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Is there a correlation between the diagnostic test results and the histopathological diagnoses of acute appendicitis in a Turkish hospital in Somalia?

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Abstract

Appendicitis is the most common cause of acute abdomen. This study aimed to investigate the demographic and clinical data of the patients diagnosed with acute appendicitis in the emergency department of a Turkish tertiary care center in Somalia. The association between the diagnostic test results and the histopathological diagnoses was also analyzed. Data of the patients diagnosed with acute appendicitis at the emergency department between the 1st of January 2021 and the 31st of December 2021 period were retrospectively reviewed. The demographic data, clinical features, laboratory test results and radiological and histopathological findings of the participants were retrieved from the hospital's electronic medical records for patients in the database. Overall, 83 patients were included. Among those, 59 (71.1%) were male, and the mean patient age was 22±8.2. The mean values of the leukocyte and neutrophil counts and the C-reactive protein levels were higher than the normal range. The laboratory test, abdominal ultrasonography, and enhanced computerized tomography results were compared with the histopathological findings. Only the neutrophil-lymphocyte ratio was found (to be) significant in the diagnosis of complicated appendicitis. The clinical data, laboratory tests, and radiological imaging findings should be evaluated together to diagnose acute appendicitis. Prompt diagnosis is essential for the prevention of postoperative complications and mortality. A statistically significant difference was found in the comparison of the lymphocyte counts, NLR values, and histopathological findings (p=0.01 and p=0.008).

Keywords: Acute abdomen, emergency department, histopathology, laboratory

Introduction

Acute appendicitis (AA) is a common reason for emergency department presentations with the complaint of lower abdominal pain [1]. As a result of various reasons, the lumen of the appendix can be obstructed, and the increased mucus production and bacterial growth may facilitate appendiceal wall tension, necrosis and perforation. The lifetime risk of AA disease is estimated to be 7%, and most cases are treated surgically [2].

The clinical diagnosis of AA is challenging; the clinical findings should be considered along with laboratory and imaging findings during its diagnostic management. The complete blood count, abdominal ultrasonography (USG), and the gold standard technique abdominal computerized tomography (CT) are the most commonly used diagnostic tests [2]. However, the definitive diagnosis can only be reached by histopathological assessment [3].

In the case of missed or delayed diagnosis, there is an increased risk of perforation, abscess formation, sepsis, and intraabdominal adhesions. In these complicated cases, such as complicated appendicitis, perforated appendicitis, or necrotizing appendicitis, the hospital stay is usually lengthened. The preoperative differentiation of complicated appendicitis from non-complicated is essential for both treatment method selection and determination of the prognosis [4].

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This study aimed to investigate the demographic, laboratory, and clinical data of patients diagnosed with AA at the emergency department and who subsequently underwent appendectomy. It also aimed to analyze the association between these test results and the histopathological diagnoses of the patients.

Material and Methods

The data of the patients diagnosed with AA in the emergency department of the Somalia Mogadishu Türkiye Recep Tayyip Erdogan Training and Research Hospital between the 1st of January 2021 and the 31st of December 2021 were retrospectively reviewed.

Patient data, including demographic features, emergency department presentation time, laboratory test results, abdominal USG made by radyologist, enhanced abdominal CT scan reported by radyologist, and histopathology findings, were all retrieved from the electronic patient folders and recorded to a computer database. Medical Records of patients with AA-related symptoms and at least one radiological imaging (US or CT or both) were analyzed. Patients who were diagnosed with AA and later underwent surgery (operated) by the general surgery team or pediatric surgery team were included in this paper. Patients who got discharged from the emergency department or did not undergo surgery were excluded.

Patients were divided into four categories according to their US scans. These are nonvisualized appendix, normal appendix, acute appendicitis, and perforated appendicitis. Histopathological results were divided into five categories. These are phlegmon appendicitis, acute appendicitis, perforated appendicitis, necrotizing appendicitis, and others. The sample size was analyzed using G-power analysis and a total of 83 patients were included

Statistical analysis

The neutrophil-lymphocyte ratios (NLR) and platelet-lymphocyte ratios (PLR) were calculated for all participants based on their complete blood count results. The complete blood count results, total bilirubin, C-reactive protein (CRP), albumin, NLR, PLR, abdominal USG, and enhanced abdominal CT scan results were compared with the histopathological findings. The conformity of the data to normal distribution was assessed by a histogram, Q-Q graphics, and the Shapiro-Wilk test. The homogeneity of the variance was analyzed by the Levene test. Mann-Whitney U and the independent two samples t-tests were used for the numerical data in inter-group comparisons. The data analysis was performed using the R 4.0.0 (www.r-project.org) software. A difference was considered significant if the calculated p value was lower than 0.05.

