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The relationship between luminal obstruction and appendix diameter and length in pediatric acute appendicitis

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Abstract

The aim of this study was to evaluate the relationship between macroscopic measurements (diameter and length) of the appendix and factors such as lumen status, gender, and histopathological diagnosis subgroups in patients diagnosed with acute appendicitis. A total of 134 patients who underwent surgery for acute appendicitis were included in the study. Demographic data such as age and gender, and clinical parameters such as lumen status and histopathological diagnosis were recorded. Appendix diameter and length were measured macroscopically and recorded in millimeters (mm). The mean age of the patients was 14.03 ± 2.78 years, with 44% being female and 56% male. The appendix lumen was found to be patent in 36 cases (26.9%) and obliterated in 98 cases (73.1%). Appendix diameter was higher in the obliterated lumen group compared to the patent lumen group ($p = 0.005$), with a significant increase in Acute Phlegmonous Appendicitis cases compared to other cases. Our findings suggest that macroscopic measurements while not alone, can significantly contribute to the evaluation of acute appendicitis and their interpretation when used in conjunction with clinical and histopathological data.

Keywords: Acute appendicitis, appendix diameter, appendix length, pediatrics

Introduction

Acute appendicitis (AA) is one of the most common surgical emergencies in the pediatric age group, occurring in approximately 1–8% of patients presenting with abdominal pain [1]. From a pathophysiological perspective, AA is characterized by ischemia and necrosis of the appendix wall, which occur due to increased intraluminal and intramural pressure resulting from the obstruction of the appendiceal lumen by factors such as foreign bodies, fecaliths, parasites, or lymphoid hyperplasia [2].

Diagnosis of AA is based on a combination of medical history, physical examination, laboratory tests, and advanced imaging modalities such as ultrasonography (US) and computed tomography (CT) [3]. Key diagnostic findings on US and CT include an increased appendiceal diameter, thickening of the appendiceal wall, inflammation of the periappendiceal tissues, and the presence of appendicoliths [2,4]. In the literature, an

appendiceal diameter exceeding 6 mm and a wall thickness greater than 2 mm are considered strong indicators for a diagnosis of appendicitis [2–4].

Recent studies have demonstrated that an increase in appendiceal diameter may be associated with the severity of inflammation and a higher risk of complicated appendicitis [5-9]. However, the relationship between macroscopic features, such as appendix length and luminal patency, and the pathological spectrum of the disease remains insufficiently clarified. Furthermore, in existing literature, appendiceal diameter in AA diagnosis has been primarily evaluated through imaging modalities [1–4]. There is a limited number of studies that collectively analyze luminal status, histopathological diagnosis subgroups, and macroscopic measurements. In this study, we aimed to contribute to the literature by evaluating the relationship between luminal patency, gender, and histopathological diagnosis subgroups with the macroscopic measurements of the appendix in cases of acute appendicitis.

CITATION

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Material and Methods

Ethical Considerations and Data Security

This study was designed as a retrospective method and conducted at a tertiary care training hospital between 01.01.2024 and 31.12.2025. Ethical approval was granted by the Ordu University Clinical Research Ethics Committee (protocol number 2026/88; approval date 27.03.2026). This study was conducted following approval from the institutional ethics committee and the acquisition of necessary administrative permissions. In accordance with the principles of patient confidentiality and data security, no identifiable data were used; all data were analyzed in an anonymized format. The data were evaluated solely for scientific purposes, were not shared with third parties, and were stored in compliance with current regulations and institutional data security policies.

Study Design, Setting, and Study Population

This study was designed as a retrospective observational study and was conducted in the Pediatric Surgery Clinic of Ordu University Training and Research Hospital, a tertiary care center, between January 2024 and December 2025. Patients who underwent appendectomy with a preliminary diagnosis of acute appendicitis at our institution during the specified period were reviewed retrospectively through hospital information management system records and pathology reports. Cases that met the inclusion criteria and had complete data for the primary variables were included in the study using a consecutive sampling approach. The study population consisted of cases that underwent appendectomy for acute appendicitis during the relevant period.

Inclusion and Exclusion Criteria

The study included patients under 18 years of age who underwent surgery in the pediatric surgery clinic with a preliminary diagnosis of acute appendicitis. Inclusion criteria required complete demographic data, and the presence of clearly documented macroscopic appendix measurements, luminal status, and a definitive histopathological diagnosis in the pathology reports.

