Pneumatic reduction of intussusception under ultrasound guidance: Technical factors and additional values beyond pneumatic reduction under fluoroscopic guidance

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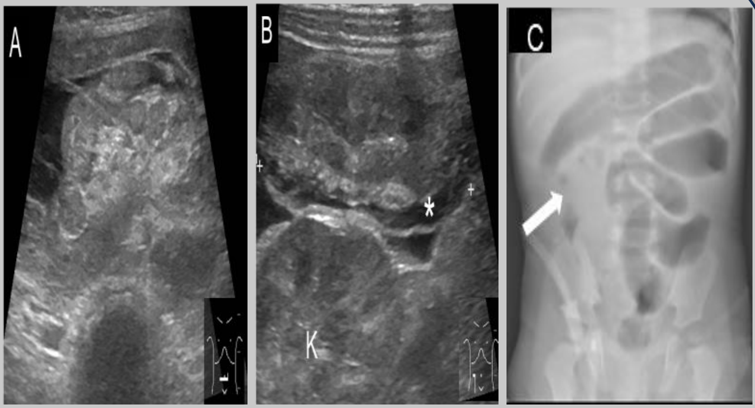
Objectives: To demonstrate the safety, effectiveness, and technical details of ultrasound (US)-guided pneumatic reduction, and the benefits over the fluoroscopic-guided method.

Materials and Methods: This retrospective study evaluated data of Thai pediatric patients diagnosed with intussusception and underwent ultrasound (US)-guided pneumatic reduction at QSNICH (Children's hospital) during May 2021 to December 2024. There were 13 patients who met the inclusion and exclusion criteria included. Clinical presentations, technical parameters using during reduction, radiological results, and reduction outcome were assessed. Additional US findings were correlate with a captured fluoroscopic image at the end of the reduction and surgical or colonoscope results. All information were discussed in detail.

Result: The mean age of the patients was 1.3 years (0.3 to 7.8 years). Successful cecal reduction was achieved in 12 patients (92.3%) while no perforation or recurrence occurred. The mean parameters of reduction were shown; the number of attempts 2.38 times (1-5 times), maximum duration per attempt was 2.07 minutes (1-3 minutes), and maximum pressure was 92.30 mmHg (30-120 mmHg). Additional ultrasound findings were noted. First, iatrogenic colonic injury was detected in 1 patient (Fig1). Second, residual small bowel intussusception was found in 2 patients. One patient received emergent surgery and found ileo-ileal intussusception with ileal obstruction and long segment serosal tear (Fig2). The other patient found polyps as leading points in an elective colonoscopy. Third, intestinal polyps were suspected in 2 patients, but a negative result was shown in one case.

US findings as correlated with fluoroscopic images

Fig.1 Iatrogenic colonic tear
A. Pre-reduction US found ileocolic intussusception located at the transverse colon.
B. Subserosal fluid (*) emerged along the ascending colon (intussuscipiens) while applying pressure during reduction.
C. Residual intussusception (arrow) remained at the ileocecal valve on the fluoroscopic image.



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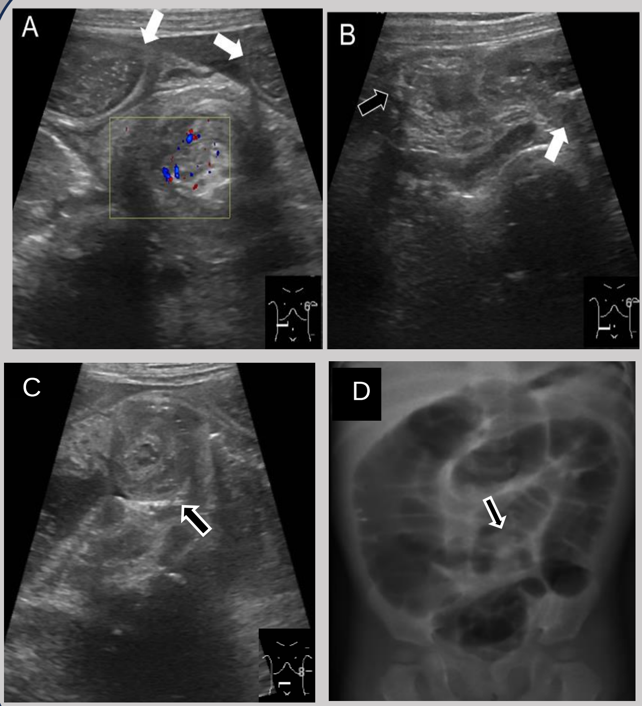

Figure 2 Residual small bowel intussusception.

A. Pre-reduction US found ileocecal intussusception located at the hepatic flexure of the colon. Dilated small bowel loops were seen (arrow) as a result of high grade ileal obstruction.
B. Successful cecal reduction was noted by disappearance of intussusception and visualization of the ileocecal valve. Marked wall thickening of the cecum (black arrow) and terminal ileum (white arrow) were shown.
C. Residual ileo-ileal intussusception (arrow) was detected at the mid abdomen during an immediate post-reduction bowel survey.
D. A captured fluoroscopic image at the end of reduction revealed a large amount of air-reflux into small bowel related to successful cecal reduction. The residual small bowel intussusception was retrospectively noted at the mid abdomen (arrow), but was hardly to be visualized by fluoroscopy due to bowel gas on the background.

Discussion Intussusception is a common acute abdominal problem and the most common cause of small bowel obstruction in infant and young children, and non-surgical reduction method is currently a first-line treatment of intussusception in children(1,2). US-guided pneumatic reduction is ideal due to radiation-free method, but seems much less popular in practice as compared to fluoroscopic guided air-reduction. This is probably due to worrisome about the downside of US to visualized air-filled areas (3-7). Our study shows that US-guided air reduction can be performed safely in children with the success rate of reduction at 92.31%, which was not different from the prior reports, and no complication of bowel perforation occurred (1, 3-6). US can directly confirm successful cecal reduction by seeing disappearance of intussusception and presence of the ileocecal valve, then increased confidence to determine successful reduction. In terms of technical considerations, US-guided air reduction provided lower maximum pressure and duration per attempts as compared to the classic reduction protocol “the rules of 3’s” (Maximum pressure at 120 mmHg, maximum duration per attempt by 3 minutes, and maximum number of attempt at 3), although slight larger number of attempts were required in some cases. These technical trends lessen a chance of colonic overinflation which is one of the major risks of colonic perforation (8). Additional US findings of iatrogenic colonic injury and residual small bowel intussusception, which were difficult or impossible to be detected by fluoroscopic examination, are crucial because these findings greatly change further management in each patient. However, US was unreliable in identifying the leading point of intussusception in our study.

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Conclusions: US-guided pneumatic reduction of intussusception provides high success rate (92.3%) equivalent to those of fluoroscopic-guided air reduction. The US-guided pneumatic reduction eases the procedure by offering direct visualization of intussusception and bowel structures. This method technically tends to reducing colonic overdistension, then decreasing risk for perforation. US is also beneficial in prompt detection of iatrogenic bowel injuries and residual small bowel intussusception, which greatly affected further management in particular cases. US has limited value to identify leading points.

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