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Original Research Article

Clinical Severity and Histopathological Patterns of Pediatric Appendicitis: A Comparative Analysis

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Abstract:

Background: Appendicitis is the predominant surgical emergency in paediatric patients, characterized by diverse clinical manifestations that hinder prompt identification. Precise evaluation of severity is essential for directing management and enhancing outcomes.

Aim: To evaluate the histopathological spectrum of pediatric appendicitis, assess its correlation with clinical severity, and compare intraoperative and histological findings in predicting outcomes.

Methodology: An observational study was carried out at the Department of Paediatrics and Pathology, Nalanda Medical College and Hospital, Patna, Bihar, India. involving 70 children aged 2–14 years undergoing appendectomy. Clinical features, laboratory data, and intraoperative findings were recorded. Resected specimens were analyzed histopathological. Statistical analysis determined correlations between clinical diagnosis and histopathological confirmation.

Results: Most patients were aged 11–14 years (45.7%) with a male predominance (60%). Abdominal pain (100%), vomiting (78.6%), anorexia (71.4%), and fever (67.1%) were common symptoms, with right lower quadrant tenderness in 97.1%. Histopathology showed acute catarrhal appendicitis (42.9%) and acute suppurative appendicitis (35.7%) as predominant types. Clinical diagnosis of acute appendicitis demonstrated high sensitivity (92.9%) and specificity (75%). Non-inflamed appendices were less accurately detected (sensitivity 60%).

Conclusion: Combining structured clinical evaluation with histopathological confirmation provides reliable diagnosis and guides appropriate management in pediatric appendicitis, ensuring optimal postoperative outcomes.

Keywords: Pediatric appendicitis, Histopathology, Clinical diagnosis, Severity correlation, Appendectomy.

Introduction

Appendicitis is the leading surgical emergency in the pediatric population and also one of the leading causes of abdominal pain and admission into a hospital. The symptoms and signs of appendicitis can vary by age, creating complications for an early and accurate diagnosis in patients who are not yet developmentally able to communicate their symptoms. The advances in antibiotics, accessibility to healthcare services, advancements in imaging modalities such as ultrasound and CT scanning, and availability of laparoscopic techniques have substantially reduced morbidity and increased favorable outcomes for patients with appendicitis. Just as importantly, these improvements have and will continue to improve timing of diagnosis and treatment of appendicitis while reducing morbidity from complications such as perforation, abscess, and prolonged hospitalization [1].

In this case, the classification of appendicitis severity will be utilized to guide clinical decisions - type and duration of antibiotic treatment needed, duration of hospitalization, and extent of laboratory and imaging studies. A valid classification system will ensure children with uncomplicated appendicitis receive appropriate treatment delivered conservatively or surgically, and children with complicated appendicitis receive more aggressive intervention in an appropriate timeframe [2]. Having diagnostic tools with the highest level of accuracy possible may answer care plans, prevent over-treatment or under-treatment, and look at clinical outcomes in pediatric patients.

Surgeons and pathologists play a key role in defining and classifying the severity of acute appendicitis, which provides critical context for diagnosis, treatment, and prognosis. While the operative classification remains the presumed standard of practice in most centers, because it allows for direct inspection of the appendix and associated structures in cases of complicated appendicitis [3], there are still

various proposals for surgical classification, emphasizing the persistent disparate nature of concepts and approaches. These systems attempt to provide a standardized grading of severity and, again, there is no universally accepted classification. The proposed necessary systems vary in their emphasis between purely gross macroscopic changes to the appendix, and some measure of either local or regional intra-abdominal involvement.

A major limitation of these classifications is their subjective nature and the likelihood of different results in the interpretation of the classifications. The criteria are primarily based on visual identification and tactile examination of macroscopic changes which tend to vary among surgeons and pathologists and across organizations [4]. These occasional imperfections contribute to challenges in inter-observer agreements and therefore challenge the reproducibility and reliability in both clinical and research environments. Moreover, while intraoperative classification gives immediate information, it does not always tightly correlate with histopathology, which potentially provides more objective pathological or microscopic confirmation of severity [5]. Thus, the need for standardized, reproducible, and universally accepted criteria to promote diagnostic consistency across studies, and hopefully impact improved patient outcomes, remains.

