

# Status survey on enema reduction of paediatric intussusception in China

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## Abstract

**Objective:** Intussusception is a common paediatric abdominal emergency in infants. The first-line treatment of choice in uncomplicated paediatric intussusception is enema reduction. The study aim was to provide an overview of the current national practice of enema reduction of paediatric intussusception in China.

**Methods:** A questionnaire on enema reduction of paediatric intussusception was sent to respondents (members of the Pediatric Anorectal Group, the Neonatal Group, the Society of Pediatric Surgery and the China Medical Association).

**Results:** Data from 128 questionnaires were analysed. Of these, 78.1% (100/128) reported the use of fluoroscopy, 17.2% (22/128) use of ultrasound monitoring, 78.9% (101/128) use of air and 17.9% (23/128) use of normal saline. A total of 78.9% (101/128) reported a success rate of 90%, 25.8% (33/128) reported that a paediatric surgeon managed the reduction, 18.8% (24/128) that a radiologist managed the reduction and 44.5% (57/128) that a paediatric surgeon and radiologist jointly managed the reduction.

**Conclusions:** There is large variation in the techniques of enema reduction of intussusception in China. Fluoroscopy-guided air enema reduction is mainly used. Enema reduction of uncomplicated cases of paediatric intussusception in China lacks standardization of equipment and personnel involvement.

## Keywords

Intussusception, enema reduction, ultrasound, paediatric, survey, China, fluoroscopy

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## Background

Intussusception is the most common paediatric abdominal emergency in the infant population. The mean annual incidence worldwide is estimated at 50–250 per 100,000 live births.<sup>1</sup>

As techniques and patient care improved in the latter half of the twentieth century, image-guided enema reduction gained widespread acceptance throughout the world and became the treatment of choice in uncomplicated cases of paediatric intussusception. The major advantages of this technique are that it reduces invasiveness, morbidity, costs and length of hospital stay. Both hydrostatic and air enemas can be used to reduce the intussuscepted bowel, under the guidance of either fluoroscopy or ultrasonography (US). Two recent surveys showed that fluoroscopy-guided air enema was the most common method in hospitals in the USA and UK.<sup>2,3</sup>

At present, there is no standard practice of image-guided enema reduction of intussusception in China. Some hospitals prefer US-guided hydrostatic enema reduction,<sup>4,5</sup> some prefer US-guided air enema reduction<sup>6</sup> and others prefer fluoroscopy-guided air enema reduction.<sup>7–9</sup> The aim of this study was to provide an overview of the current national practice of enema reduction of paediatric intussusception in China.

## Methods

This study was approved by the Institutional Review Board of Shengjing Hospital, China Medical University (Approval No. 2018PS477K), and verbal consent was obtained from the patients' parents. A questionnaire on the current practice of enema reduction of paediatric intussusception in China was launched in August 2017 using wenjuan.com, an online questionnaire survey platform.

The questionnaire was distributed through the social platform WeChat. We first set up a WeChat group. The link to the questionnaire was then sent to respondents; these were members of the Pediatric Anorectal Group, the Neonatal Group, the Society of Pediatric Surgery and the China Medical Association who had expertise in the treatment of intussusception and were members of the WeChat group. Data from completed questionnaires were automatically uploaded to the wenjuan.com site and converted into a Microsoft Office Excel database (version 2007). Duplicate questionnaires from the same hospital were discarded to avoid data repetition. Data analysis is based on the data analysis function of wenjuan.com and Microsoft Office Excel (version 2007).

The questionnaire was designed to assess monitoring equipment, ionizing radiation protection, enema medium, success rate, number of cases each year, personnel present, maximum pressure, enema equipment, hospitalization, sedation, delayed attempts and perforation during the reduction. The questionnaire items are summarized in Table 1.

