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Factors affecting misdiagnosis of non-complicated and complicated appendicitis in pediatric patients

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ABSTRACT

Background: Diagnosing appendicitis in children remains challenging due to difficulties in expressing complaints, localizing pain, nonspecific symptoms, and broad differential diagnoses. Diagnostic supports like ultrasound and CT scans are not routinely performed on children. This necessitates data analysis to identify factors influencing misdiagnosis.

Methods: This retrospective cross-sectional study analyzed pediatric appendicitis patients undergoing surgery at General Hospital Dr. Soetomo, Surabaya, from January 2023 to September 2024. Data from 84 patients who met inclusion criteria were collected from electronic medical records. Bivariate analysis assessed relationships between age, clinical symptoms, leukocyte levels and Neutrophil-to-Lymphocyte Ratio (NLR) with appendicitis misdiagnosis.

Results: Out of 84 subjects, 48 subjects (57.1%) had non-complicated appendicitis and 36 (42.8%) had complicated appendicitis. Misdiagnosis occurred in 11% of patients. Analyses revealed no significant associations between age (p=0.391), clinical symptoms, leukocyte levels (p=0.843), NLR (p=0.273) and appendicitis misdiagnosis.

Conclusion: There is no significant association between age, clinical factors, leukocyte levels and NLR with the incidence of misdiagnosis of non-complicated and complicated appendicitis in pediatric patients.

Keywords: *: misdiagnosis, appendicitis, age, clinical, leukocytes, NLR.*

1. INTRODUCTION

Appendicitis is one of the most common causes of acute abdominal pain requiring surgical intervention in children. Despite its frequent occurrence, diagnosing appendicitis in the pediatric population remains a significant challenge, particularly in children under five years of age who have difficulty expressing complaints, localizing pain, and presenting with nonspecific symptoms.[1–3] As a result, misdiagnosis rates are notably high, reaching 28–57% in children aged 2–12 years and nearly 100% in children under two years old.[4]

Accurate preoperative diagnosis is crucial in determining the optimal management for patients with appendicitis. RSUD Dr. Soetomo, as the main referral hospital in East Java, plays a vital role in ensuring successful diagnosis and treatment. According to data collected from 2017 to 2021 at the Emergency Department of RSUD Dr. Soetomo, 245 pediatric patients were diagnosed with appendicitis, with approximately 65% presenting with perforated appendicitis.[5] Therefore, a thorough analysis is needed to identify the factors contributing to the misdiagnosis of both uncomplicated and complicated appendicitis in pediatric patients at this hospital.

This study aims to evaluate the factors influencing the misdiagnosis of appendicitis in pediatric patients at RSUD Dr. Soetomo, with a focus on clinical aspects, patient age, and supporting laboratory tests such as leukocyte count and neutrophil-to-lymphocyte ratio (NLR). The findings of this study are expected to provide additional insights to enhance the accuracy of appendicitis diagnosis in children, reduce misdiagnosis rates, and improve the quality of pediatric surgical care.

2. METHODS

This retrospective analytical study with a cross-sectional design was conducted to assess the incidence of misdiagnosed appendicitis in pediatric patients at RSUD Dr. Soetomo, Indonesia. The study analyzed factors such as age, clinical presentation, and supporting laboratory tests. Subjects included children aged 0–18 years diagnosed with appendicitis at RSUD Dr. Soetomo between January 2023 and September 2024. The sampling method used was total sampling, and data collection was performed using secondary data from medical records.

Inclusion criteria included patients diagnosed with appendicitis who underwent appendectomy or laparotomy appendectomy. Subjects with incomplete data on age, clinical symptoms, leukocyte levels, or NLR, as well as those whose surgical findings did not confirm appendicitis, were excluded from the study.

The variables assessed in this study included patient age, clinical conditions, laboratory findings such as leukocyte levels and neutrophil-to-lymphocyte ratio (NLR), and the occurrence of misdiagnosis. Clinical parameters evaluated included complaints of nausea and vomiting, abdominal pain, diarrhea, fever, abdominal muscle rigidity, and abdominal distension. Leukocyte count and NLR were measured using Sysmex XN1000 and XN3000 analyzers. Leukocytosis was defined as a leukocyte count of ≥11,000/mm³, while an increased NLR was considered as >7.5. Misdiagnosis was defined as a preoperative diagnosis of uncomplicated appendicitis but a postoperative diagnosis of complicated appendicitis, or vice versa.