Ethical principles

Ethics committee approval was received for this study from the Ethics Committee of Somalia Mogadishu Türkiye Recep Tayyip Erdoğan Training and Research Hospital and approved by the scientific committee (Decision no: MSTH/9039-481 Date: 07.02.2022).

Results

Overall, 83 patients diagnosed with AA at the emergency department and underwent appendectomy following the assessment by the general surgery or pediatric surgery teams during the 1-year study period were included in this study. Among all patients, 71.1% (n=59) were male. The mean patient age was 22 (16-30). Categorizing the patients into three groups per the presentation time to the emergency department (08:00-15:59, 16:00-23:59, and 00:00-07:59) revealed that most (50.6%, n=42) presentations occurred between 08:00 and 15:59. The reason why patients got categorized this way was because working hours were scheduled into three eight-hour shifts in the hospital.

The laboratory (complete blood count, bilirubin, CRP, albumin), abdominal USG, and enhanced CT scan results of the patients were reviewed. The patients were divided into groups based on abdominal USG findings as “AA”, “perforated appendicitis”, “no appendix detected,” and “normal appendix”. Overall, 92.8% (n=77) of the patients had undergone abdominal USG. The comparison based on abdominal USG findings revealed the diagnosis of AA in 50.6% (n=42) of the cases. An enhanced abdominal CT scan was performed in 51.8% (n=43) of the cases. The patients were divided into groups based on enhanced abdominal CT scan results as AA and perforated appendicitis. The relevant comparison revealed that AA (31.3%, n=26) was the most common diagnosis. Overall, 43.4% (n=37) of the patients underwent both abdominal USG and enhanced abdominal CT scans. The histopathological diagnoses were classified as phlegmonous appendicitis, AA, perforated appendicitis, necrotizing appendicitis, and "others". The latter group included histopathological diagnoses such as obliterated appendix vermiformis, carcinoid tumor, and chronic inflammation. Among all patients who underwent appendectomy, 94% (n=78) were histopathologically diagnosed with AA. Phlegmonous appendicitis is (was) the most frequent histopathological diagnosis (32.5%, n=27). Analysis regarding hospitalization stata of the patients revealed that only two (2.4%) patients were referred to the intensive care unit (ICU). The demographic data, diagnostic test results, and histopathological diagnoses of the patients are displayed in Table 1 and Table 2.

The NLR and PLR values of the patients were compared with the histopathological diagnoses (Table 3). A statistically significant difference was found in the comparison of the lymphocyte counts, NLR values, and histopathological findings (p=0.01 and p=0.008).

However, there was no significant difference in the comparative analysis of the abdominal USG, enhanced abdominal CT scan, and histopathology findings (p=0.24 and p=0.18).

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Table 1. Demographic data. radiological findings and histopathology results of the patients

	n	%
Gender		
Female	24	28.9
Male	59	71.1
Presentation times		
08:00-15:59	42	50.6
16:00-23:59	27	32.5
00:00-07:59	14	16.9
Abdominal ultrasonography		
Acute appendicitis	42	50.6
Perforated appendicitis	19	22.9
No appendix detected	12	14.5
Appendix looks normal	4	4.8
Abdominal computerized tomography		
Acute appendicitis	26	31.3
Perforated appendicitis	17	20.5
Histopathology		
Phlegmonous appendicitis	27	32.5
Acute appendicitis	26	31.3
Perforated appendicitis	18	21.7
Necrotizing appendicitis	7	8.4
Other	5	6
Hospitalization		
Inpatient floor	81	97.6
Intensive care unit	2	2.4

*Data were expressed as n (%)

Table 2. Laboratory results of the patients

	Mean/Median	Min-Max/SD
Leukocyte (x10^3/µl)	13.0	9.0-16.3
Platelet (x10^3)	286.0	222.0-353.0
Neutrophil (x10^3/µl)	10.9	7.1-14.0
Lymphocyte (x10^3/µl)	1.3	0.8-1.7
Monocyte (x10^3/µl)	0.7	0.5-1.1
MPV (fL)	10.88	±1.47
NLR	8.6	5.7-13.8
PLR	214.0	167.0-368.3
CRP (mg/dL)	67.6	19.4-142.9
Bilurubin (mg/dL)	0.5	0.4-0.8

