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Early diagnosis and treatment for intussusception in children is mandatory

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ABSTRACT

INTRODUCTION: In some cases, surgical treatment is necessary to manage intussusception despite advances in enema reduction. The purpose of this study was to analyse treatment in two tertiary referral university centres for paediatric surgery to identify time-related factors influencing treatment of intussusception.

METHODS: This was a retrospective two-centre chart review, performed for all patients under the age of 16 years who underwent treatment for intussusception during the period from 2005 to 2015. Demographic data and data on different time intervals from symptom debut to end of treatment and compliacations were retrieved from the medical record.

RESULTS: A total of 158 children were included. Non-surgical reduction was used as the primary treatment modality in 48% and intussusception was successfully reduced in 32% of these cases. The non-surgical success rate was found to be significantly higher when the diagnosis was confirmed within four hours of hospitalisation (p = 0.003). A lower rate of bowel resection was observed when the diagnosis was confirmed within four hours of hospitalisation (p = 0.026) and treatment was initiated within six hours of hospitalisation (p = 0.033).

CONCLUSIONS: This study found a relatively low utilisation rate for enema reduction and an overall low enema success rate. The success rate of enema was significantly higher and the intestinal resection rate lower when the diagnosis was confirmed within four hours of hospitalisation, which underpins the importance of a quick and timely diagnosis.

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Intussusception is the most frequent cause of intestinal obstruction in early childhood with 80% of cases occurring before the age of two years [1]. A pathologic lead point can be identified in approximately one quarter of the cases, whereas the majority are idiopathic [2]. Viral infection with associated hypertrophy of the Peyer's patches and hypermotility have been suggested as pathogenesis [3]. Among the pathological lead points are Meckel's diverticulum, lymphoma, polyps, duplication cysts and bowel wall tumours [4]. Symptoms of intussusception are often insidious with abdominal pain, bloody stool and a palpable abdominal mass forming the classic triad. However, this triad occurs in only half of patients [5].

Abdominal ultrasonography is the gold standard investigatory method, demonstrating a sensitivity and specificity of almost 100% [6, 7]. Alternatively, a combination of enema and plain abdominal X-ray can be used.

The advantage of a diagnostic enema is the possibility of immediate reduction of the intussusception. The disadvantages of this method are a low sensitivity for small bowel intussusception and exposure to ionizing radiation [7]. Plain abdominal X-ray alone has a low sensitivity of 45-90% [6, 7].

Hydrostatic or pneumatic reduction is the gold standard treatment. Its success rate depends on symptom duration and radiological experience, and varies from 40% to 90% [8-10]. In cases of failure in enema reduction or if a successful result is not expected due to clinical conditions or long-lasting symptoms, primary surgery may be indicated despite a higher risk of complications and intestinal resection [11]. The aim of the present study was to explore the use of primary hydrostatic reduction versus surgery in a clinical setting and evaluate the success rate of hydrostatic reduction and the rate of intestinal resection in relation to different time intervals according to disease course.

METHODS

A retrospective study was conducted according to the STROBE statement for observational studies [12]. Medical records of children aged 0-15 years undergoing treatment for intussusception were reviewed. Records were collected from January 2005 to December 2015. To obtain an estimate of the number of children with intussusception in all of Denmark, a search was conducted in the Danish National Patient Register (DNPR) for the same period, including all children aged 0-15 years with an intussusception as identified by ICD-10 codes (DK561, DK561A, DK561B, DK561C, DK561D) combined with procedure codes for surgery (KJFL00, KJFB20, KJAH01, KJFB00, KJFB30, KJFB33) and radiology intervention (UXRD31, UXRD00, UXRD25).

Non-operative treatment

For hydrostatic reduction, a wastersoluble contrast enema was used and administered slowly into the rectum by a catheter to a maximal pressure of 120 mmHg. An enema reduction was considered succesfull when a sudden drop in pressure was oberved together with contast filling of the terminal ileum. Enemas were carried out by the attending radiologist. In our departments, it was not possible to have access to a specialised paediatric radiologist at all times.