Descriptive analysis was performed to assess the distribution and demographics of the study subjects. A Chi-square test was used for bivariate analysis to evaluate the relationship between each variable and misdiagnosis. Multivariate analysis using logistic regression was conducted to further assess the influence of variables on misdiagnosis. A p-value <0.05 was considered statistically significant. Data analysis was performed using SPSS software. This study has been approved by the Ethics Committee of Dr. Soetomo Hospital with the number 1868/LOE/301.4.2/XII/2024.

3. RESULTS

A total of 84 subjects were included in the study, comprising 58 males (69%) and 26 females (31%). The mean age of the subjects was 9.38±4.3 years. Among the total subjects, 22 (26%) had a postoperative diagnosis of uncomplicated appendicitis, while 62 (74%) had complicated appendicitis. Nine subjects (11%) experienced a misdiagnosis based on surgical findings. Of these, five subjects had a preoperative diagnosis of complicated appendicitis but were postoperatively diagnosed with uncomplicated appendicitis, while four subjects had a preoperative diagnosis of uncomplicated appendicitis but were postoperatively diagnosed with complicated appendicitis. Regarding symptoms, most subjects experienced abdominal pain (95.2%) and vomiting (52.3%) (Table 1).

Table 2 presents the analysis of the relationship between various clinical and laboratory factors and the incidence of appendicitis misdiagnosis. The Chi-square test results showed no significant association between misdiagnosis and abdominal pain, vomiting, diarrhea, fever, abdominal distension, abdominal muscle rigidity, age, leukocyte count, or NLR (p-value >0.05). A comparative analysis using the Mann-Whitney U test between NLR levels in uncomplicated and complicated appendicitis showed a p-value of 0.046, indicating a statistically significant difference.

Table 1. Subjects' characteristics based on clinical features

Clinical features	**Total (n)**		**Percentage (%)**	
Abdominal pain	80		95.2%	
Vomiting	44		52.3%	
Diarrhea	25		29.7%	
Fever	17		20.2%	
Abdominal stiffness	14		16.6%	
Abdominal distention	10		11.9%	
	Acute appendicitis		**Complicated appendicitis**	
	Total (n)	Percentage (%)	Total (n)	Percentage (%)
Abdominal pain	22	100 %	58	93.5 %
Vomiting	7	31.8 %	37	59.7 %
Diarrhea	5	22.7 %	20	32.3 %
Fever	4	18.2 %	13	21 %
Abdominal stiffness	2	9.1 %	12	19.4 %

Abdominal distention	1	4.5 %	9	14.5 %
Age (mean±SD)	9.5±3.9		9.3±4.4	
Leukocyte levels (mean±SD)	12,996±4,003		16,006±6,306	
NLR levels (mean)	13.9		28.1	

Table 2. The association between factors and misdiagnosis of appendicitis

		Diagnosis		P-value
Clinical features		**Correct**	**Misdiagnosis**	
Abdominal pain	No	4	0	0.451
	Yes	70	10	
Vomiting	No	34	6	0.404
	Yes	40	4	
Diarrhea	No	50	9	0.145
	Yes	24	1	
Fever	No	59	8	0.984
	Yes	15	2	
Abdominal distention	No	64	10	0.216
	Yes	10	0	
Abdominal stiffness	No	63	7	0.228
	Yes	11	3	
Age	<5 year-old	16	1	0.391
	>5 year-old	58	9	
Leukocyte levels	Normal	20	3	0.843
	Leukocytosis	54	7	
NLR levels	Normal	35	5	0.614
	Elevated	40	4	

4. DISCUSSION

The study findings indicate that 69% of pediatric patients diagnosed with appendicitis were male. This aligns with previous research, which also reported a higher prevalence of appendicitis in male pediatric patients. A study on pediatric appendicitis patients found that 57.1% were male. One possible explanation for this is differences in immune response or connective tissue composition between sexes.[6] Regarding age, the mean age of patients in this study was 9.4 years. This result is consistent with previous research on 402 pediatric patients, which reported an average age of 9.6 ± 3.1 years.[7] In pediatric patients, inflammatory processes in the appendix progress more rapidly than in other age groups. Additionally, variations in appendiceal development, which are age-dependent, may contribute to differences in disease progression. The thinner appendiceal wall and inadequate omental barrier function in children can lead to rapid infection spread.[3]

