Risk factors for failure of hydrostatic reduction in children with intussusception in Hasan Sadikin General Hospital

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ABSTRACT

Introduction: Intussusception is a medical emergency caused by proximal insertion of the intestinal segment to its lumen, which results in ischemia, necrosis, and sepsis-associated mortality in pediatric patients. Intussusception is managed mainly by surgical reduction; hydrostatic reduction is a noninvasive alternative with lower risk of complications. The study was aimed to analyze the risk factors for the failure of hydrostatic reduction in children with intussusception at the Hasan Sadikin General Hospital. Materials and Methods: The medical records of children diagnosed with intussusception and treated with hydrostatic reduction during January 2010 and September 2019 were included. Variables of the study included age, sex, onset of symptoms, and outcome. Logistic regression analyses were performed to determine the significance and strength of correlation on the included characteristics with outcomes of hydrostatic reduction in the population. The $p < 0.05$ was deemed significant.

Results: There were a total of 56 children with intussusception who were treated with hydrostatic therapy during the study period. The failure rate of hydrostatic therapy was 83.9%. Age, sex, onset of symptoms, and location of intussusception were not significantly associated with the failure of hydrostatic reduction ($p > 0.05$). Dehydration was the only symptom significantly associated with the failure of hydrostatic reduction (OR 16.80; $p = 0.001$).

Conclusion: Dehydration is significantly associated with the failure of hydrostatic reduction in children with intussusception.

KEYWORDS:
intussusception, dehydration, risk factor, pediatric

INTRODUCTION

Intussusception is a potentially life-threatening medical emergency caused by the insertion of the proximal portion of the intestine into the distal lumen of the intestine, which causes obstruction, followed by ischemia and subsequent intestinal necrosis in pediatric patients. Morbidity and mortality may occur due to sepsis related to intestinal necrosis; this condition is associated with higher morbidity and mortality in cases of delayed diagnosis and/or treatment.[1–6] Fatalities associated with delayed diagnosis and/or treatment in children with intussusception has been reported to reach up to 20% in Indonesia.[7]

Intussusception requires immediate surgical reduction to treat; less-invasive alternative that may be utilized in treating intussusception in children is through hydrostatic reduction.[8,9] Management using hydrostatic reduction was associated with lower complication rates when compared to conventional surgical reduction.[9,10] The cure rates for hydrostatic reduction in previous studies were noted to be similar to that of conventional surgical reduction.[10] This study was aimed to analyze the variables correlated with the failure rate of hydrostatic reduction of pediatric patients with intussusception treatment in Hasan Sadikin General Hospital (HSGH).

MATERIAL AND METHODS

An analytical study with retrospective data was performed in the HSGH. Data was collected from medical records and consisted of pediatric intussusception cases treated with hydrostatic reduction during January 2010 and September 2019. The inclusion criteria for the study were as follows: patients aged <18 years, diagnosed with intussusception, and treated with hydrostatic reduction at the HSGH. The patients were excluded from the study if they had incomplete medical record or had refused treatment. Consecutive sampling was performed in this study.

Dependent and independent variables in this study were collected from the medical records for children with intussusception who were treated at the HSGH between January 2010 and September 2019. The dependent variable of this study was the outcome of hydrostatic reduction. Independent variables of this study included age, sex, onset of symptoms (until management with hydrostatic reduction), location of intussusception, symptoms, and outcomes. The patients were grouped into 3 age groups: 0–12 months; 13 months–3 years; and >3 years. Onset to management was defined as time (in hours) from the first reported symptoms to receiving treatment for intussusception. Locations of intussusception were defined into ileoileal, ileocolic, ileocolocolic, ileocecal, and colocolic. The symptoms were defined as the chief complaint found during the initial presentation in the emergency department. The assessment of the outcome was defined postoperatively; unsatisfactory

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Table I: Baseline characteristics