Indication for non-operative or operative treatment

The indication for operative or non-operative treatment was based on a clinical evaluation of the child´s general health condition made by the attending surgeon. Children with an acceptable clinical condition (no sepsis or peritoneal redundance) were referred for non-operative treatment. Children whose condition was considered problematic for non-operative treatment or with failure of previous non-operative treatment were referred for operative treatment. The decision to make a bowel resection or not was made at the discretion of the surgeon.

Data recorded

The following demographic data were retrieved from the medical records: gender, age, diagnostic and therapeutic radiology interventions, surgical reduction or resection, pathological reports and post-operative complications according to the Clavien-Dindo classification [13]. The following time points were registered during the disease course: onset of symptoms, hospital admittance, time of diagnosis, time of treatment initiation and discharge. The intervals separating the time registrations were subsequently calculated.

Statistical analysis

Demographic data are presented as absolute numbers with percentages, unless otherwise indicated. Missing time registrations were left blank in the datasheets and not included in the calculations. The unadjusted relationship between the time intervals and primary treatment modality was assessed using an independent χ^2-

test. For the statistical analysis, the duration of the different time intervals was divided into two groups for each time interval: above and below the median value. $p \leq 0.05$ was considered significant. All data were statistical analysed.

Ethics and approvals

The present study was approved by the Danish Data Protection Agency (REG-16/7304) and the Danish Patient Safety Authority (REG-3-3013-1593/1).

Trial registration: not relevant.

RESULTS

A total of 363 children were identified in the DNPR of whom 190 (52%) were treated outside our institutions and therefore not included in the present study. Among the 173 children identified at our institutions by chart review, ten were excluded due to incorrect diagnoses and five were excluded because no further treatment was needed after transfer to the university centre. Among the 158 included patients, the majority were male (72.2%) and the overall median age was zero years ranging from zero to 12 years.

Enema and referral

Among the 158 children treated at our institutions, 76 were initially diagnosed with intussusception at the referring hospital, 61 of whom were transferred directly to a university centre for treatment. A failed radiological reduction was the reason why the remaining 15 children went directly to surgery (**Figure 1**). Among the 82 children with primary referral to the university centre, an enema was used as the initial treatment in 43.9% of the cases. The success rate of enemas was 27.8%. In patients diagnosed at a referral centre, approximately half (32 out of 61) underwent an attempted enema reduction with a success rate of 37.8%. The difference between the two groups was not significant. The intestinal resection rate was significantly lower in the group of patients referred from another hospital than in the group referred directly to the university hospital. The values were 30.6% and 56.9%, respectively (**Table 1**).

FIGURE 1 Patients flow diagram.