Patients with missing data regarding the primary variables, specimens unsuitable for morphometric evaluation due to fragmentation or inadequate fixation, and patients aged 18 years and older were excluded from the study. Furthermore, cases identified with acute abdomen etiologies other than appendiceal inflammation during surgery or histopathological examination, as well as specific pathologies falling outside the primary inflammatory process of the appendix (e.g., appendiceal tumors, severe parasitic infestations, and incidental appendectomies), were excluded from the analysis. Conversely, inflammatory sub-diagnoses within the acute appendicitis spectrum—other than acute suppurative appendicitis $\pm$ periappendicular panniculitis (ASA-PAP)—were retained within the scope of the study and evaluated in the subgroup analyses.

Data Sources and Data Collection Process

Data were retrospectively compiled from hospital information management system records and pathology reports. For each case, demographic variables (age, gender), luminal status, appendix diameter, appendix length, and histopathological diagnosis were recorded using a standardized data extraction form. Prior to analysis, the dataset was checked for duplicate records, and data cleaning was performed by screening for missing values and outliers.

Measurements and Operational Definitions

Within the scope of appendiceal morphometry, diameter and length measurements were assessed in millimeters (mm). Appendix diameter was recorded based on the maximum external diameter reported during routine macroscopic evaluation in the pathology laboratory, while appendix length was obtained from the records as the total length reported along the base-to-tip axis.

Luminal status was classified as “patent” and “obliterated” based on the findings documented in the macroscopic evaluation reports. The lumen was recorded as “patent” in cases where the luminal space was discernible and no signs of obstruction were present. Conversely, the lumen was coded as “obliterated” in the presence of macroscopic findings consistent with obstruction, such as fecaliths, intraluminal purulent content, obliteration due to marked mucosal edema/thickening, stricture-like narrowing, or cases where the luminal passage could not be identified. Histopathological diagnosis was coded based on the final diagnostic statements in the pathology reports, in accordance with the study’s classification approach.

In the histopathological subgroup analyses, cases were classified as either ASA-PAP (Acute Suppurative Appendicitis $\pm$ Periappendicular Panniculitis) or other inflammatory histopathological sub-diagnoses (Acute Phlegmonous Appendicitis (APA), lymphoid hyperplasia (LH)) within the spectrum. Pathologies other than acute appendicitis were not included in this classification.

Study Endpoints

The primary analytical focus of this study was to evaluate the relationship between appendix diameter, length, and luminal status. Secondary analyses examined the associations of appendix diameter and length with gender and histopathological diagnosis subgroups. In the histopathological subgroup analyses, comparisons were performed between ASA-PAP and other inflammatory sub-diagnoses within the acute appendicitis spectrum.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics software. The distribution characteristics of continuous variables were assessed using the Kolmogorov–Smirnov test. Normally distributed data were presented as mean $\pm$ standard deviation, while non-normally distributed data were presented as median

(minimum–maximum). Depending on the distribution, the independent samples t-test or the Mann–Whitney U test and Fisher exact test were used for comparisons between two groups. The Chi-square test was employed for the analysis of categorical variables. In all analyses, a two-sided p-value of <0.05 was considered the threshold for statistical significance.

Results

A total of 134 cases were included in this study. The mean age of the patients was 14.03 ± 2.78 years, with an age range of 5–17 years. Of the patients, 59 (44.0%) were female and 75 (56.0%) were male. Regarding luminal status, the lumen was found to be patent (open) in 36 cases (26.9 %) and obliterated (closed) in 98 cases (73.1%). Histopathological examination revealed that the vast majority of cases belonged to the acute suppurative appendicitis-periappendicular panniculitis (ASA-PAP) group (97 cases). Diagnoses other than ASA were categorized as other diagnosis (APA (29 cases), LH (8 cases)). Parameters were also compared individually. The demographic and clinical characteristics of the patients are presented in Table 1.

