Intussusception: factors related to treatment

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Abstract

To provide guidelines for the choice of treatment of intussusception, 10 factors that are known to be related to the outcome of treatment were studied in a series of 146 children with intussusception. The length of history, vomiting, rectal bleeding, small bowel obstruction, ileoileocolic intussusception, and the presence of a leading point were all significantly related to failure of hydrostatic reduction. Only 'rectal bleeding' and 'duration of symptoms of more than 48 hours' contributed significantly to the prediction of failure of hydrostatic reduction by logistic regression analysis. We believe that as well as the generally accepted contraindications—signs of peritonitis or bowel perforation—the presence of rectal bleeding when symptoms have lasted more than 48 hours is a contraindication to hydrostatic reduction.

Hydrostatic reduction during barium enema examination has become an accepted way of managing intussusception in children, and a success rate of over 80% can be achieved.[1-3] Controversy still exists, however, about the contraindications to non-operative treatment. Several clinicians have reported that they carry out the examination for every child presenting with intussusception, provided that the correct principles of the procedure are rigorously observed,[4] but some increase the pressure to as much as 14·72 kPa (150 cm H_2O), use bimanual manipulation, and make as many as 10 attempts at hydrostatic reduction.[1,3] The risk of perforating the bowel during barium enema reduction is less than 1%,[5,6] and bowel resection because of irreducibility or non-viability is necessary in about 12%.[7-11]

Signs of peritonitis or bowel perforation are absolute contraindications to hydrostatic reduction, but there is no consensus about the duration of symptoms (over 24 or 48 hours) and evidence of small bowel obstruction. Several other factors have been correlated with the outcome of treatment, including age, the presence of vomiting or rectal bleeding, the absence of abdominal pain, a high white cell count, the type of intussusception, localisation of the apex, and the presence of a leading point.[1,2,4-8,10-21] The diversity of opinion made us feel that it would be worthwhile to review our series of intussusceptions. We submitted it to statistical analysis with special interest in those intussusceptions that could be reduced hydrostatically and those that required bowel resection because of irreducibility or non-viability at laparotomy. The aim of our study was to provide practical guidelines for the choice of treatment.

Patients and methods

The fully documented records of 146 children under the age of 15 years who had been admitted to the department of paediatrics or paediatric surgery of the University Hospital St Radboud and of the St Canisius-Wilhelmina Hospital of Nijmegen from 1968 to 1988 and in whom the clinical diagnosis of intussusception was supported either by radiological or by laparotomy evidence, were reviewed. Ten factors were recorded (table 1). Hydrostatic reduction was carried out by the method described by Ravitch.[4] Absolute contraindications for an attempt at hydrostatic reduction were signs of peritonitis or bowel perforation. Other indications for primary surgical treatment were poor general condition of the child, duration of symptoms of more than 48 hours, and complete small bowel obstruction. As these criteria were not rigidly followed, it was possible to examine the outcome of the treatment against these criteria. Children with abdominal distension, hyperresonance, abnormal bowel sounds, air-fluid levels, and grossly distended bowel loops on the plain abdominal radiograph, were diagnosed as having complete small bowel obstruction. An intussusception was called ileoileo(caeco)colic if evidence for an ileoileal component was found radiologically or at laparotomy.

Patients in group A were treated by hydrostatic reduction. Patients in group B were treated by laparotomy after hydrostatic reduction had failed;

Table 1 Distribution of factors in four treatment groups

Factor related to treatment	No (%) in group A: hydrostatic reduction only (n=65)	No (%) in group B: laparotomy after failed hydrostatic reduction (n=36)	No (%) in group C: primary laparotomy (n=21)	No (%) in group D: bowel resection (n=8)
Age >36 months	19 (29)	9 (25)	4 (19)	2 (25)
Duration of symptoms >48 hours	13 (20)	19 (53)	6 (29)	4 (50)
Vomiting	45 (69)	29 (81)	21 (100)	8 (100)
No abdominal pain	10 (15)	2 (6)	2 (10)	5 (62)
Rectal bleeding	11 (17)	17 (47)	14 (67)	6 (75)
Complete small bowel obstruction	7 (11)	9 (25)	10 (48)	7 (88)
White cell count >20×10⁹/l	2 (3)	3 (8)	1 (5)	2 (25)
Ileocaecocolic intussusception	2 (3)	9 (25)	5 (24)	4 (50)
Apex at or beyond splenic flexure	7 (11)	6 (17)	4 (19)	4 (50)
Presence of leading point	4 (6)	7 (19)	6 (29)	5 (62)

patients in group C were treated by primary laparotomy; and patients in group D were treated by bowel resection.

