ORIGINAL ARTICLE

The relationship between neutrophil to lymphocyte ratio and the success of hydrostatic reduction in patients with intussusception

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ABSTRACT

Introduction: Intussusception is a common emergency condition in children. Intussusception leads to inflammation, which is marked by an increase in acute inflammatory markers, including the Neutrophil-Lymphocyte Ratio (NLR). Reduction of sedation (SR) using air or fluid enema is considered safe and effective. We present examining the relationship between NLR and the success of hydrostatic reduction in patients with intussusception for 3 years.

Materials and Methods: A retrospective study was conducted from July 2021 to July 2024 in Yogyakarta, Indonesia, involving 41 children with intussusception who underwent hydrostatic reduction under sedation. Demographic, clinical, and laboratory data were collected from medical records, and NLR values were calculated from neutrophil and lymphocyte counts. Receiver operating characteristic (ROC), bivariate, and multivariate analyses were performed to evaluate the association between NLR and successful reduction.

Results: The average age of children who successfully underwent reduction was 25.5 months, compared to 9 months in those who failed. The proportion of children with bleeding stool in the successful reduction group was 28.6%, while it was 73.3% in the unsuccessful, with a p-value <0.05 (0.005). Bivariate analysis indicated that NLR is a significant predictor of successful reduction under sedation procedure with a p-value <0.05 (0.031). Children with NLR <1.73 had a success rate of 84.6%, with a p-value of <0.05 (0.036).

Conclusion: The success rate of hydrostatic reduction is higher in children with a low NLR. This study provides new insights into how NLR can predict the success of SR in children with intussusception.

KEYWORDS:
Intussusception, pediatric surgery, neutrophile lymphocyte ratio, hydrostatic reduction with sedative

INTRODUCTION

Intussusception is a medical emergency in which one part of the intestine slides into and partially folds within another, leading to a bowel obstruction.[1] This condition is often referred to as "telescoping" because the way the segments fit together resembles the structure of a telescope.[2] Typically, intussusception affects the small intestine. This condition is a serious medical condition and a type of bowel obstruction. While it can occur at any age, it is most frequently seen in children aged 3 months to 3 years.[1,3,4]

Obstruction that occurs in the case of intussusception will increase intraluminal pressure and cause an inflammatory reaction, which subsequently increases the risk of perforation of the intestinal wall and leads to peritonitis or sepsis.[1,3,4] In recent decades, the role of neutrophils in chronic inflammation has been widely studied. Neutrophil are the first line defense mechanism in human body, which will go to the sites of ongoing inflammation, where they actively propel the inflammatory response. The neutrophil will secrete serine proteases and neutrophil extracellular traps (NETs), alongside with cytokines.[5]

The treatment of colonic intussusception is usually managed by first reducing the telescoped section. If the reduction procedure failed to resolve the intussusception or if there has been a perforation or sepsis, then performing a surgical resection is necessary.[1,3,6] Some studies had been shown that the inflammation that happened in intussusception has a significant effect on the need of surgery.[2,4,6,7] The use of the Neutrophil-Lymphocyte ratio (NLR) as an inflammatory marker has been explored in various clinical settings, including those with gastrointestinal (GI) obstruction.[8]

The NLR is simply the number of neutrophils divided by the number of lymphocytes. Under physiologic stress, the number of neutrophils increases, while the number of lymphocytes decreases.[9–15] However, the relationship between NLR and the success of hydrostatic reduction in pediatric intussusception remains unclear. Therefore, this study aimed to evaluate the relationship between NLR and the success of hydrostatic reduction in patients with intussusception.

MATERIALS AND METHODS

Study Design and Patients

A retrospective study was conducted from July 2021 to July 2024 in Yogyakarta, Indonesia. The study evaluated children diagnosed with intussusception who underwent hydrostatic reduction under sedation. A total of 41 pediatric patients

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were included in this study. Patients with incomplete medical record were excluded from the analysis. The outcome of hydrostatic reduction was classified as successful or failed reduction and was subsequently analyzed in relation to NLR levels.

Data Collection

Demographic and clinical characteristics, including age, sex, vomiting, bloody stool, abdominal distension, pseudoportio, location of intussusception, duration of symptoms, and NLR values, were collected from medical records. Laboratory findings obtained before the reduction procedure were used to calculate NLR values by dividing the absolute neutrophil count by the absolute lymphocyte count. The success of hydrostatic reduction under sedation was recorded and compared according to patients' NLR levels.

Statistical Analysis

The data collected were analyzed using Statistical Package for the Social Sciences (SPSS) software. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the relationship between NLR and the success of hydrostatic reduction in patients with intussusception. The optimal cutoff value of NLR was determined using the Youden index. Bivariate and multivariate analyses were also performed to identify factors associated with successful reduction. A p-value of <0.05 was considered statistically significant.