## Results

The questionnaire was sent to 270 paediatric surgeons from 140 hospitals in China on August 19, 2017, and collected on March 1, 2018. A total of 194 questionnaires were received. Incomplete and duplicate questionnaires from the same hospital were discarded on March 10, 2018 (n = 66). Finally, 128 questionnaires from 128 hospitals, including all Provincial Children's Hospitals and Children's Medical Centers across 31 provinces and municipalities in China, were included for data analysis. (Figure 1)

**Table I.** Survey questions.

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The questionnaire sent to paediatric surgeons in China

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- Which hospital do you work in? \_\_\_\_
  - What is your name? \_\_\_\_
  - How many cases of intussusception are managed in your hospital every year?
    - 0–20 cases
    - 21–50 cases
    - 51–100 cases
    - 101–150 cases
    - 151–200 cases
    - 201–300 cases
    - More than 300 cases
  - What was the reduction success rate in your department in the last year?
  - Are intussusception patients systematically hospitalized?
    - All intussusception patients are hospitalized
    - Only patients who have had an unsuccessful reduction and seriously ill patients are hospitalized
  - Are you routinely using sedation for the reduction?
    - Sedation
    - No sedation
    - Sedation of very distressed children
    - Other \_\_\_\_\_
  - What technique is used to monitor the reduction?
    - Fluoroscopy
    - Ultrasound
    - No image monitoring, relies only on pressure
    - Relies on abdominal auscultation using stethoscope
  - Do you use ionizing radiation protection measures for parents of children during the reduction?
    - Yes
    - No
    - Enema without radiation is used for reduction so protection is not needed
  - Who manages the enema reduction?
    - Radiologist
    - Ultrasonographer
    - Paediatric surgeon
    - Radiologist and Paediatric surgeon
    - Ultrasonographer and Paediatric surgeon
  - What type of medium do you use for the reduction?
    - Air
    - NS
    - O2
    - Meglumine diatrizoate
    - Barium
    - Other \_\_\_\_\_
  - What is the maximum pressure during reduction?
    - 80 mmHg
    - 100 mmHg
    - 120 mmHg
    - Other \_\_\_\_\_
  - Which equipment is used during the reduction?
    - Automatic enema machine
    - Manual enema
    - A suspended enema bag
    - Other \_\_\_\_\_
  - If the first reduction is unsuccessful, how many reduction attempts do you make before surgery?
    - No attempt, immediate surgery.
    - Once
    - Twice
    - 3 times
    - More than 3 times
  - How many cases of perforation during reduction have occurred in the last 3 years? \_\_\_\_\_
- 

### Monitoring equipment

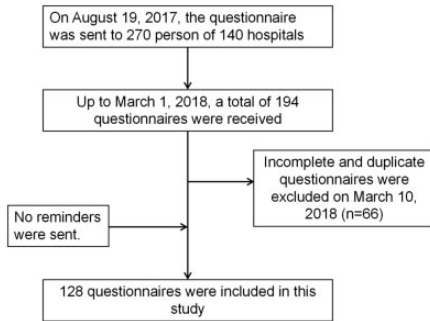
A total of 78.1% (100/128) respondents used fluoroscopy during the reduction, 17.2% (22/128) used ultrasound, 0.8% (1/128) relied only on reduction pressure and did not use image monitoring and 3.9% (5/128) relied on abdominal auscultation using a stethoscope and did not use image monitoring. Of the 100 hospitals using fluoroscopy-guided enema reduction, 68% (68/100) used ionizing radiation protection measures for parents of children during the reduction and 32% (32/100) did not use ionizing radiation protection measures.

### Enema medium

A total of 78.9% (101/128) respondents used air, 17.9% (23/128) used normal saline, 1.6% used barium (2/128) and 1.6% (2/128) used meglumine diatrizoate.

### Success rate

A reduction success rate of over 90% was reported by 78.9% (101/128) of respondents, a rate of 80%–90% by 14.1% (18/128) of respondents, a rate of 70%–80% by 2.3% (3/128) of respondents, a rate of 60%–70% by 3.9% (5/128) of respondents and a rate of under 60% by 0.8% (1/128) of respondents.



**Figure 1.** Survey analysis flowchart.

The questionnaire was sent to 270 paediatric surgeons from 140 hospitals in China on August 19, 2017, and collected on March 1, 2018. A total of 194 questionnaires were received. Incomplete and duplicate questionnaires from the same hospital were discarded on March 10, 2018 ( $n = 66$ ). Finally, 128 questionnaires from 128 hospitals, including all Provincial Children's Hospitals and Children's Medical Centers across 31 provinces and municipalities in China, were included for data analysis.