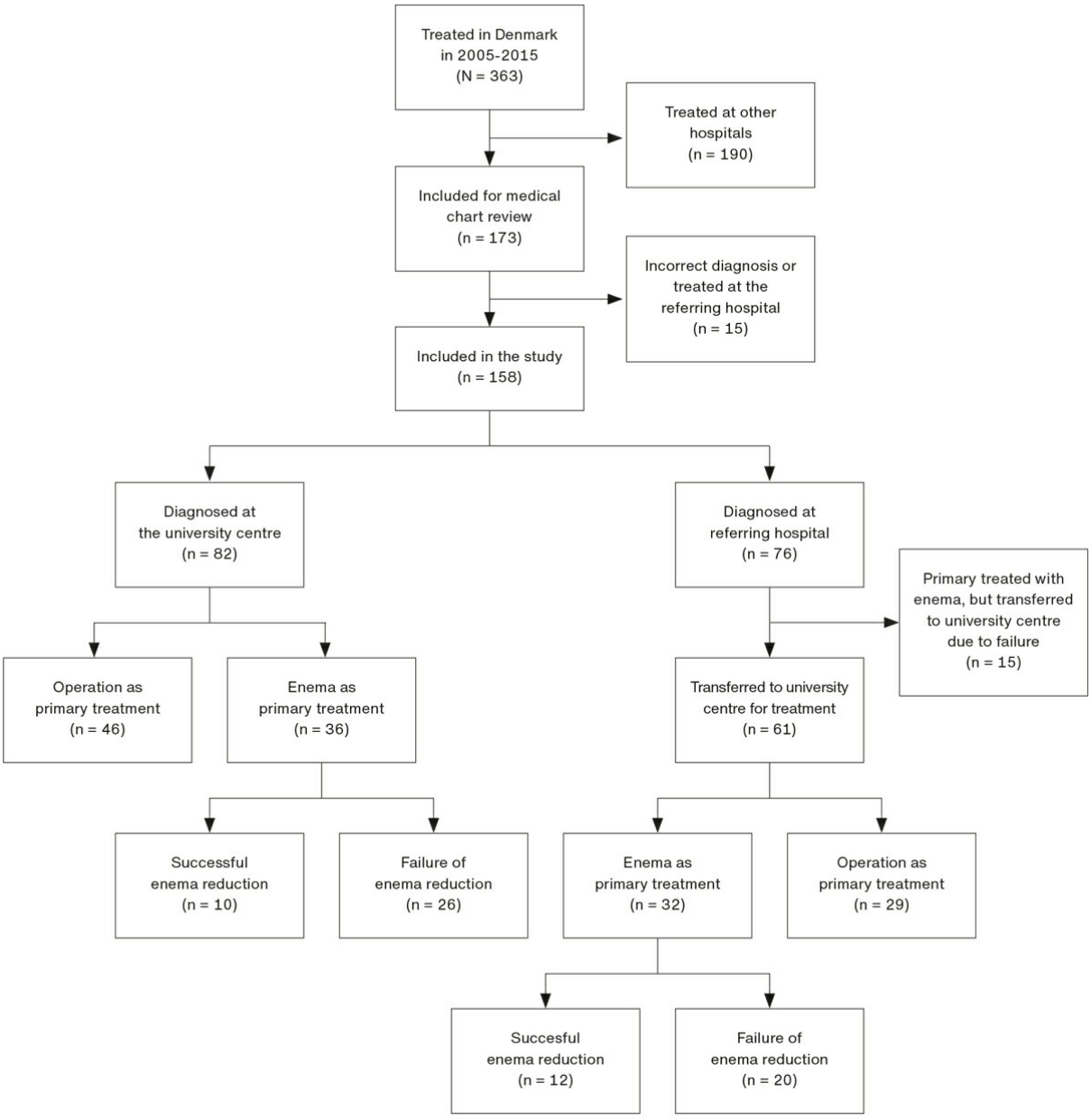

TABLE 1 Summary of treatment results at the university centres in the group of patients with a primary referral and referred form another hospital.

	Primary referral to university centre (N = 82)	Referred from another hospital (N = 61)	p-value
Initially treatment, n (% in the group)			
Operation	46 (56.1)	29 (47.5)	0.311
Enema	36 (43.9)	32 (52.5)	
Successful reduction by enema, n (% in the group)			
Yes	10 (27.8)	12 (37.5)	0.392
No	26 (72.2)	20 (62.5)	
Intestinal resection at surgery, n (% in the group)			
Yes	41 (56.9)	15 (30.6)	0.004
No	31 (43.1)	34 (69.4)	

Surgery

Overall, 136 (86.1%) of the 158 included children underwent surgery. In 129 cases, an open procedure was performed, whereas a laparoscopic approach was used in seven cases of which three were converted to open surgery. Intestinal resection was performed in 63 of the surgically treated patients (46.8%).

Post-operative complications

Post-operative complications during the first 30 post-operative days were registered in 12 patients (8.9%). Four (2.9%) were reoperated (Clavien-Dindo grade ≥ 3b); two because of ileus due to peritoneal adhesions and two because of a wound infection. No mortalities occurred.

Time intervals

The relationship between each of the calculated time intervals and the following end points was analysed: primary treatment modality, definitive treatment modality and the result of any primary enema treatment. A significantly higher use of enema as the primary treatment modality was observed when the intussusception diagnosis was confirmed within four hours of hospitalisation ($p = 0.003$) (**Table 2**).