The four groups were compared in three different ways. Firstly the group treated by hydrostatic reduction was compared with the group of children treated surgically (group A compared with groups B, C, and D). To exclude subjective influences that may have led to primary surgical treatment (group C), children treated by hydrostatic reduction were also compared with children treated surgically after hydrostatic reduction had been tried unsuccessfully, or by bowel resection (group A compared with groups B and D). Finally, the group treated by bowel resection was compared with the children treated by hydrostatic reduction or by manual reduction only at laparotomy (group D compared with groups A, B, and C).

The significance of differences between different sets of groups were assessed by the χ^2 test or Fisher's exact test, as appropriate, and a probability of <0·05 was accepted as significant. To analyse whether the outcome of treatment was influenced by a combination of the above mentioned factors, we also carried out stepwise logistic regression analysis. For the parametric end points failure of hydrostatic reduction attempt and bowel resection, the following mathematical model was applied:

$$\text{Ln } [p/(1-p)] = \mu + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_n X_n$$

where Ln is the natural logarithm, p is the estimated probability of failure of hydrostatic reduction or of bowel resection, μ is the intercept, $\beta_1 \ldots \beta_n$ are the regression coefficients, and $X_1 \ldots X_n$ are the independent variables.

Results

Sixteen patients had enteric intussusceptions, and a precipitating factor was present in 12 cases. One jejunal and six ileal resections, two resections of Meckel's diverticula, and two enterotomies were done. These enteric intussusceptions form a distinct group that should be managed surgically, and are not analysed here.

The remaining 130 children (90 boys and 40 girls) had colonic components to their intussusceptions. Their ages ranged from 1 day to 14·3 years. Twenty five children were aged 6 months or younger, and 45 were over 3 years of age. The distribution of patients according to the treatment they received, and possible factors influencing treatment in the four separate groups are shown in table 1.

Results of the statistical analyses are given in table 2. These results did not change if different

cutoff points were chosen for age and duration of symptoms.

STEPWISE LOGISTIC REGRESSION ANALYSIS

Group A compared with groups B, C, and D: only the factors 'rectal bleeding' and 'duration of symptoms longer than 48 hours' were significant in predicting failure of hydrostatic reduction. The estimated logistic regression equation was:

$$\text{Ln } [p/(1-p)] = -1·3 + 2·4X + 1·4Y$$

with X=rectal bleeding (present=1, absent=0), and Y=duration of symptoms longer than 48 hours (present=1, absent=0). In our complete series this equation resulted in the estimated numbers shown in table 3. The sensitivity was 79%, the specificity 64%, and the accuracy 72%. Patients with both rectal bleeding and symptoms lasting more than 48 hours had an estimated probability of failure of hydrostatic reduction of over 92%. If, in the presence of rectal bleeding, an attempt at hydrostatic reduction was made within two days, there was an estimated probability of more than 25% success. A probability of almost 50% of successful hydrostatic reduction was calculated if the attempt was made after more than 48 hours in the absence of rectal bleeding. According to the results, 14% of all children successfully treated by hydrostatic reduction would have had a probability of failure of over 74%. Of all children treated surgically, 21% would have had a probability of hydrostatic reduction of over 78%.

Group A compared with groups B and D: the results of the stepwise logistic regression analysis were essentially the same as for group A compared with groups B, C, and D.

Group D compared with groups A, B, and C: Only the factors 'complete small bowel obstruc-

Table 3 Results of logistic regression analysis with failure of hydrostatic reduction as end point

	Group A	Groups B, C, and D
Estimated No of patients in whom:		
Hydrostatic reduction failed	12	38
Hydrostatic reduction was successful	46	21

Table 4 Results of logistic regression analysis with bowel resection as end point

	Group D	Groups A, B, and C
Predicted No of patients having:		
Bowel resection	5	3
No bowel resection	3	106