Table 1. Demographic and clinical characteristics of the cases	
Variable	Value (n)
Number of cases	134
Age (years), mean ± SD	14.03 ± 2.78
Age (years), minimum–maximum	5-17
Gender	n (%)
Female	59 (44.0)
Male	75 (56.0)
Luminal status	n (%)
Patent	36 (26.9)
Obliterated	98 (73.1)
Histopathological diagnosis	n (%)
Suppurative appendicitis	97 (72.4)
Phlegmonous appendicitis	29 (21.6)
Lymphoid hyperplasia	8 (6)
Data are presented as mean ± standard deviation or n (%), as appropriate	

In the comparison based on luminal status, the appendix diameter was found to be greater in the obliterated lumen group compared to the patent lumen group (11.85 ± 4.60 mm versus 10.42 ± 4.43 mm); however, this difference remained at the borderline of statistical significance (p = 0.051).

Patients diagnosed with APA have a significantly higher probability of lumen closure compared to those diagnosed with ASA (p = 0.0006). When all diagnoses were evaluated according to lumen condition, a statistically significant relationship was found (p = 0.007) (Table 2).

Table 2. Comparison of lumen condition according to histopathological diagnosis				
Variable	ASA-PAP n (%)	APA n (%)	LH n (%)	p Value
Patent lumen	34 (35.05)	1 (3.4)	1(12.5)	0.007
Obliterated lumen	63 (64.85)	28 (96.6)	7 (87.5)	

The macroscopic diameter was larger in patients with lumen obstruction (p = 0.005), and the diameter was found to be higher in the APA group compared to other diagnoses (p = 0.001). No significant difference was observed between the patent and obliterated lumen groups regarding appendix length (65.29 ± 22.03 mm versus 68.60 ± 18.96 mm; p = 0.197). The comparison of macroscopic measurements of the appendix according to luminal status is presented in Table 3.

Table 3. Comparison of macroscopic appendix measurements according to luminal status			
Variable	Patent lumen (n = 36)	Obliterated lumen (n = 98)	p value
Diameter (mm)	10.42 ± 4.43 (3-30)	11.85 ± 4.60 (3-35)	0.051
Length (mm)	65.29 ± 22.03 (30-120)	68.60 ± 18.96 (20-115)	0.197
Data are presented as mean ± standard deviation (minimum–maximum); Groups were compared using the Mann–Whitney U test			

In the analysis by gender, the appendix diameter was 11.27 ± 4.74 mm in females and 11.39 ± 4.48 mm in males, with no significant difference observed between the groups (p = 0.87). Similarly, appendix length was found to be comparable between female and male patients (67.08 ± 19.71 mm and 67.96 ± 20.35 mm, respectively; p = 0.91). The distribution of macroscopic appendix measurements by gender is presented in Table 4.

Table 4. Comparison of macroscopic appendix measurements by gender			
Variable	Female (n = 59)	Male (n = 75)	p value
Diameter (mm)	11.27 ± 4.74 (3-35)	11.39 ± 4.48 (3-30)	0.87
Length (mm)	67.08 ± 19.71 (20-115)	67.96 ± 20.35 (30-120)	0.91
Data are presented as mean ± standard deviation (minimum–maximum); Groups were compared using the Mann–Whitney U test			

In the subgroup analysis based on histopathological diagnosis, no statistically significant difference was observed between patients diagnosed with ASA-PAP and those with other diagnoses regarding appendix diameter (11.58 ± 4.54 mm versus 10.91 ± 4.77 mm; p = 0.42) and appendix length (67.42 ± 19.82 mm versus 66.88 ± 20.41 mm; p = 0.78). The comparison of macroscopic appendix measurements by histopathological diagnosis subgroups is presented in Table 5.

Table 5. Comparison of macroscopic appendix measurements by histopathological diagnosis

Variable	ASA-PAP	Other diagnoses	p value
Diameter (mm)	11.58 ± 4.54	10.91 ± 4.77	0.420
Length (mm)	67.42 ± 19.82	66.88 ± 20.41	0.780

