Comparison of image guided enema reduction techniques for paediatric intussusception: Review of the literature

Poster No.: R-0228
Congress: 2014 CSM
Type: Scientific Exhibit
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Keywords: Pediatric, Interventional non-vascular, Gastrointestinal tract, Ultrasound, Fluoroscopy, Treatment effects, Outcomes analysis, Outcomes, Obstruction / Occlusion
DOI: 10.1594/ranzcr2014/R-0228

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Aim

Intussusception is the invagination of one segment of intestine into a distal segment.

- Classified as idiopathic or secondary to a pathological lead point (PLP).
  - In idiopathic cases the lead point is hyperplasia of lymphoid tissue in the distal ileum and accounts for over 90% of cases [1, 2].
  - PLP are most commonly Meckel's diverticulum and occur in older children, with PLP found in more than half of cases of intussusception in children over 4 years old [3].
- Common cause of bowel obstruction in infants and toddlers, most commonly seen within the first 2 years of life with the majority occurring between 3 and 9 months of age [4].
- If left untreated, intussusception may result in arterial obstruction, necrosis, perforation, bowel resection and may be fatal [1].

Non-operative enema reduction has been widely accepted as the first line treatment for paediatric intussusception where facilities and expertise exist [5].

- Hydrostatic or pneumatic enemas have been used under fluoroscopic or ultrasound (US) guidance to reduce intussuscepted bowel.
- Surgical intervention is indicated when non-operative reduction fails, in the presence of peritonitis or pneumoperitoneum and after the third recurrent episode of intussusception [6-8].
- Several factors affect the success rate of enema reduction for example, the location of intussusception, PLP, bowel obstruction, longer duration of symptoms and the enema reduction technique [3, 8-10].

There is variable international practice regarding the technique as well as the use of procedural sedation and general anaesthesia (GA) which may impact on radiation exposure, complication rates, and the requirement for surgery. Up-to-date evidence comparing safety and efficacy of various methods of image guided enema reduction for paediatric intussusception is lacking and may in part account for this variation in practice.

- Contrast enema under fluoroscopic guidance as described by Retan in 1927 [11] was the most common technique for image guided enema reduction until air enema gained popularity in the 1980s.
- A large case series by Guo et al [12] described 6396 cases of intussusception managed with air enema reduction under fluoroscopic control and reported high reduction rates with low incidence of complications.
  - Advantages of pneumatic reductions include less peritoneal contamination and morbidity compared to barium when perforation
occurs [13], a lower radiation dose because of shorter reduction times and lower absorption of X-rays by air compared to barium [14].

- In contrast, there are reports that pneumatic enemas are limited in identifying PLP [15] and there is a risk of tension pneumoperitoneum with perforation [16].

- In the 1980s the use of hydrostatic enema reduction under US control was also becoming popular with several studies reporting similar outcomes to fluoroscopic guided reduction techniques [17, 18].
  - Advantages of US guided techniques include no ionising radiation [17, 19] and no need for expensive fluoroscopic equipment with portable US machines allowing flexibility with regard to the location and timing of reductions.

- More recently, studies have advocated pneumatic reduction under US control as the preferred technique [20-22].

- Controversy surrounds the use of procedural sedation and GA with many institutions not using either.
  - Sedation may increase successful reduction rates by smooth muscle relaxation [23]. Sedation is thought to make the procedure less uncomfortable for the child and parents. Compliance by the child may also decrease the length of time exposed to ionized radiation for fluoroscopy controlled reductions.
  - GA may increase success rates [24] and a trial of enema reduction under GA in cases of failed reductions should be considered [25, 26]. Conversely, the requirement of an anesthetist to administer GA may lengthen time to reduction and may not be feasible in some institutions.

The aims of our study:

1. To review the literature regarding efficacy and safety of hydrostatic versus pneumatic paediatric intussusception reduction performed under fluoroscopic versus ultrasound (US) control.
2. To determine whether procedural sedation or GA influences outcomes.

Methods and materials

- A search of OVID Medline was performed on 21/02/14 using keywords "intussusception", "child" and "treatment". Abstracts of retrieved citations were scanned to determine relevance to the clinical question.
  - Searches were limited to 1970-present, English language, humans and all child.
  - Exclusion criteria were editorials, letters, clinical practice guidelines, narrative reviews, case reports or case series reporting <10 patients,
intussusception in the context of a single disease process, surgical operative findings and surveys of prevalence of intussusception cases (figure 1).