### Personnel presence

A total of 25.8% (33/128) respondents reported that a paediatric surgeon alone managed the reduction, 18.8% (24/128) reported that a radiologist alone managed the reduction, 44.5% (57/128) reported that a paediatric surgeon and radiologist jointly managed the reduction, 8.6% (11/128) reported that a paediatric surgeon and ultrasonographer jointly managed the reduction and 2.3% (3/128) reported that an ultrasonographer alone managed the reduction.

### Number of cases each year

A total of 10.2% (13/128) of respondents managed 0 to 20 cases of intussusception each year, 9.4% (12/128) managed 21 to 50 cases, 25.8% (33/128) managed 51 to 100 cases, 17.2% (22/128) managed 101 to 150 cases, 9.4% (12/128) managed 151 to 200 cases, 8.6% (11/128) managed 201 to 300 cases and 19.5% (25/128) managed over 300 cases.

### Maximum pressure

A total of 12.5% (16/128) of respondents reported a maximum pressure during the reduction of 80 mmHg, 0.8% (1/128) of respondents reported 90 mmHg, 8.4% (62/128) reported 100 mmHg, 0.8% (1/128) reported 110 mmHg and 37.5% (48/128) reported 120 mmHg.

### Enema equipment

Of respondents, 73.4% (94/128) used an automatic enema machine, 20.3% (26/128) used manual enema and 6.3% (8/128) used a suspended enema bag.

### Hospitalization

All intussusception patients were hospitalized in 59.4% (76/128) of hospitals; in 40.6% (52/128) of hospitals, only seriously ill patients and patients who had an unsuccessful reduction were hospitalized.

### Sedation

A total of 28.2% (36/128) of respondents used sedation in all patients, 44.5% (57/128) did not use sedation and 27.3% (35/128) only used sedation for very distressed children.

### Number of reduction reattempts

If the first reduction was unsuccessful, 19.5% (25/128) of respondents did not reattempt reduction before surgery, 43.8% (56/128) reattempted once, 21.1% (27/128) reattempted twice, 8.6% (11/128) reattempted three times and 7.0% (9/128) reattempted more than three times.

### Perforation

In the last 3 years, 65.6% (84/128) of respondents had no perforations during reduction, 21.9% (28/128) had one or two cases of perforation, 9.4% (12/128) had

three to five cases of perforation and 3.1% (4/128) had six to eight cases of perforation.

## Discussion

Intussusception is the most common abdominal emergency in infants and small children. The first-line treatment of uncomplicated cases of intussusception is image-guided enema reduction, with surgical management reserved for patients in unstable conditions who have evidence of peritonitis or perforation and patients with failed enema reduction.

The present study represents the first status survey of enema reduction practices of paediatric intussusception in China. The questionnaire was distributed to all Provincial Children's Hospitals and Children's Medical Centers. In this survey, 54.7% (70/128) of hospitals managed over 100 cases of intussusception each year and 19.5% (25/128) of hospitals managed over 300 cases each year. Currently, international results suggest that a success rate of over 90% is achievable.<sup>10,11</sup> In 2014, a survey distributed to 22 centres in the UK showed that the reduction rate varied from 38%–90%.<sup>3</sup> In 2015, a survey in the USA of 3834 attempted enema reductions reported an overall success rate of 83%.<sup>2</sup> In the present survey, 78.9% (101/128) of hospitals achieved this standard (success rate >90%), suggesting that image-guided enema reduction is well-developed in China.

The findings indicated a trend away from the use of barium (1.6%) and iodinated contrast agent (1.6%), and an increasing use of air (78.9%, 101/128) reduction, which is in accordance with surveys in the USA and the UK.<sup>2,3</sup> Fluoroscopy-guided air enema is accepted as an effective method<sup>10,11</sup> and is the most commonly used technique in UK centres.<sup>3</sup> Fluoroscopy-guided air enema reduction has gained widespread acceptance worldwide as it has several advantages. It is

easy to perform, quick and clean. In this survey, fluoroscopy-guided air enema reduction was the most commonly used method (77.3%, 99/128). A major disadvantage of fluoroscopy-guided air enema reduction is ionizing radiation. In this survey, 68% (68/100) of hospitals using fluoroscopy-guided enema reduction used ionizing radiation protection measures. We suggest that ionizing radiation protection measures should be routinely used in fluoroscopy-guided air enema to reduce radiation damage.