RESULTS

We had a total of 41 patients in the sample. The group with successful reduction was older than the group with unsuccessful reduction (25.5 months vs. 9 months), with a significant difference. The proportion of bloody stools in the successful reduction group (28.6%) was lower compared to the unsuccessful group (73.3%), with a significant difference. Patients with a lower NLR value have better outcomes compared to those with a higher NLR value ($p<0.05$).

On the other hand, no significant differences ($p>0.05$) were observed based on sex, vomiting, abdominal distension, pseudoportio, duration of symptoms (Table I).

The ROC analysis (Figure 1) results showed that NLR is a significant predictor of reduction success ($p=0.031$). The AUC value of 0.723 indicates moderate discriminatory ability of NLR in predicting the success of reduction. Optimal cutoff point using the Youden index method was found to be an NLR of 1.195, with a sensitivity of 50.0% and specificity of 90.0%.

Based on Table II, patients with a low NLR had a higher success rate in reduction (93.8%) than high NLR (60.0%), with a significant difference ($p=0.028$). The RR value of 1.56 means that patients with a low NLR are 1.56 times more likely to experience a successful reduction.

Variables that are significant in the bivariate test are continued in multivariate analysis using the backward method, which is excluding one by one the variables that are not significant (Table III). In the final step, the significant variables were found to be NLR ($p=0.045$, adj. RR=1.57) and bloody stool ($p=0.016$, adj. RR=1.09).

DISCUSSION

The patient characteristics (Table I) indicate that age tends to be a factor in experiencing intussusception, particularly at 9 months, along with the presence of bloody stools and pain located on the right side ($p<0.05$). However, characteristics such as sex, vomiting, abdominal distension, pseudoparalysis, pain duration, and NLR did not show significant results ($p>0.05$).

Intussusception is defined as the invagination of one part of the bowel into another.[1] It is also recognized as the second most common cause of acute abdominal pain in preschool children, after constipation.[3] Intussusception has the classical clinical presentation of colicky abdominal pain and vomiting with signs of red currant jelly stools and abdominal lump in a child less than 2 years. In addition, doughnut and pseudo-kidney sign on abdominal ultrasound are diagnostic features of intussusception.[16–19] These findings are important as they may help in the early identification of disease severity and progression.

The ROC curve analysis shows that NLR can be a significant predictor for measuring reduction success in patients with intussusception, with an AUC value of 0.723 (>0.5). The optimal cutoff point of NLR at 1.195 has a sensitivity of 50% and specificity of 90.9%. Based on these results, patients with a low NLR had a reduction success rate 1.56 times higher compared to those with a high NLR, with a p-value <0.05 (Table II). These findings are consistent with previous predictions, where a high NLR is expected to indicate a higher level of inflammation in the body, which in turn can affect the success of the reduction.

In Table III, both NLR and the presence of bloody stool were significant predictors for the need of surgery. Patients with a low NLR had a reduction success rate 1.57 times higher compared to those with a high NLR, while patients without bloody stool had a reduction success rate 1.09 times higher compared to those with bloody stool. Taken together, these findings suggest that both the level of inflammation in the body and patient's clinical manifestations may play an important role in determining the need for surgical intervention.

NLR is a well-recognized marker of the inflammatory response, where an increase in NLR is known to be a sign that active inflammation is occurring.[5] During intussusception, this inflammatory process increases the risk of intestinal wall perforation and causing peritonitis or sepsis.[1,3,4] The inflammation that occurs will also create edema in the intestinal wall and make the intussusception folds more difficult to reduce with hydrostatic reduction.10 As a result, a higher NLR may indicate a more severe inflammatory response, which could make non-surgical reduction less likely to succeed.

The findings in this study are in line with previous research. In a study by Delgado-Miguel et al. (2023) of 511 pediatric patients who had ileocolic intussusception, reported that high NLR values indicate a high level of intestinal inflammation and may anticipate the need for surgical treatment of ileocolic intussusception in children.[7] Similarly, Chen et al. (2021), in a study of 115 patients with intussusception found that NLR value, CRP level, neutrophil