Groups were compared using the Mann–Whitney U test

Discussion

The present study investigated the relationship between luminal patency and macroscopic appendiceal measurements in pediatric acute appendicitis, and three principal findings emerged. First, luminal obliteration was significantly associated with greater appendiceal diameter, an association that reached statistical significance specifically in the Acute Phlegmonous Appendicitis (APA) subgroup. Second, appendiceal length did not differ meaningfully between patent and obliterated lumen groups, suggesting it reflects individual anatomical variation rather than disease progression. Third, neither appendiceal diameter nor length varied significantly by gender. These findings are consistent with the well-established pathophysiological cascade of acute appendicitis, in which luminal obstruction leads to rising intraluminal pressure, impaired venous drainage, and subsequent mural distension [10-12]. Prior studies have confirmed that macroscopic appendiceal diameter correlates with the degree of inflammatory severity, and that a diameter exceeding 6 mm on imaging is strongly predictive of acute appendicitis [13-16]. Our results extend this evidence by demonstrating that the diameter–obstruction relationship is histopathological-subtype dependent, being most pronounced in phlegmonous disease, where transmural inflammation and edema are expected to maximally contribute to luminal expansion [6,7].

The high proportion of obliterated lumens observed in our cohort (73.1%) reflects the central role of luminal obstruction as the initiating event in the pathogenesis of acute appendicitis [10,12].

When luminal condition was compared with macroscopic measurements across the entire cohort, appendiceal diameter was larger in the obliterated lumen group; however, this difference did not reach statistical significance. The significant association emerged only when the analysis was stratified by histopathological subtype, specifically in the APA group. This subtype-dependent pattern suggests that macroscopic dilation becomes detectable only when transmural inflammation reaches a critical threshold, and that diameter alone may be insufficient to reflect luminal status in milder forms of appendicitis [13,14].

No statistically significant difference was observed between the patent and obliterated lumen groups regarding appendiceal length. This finding suggests that appendiceal length is influenced more by individual anatomical variation than by the inflammatory process itself, consistent with reports indicating its limited diagnostic value and poor correlation with disease severity [14,17].

In the analyses by gender, no significant difference was observed between female and male patients regarding appendiceal diameter or length. Although acute appendicitis is reported to be more frequent in males, published data indicate no significant gender-related difference in macroscopic appendiceal dimensions [10,18]. Our findings support the notion that gender does not determine the macroscopic morphology of the inflamed appendix.

In the subgroup analysis based on histopathological diagnosis, no statistically significant difference was found in appendiceal diameter or length between patients with ASA-PAP and those with other diagnoses. This suggests that histopathological inflammation severity does not always parallel macroscopic measurements, a pattern previously reported in early-stage appendicitis [17,19]. Nonetheless, the APA subgroup showed both significantly greater appendiceal diameter and higher obliteration rates, supporting the concept that luminal obliteration and appendiceal dilation may together serve as markers of advanced inflammatory disease in the pediatric population.

To our knowledge, this is one of the few studies to jointly evaluate luminal patency, histopathological subtype, gender, and macroscopic appendiceal measurements in a pediatric surgical cohort. While the existing literature has addressed appendiceal morphometry and perforation risk from various angles [13,14], data simultaneously examining luminal patency in relation to both diameter and length remain scarce, particularly in children. A further distinguishing feature of our study is its reliance on direct surgical and pathological measurements rather than imaging-based estimates, which are subject to technical variability and operator dependence. This approach provides a more objective morphometric characterization of the appendix across inflammatory subtypes and contributes to a more precise understanding of the macroscopic correlates of luminal obstruction in pediatric acute appendicitis.

Limitations

Our study has several limitations. Its retrospective design, being a single-center study, and the presence of missing data in some cases may limit the generalizability of the results. However, the large sample size and the inclusion of multiple subgroup analyses are among the strengths of our study.

Conclusion

In our study, a significant association was found between the presence of an obstructed lumen and appendicitis diameter in pediatric appendicitis cases for APA cases; the statistically significant association was borderline for ASA cases. This indicates that macroscopic measurements become more important in delayed cases, that macroscopic measurements alone may not be sufficient, and that they should be evaluated together with clinical, radiological, and histopathological data.

Ethical Approval

Ethical approval was granted by the Ordu University Clinical Research Ethics Committee (protocol number 2026/88; approval date 27.03.2026).

Patient Consent

Written informed consent was not required because of the retrospective design of the study, the use of anonymized data, and the absence of direct patient contact or any additional intervention. The study was conducted in accordance with the approval of the Ordu University Clinical Research Ethics Committee.

Conflict of Interest

The authors confirm the absence of any conflicts associated with this work.

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