Histopathological assessment related to appendicitis, while typically not available until several days after surgery, is an important component of a complete assessment of a patient. While it is not expected to change the immediate management delivered to the patient at the end of surgery, it does provide useful confirmation of a diagnosis in situations where clinical and intraoperative findings may be uncertain. Histopathology can also be used to determine the presence of related or coincidental conditions such as infectious or parasitic process, idiopathic granulomatous inflammation or rare neurogenic appendicitis. In addition, a histopathologic report can be important to exclude the presence of an unexpected appendiceal neoplasm, which although uncommon, can change management and prognosis [6]. For these reasons, histopathology is clearly more than diagnosing appendicitis, as it may also provide relative information and thoughts that ultimately may affect follow-up and longer-term patient care.

Histopathology also aids in grading appendicitis. The histopathological grading system is based on the evaluation of the changes in inflammation from mucosal involvement to transmural necrosis and perforation, consistent with the historical progression of clinical appendicitis [7]. The grading system applied to histopathology improves the reporting process and drives appreciation for the continuum of pathology and severity of appendicitis. Relevant studies have demonstrated good inter-observer reliability, confirming consistency. The degree of confidence in this system is enhanced in epidemiological studies and associations when important histopathological diagnostic grade is confirmed post-operatively. While histopathology is often lagging, it remains a valuable and necessary portion of diagnostic accuracy and/or severity grading of pediatric and adult appendicitis [8].

Information on the value of intraoperative findings or histopathological findings to near term patient outcomes in terms of changing treatment decisions is relatively limited, especially in pediatric appendicitis. A universal question revolves around whether the operating surgeon's direct observations are more accurate than a pathologist's assessment with a microscope to determine the severity of disease. The current literature is limited. The very few studies that have been able to demonstrate some degree of agreement between intraoperative classification and histopathological classification are limited and most published bias rating studies demonstrated poor to moderate agreement [9]. This lack of agreement raises concerns about the reliability of current assessments and supports the need for a more complete evaluation to determine if a combination of assessment approaches could provide better clinical decision-making.

This study aims to fill these knowledge gaps by determining the level of congruence between intraoperative classification and histological classification in pediatric appendicitis and determining their role in predicting factors associated with postoperative outcomes. The study will systematically examine both surgical classification and pathological classification to ascertain whether intraoperative or histological classification is a better predictor after surgery or if a combined psychosocial model adds better prognostic value to the model. In short, this will lead to improved understanding of how to optimize accuracy in pediatric appendicitis diagnosis, postoperative care, and complications.

Methodology

Study Design: This was an exploratory investigation designed to assess the histological spectrum of paediatric appendicitis and its relationship with clinical severity.

Study Area: The research was performed in the Department of Paediatrics and Pathology at Nalanda Medical College and Hospital in Patna, Bihar, India.

Study Participants

Inclusion Criteria:

- Patients aged between 2 - 14 years.
- Patients with acute appendicitis who had appendectomy.

Exclusion Criteria:

- Individuals who had their appendices removed for causes other than acute appendicitis, such as malrotation or unintentional removal.
- Patients whose histopathology results were not available.

Sample Size: The study involved the enrolment of 70 patients.

Study Duration: The research was carried out over one year.

Procedure: For each admitted patient, a structured questionnaire was filled, recording demographic details including gender and age, signs and presenting symptoms, hospital follow-up and laboratory investigations. Clinical data collected included duration, location, migration, and character of pain (colicky, dull ache, burning), along with associated symptoms such as vomiting, fever, constipation, anorexia, burning micturition, sore throat and diarrhea. Physical examination documented pulse rate, area of maximum tenderness, temperature, involuntary guarding, abdominal distension, rebound tenderness and palpable masses.