*The data were expressed as means±standard deviations, medians (1.quartile-3.quartile), MPV: mean platelet volume, NLR: neutrophil-lymphocyte ratio, PLR: platelet-lymphocyte ratio, CRP: C-reactive protein, SD: standard deviation

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Table 3. Comparison of the diagnostic test results with histopathological diagnoses

	Phlegmonus appendicitis (n:27)	Acute appendicits (n:26)	Perforated appendicitis (n:18)	Necrotizing appendicitis (n:7)	Other (n:5)	p
Leukocyte	13.2 (9.0-16.5) 10^3/μL	11.0 (7.6-17.2) 10^3/μL	14.1 (10.6-16.0) 10^3/μL	13.7 (8.1-15.8) 10^3/μL	12.8 (10.8-17.3) 10^3/μL	0.820
Platelet	283.0 (221.0-339.0) 10^3/μL	299.0 (232.8-463.8) 10^3/μL	271.5 (219.8-332.8) 10^3/μL	245.0 (216.0-345.0) 10^3/μL	263.0 (229.0-610.0) 10^3/μL	0.587
Neutrophil	11.9 (7.6-15.4) 10^3/μL	8.2 (4.6-13.9) 10^3/μL	12.1 (8.6-14.5) 10^3/μL	10.9 (6.2-13.4) 10^3/μL	10.0 (8.5-14.6) 10^3/μL	0.549
Lymphocyte	1.3 (0.6-1.6) 10^3/μL	1.6 (1.0-2.2) 10^3/μL	1.0 (0.7-1.2) 10^3/μL	1.3 (0.8-1.8) 10^3/μL	1.7 (1.2-1.9) 10^3/μL	0.010
Monocyte	0.7 (0.5-1.2) 10^3/μL	0.7 (0.5-1.1) 10^3/μL	0.6 (0.4-1.2) 10^3/μL	0.8 (0.6-1.2) 10^3/μL	1.0 (0.6-1.0) 10^3/μL	0.928
MPV	10.95±1.58	10.72±1.41	11.11±1.56	11.04±1.17	10.34±1.55	0.674
NLR	8.8 (7.4-19.5)	6.8 (2.7-9.8)	12.7 (9.0-19.1)	7.3 (5.9-10.2)	6.0 (4.6-12.0)	0.008
PLR	236.3 (175.5-377.3)	188.8 (147.4-292.5)	252.3 (189.3-471.6)	191.7 (133.2-233.6)	245.8 (143.5-369.9)	0.248
CRP	67.6 (19.2-139.1) mg/dL	91.8 (19.1-145.4) mg/dL	69.5 (20.9-153.1) mg/dL	25.5 (8.1-32.1) mg/dL	183.1 (85.6-212.7) mg/dL	0.127
Billurubin	0.5 (0.4-0.9) mg/dL	0.4 (0.3-0.8) mg/dL	0.6 (0.4-0.9) mg/dL	0.8 (0.4-0.8) mg/dL	0.5 (0.2-0.7) mg/dL	0.571

*The data were expressed as means±standard deviations, medians (1.quartile-3.quartile), MPV: mean platelet volume, NLR: neutrophil-lymphocyte ratio, PLR: platelet-lymphocyte ratio, CRP: C-reactive protein, SD: standard deviation

Discussion

Acute appendicitis is one of the most frequent reasons for abdominal pain and emergency surgeries [5]. The essential diagnostic tools are physical examination, laboratory tests, and radiological imaging [6]. While diagnosing AA in patients presenting with classical signs and symptoms is not challenging, delayed diagnosis and treatment may occur in atypical cases. The standard treatment is appendectomy via laparotomy or laparoscopy [2].