The rate of intestinal resection was significantly lower when the intussusception diagnosis was confirmed within four hours of hospitalisation ($p = 0.026$) and when treatment was initiated within six hours of hospitalisation ($p = 0.02$) (Table 2). The median times for each time interval are summarised in **Table 3**.

TABLE 2 Time intervals relationship to primary treatment modality and risk of resection during surgery.

	Primary treatment				Resection during surgery		
Time interval	Time, h	operation, n (%)	enema, n (%)	p-value	resection, n (%)	no resection, n (%)	p-value
Debut of symptoms to hospitalisation	≤ 18	23 (48.9)	22 (51.1)	0.138	19 (48.7)	20 (51.3)	0.739
	> 18	18 (36.0)	32 (64.0)		22 (51.2)	21 (48.8)	
Debut of symptoms to diagnosis	≤ 30	20 (39.2)	31 (60.8)	0.113	24 (54.6)	20 (45.4)	0.691
	> 30	28 (54.9)	23 (45.1)		27 (58.7)	19 (41.3)	
Debut of symptoms to start of treatment	≤ 37	27 (54.5)	26 (45.5)	0.708	25 (53.2)	22 (46.8)	0.614
	> 37	30 (54.6)	25 (55.4)		28 (58.3)	20 (41.7)	
Hospitalisation to diagnosis	≤ 4	11 (28.2)	28 (71.8)	0.003	14 (41.2)	20 (58.8)	0.026
	> 4	24 (61.5)	15 (28.5)		25 (67.6)	12 (32.4)	
Hospitalisation to start of treatment	≤ 6	19 (45.2)	23 (54.8)	0.087	15 (39.5)	23 (60.5)	0.033
	> 6	28 (55.7)	16 (44.3)		26 (63.4)	15 (36.6)	
Diagnosis to start of treatment	≤ 1	29 (52.7)	26 (47.3)	0.567	28 (56.0)	22 (44.0)	0.626
	> 1	26 (47.3)	29 (52.7)		24 (51.1)	23 (48.9)	

TABLE 3 Time intervals and missing observations for 158 children.

Time interval	Time, h, median (range)	Missing observations n (%)
Debut of symptoms to hospitalisation	20.4 (0-792)	60 (38)
Debut of symptoms to diagnosis	30.3 (2.5-300)	56 (35)
Debut of symptoms to start of treatment	37.7 (0.5-300)	50 (32)
Hospitalisation to diagnosis	4.2 (0.1-166)	80 (51)
Hospitalisation to start of treatment	6.3 (0.5-178)	72 (46)
Diagnosis to start of treatment	1.0 (0-31)	48 (30)

DISCUSSION

Our results showed a low rate of success for reduction by enema and a high incidence of intestinal resection during surgical treatment compared with previous literature. A duration of symptoms exceeding 24 hours was associated with a lower likelihood of successful enema reduction, whereas in another study a duration exceeding 12 hours was found to be a significant predictor of an unsuccessful enema [14, 15]. In the present study, we found that a median duration of 37.3 hours from symptoms to start of treatment was associated with a successful enema, although this association was not significant. Subgroup analyses of the different time intervals in this study demonstrated a significantly lower rate of bowel resection when the time from hospitalisation to start of the treatment time was less than six hours. We also observed a significantly lower rate of bowel resections in the group of children diagnosed at a referring hospital. This is in contrast to the result of McAteer et al who found that bowel resection was more likely at a hospital without paediatric surgeons (59.3%) than at a hospital with paedatric surgeons (33%) [16].

The hospital setting may also be important. Blanch et al found that children who initially presented with their symptoms at a specialised hospital had a 90% rate of successful enema reduction, whereas only 74% of those who initially presented at a non-specialised hospital underwent reduction surgery [10]. In our study, the success rate was only 32%.

The total post-operative complication rate was 8.6%, and four children (2.9%) needed re-intervention under general anaesthesia, two due to wound infection and another two due to ileus. The laparoscopic approach was

uncommen and had a high conversion rate. Generally, the mortality rate among children treated for intussusception is very low [17-19], and mortality was zero in our study.