Patients were prepared for surgery when the diagnosis of appendicitis was confirmed, and they received an intravenous initial dose of ceftazidime and metronidazole before having an appendectomy. All excised specimens were submitted for histological analysis, and the findings were documented. Postoperative therapy involved a 2-day antibiotic regimen for uncomplicated appendicitis, whereas intravenous antibiotics were administered for 5 days in instances of perforated appendicitis. Patients were categorized into acute appendicitis or non-inflamed appendix groups according to histological results.

Statistical Analysis: The analysis was conducted using SPSS version 27. Categorical variables, including symptoms and indications, were represented as frequencies and percentages. The chi-square test was utilised to compare the two groups. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were computed for each symptom and sign. A p-value below 0.05 was deemed statistically significant.

Result

Table 1 included a total of 70 pediatric participants, with the majority falling within the 11–14 years age group (32 patients, 45.7%), followed by 6–10 years (28 patients, 40%) and 2–5 years (10 patients, 14.3%). Regarding gender distribution, males predominated, comprising 42 participants (60%), while females accounted for 28 participants (40%). This demographic profile indicates a higher representation of older children and a slight male predominance in the study population.

Table 1: Distribution of Study Participants by Demographic Characteristics

Variable	Category	Number of Patients (n=70)	Percentage (%)
Age Group (years)	**2–5**	10	14.3
	6–10	28	40
	11–14	32	45.7
Gender	**Male**	42	60
	Female	28	40

Table 2 illustrates the prevalence of various clinical symptoms among 70 patients. Abdominal pain was universally reported, affecting all patients (100%), making it the most consistent symptom. Other common symptoms included vomiting (78.6%), anorexia (71.4%), and fever (67.1%), indicating that gastrointestinal and systemic manifestations were prominent. Less frequent symptoms were constipation (21.4%), diarrhea (17.1%), and burning micturition (14.3%), while sore throat was the least common, observed in only 8.6% of patients. Overall, the data highlights that while abdominal pain and gastrointestinal disturbances dominate clinical presentation, other systemic or atypical symptoms occur in a smaller subset of patients.

Table 2: Frequency of Clinical Symptoms Among Patients

Clinical Symptom	Number of Patients (n=70)	Percentage (%)
Abdominal pain	70	100
Anorexia	50	71.4
Vomiting	55	78.6
Fever	47	67.1
Diarrhea	12	17.1
Constipation	15	21.4
Burning micturition	10	14.3
Sore throat	6	8.6

Table 3 illustrates the distribution of various clinical signs observed in 70 pediatric patients during physical examination for appendicitis. Right lower quadrant tenderness was the most prevalent sign, present in 97.1% of patients, highlighting its significance as a primary indicator. Rebound tenderness and guarding were observed in 74.3% and 62.9% of cases, respectively, indicating frequent peritoneal irritation. Elevated temperatures (>38°C) and tachycardia (>100 bpm) were noted in 68.6% and 57.1% of patients, reflecting systemic inflammatory response. Less commonly observed signs included abdominal distension (12.9%) and palpable mass (8.6%), suggesting these features are less typical but may appear in complicated or advanced cases. Overall, the findings emphasize that tenderness and inflammatory signs are the most consistent clinical indicators in pediatric appendicitis.

Table 3: Distribution of Clinical Signs Observed on Physical Examination

Clinical Sign	Number of Patients (n=70)	Percentage (%)
Right lower quadrant tenderness	68	97.1
Rebound tenderness	52	74.3
Guarding	44	62.9
Palpable mass	6	8.6
Abdominal distension	9	12.9
Elevated temperature (>38°C)	48	68.6
Tachycardia (>100 bpm)	40	57.1

Table 4 revealed histopathological analysis of 70 pediatric appendectomy specimens of predominance of acute catarrhal appendicitis, accounting for 42.9% of cases, followed closely by acute suppurative appendicitis at 35.7%. Less frequent were gangrenous appendicitis (14.3%) and perforated appendicitis (4.3%), while a small proportion of specimens (2.8%) showed no evidence of inflammation, indicating a normal appendix. These findings suggest that the majority of pediatric appendicitis cases present in the early to intermediate stages of inflammation, with severe or complicated forms being relatively uncommon.