The mean age and gender distribution of our cohort are similar to the existing literature. The complete blood count is one of the most frequent tests performed during diagnostic management since it is cost effective, fast, and ubiquitous [3]. Although the increased leukocyte and neutrophil counts measured in the context of complete blood counts are early indicators of inflammation, they are non-specific for AA since they may also increase in other inflammatory conditions [7]. In our study, the mean leukocyte and neutrophil counts were $13x10^3$/μl and $10.9x10^3$/μl. In line with the literature, these levels are higher than the normal range [$4\text{-}10x10^3$/μl and $2\text{-}7x10^3$/μl). However, in our study, the comparison of the leukocyte and neutrophil counts and histopathological diagnoses did not reveal a statistically significant difference (p=0.82 and p=0.54).

Previously, the researchers worked on several parameters such as NLR, platelet counts, mean platelet volume (MPV), and PLR to correctly diagnose AA preoperatively [8]. The NLR is defined as the division of the absolute neutrophil count to the absolute lymphocyte count. Relatively high NLR values are significant for the diagnosis of AA since neutrophil counts are increased, and lymphocyte counts are reduced in the setting of systemic inflammation [8]. Xu et al. found relatively high mean NLR values in patients with AA and reported that NLR values could differentiate complicated cases from non-complicated ones [9]. Similarly, in our study, the NLR levels of the AA patients were relatively high, and we found a significant difference in the comparison of these values with the histopathological diagnoses. Therefore, it was suggested that NLR be used for diagnosis of AA and as a prognostic indicator. The MPV is a marker of platelet activation and function; low levels were shown in AA cases [10]. In the literature, it was reported that the PLR values were relatively higher in patients with AA [11]. In our study, MPV and PLR values were not found as significant parameters in the comparison with the histopathological diagnoses.

The CRP is an acute phase reactant that increases within 8-12 hours in the setting of an inflammatory process and reaches peak levels between 24 and 48 hours [12]. Fujiwara et al. found that the CRP levels of complicated appendicitis patients were significantly higher than those in the non-complicated patients [13]. In our study, the mean CRP level was higher (67.6 mg/dL) than the normal range [0-10 mg/dL]; however, there was no statistically significant difference in comparison with the histopathological diagnoses (p=0.15). We believe that the relatively high CRP levels in our cohort are due to the fact that most patients present to the hospital at a later stage in our study region. Thus, the CRP levels we found could not correctly

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differentiate between complicated and non complicated cases.

In complicated appendicitis cases with severe inflammation, intestinal edema, and hypomobility may induce cholestasis and lead to hyperbilirubinemia [14]. However, since there were only a few perforated or necrotizing appendicitis cases in our cohort, the comparison of the total bilirubin levels and histopathological diagnoses did not reveal a significant difference.

Abdominal USG is recommended as an imaging modality in the diagnostic management of AA since it is readily available, cheap, and sensitive in determining abdominal organ injuries [5]. Enhanced abdominal CT is the ideal imaging technique for differential diagnosis of acute right lower abdominal quadrant pain; thus, it should be preferred following abdominal USG [15]. In our study, 92.8% (n=77) of our patients underwent abdominal USG, and 51.8% (n=43) underwent enhanced abdominal CT for a definitive diagnosis of AA or delineation of complicated appendicitis. The comparison of the enhanced abdominal CT and histopathology diagnoses did not reveal a significant difference (p=0.18). Gaskill et al., who worked on a similar number of patients and compared the CT results with the histopathological findings, found similar findings [16]. We suggest that a comparison of the imaging results and histopathological findings did not reveal a significant difference in our study because approximately half of our patients underwent enhanced abdominal CT scans, and abdominal USG is an operator-dependent technique.

Limitations

The retrospective and single center design is the primary limitation of our study. A relatively more detailed data analysis involving the patients' histories, physical examination findings, and

Conclusion

A single parameter is not sufficient for diagnosing AA. The patient's clinical findings, laboratory data, and radiological imaging findings should be considered. The preoperative differentiation of complicated appendicitis cases is essential for reducing the risk of postoperative complications and improving the prognosis. To predict pre-op complicated appendicitis, it is statistically significant that lymphocyte counts and NLR values can be used. With this paper, we believe assessing histopathological results and statistically significant parameters together may improve medical literature. Multi-center and comprehensive studies are required to analyze further the diagnostic tests that can be used in the diagnostic management of AA cases.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
Ethics committee approval was received for this study from the Ethics Committee of Somalia Mogadishu Turkiye Recep Tayyip Erdogan Training and Research Hospital and approved by the scientific committee (Decision no: MSTH/9039-481 Date: 07.02.2022).

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