This study has several limitations, including its retrospective design and a relatively large amount of missing data in time interval registrations due to a lack of time registrations in patients charts, especially in the beginning of the study period. Furthermore, for the patients who were transferred from a referring hospital, we had no access to the patient charts from the referring hospital.

The study only includes 44% of the children treated for intussusception in Denmark during the inclusion period; the remaining children were treated outside the two tertiary referral centres in Denmark for paediatric surgery, preventing access to the treatment results.

Conclusions

This study found a relatively low utilisation rate for enema reduction and an overall low enema success rate. The success rate of enema was significantly higher and the intestinal resection rate lower when the diagnosis was confirmed within four hours of hospitalisation, which underpins the importance of a quick and timely diagnosis. The post-operative complication rate was low and no deaths occurred.

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REFERENCES

1. Shekherdimian S, Lee SL. Management of pediatric intussusception in general hospitals: diagnosis, treatment, and differences based on age. World J Pediatr 2011;7:70-3.
2. Ntoulia A, Tharakan SJ, Reid JR et al. Failed Intussusception Reduction in Children: Correlation Between Radiologic, Surgical, and Pathologic Findings. AJR Am J Roentgenol 2016;207:424-33.
3. Arbizu RA, Aljomah G, Kozielski R et al.Intussusception associated with adenovirus. J Pediatr Gastroenterol Nutr 2014;59:e41.
4. Fiegel H, Gfroerer S, Rolle U. Systematic review shows that pathological lead points are important and frequent in intussusception and are not limited to infants. Acta Paediatr 2016;105:1275-9.
5. Tareen F, Ryan S, Avanzini S et al. Does the length of the history influence the outcome of pneumatic reduction of intussusception in children? Pediatr Surg Int 2011;27:587-9.
6. Mendez D, Caviness AC, Ma L et al. The diagnostic accuracy of an abdominal radiograph with signs and symptoms of intussusception. Am J Emerg Med 2012;30:426-31.
7. Edwards EA, Pigg N, Courtier J et al. Intussusception: past, present and future. Pediatr Radiol 2017;47:1101-8.
8. Curtis JL, Gutierrez IM, Kirk SR et al. Failure of enema reduction for ileocolic intussusception at a referring hospital does not preclude repeat attempts at a children's hospital. J Pediatr Surg 2010;45:1178-81.
9. McDermott VG, Taylor T, Mackenzie S, et al. Pneumatic reduction of intussusception: clinical experience and factors affecting

outcome. Clin Radiol 1994;49:30-4.

10. Blanch AJ, Perel SB, Acworth JP. Paediatric intussusception: epidemiology and outcome. Emerg Med Australas 2007;19:45-50.
11. Jiang J, Jiang B, Parashar U et al. Childhood intussusception: a literature review. PLoS One 2013;8:e68482.
12. von Elm E, Altman DG, Egger M et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet 2007;370:1453-7.
13. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205-13.
14. Katz M, Phelan E, Carlin JB, Beasley SW. Gas enema for the reduction of intussusception: relationship between clinical signs and symptoms and outcome. AJR Am J Roentgenol 1993;160:363-6.
15. Beasley SW, Glover J. Intussusception: prediction of outcome of gas enema. J Pediatr Surg 1992;27:474-5.
16. McAteer JP, Kwon S, LaRiviere CA et al. Pediatric specialist care is associated with a lower risk of bowel resection in children with intussusception: a population-based analysis. J Am Coll Surg 2013;217:226-32 e1-3.
17. Samad L, Marven S, El Bashir H et al. Prospective surveillance study of the management of intussusception in UK and Irish infants. Br J Surg 2012;99:411-5.
18. Fallon SC, Lopez ME, Zhang W et al. Risk factors for surgery in pediatric intussusception in the era of pneumatic reduction. J Pediatr Surg 2013;48:1032-6.
19. Kaiser AD, Applegate KE, Ladd AP. Current success in the treatment of intussusception in children. Surgery 2007;142:469-75; discussion 75-7.