US-guided hydrostatic enema is another effective method to treat uncomplicated intussusception.<sup>5,12,13</sup> In recent years, there has been an increasing trend to use US-guided hydrostatic enema reduction.<sup>14</sup> Two recent studies demonstrated similar safety and efficacy between fluoroscopy-guided air enema reduction and US-guided hydrostatic enema reduction.<sup>15,16</sup> A study from China showed a higher success rate of US-guided hydrostatic reduction versus fluoroscopy-guided pneumatic reduction (statistical significance,  $P=0.015$ ).<sup>5</sup> Compared with fluoroscopy-guided air enema, US-guided hydrostatic enema has the advantage that it is completely free of radiation. The ALARA (dose as low as reasonably achievable) principle mandates that we strive to reduce or eliminate medical radiation when safe and feasible. Therefore, US-guided hydrostatic enema is very suitable for paediatric patients. Another advantage is visualization of all components of the intussusception (including the oedematous ileocecal valve following reduction) as well as easier recognition of the pathological leading point and residual intussusception.<sup>15</sup>

Despite the above-mentioned advantages, US-guided hydrostatic enema has failed to gain widespread support in China. In this survey, US-guided hydrostatic enema was used in 17.2% (22/128) of hospitals, and was performed by a

paediatric surgeon, an ultrasonographer or a paediatric surgeon and ultrasonographer jointly. Special training is needed to master US-guided hydrostatic enema. In Germany, US is an integral part of paediatric surgical training.<sup>17</sup> Therefore, paediatric surgeons in Germany can routinely use US to diagnose typical paediatric surgical disorders and can perform US-guided hydrostatic enema reduction on their own. However, US is not included in basic training in paediatric surgical training in China, so not all paediatric surgeons in China would be able to perform US-guided hydrostatic enema reduction alone. In this survey, paediatric surgeons were solely responsible for performing US-guided hydrostatic enema in only 36.4% (8/22) of hospitals. We suggest that basic ultrasound training should be included in paediatric surgical training in China, which would help to promote the development of US-guided hydrostatic enema in China.

Both fluoroscopy-guided air enema and US-guided hydrostatic enema are effective methods to treat uncomplicated paediatric intussusception. Considering the differences in available equipment and expertise of present clinicians, the choice of either fluoroscopy-guided air enema or US-guided hydrostatic enema depends on the person reducing the intussusception.

The present study also compared personnel presence at the enema reduction. There is no consensus for paediatric surgical involvement during reduction of intussusception. Paediatric surgeons operate on cases of failed enema reduction, but the role of paediatric surgeons in the enema reduction process is not standardized. In most countries, enema reduction of intussusception is performed by radiologists,<sup>18,19</sup> with or without the presence of a paediatric surgeon. In this survey, enema reduction was performed by radiologists with or without the presence of a paediatric surgeon in 63.3% (81/128) of hospitals, and paediatric

surgeons performed enema reduction alone in only 25.8% (33/128) of hospitals. A recent survey in the UK found a much higher success rate if the paediatric surgeon was involved in the reduction procedure.<sup>3</sup> A retrospective review in Japan of the personnel performing reduction also supported the active role of the paediatric surgeon during enema reduction.<sup>20</sup> Intussusception requires immediate surgical attention if enema reduction fails or perforates the intestine. Paediatric surgeons present at the reduction could immediately indicate whether an operation is required for reduction failure, which may decrease the delay of surgical treatment. Above all, radiologists/ultrasonographers should reduce intussusceptions in the presence of a paediatric surgeon who is solely competent to deal with the complications of intussusception.

## **Limitations**

Some limitations of the present study should be acknowledged. First, this was a retrospective study; such studies have a greater potential for bias than prospective studies. Second, although questionnaires were distributed to all Provincial Children's Hospitals and Children's Medical Centers across 31 provinces and municipalities in China, some hospitals that treat paediatric intussusception were inevitably not included in this study, which may have increased the potential for bias.

## **Conclusion**

There is large variation in the techniques of enema reduction of intussusception in China. Fluoroscopy-guided air enema reduction is mainly used. Enema reduction of uncomplicated cases of paediatric intussusception in China lacks standardization of equipment and personnel involvement.

### Author contributions

XT and YB designed the study; JZ and XT collected and analysed the data; XT and JZ drafted the manuscript; YB revised the manuscript carefully; and all authors read and approved the final version of the manuscript.

### Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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