

## Chapter 4

### Prognostic indicators for Failed Non-Surgical Reduction of Intussusception



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Publication of short communication in this chapter is listed below.

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The nonsurgical reduction of intussusception is widely used at present. The outcome is determined by success and failed reduction. The results of nonsurgical reduction vary around the world. Many factors influence the outcome which might be from patient's factors, technique of reduction, operators who perform reduction or the equipment used. This chapter focuses on the patient's factors including signs, symptoms and results of the investigation that could predict the outcome of the nonsurgical reduction.

Many studies have endeavored to identify the prognostic factors for failed non-surgical reduction. Contraindications for non-surgical reduction are still the same as those for peritonitis, and the abdominal radiography showed free air collection and nonresponsive shock. In 1988, Wang reported the reduction could be cautiously performed in some conditions.<sup>1</sup> These comprised a history more than 48 hours, the location of mass below the splenic flexure, the patient in poor condition and younger than three months. Later, after non-surgical reduction was accepted and performed widely, plenty of studies reported about the factors associated with the poor outcome of nonsurgical reduction. (Table 4.1)

In addition, some studies focused on the factors associated with bowel viability regarding intussusception. Those were the prediction for bowel necrosis and the need for bowel resection that might have extrapolated the failed nonsurgical reduction. In 2015, Yao conducted a study in China including 316 intussusception patients. They found that a history longer than 27.5 hours was significantly associated with the loss of intestinal viability.<sup>2</sup> In 2016, Wong found that older age and duration of symptoms were associated with the need of bowel resection.<sup>3</sup> Older age might be associated with the pathologic leading point, and longer duration might be associated with the bowel necrosis.

Our two institutional studies reported in 2016 about the prognostic indicators of failed nonsurgical reduction of intussusception were retrospectively conducted by collecting data of patients with intussusception. Sex, age, body weight, vomiting, abdominal pain, rectal bleeding, diarrhea, distension, constipation, duration of symptoms, temperature, palpable mass, location of the mass, white blood cell counts, neutrophils, electrolytes, abdominal radiography and ultrasound findings were recorded. The results of the nonsurgical reduction were compared between the success and failure groups.

**Table 4.1** The identified prognostic factors for failed nonsurgical reduction reported in related studies.

Year	Author	Prognostic factors
2007	Fragoso <sup>4</sup>	sex, age, duration of symptom and neutrophils count.
2012	Fike <sup>5</sup>	duration of symptom more than 24 hour, bloody diarrhea, lethargy and extent of location of intussusception
2013	Fallon <sup>6</sup>	abdominal symptoms more than 2 days, age less than 1 year, ultrasound findings, and failure of initial enema reduction
2014	He <sup>7</sup>	location of intussusception in the descending colon/rectum, the presence of peritoneal fluid, trapped fluid in the intussusception, and bloody stool
2016	Ntoulia <sup>8</sup>	The distal of the mass, Ultrasound showed presence of enlarged lymph nodes, contrast enema showed the dissecting sign
2016	Khorana <sup>9</sup>	weight <12 kg , symptom duration >2 days, vomiting, rectal bleeding, abdominal distension, temperature >37.8°C , palpable abdominal mass, location of mass (left over right side), poor prognostic signs on ultrasound scans, and method of reduction (hydrostatic over pneumatic)

Ten significant risk factors of failed reduction were identified in our study. These comprised weight less than 12 kilograms, duration of symptoms more than two days, vomiting, rectal bleeding, abdominal distension, temperature more than 37.8°C, palpable abdominal mass, location of mass (left over right side) and ultrasound indicating poor prognostic signs and method of reduction (hydrostatic over pneumatic). Multivariable risk ratio of prognostic

indicators for failed reduction of intussusception clustered by age of three years old due to the risk of pathologic leading points is shown in Table 4.2.

In our studies, ten identified risk factors were similar to several reports but not all. Most literature did not mention the patient's bodyweight; instead, the age of patients was mostly used. In 2013, Fallon<sup>6</sup> and in 2010, Tota-Maharaj<sup>10</sup> reported similar results. They found that age less than one year was significantly associated with failed reduction. In our study, we used the age for clustering the risk factors because the risk of pathologic leading point was higher among children with weight less than 12 kilograms was significantly associated with failed reduction. Intussusception in the bowel of a smaller child might be difficult to reduce due to the small caliber of the bowel in the small children.