Variables	N = 56, count (%)
Body weight (kg), mean (± SD)	8.20 ± 2.60
Age	
0–12 months	50(89.3%)
13 months–3 years	3(5.4%)
>3 years	3(5.4%)
Sex	
Male	35(62.5%)
Female	21(37.5%)
Onset of symptoms	
<24 hours	31(55.4%)
> 24 hours	25(44.6%)
Location	
Ileoileal	2(3.6%)
Ileocolic	40(71.4%)
Ileocolocolic	5(8.9%)
Colocolic	6(10.7%)
Ileocecal	3(5.4%)
Bloody stool	
Yes	53(94.6%)
No	3(5.4%)
Vomiting	
Yes	51(91.1%)
No	5(8.9%)
Bloated stomach	
Yes	44(78.6%)
No	12(21.4%)
Dehydration	
Yes	45(80.4%)
No	11(19.6%)
Obstipation	
Yes	1(1.8%)
No	55(98.2%)
Diarrhea	
Yes	34(60.7%)
No	22(39.3%)
Hydrostatic reduction outcome	
Successful	9(16.1%)
Failed	47(83.9%)

hydrostatic reduction (assessed by Doppler ultrasonography) was continued with the conventional intestinal reduction.

Descriptive statistics were employed to describe the frequency and percentage of categorical variables. Mean with standard deviation and median with range (min–max) were used to describe numerical variables. Chi-square test (with the alternative of Fisher's exact test) was applied to compare the differences between both the outcomes of hydrostatic reduction. The strength of correlation of a variable with the outcome of hydrostatic reduction was analyzed by logistic regression, with the values described in odds ratio (OR). The $p < 0.05$ were deemed to be significant.

RESULTS

During the study period, there were a total of 180 children who were treated for intussusception. Of these, 56 children had received hydrostatic reduction for the treatment of intussusception. Mean body weight of the patients was 8.2 kg. The majority of the patients were aged 0–12 months. Most patients were males. Most the patients received treatment in <24 h since the first onset of symptoms; 25 patients had received delayed treatment (>24 h after the first onset of symptoms). Ileocolic intussusception was the most prevalent location of intussusception. Bloody stool was the most commonly detected symptoms in patients with intussusception, followed by vomiting, dehydration, bloated stomach, diarrhea, and obstipation. Hydrostatic reduction success rate was low; only 9 out of 56 cases (16.1%) were successfully treated with hydrostatic reduction and 47 out 56 cases failed (83.9%). The remaining cases require conventional surgery after failure of hydrostatic reduction.

The success rate of hydrostatic reduction in treating intussusception was low in 0–12-month-old patients and in patients >3 years. No significant difference in terms of the outcomes between male and female patients ($p = 0.231$) were noted. The onset of symptoms ($p = 0.475$) was not significantly correlated with the hydrostatic reduction outcomes. Dehydration is the only symptom that was significantly correlated with worse outcome of hydrostatic reduction in this study (OR 16.80, $p = 0.001$). Other symptoms included in this study were not significantly correlated with the outcome of hydrostatic reduction in treating intussusception.

Table II: Patients' characteristics correlated with successful outcome

Variables	N	%	OR	*p*
Age			N/A	
0–12 months	8	16		
13–3 years	0	0		
>3 years	1	33.3		
Sex			2.4	0.231
Male	4	11.4		
Females	5	23.8		
Onset of symptoms			1.70	0.475
<24 hours	4	12.9		
>24 hours	3	20.0		
Location			N/A	
Ileoileal	2	100		
Ileocolic	3	7.5		
Ileocolocolic	1	20		
Colocolic	2	33.3		
Ileocecal	1	33.3		
Blood stool			2.81	0.420
Yes	8	15.1		
No	1	33.3		
Vomiting			4.19	0.152
Yes	7	13.7		
No	2	40		
Bloated stomach			2.11	0.349
Yes	6	13.6		
No	3	25.0		
Dehydration			16.80	0.001***
Yes	0	0		
No	9	54.5		
Obstipation			N/A	
Yes	0	0		
No	9	16.4		
Diarrhea			3.88	0.079
Yes	3	8.8		
No	6	27.3		

OR=odds ratio

DISCUSSION

In this study, hydrostatic reduction showed higher success rate in children aged <3 years. Previous study had hypothesized the correlation between the diameter of small intestines and the outcomes of hydrostatic reduction. In this case, younger children had smaller lumen diameter of small intestines. The smaller diameter may have caused difficulties in reducing the portion of the intestine that were strangulated on the distal part.[11]