In this study, 11% of patients experienced misdiagnosis. Previous research reported a similar misdiagnosis rate of 15%, with acute gastritis being the most common initial diagnosis. Several studies have suggested that gastroenteritis is the most frequent misdiagnosis in pediatric patients with appendicitis.[8] In this study, Initially, 48 patients (57.1%) were categorized as having uncomplicated appendicitis, while 36 patients (42.8%) were classified as having complicated appendicitis. However, postoperative findings led to a diagnostic revision in 10 cases (12%) of uncomplicated appendicitis and 74 cases (88%) of complicated appendicitis, with nine cases confirmed as misdiagnosed at the time of surgery.

Analysis of clinical symptoms showed a p-value > 0.05, indicating no statistically significant association between misdiagnosis and clinical symptoms such as abdominal pain, vomiting, diarrhea, fever, abdominal distension, or muscle rigidity. Possible explanations for this finding include shorter symptom duration, nonspecific early physical examination findings, and intermittent abdominal pain. Additionally, delayed presentation to the hospital and late-night hospital admissions may contribute to clinical signs of appendicitis being overlooked in pediatric patients.[8]

Based on age variable, our study found no significant association between patient age and appendicitis misdiagnosis. This may be due to the challenges pediatric patients face in accurately describing their symptoms and localizing abdominal pain. These factors increase the risk of misdiagnosis and diagnostic delays.[3] A study by Nance et al. in 2000 reported that perforated appendicitis was highly prevalent in children, occurring in 69% of patients under five years old and 100% of those under one year old. The misdiagnosis rate in previous studies ranged from 28% to 57% in children aged 2–12 years and

approached 100% in children under two years old.[4] Another study by Lounis et al. highlighted the difficulty of diagnosing appendicitis in children, emphasizing the high rate of misdiagnosis due to nonspecific clinical signs.[9]

The contribution of leukocyte count in diagnosing acute appendicitis in children remains controversial. Some studies have reported elevated leukocyte levels in pediatric patients with acute appendicitis compared to those with negative appendectomy findings. However, other studies found no significant difference in leukocyte counts between these two groups. Research by Monsalve et al. demonstrated that leukocyte counts were significantly higher in children with acute appendicitis compared to those with negative appendectomy, and even higher in cases of complicated appendicitis compared to uncomplicated cases.[10] Similarly, a study by El Haissoufi et al. found a significant increase in leukocyte count among pediatric patients with acute appendicitis, emphasizing its role in distinguishing between perforated and non-perforated appendicitis.[7] Nevertheless, our study did not identify a significant association between leukocyte count and misdiagnosis of appendicitis. Variability in research findings regarding leukocyte count as a diagnostic factor may be due to initially low leukocyte levels at the time of hospital admission, reflecting prolonged symptom duration.[11] Acute appendicitis follows a progression beginning with luminal obstruction, leading to altered blood flow, mucosal damage, bacterial invasion, and leukocyte infiltration. Leukocyte count may be low at the initial stage of admission before the leukocytic infiltration phase. Approximately 20% of pediatric patients with acute appendicitis may present with normal leukocyte counts.[12]

Other examinations, such as the NLR is a marker of subclinical inflammation that can help predict complications. Recent studies suggest that NLR is a reliable predictor of inflammation, as it effectively indicates activation and severity of acute inflammatory conditions, including inflammatory bowel disease.[13] However, our study found no significant association between NLR and appendicitis misdiagnosis. This finding differs from previous studies, such as the study by Yazici et al., which reported that an NLR threshold of 3.5 could be used to predict appendicitis in pediatric patients.[14] Another study evaluating the utility of NLR in differentiating between complicated and non-complicated acute appendicitis identified an NLR cutoff value of 5 ($p=0.003$), with a sensitivity of 72.7% and specificity of 67.8%. For diagnosing complicated appendicitis, a cutoff value of 7.2 ($p=0.017$) was determined, with a sensitivity of 83.6% and specificity of 69.6%.[15] Differences in our findings may be attributed to confounding factors influencing NLR measurement, including systemic inflammatory conditions unrelated to appendicitis, underlying disorders, and patient characteristics such as anemia, dietary habits, age, and sex.[16]

5. CONCLUSION

In conclusion, our study indicates that the majority of pediatric appendicitis cases involved complicated appendicitis, with the most common clinical symptoms being abdominal pain followed by vomiting. No significant associations were found between age, leukocyte count, or NLR and the misdiagnosis of appendicitis.

