%)	2 (28.6%)
Acute app.	0 (0.0%)	11 (28.9%)	7 (9.9%)	0 (0.0%)	1 (14.3%)
Computed tomography					
Not performed	0 (0.0%)	11 (28.9%)	9 (12.7%)	0 (0.0%)	0 (0.0%)
Normal	0 (0.0%)	2 (5.3%)	2 (2.8%)	0 (0.0%)	1 (12.5%)
Acute app.	3 (100%)	25 (65.8%)	59 (83.1%)	2 (66.6%)	1 (12.5%)
Perforated	0 (0.0%)	0 (0.0%)	1 (1.4%)	1 (33.4%)	5 (62.5%)
Plastron	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (12.5%)

Further, 66 patients (53.6%) were operated with LA, and 57 patients (46.4%) were operated with AA. We chose laparoscopy in almost all patients (excepting children and perforated patients) when the laparoscopic material is adequate (eg harmonic, knot pusher, etc.). When laparoscopic material was not available, open surgery was performed. McBurney's incision was used in 55 patients operated with AA (96.5%). Upper and lower midline incision was used in 2 patients (3.5%) who underwent open surgery and whose appendix was normal and stomach perforation was detected in laparoscopy. The mean duration of surgery was 71.5 (±24.0) min in LA and 66.6 (±23.7) min in OA. No significant difference was found between the two groups ($p<0.05$).

Patients operated with LA were hospitalized for 2 (range: 1–7) days, and patients operated with OA were hospitalized for 2 (range: 1–8) days. No significant difference was observed in the hospitalization periods between patients who underwent LA and patients who underwent OA ($p=0.266$). Also, no significant difference was noted in the duration of surgeries between suppurative appendicitis and catarrhal appendicitis groups ($p=0.784$).

Moreover, 65 (98.5%) of the patients who underwent LA had no complication, and 1 (1.5%) had ileus. Also, 53 (93%) of the patients who underwent OA had no complication, 3 (5.2%) had ileus, and 1 (1.8%) had wound infection.

No additional operative findings were noted in 115 (96%) patients with a histopathological diagnosis of appendicitis; 4 (3.2%) of them had an ovarian cyst, and 1 (0.8%) had ileus. Further, two (1.6%) of the three patients with a normal histopathological diagnosis had gastric perforation and 1 (0.8%) had an ovarian abscess.

The surgical time, duration of stay, and complication rate according to the type of surgery are given in Table 3.

Table 3. Surgery time, hospitalization duration, and complication rates according to the type of surgery

Surgical method	No. of cases (n)	Surgery duration (min)	Hospitalization (day)	Complication rate
Laparoscopic appendectomy	66 (53.6%)	71.5 (±24.0)	2 (1–7)	1 (1.5%)
Open appendectomy	57 (46.4%)	66.6 (±23.7)	2 (1–8)	4 (7%)

Discussion

Acute appendicitis is a disease requiring urgent surgical intervention. It is frequently encountered in general surgical clinics. The disease was defined by McBurney in 1894; it was then treated with OA.[12] However, with the development of new surgical techniques and the increase in experience, Semm introduced the application of LA in 1983.[4]

The incidence rate of appendicitis varies between 6.7% and 20% during the whole lifetime. Although 12% of male patients have an appendectomy in their lives, this incidence is 23% for female patients. The disease is known to be more common in young males, and the male/female ratio is reported to be 1.4/1. Younger age is a risk factor for the disease, and approximately 70% of patients with appendicitis have an average age of 30 years. In the present study, the average age and male/female ratio of patients were compatible with those quoted in the literature.[12]

The most common symptoms of appendicitis are abdominal pain, nausea, and vomiting. Loss of appetite is also one of the most important complaints. If vomiting is experienced before abdominal pain, the diagnosis of appendicitis should be reviewed. It is important for diagnosis that the abdominal pain initially begins in the peri-umbilical region, spreads to the right lower quadrant, and then increases in severity. Sensitivity in the right lower quadrant, defenses, and rebounds are the most important physical examination findings.[2,9]

When medical history and physical examination are not sufficient for diagnosis, laboratory and assisted imaging methods may be useful in diagnosing appendicitis. White blood cell count and neutrophil count (left shift) are the most commonly used laboratory methods.[13]

The sensitivity (60%–90%) of white blood cell count is high, but the specificity (46%–70%) is low. The diagnostic efficacy is not as high as physical examination and clinical follow-up, but increased leukocyte counts support clinical diagnosis. The white blood cell count increases in patients with acute and uncomplicated appendicitis. A total of 10,000 to 18,000/mm^3 leukocytes are seen, with a neutrophil ratio of more than 75%. Approximately 10% of patients may have a normal leukocyte count. A white blood cell count of more than 20,000/mm^3 may be the sign of gangrenous and perforated appendicitis.[13,14]