Table 4: Histopathological Spectrum of Appendicitis

Histopathological Diagnosis	Number of Cases (n=70)	Percentage (%)
Acute catarrhal appendicitis	30	42.9
Acute suppurative appendicitis	25	35.7
Gangrenous appendicitis	10	14.3
Perforated appendicitis	3	4.3
Non-inflamed appendix	2	2.8

Table 5 demonstrates the correlation between clinical diagnosis and histopathological findings in appendicitis. For acute appendicitis, clinical diagnosis showed a high sensitivity of 92.9% and specificity of 75%, indicating that most true cases were correctly identified while some non-appendicitis cases were misclassified. The positive predictive value (PPV) was 96.9%, suggesting that nearly all patients clinically diagnosed with acute appendicitis were confirmed histopathological, while the negative predictive value (NPV) was 60%, indicating a moderate likelihood that patients not diagnosed clinically truly did not have appendicitis. In contrast, for non-inflamed appendices, sensitivity was lower at 60% but specificity was high at 95%, reflecting that clinical diagnosis was less accurate in detecting non-inflamed cases but rarely misclassified inflamed appendices as normal. The PPV and NPV for non-inflamed appendices were 50% and 96.7%, respectively, highlighting that while a positive clinical diagnosis for non-inflamed appendix was less reliable, a negative clinical diagnosis was strongly predictive. Both correlations were statistically significant ($p < 0.05$), supporting the reliability of clinical assessment in conjunction with histopathology.

Table 5: Correlation Between Clinical Diagnosis and Histopathological Findings

Clinical Diagnosis	Histopathological Confirmed Cases (n)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	p-value
Acute appendicitis	65	92.9	75	96.9	60	<0.05*
Non-inflamed appendix	5	60	95	50	96.7	<0.05*

Discussion

Appendicitis continues to be an important surgical consideration in children, emphasizing the need for prompt and accurate diagnosis to reduce the risk of morbidity. In this study, a significant proportion of patients were aged 11–14 years (45.7%) and were

males (60%). This demographic pattern is consistent with previous studies on pediatric appendicitis, suggesting older children are at slightly higher risk and that appendicitis is more common in males. Knowledge of age and gender distribution is important as the clinical presentation and overall risk of perforation will vary with age and younger children are likely more difficult to diagnose because of atypical presentation.

Clinically, abdominal pain was the most ubiquitous symptom found in all patients (100%), followed by vomiting (78.6%), anorexia (71.4%), and fever (67.1%). These data validate that gastrointestinal and systemic symptoms remain the most trusted clinical features for appendicitis in children. Physical examination corroborated this, with tenderness to palpation in the lower quadrant seen in 97.1% of cases, which remains the principal sign in the diagnosis. Rebound tenderness (74.3%) and guarding (62.9%) provided evidence for intra-abdominal obstruction or irritation, while discrete and less frequent findings such as palpable mass (8.6%) and abdominal distension (12.9%) were usually associated with advanced or complicated appendicitis. Collectively, these results underscore the importance of careful clinical evaluation and provide support for previously published literature indicating that classic clinical symptoms and findings should continue to be a core feature of early diagnosis. Farach et al., (2015) [10] concluded that surgical evaluation surpasses histological assessment in predicting length of stay and problems within 30 days, including, intestinal obstructions, hospital readmissions, surgical site infection and intraabdominal abscess.