REFERENCES

[1] Sullins V, Lee S. Appendicitis. In: Holcomb G, Murphy J, St Peter S, editors. Ashcraft's Pediatric Surgery. 6th ed. Philadelphia, PA: Elsevier; 2019. p. 568.

[2] Haxhirexha K, Dogjani A, Zylbeari L, Haxhirexha FD. Misdiagnosed Appendicitis in Children. Albanian J Trauma Emerg Surg. 2018;2(2):99–104.

[3] Aneiros B, Cano I, García A, Yuste P, Ferrero E, Gómez A. Pediatric apendisitis: age does make a difference. Rev Paul Pediatr. 2019;37(3):318–24.

[4] Nance ML, Adamson WT, Hedrick HL. Appendicitis in the young child: a continuing diagnostic challenge. Pediatr Emerg Care. 2000;16(3):160–2.

[5] Rachman BM, Hasriastawa IGBA, Setiawan A. Diagnostic accuracy of hyponatremia as a biomarker of perforated appendicitis in pediatrics in Dr. Soetomo General Hospital, Surabaya. Bali Med J. 2023;12(2):2106–9.

[6] Salö M, Ohlsson B, Arnbjörnsson E, Stenström P. Appendicitis in children from a gender perspective. Pediatr Surg Int. 2015;31(9):845–53.

[7] El Haissoufi K, Hadi EH, Habib S, Aissaoui H, Atassi M, Ammor A, et al. Appendicitis in Children: Does Age Really Matter? Afr J Paediatr Surg. 2024;0(0):0.

[8] Chang YJ, Chao HC, Kong MS, Hsia SH, Yan DC. Misdiagnosed acute appendicitis in children in the emergency department. Chang Gung Med J. 2010;33(5):551–7.

[9] Lounis Y, Hugo J, Demarche M, Seghaye MC. Influence of age on clinical presentation, diagnosis delay and outcome in pre-school children with acute appendicitis. BMC Pediatr. 2020;20(1):151.

[10] Monsalve S, Ellwanger A, Montedonico S. White blood cell count and C-reactive protein together remain useful for diagnosis and staging of acute appendicitis in children. Afr Med J. 2017;107(9):773–6.

[11] Groselj-Grenc M, Repse S, Vidmar D, Derganc M. Clinical and laboratory methods in diagnosis of acute appendicitis in children. Croat Med J. 2007;48(3):353–61.

[12] Kim E, Subhas G, Mittal VK, Golladay ES. C-reactive protein estimation does not improve accuracy in the diagnosis of acute appendicitis in pediatric patients. Int J Surg. 2009;7(1):74–7.

[13] Tasleem S, Gulnaz N, Afzal A, Courtney D. Nuetrophil-To-Lymphocyte Ratio (NLR) as a Predictor of Acute Appendicitis. Ann Pak Inst Med Sci. 2018;14(1):79–83.

[14] Yazici M, Ozkisacik S, Oztan MO, Gürsoy H. Neutrophil/lymphocyte ratio in the diagnosis of childhood appendicitis. Turk J Pediatr. 2010;52(4):400–3.

[15] Bekdas M, Ozturk H, Goksugur SB, Demircioglu F, Tahaoglu M. Neutrophil to lymphocyte ratio in diagnosis of complicated and non-complicated appendicitis. Sri Lanka J Child Health. 2017;46(1).

[16] Süzen A. The Role of Platelet Indices, Red Cell Distribution Width and the Ratios of Neutrophil to Lymphocyte, Platelet to Lymphocyte and Lymphocyte to C-reactive Protein as Markers for the Diagnosis of Acute Appendicitis in Children. Bezmialem Sci. 2022;10(2):135–8.