Table I: Baseline Characteristics of the Patients

Characteristics		Success (n = 30)	Failed (n = 11)	Total (n = 41)	p-value
Age (months)	Median (min–max)	25.5 (0-60)	9 (6-72)	24 (0-72)	0.002*
Sex Male	16 (53.3%)	7 (63.6%)	23 (56.1%)	0.726	
	Female	14 (46.7%)	4 (36.4%)	18 (43.9%)	
Vomit	Yes	17 (56.7%)	10 (90.9%)	27 (65.9%)	0.064
	No	13 (43.3%)	1 (9.1%)	14 (34.1%)	
Bloody stool	Yes	10 (33.3%)	9 (81.8%)	19 (46.3%)	0.006*
	No	20 (66.7%)	2 (18.2%)	22 (53.7%)	
Abdominal distension	Yes	6 (20.7%)	6 (54.5%)	12 (30.0%)	0.056
	No	23 (79.3%)	5 (45.5%)	28 (70.0%)	
Location	Right	30 (100.0%)	8 (72.7%)	38 (92.7%)	0.015*
	Left	0 (0.0%)	3 (27.3%)	3 (7.3%)	
Pseudoportio	Yes	0 (0.0%)	2 (18.2%)	2 (4.9%)	0,067
	No	30 (100.0%)	9 (81.8%)	39 (95.1%)	
Duration (hours)	Median (min – max)	48 (24-168)	48 (24-168)	48 (24-168)	0,988
NLR	Mean ± SD	1.48 ± 0.90	2.16 ± 0.89	1.67 ± 0.94	0,039*

*Statistically significant at p=0.05

Table II: NLR Predicted Success for Reduction of Intussusception

	Success (n = 30)	Failed (n = 11)	p-value	RR	95% CI
NLR <1.195	15 (93.8%)	1 (6.3%)	0.028*	1.56	1.11-2.20
NLR >1.195	15 (60.0%)	10 (40.0%)			

*Statistically significant at p=0.05

Table III: Multivariate analysis

Variable	Step 1 p-value	Step 2 p-value	Step 3	
			p-value	Adj. RR (CI 95%)
NLR	0.089	0.051	0.045*	1.57 (1.08-2.27)
Age	0.250	0.171		
Bloody stool	0.144	0.079	0.016*	1.09 (1.02-1.16)
Location	0.999			

*Statistically significant at p=0.05

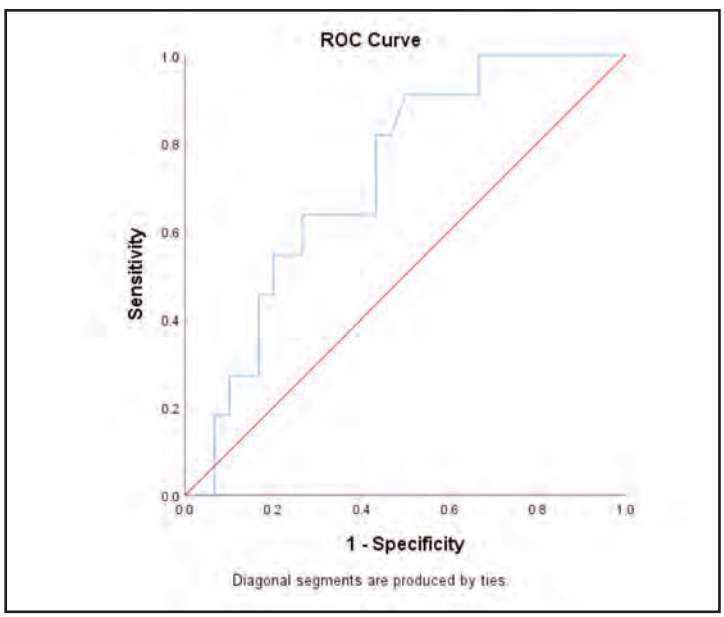

Fig. 1: ROC curve of NLR predicting successful hydrostatic reduction

count, and lymphocyte-CRP ratio have significant correlation with the need for surgical treatment of ileocolic intussusception.[2] In addition, a study conducted by Zhu et al. (2023) in 136,347 patients who underwent surgery at Sichuan University West China Hospital also stated that the prognostic model scores were significantly higher in the High-NLR group. The High-NLR group had a higher proportion of emergency cases (27.0% vs. 1.7%; p<0.001), higher intraoperative transfusion rates (11.7% vs. 2.4%; p<0.001), and chronic comorbidities such as chronic heart failure, cardiomyopathy, hemiplegia, paraplegia, and paralytic syndrome. This is in-line with research indicating that NLR values can be a prognostic factor in determining a patient's condition.[19]

Consistent with these findings, Putranto and Pramesta (2023) reported that NLR can be a reliable indicator for predicting surgical outcomes in 150 patients with GI obstruction at Cipto Mangunkusumo Hospital, Jakarta. They found that patients with a higher NLR have a greater risk of morbidity and mortality postoperatively. A higher NLR may indicate more intense systemic inflammation, which may potentially affect the success of recovery after major medical procedures.[14]

Although this study had a small sample size, our findings were consistent with previous studies that used larger samples. Therefore, further studies with larger sample sizes are needed to confirm these findings and minimize potential bias. Finally, the novelty of this study lies in the use of an Indonesian population to provide locally relevant evidence and broaden the existing literature on pediatrics intussusception.