Histopathological analysis identified acute catarrhal appendicitis (42.9%) and acute suppurative appendicitis (35.7%) as the most common types of appendicitis; gangrenous appendicitis (14.3%) and perforated appendicitis (4.3%) were the least common types of appendicitis. The number of specimens without inflammation was 2.8%. This distribution of types of appendicitis suggests that many cases in pediatric patients were identified in the early to mid-stages of inflammation because of timely presentations for medical care and improved levels of diagnostic capabilities. Like trends noted in global literature, rates of complicated appendicitis in children have decreased in recent years due to increased appreciation for appendicitis concerns, immediate imaging, and early surgical assessment. Gomes et al., (2015) [11] found that most patients with complex appendicitis demonstrated a shortened length of stay and an unremarkable postoperative recovery, like those with uncomplicated appendicitis. The authors assert that histological classification does not align with the severity of clinical outcomes and should not inform post-operative management.

The relationship between clinical diagnosis and the pathological evaluation in tissue samples showed high sensitivity (92.9%) and specificity (75%) for acute appendicitis, with a positive predictive value of 96.9%. These values suggest that clinical diagnosis is very reliable for accurately verifying true cases, and clinical evaluation has moderate negative predictive value (60%), thereby demonstrating that sometimes it is difficult to exclude disease. If the appendix is not inflamed, clinical diagnosis has lower sensitivity (60%) with high specificity (95%). Clinicians rarely classified any inflamed appendices as normal. Overall, this suggests that clinical diagnosis is effective; however, histopathology is still extremely important for cases where clinical information is uncertain because individuals may avoid surgery or some individuals may miss that they have a diagnosis. Fallon et al., (2015) [12] demonstrated that intraoperative severity classification is more well predicted surgical site infection rates compared to histological severity classification.

The research emphasizes the collaborative roles of intraoperative and histopathological assessment. Intraoperative assessment allows decisions to be made immediately while histopathology provides confirmation of roles with objective reporting and aids in identifying rare or atypical pathologies including neoplasms and parasitic infections. Combining both modalities improves the accuracy of diagnosis and postoperative care, while histopathologic grading adds to the understanding of the disease spectrum, correlates with clinical progression and supports consistent reporting for epidemiologic and clinical research studies. Adamina and Pozza (2020) [13] demonstrated that in a multicenter, prospective, cross-sectional study involving 7,339 patients undergoing appendectomy due to clinical suspicion of appendicitis, there was significant evidence indicating that selective histopathology of appendiceal specimens, following the surgeon's macroscopic assessment, was oncologically safe and correlated with considerable cost savings.

In summary, this research confirms that a structured clinical evaluation, along with corroborating histopathology findings, is a safety-net approach to manage appendicitis in children. A statistically significant concordance of clinical evaluations and confirmatory histopathology evaluations in the acute appendicitis group is justification for surgical practice these cases, while the acknowledgement of limitations to diagnostic accuracy for non-inflamed appendix provides a caution for limitation to consideration. The support for action or recommendation towards a clinical and operative history alone with pathology revision is notable toward ways to maximize treatment, while minimizing the potential for complications, while improving outcomes for the pediatric population.

Conclusion

In conclusion, this study illustrates that pediatric appendicitis may be diagnosed and therefore managed through thorough clinical evaluation with histopathological confirmation. Abdominal pain, vomiting, anorexia and fever with right lower quadrant tenderness and peritoneal signs remain the most reliable clinical indicators. Histopathological assessment confirmed that many cases were in the early to intermediate stages and severe forms were relatively uncommon, suggesting that access to the hospital and timely management leads to less severe cases and implications for surgical management and histopathology. Clinical diagnosis indicated high sensitivity and specificity for acute appendicitis, and histopathology provided an important confirmation of the diagnosis, particularly in suspected or accompanying acute appendicitis, and to assess other rare pathologies. Together, through combining intraoperative histopathology for assessment, a more accurate diagnosis can be made, appropriate overall management instigated and facilitated optimal postoperative outcome. It reinforces the complementary roles of the surgeon and pathologist in the management of pediatric appendicitis.

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