The duration of symptoms was mostly stated in the literature. However, the results and duration varied. Duration of symptoms might be associated with the present intestinal viability for reduction and was associated with failed reduction. Some studies did not find any association between duration and the failed results.<sup>11, 12</sup> Another study found the association but differing in duration. In 1990, Reijnen reported that duration of symptoms of more than 48 hours was a significant predictor.<sup>13</sup> In 1994, Chung found that duration more than 24 hours was a primary factor.<sup>14</sup> In our study, we found that duration of symptoms more than 48 hours was one predictor.

Vomiting was a common symptom of intussusception. In related studies, no significant predictor was found for failed reduction but was found in our study. Vomiting is one of the two classic symptoms of intussusception in addition to abdominal pain and can be the cause of dehydration in patients with intussusception.

The two classic signs of intussusception were rectal bleeding and abdominal mass. We found the association of these two factors with failed non-surgical reduction. In 2014, He N. also found that rectal bleeding was a predictor for failed reduction.<sup>7</sup> In 2015, Wong reported that palpable abdominal mass was a significant factor.<sup>12</sup>

**Table 4.2** Multivariable risk ratio of prognostic indicators for failed reduction of intussusception clustered by age three years.

Characteristics	Crude RR	95% CI	Multivariable RR	95% CI
Weight < 12 Kilograms	3.81	2.43-5.98	1.48	1.13-1.94
Duration of symptoms > 48 hours	1.24	0.87-1.77	1.26	1.25-1.26
Vomiting	2.22	1.42-3.48	1.63	1.54-1.73
Rectal bleeding	2.53	2.27-2.83	1.50	1.20-1.89
Abdominal distension	2.02	1.49-2.74	1.60	1.18-2.17
Temperature > 37.8°C	2.10	1.82-2.42	1.51	1.47-1.55
Palpable mass	1.32	1.09-1.60	1.26	1.24-1.28
Location (Left over right side)	1.52	1.48-1.55	1.48	1.40-1.56
Ultrasound (poor prognosis sign)	1.21	1.12-1.31	1.35	1.29-1.42
Method of reduction (hydrostatic over pneumatic)	1.44	1.11-1.88	1.34	1.04-1.71

RR=Risk ratio, CI=Confidence interval

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Location of the mass was found to be a significant factor in our study. It determined the length of intussusception which was not mentioned in a related study as a predictor. The length of 2 cm of intussusception without clinical signs that spontaneously reduced constituted a transient intussusception.<sup>15</sup> In 2014, He N. found the left side location was significantly associated with decreased success rate of reduction.<sup>7</sup> In 2016, Flaum found that right side location was associated with successful of reduction.<sup>16</sup> In our study, a mass located on the left side of the abdomen was significantly associated with failed reduction.

Abdominal distension was associated with failed reduction in our study but not the sign of small bowel obstruction in the plain abdominal x-ray. The small bowel obstruction was

significantly associated with failed reduction in univariable analysis but not in multivariable analysis. Some studies showed this association. In 2008, Ramachandan found that small bowel obstruction was one of the risk factors of failed reduction.<sup>17</sup>

A temperature more than 37.8°C was one of the predictors for failed reduction in our study. Fever in a related study was the risk factor of bowel resection as reported by Fike, 2012.<sup>5</sup> Fever might be the systemic response resulting from the compromised blood supply to the intussusception.

The ultrasound poor prognosis signs were associated with failed results as reported in many studies. In 2014, He N. reported the presence of peritoneal fluid and trapped fluid in the intussusception were the predictors.<sup>7</sup>

Many studies have compared between pneumatic and hydrostatic reduction. In 2015, Sadigh conducted a meta-analysis of air versus liquid enema concerning intussusception and found that air enema was superior to liquid enema presenting lower complications.<sup>18</sup> In our previous series of intussusception, we found the success rate of pneumatic reduction was 1.48 times greater than hydrostatic reduction.<sup>19</sup> In this study, hydrostatic reduction was associated with failed reduction.

The prognostic factors of failed reduction of intussusception were found to help predict the nonsurgical reduction outcome. However, clear prediction scores have not yet been established. The next goal of the studies series will be to set up the prediction score.

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