Successful reduction in higher rates in female patients relative to that in male patients were noted in this study, although the difference was not significant. Physiological differences between both the sexes may have contributed to the difference in the outcomes of hydrostatic reduction for the management of intussusception. In females, food digestion rate was slower, and the colon was longer relative to those in males. Weaker peristaltic forces associated with the physiological difference mentioned above may have contributed to the higher success rate of hydrostatic reduction in female patients than in male patients.[12]

The onset of symptoms was not significantly correlated with the success of hydrostatic reduction; this study had found that delayed presentation and treatment of intussusception (as defined as >24 hours had elapsed from the first onset of the symptoms to receiving treatment) was more common when compared to early treatment of intussusception (<24 hours). Khorana et al. noted the onset of symptoms to treatment was not correlated with the outcomes of hydrostatic therapy (with presentation ranging from 1 hour to the maximum of 120 hours). Hydrostatic reduction was indicated as an alternative to conventional surgery in treating intussusception; it may be performed even in individuals with delayed presentation of intussusception and still garner similar outcomes.[10,13]

In this study, intussusception of the ileocolic region was the most prevalent location of intussusception. The ileocolic region had numerous free-hanging structures of the abdominal region. Anatomical variations of the cecum and ileus may have contributed to the development of ileocolic intussusception, such as decreased cecum rigidity due to the absence of a secondary cecum and taenia coli; papillary structure of the ileocecal valve; and longitudinal muscle fibers of the colon around the valve. Decreased rigidity by anatomical variation may have caused intussusception due to the prolapse of the ileocolic segment.[14,15]

Several symptoms are associated with higher risk of failure in hydrostatic reduction. In this study, patients with dehydration showed significantly higher risk of failure in treatment using hydrostatic reduction; other symptoms, such as bloody stool and other gastrointestinal symptoms were not associated with the failure of hydrostatic reduction; however, patients with bloody stools were present in relatively higher

rate when compared to those with other symptoms listed. Dehydration may be related to the hardening of the feces; reduction of intestinal content requires higher pressure to treat through hydrostatic reduction; as such, it was associated with higher risk of failure of hydrostatic reduction in patients with dehydration.[11,16] In a previous study by Ekenze et al., patients with bloody stool were at higher risk for gastrointestinal complication and intestinal resection, while patients with bloody stool often presented with a higher prevalence of intestinal angulation, strangulation, and/or compression. Bloody stool was associated with a reduction of the venous blood flow of the intestine.[17] The study showed different findings related to the risk factors associated with the failure of hydrostatic reduction by He et al.; in the referenced study, bloody stool was significantly associated with the failure of hydrostatic reduction (OR 9.27; $p < 0.05$).[18] Conversely, in this study, bloody stool, despite the higher prevalence-failed treatment group, was not significantly associated with the failure of hydrostatic reduction. Katz et al. had noted that dehydration (mild, moderate, and severe) was significantly associated with the failure of hydrostatic reduction;[19] this study had found the similar results that patients with dehydration is significantly associated with failure of hydrostatic reduction in children with intussusception.

There were several limitations for this study. The disease is relatively rare and performed only at a single institution (with the consideration that the said institution is a tertiary referral hospital); as such, the sample may not be wholly representative of the characteristics of the patients in West Java, Indonesia. In this study, there were several patients who had experienced delays in treatment for >24 hours; there were some cases in which the patients had only sought treatment after experiencing the symptoms up to a week's period. In cases of extreme delays, there was a probable confounding factor in the evolution of symptoms (which may explain the current study to have several differences with previous studies performed outside Indonesia). Despite these limitations, this is one of the first studies to discuss the risk factors associated with the failure of hydrostatic reduction in treating children with intussusception, particularly in West Java, Indonesia.

CONCLUSION

Dehydration in pediatric intussusception cases is significantly associated with the failure of hydrostatic reduction in children with intussusception. Age, sex, and other gastrointestinal symptoms were not significantly associated with the failure of hydrostatic reduction.

ACKNOWLEDGMENTS

The authors would like to express their gratitude to the Hasan Sadikin General Hospital Pediatric Surgery division for aiding with the data collection for the patients included in this study.

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