Table 2 Results of χ^2 and Fisher's exact tests, as appropriate

Factor related to treatment	Group A (n=65) compared with groups B, C, and D (n=65)	Group A (n=65) compared with groups B and D (n=44)	Group D (n=8) compared with groups A, B, and C (n=122)
Age >36 months	0·42	0·63	1·0
Duration of symptoms 48 hours*	0·003	<0·001	0·5
Vomiting	0·005	0·08	0·3
No abdominal pain	0·80	0·94	0·003
Rectal bleeding	<0·001	<0·001	0·06
Pronounced small bowel obstruction	<0·001	<0·001	<0·001
White cell count >20×10⁹/l†	<0·14	0·19	0·03
Ileocaecocolic intussusception	<0·001	<0·001	0·02
Apex at or beyond splenic flexure	0·09	0·09	0·03
Presence of leading point	0·002	0·004	0·002

*1 value not known; †12 values not known.

tion' and 'no abdominal pain' showed significant predictive value of needing bowel resection. The estimated logistic regression equation was:

$$Ln \ [p/(1-p)] = -2 \cdot 8 + 3 \cdot 1X + 2 \cdot 2Y$$

with X='complete small bowel obstruction' (present=1, absent=0), and Y='no abdominal pain' (no pain=1, pain=0). In the complete series this equation resulted in the estimated numbers shown in table 4. The sensitivity was 63%, the specificity 97%, and the accuracy 95%. Patients with pronounced small bowel obstruction without abdominal pain had an estimated probability of bowel resection of over 56%. Children without abdominal pain and without small bowel obstruction had estimated probability of bowel resection of 6%. In the presence of abdominal pain and small bowel obstruction, the estimated probability of bowel resection was 12%. In children with pain but no obstruction, the estimated probability of bowel resection was less than 1%. The 3% of all children successfully treated by hydrostatic reduction or manual reduction at laparotomy that were wrongly classified had a probability of bowel resection of 56%. In three of all eight cases of bowel resection there was a probability of bowel resection of 12% or less.

Discussion

Hydrostatic reduction during barium enema examination has gained acceptance as the initial procedure in most cases of intussusception, but the reported success rates vary enormously.[9] Low rates may be explained by a low incidence of intussusception and lack of experience, and the use of premedication and more vigorous technique may lead to a higher success rate. Signs of peritonitis or bowel perforation are generally accepted indications for primary surgical treatment.

In the past lower success rates have been reported for children under the age of 1 year,[2 10 15] for children over the age of 3 years,[2 12 16 17] for duration of symptoms of more than 48 hours,[8 13] and for duration of symptoms of more than 12 hours.[10] In cases with vomiting,[1] those with no abdominal pain,[10 19] those with bloody stools,[1 13] and those with small bowel obstruction,[5-7 12 13 16 20] lower success rates for hydrostatic reduction have also been found. In addition ileoileocolic intussusceptions,[1 20] those with an apex beyond the transverse colon,[16] and the presence of a leading point,[1 4 21] have been associated with lower success rates.

Higher bowel resection rates have been reported in children under the age of 1 year,[14 15] those whose symptoms have lasted for more than 48 hours,[11 12 18] those with white cell counts of more than $20 \times 10^9/l$ with a shift to the left,[18] and those with ileoileocolic intussusceptions.[1 20]

Most of these factors seem to be associated with the simultaneous interference of the intussusception with the vascular supply of the intussusceptum, and with the patency of the alimentary canal. As far as age is concerned, Eklöf et al assumed that the ileocaecal valve in children under 1 year of age was more competent. In children over the age of 3 years a higher incidence of leading points was encountered.[2] Published reports give no clear explanation for the lower hydrostatic reduction rates either in the presence of leading points or in the absence of abdominal pain.

The aim of our study was to provide guidelines for the choice of treatment in children with intussusception, indicating in which cases no attempt at hydrostatic reduction should be made, and those circumstances in which it should be attempted cautiously. To reach such recommendations one has to decide which probability of mortality and morbidity as well as which delay and associated need for bowel resection are acceptable. According to Leonidas survival seems to be less critical as mortality is very low.[6] He calculated that hydrostatic reduction is the best therapeutic option for morbidity if the anticipated rate of success exceeds 14%. The delay caused by an attempt at hydrostatic reduction has never been evaluated but it does not seem to be important.

In conclusion, we believe that no attempt at hydrostatic reduction should be made in the presence of rectal bleeding if the symptoms have lasted for more than 48 hours. In the presence of rectal bleeding within two days, or after more than 48 hours in the absence of rectal bleeding, an attempt at hydrostatic reduction seems justified provided that the correct procedure is carried out: the height of the reservoir should not exceed 100 cm and the abdomen should not be manipulated. In the absence of rectal bleeding and if the symptoms have lasted less than 48 hours it seems justified always to make an attempt at hydrostatic reduction.

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