CONCLUSION

The success rate of hydrostatic reduction is higher in children with a low NLR. This study provides new insights into how NLR can predict the success of SR in children with intussusception.

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REFERENCES

1. Agnoni AA. Intussusception. In: Pediatric Surgery. Cham: Springer International Publishing; 2014. p. 217-9.
2. Cleveland Clinic. What Is Intussusception? [Internet]. 2026 [cited 2024 Sep 10]. Available from: https://my.clevelandclinic.org/health/diseases/10793-intussusception
3. Essig R, Jones BA, Slidell MB. Intussusception. In: Textbook of Pediatric Gastroenterology, Hepatology and Nutrition. Cham: Springer International Publishing; 2022; 663-8.
4. Marsicovetere P, Ivatury S, White B, Holubar S. Intestinal Intussusception: Etiology, Diagnosis, and Treatment. Clin Colon Rectal Surg. 2016; 30(01): 030-9.
5. Delgado-Miguel C, García A, Delgado B, Muñoz-Serrano AJ, Miguel-Ferrero M, Camps J, et al. Neutrophil-to-Lymphocyte Ratio as a Predictor of the Need for Surgical Treatment in Children's Intussusception. European Journal of Pediatric Surgery 2023; 33(05): 422-7.
6. Lioubashevsky N, Hiller N, Rozovsky K, Segev L, Simanovsky N. Ileocolic versus Small-Bowel Intussusception in Children: Can US Enable Reliable Differentiation? Radiology. 2013; 269(1): 266-71.
7. Zhu Y, Bi Y, Liu B, Zhu T. Assessment of prognostic value of preoperative neutrophil-to-lymphocyte ratio for postoperative mortality and morbidity. Front Med (Lausanne) 2023; 10.
8. Putranto AS, Premesta BD. Neutrophil-Lymphocyte-Ratio as Predictor of Morbidity and Mortality in Adults with Gastrointestinal Obstruction. The New Ropanasury Journal of Surgery. 2023 Dec 28;8(3). doi:10.7454/nrjs.v8i3.1195
9. EMCrit Project. PulmCrit: Neutrophil-Lymphocyte Ratio (NLR): Free upgrade to your WBC [Internet]. 2019 [cited 2024 Sep 10]. Available from: https://emcrit.org/pulmcrit/nlr/
10. Herrero-Cervera A, Soehnlein O, Kenne E. Neutrophils in chronic inflammatory diseases. Cell Mol Immunol 2022; 19(2): 177-91.
11. Kourilovitch M, Galarza–Maldonado C. Could a simple biomarker as neutrophil-to-lymphocyte ratio reflect complex processes orchestrated by neutrophils? J Transl Autoimmun. 2023; 6: 100159.
12. Leonard SP, Martin K. Surgical management of small bowel-small bowel intussusception in Henoch-Schönlein Purpura. J Pediatr Surg Case Rep 2021; 64: 101703.
13. Chen B, Cao J, Yan C, Zheng C, Chen J, Guo C. A promising new predictive factor for detecting bowel resection in childhood intussusception: the lymphocyte-C-reactive protein ratio. BMC Pediatr 2021; 21(1): 577.
14. Liu X, Xia B, Yu H kui, Hu L zhen, Fan S min, Xiao D, et al. Atropine Premedication Facilitates Ultrasound-Guided Reduction by Saline Enema in Children With Intussusception. Front Pharmacol 2019; 10.
15. Amini B, Mahsoub M, Ashraf A. Intussusception. In: Radiopaedia.org. Radiopaedia.org; 2008. doi:10.53347/rID-1526
16. Singh S. Retrograde intussusception and Giant Meckel's diverticulum: a rare occurrence in Waugh's syndrome. J Pediatr Neonatal Care 2018; 8(5).
17. Syukur RB, Utariani A, Achmad MR, Andriyanto L, Octaliansah E, Purnomo W, et al. Comparison of Changes in the Neutrophil-lymphocyte Ratio (NLR) and Post-surgery Outcomes in Child Patients with COVID-19 and Non-COVID-19. The Open Anesthesia Journal 2024; 18(1).
18. Tiwari C, Shah H, Sandlas G, Bothra J. Paediatric Intussusception: A Clinical Scoring System to Predict the Risk of Operative Intervention. J Mother Child 2020; 24(1): 19-23.
19. Vujovic D, Lukac M, Sretenovic A, Krstajic T, Ljubic V, Sindjic-Antunovic S. Indications for repeated enema reduction of intussusception in children. Srp Arh Celok Lek 2014; 142(5–6): 320-4.