- Abstracts were reviewed manually by 2 independent reviewers.
  - Systematic reviews (SR) were appraised with the PRISMA critical appraisal tool.
  - Primary studies were appraised using a set of criteria developed a priori by 2 reviewers.
- The comparative studies and non-comparative studies were grouped according to reduction technique. Successes per attempt (number of successful reductions/ number of attempts at reduction) and perforation per attempt (number of perforations/ number of attempts at reduction) were calculated for each study and an average calculated for each technique.

Images for this section:

![Flow diagram for the intussusception literature review](image)

**Fig. 1:** Flow diagram for the intussusception literature review
Results

- 480 articles were retrieved from the Ovid Medline search and 1 article was retrieved by scanning abstracts of retrieved citations. Following application of exclusion criteria and critical appraisal (figure 1), a SR and 87 primary studies (5 studies comparing 2 techniques, but no randomised controlled trials (RCTs), and 82 studies relating to a single technique) were included.
  - Of the 88 articles, 17 reported consistent use of sedation and 4 reported the use of GA.
  - The majority of studies which reported outcomes of image guided enema reduction were retrospective case series reporting an institution's experience of a single technique. Efficacy and perforation rates for studies relating to a single technique are summarized in table 1.
  - The SR by A.L. Beres & R. Baird published in 2013 [27] compared hydrostatic with pneumatic reduction techniques. It did not compare fluoroscopic and ultrasound guided techniques, however the majority of studies performed reductions under fluoroscopic control.

- Critical appraisal using the PRISMA checklist for detection of bias revealed a score of 24 out of a possible 27. The SR reported limited information on 'study selection', 'study characteristics' and 'risk of bias within studies'.
  - The meta-analysis of failure rate produced a point estimate of odds ratio of 0.45 (95% CI 0.34-0.60) supporting pneumatic reduction.
  - The number needed to treat to eliminate 1 failed reduction was calculated to be 9 pneumatic reductions and there was no noted difference in perforation rate.
  - The SR advised on the adoption of pneumatic over hydrostatic reduction techniques for paediatric intussusception in cases without operative indications.

- Three comparative studies (table 2) and non-comparative studies support pneumatic enema over hydrostatic enema under fluoroscopic control because of a higher success rate with no additional incidence of complications.

- Two comparative studies (table 3) and non-comparative studies support ultrasound guided hydrostatic reduction over fluoroscopy guided hydrostatic reduction (table 4) because of a higher success rate with no additional incidence of complications.

- Hydrostatic reduction under US control (table 5) appears to have a similar efficacy and safety profile to pneumatic reduction under fluoroscopic control (table 6) in a number of non-randomised studies.

- There is growing evidence supporting pneumatic reductions under US control (table 7) with high success rates and no reported complications of pneumoperitoneum in the studies that were retrieved.
- Sedation is not associated with increased procedural risk or reduced efficacy based on non-randomised studies in which it was used (table 8).
- Data from 4 retrospective case series relating to GA (table 9) did not report increased procedural risk.

**Fig. 1**: Flow diagram for the intussusception literature review
**Table 1:** Summary of efficacy and perforation rates for non-comparative studies

**Table 2:** Efficacy and perforation rates for studies comparing barium enema and pneumatic enema under fluoroscopic control.
**Table 3:** Efficacy and perforation rates for studies comparing contrast enema under fluoroscopic control and Hartmann’s solution enema under US control.

**Table 4:** Efficacy and perforation rates for non-comparative studies: Fluoroscopic guided hydrostatic enema reduction.
Table 5: Efficacy and perforation rates of non-comparative studies: Ultrasound guided hydrostatic enema reduction.
Table 6: Efficacy and perforation rates of non-comparative studies: Fluoroscopic guided pneumatic reduction.

Table 7: Efficacy and perforation rates for non-comparative studies: Ultrasound guided pneumatic enema reduction
Table 8: Efficacy and perforation rates for non-comparative studies: Sedation.

Table 9: Efficacy and perforation rates for non-comparative studies: General anaesthetic.
Conclusion

- Our SR found limited data comparing the efficacy and safety of image guided enema reduction techniques for paediatric intussusception using an RCT or comparison of different techniques in the same institution.
- It supports use of pneumatic reduction over hydrostatic reduction under fluoroscopic guidance based on greater efficacy and comparably low perforation rate.
- Recent large studies indicate that hydrostatic enema reduction under US control should be considered an alternative as it affords no ionised radiation exposure.
- Sedation does not appear to alter likelihood of reduction or procedural morbidity.
- Data relating to GA are too limited to allow practice recommendations with regard to its effect on efficacy and safety.

Personal information

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References