In the present study, the white blood cell count was significantly higher in the suppurative appendicitis group than in the catarrhal appendicitis group. No evaluation was done for these groups due to the lack of sufficient cases of perforation and gangrenous appendicitis. In addition, neutrophil ratios were higher than 75% in the suppurative group in 66 patients (93%), in the catarrhal group in 30 patients (78.9%), and in all of the patients in the gangrenous and perforated appendicitis group. These results were compatible with the literature.[14]

Prolongation of symptom duration and development of appendicitis with different complaints lead to a delayed diagnosis. A delay in the diagnosis of acute appendicitis increases the likelihood of perforation, thus increasing morbidity rates. In the earlier surgical decisions to avoid complications, the probability of encountering a disease-free vermiform appendix called negative appendectomy was reported to be 13%–36% in many studies.[15–17] In the present study, the duration of symptoms and Alvarado scores were significantly higher in the suppurative appendicitis group than in the catarrhal appendicitis group. Furthermore, symptom duration and Alvarado score increased in gangrenous and perforated appendicitis, but the number of cases was not sufficient and hence statistical evaluation was not possible.

US and CT are the most commonly used imaging methods for detecting appendicitis in patients with abdominal pain. A number of studies comparing these two methods have been conducted, suggesting that CT is a more sensitive method for detecting appendicitis compared with US. The sensitivity of US to acute appendicitis varies from 55% to 96%, and the specificity varies from 85% to 98%. The sensitivity of CT to acute appendicitis is 92%–97%, and the specificity is 85%–94%.[18,19]

In the present study, the sensitivity of US was 57.5% and the sensitivity of CT was 95.1%. These values were compatible with those quoted in the literature.

In the present study, 53.6% of patients with appendicitis were operated with LA, and 46.4% were operated with OA. None of the patients underwent open LA. Appendices were normal in three patients (2.4%); two (1.6%) of these had a gastric perforation, and one (0.8%) had ovary abscess. The necessary medical intervention was performed on these patients. The negative appendectomy rate was 2.4%, which was lower than the values quoted in the literature.[16,17]

During LA, various diseases such as pelvic inflammatory disease, endometriosis, ovarian cysts, ectopic pregnancy, cholecystitis, and colon perforation are detected with laparoscopy in women and elderly patients. Further, the rate of negative appendectomy can be decreased. Moreover, necessary interventions can be performed intraoperatively. In addition, LA may be more preferable because scars in female patients are small using this method compared with OA. In working patients, LA is generally preferred because of the shorter hospital stay after surgery and earlier return to work. LA has been proposed as the preferred technique for obese patients with suspected acute appendicitis, including elderly patients.[20]

Işık et al.[21,22] reported an average hospital stay of 1.5 days for patients who underwent LA. In the present study, the average length of hospitalization in both groups was 2 days. No significant difference was found in the hospitalization periods between patients who underwent LA and patients who underwent OA. This might be due to the low number of complicated cases.

In the first years of LA application, the duration of surgery was longer in LA than in OA.[22] However, with the increasing popularity of LA in the following years and the increased surgical experience, no difference in surgical time was observed. The mean duration of surgery in the present study was 66.6 (±23.7) min in patients who underwent OA. No significant difference was observed in surgical time between patients who underwent LA and patients who underwent AA. The mean duration of surgery in patients who underwent LA was 68.5±21.7 min, which was slightly more than 54.9–61.9 minutes in some series.[23] The long surgical time in LA might be due to the lack of experience in operating room team and the lack of surgical equipment.

Surgical wound infections are less common in LA than in OA.[24,25] In the present study, wound infection was observed in one patient who underwent OA (1.8%); wound infection was not seen in patients who underwent LA. This might be the result of removing the appendix with an endobag or sterile gloves.

In conclusion, this study showed that maintaining good medical records and a good physical examination in the early period and the effective use of laboratory (white cell count and neutrophil ratio), scoring, and assisted imaging methods in acute appendicitis reduced the incidence of negative appendectomy numbers postoperative complication rates. Besides the routine use of US in diagnosing acute appendicitis, a CT scan is particularly appropriate for differential diagnosis in elderly, female, and obese patients. The accuracy rates of radiological methods may be different. The proportion of negative appendectomy may be reduced if the surgeons share the results of these methods with radiology units. LA and AA have similar rates in terms of surgical time, hospitalization time, and morbidity, whereas the laparoscopic method has a better effect on postoperative pain and quality of life. Based on these findings, if surgical experience and laparoscopic equipment are sufficient, the laparoscopic method should be preferred for patients with suspected appendicitis, women in the reproductive age group, or obese patients.

Disclosures

Ethichs Committee Approval: Retrospective study.

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