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Ultrasound guided intussusception reduction: are we there yet?

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Clinical scenario

An 8-month old boy presented to the pediatric surgery service with a 3-day history of irritability and vomiting followed by passage of currant jelly stool over the last 24 h. The patient was referred to radiology for an ultrasound study, which revealed the diagnosis of ileocolic intussusception. An air enema for reduction under fluoroscopic guidance was recommended. A total of five attempts at intussusception reduction was made, with the total time of 40 min spent in the fluoroscopic suite and a radiation exposure time of 9 min, using pulsed fluoroscopy. The intussusception could not be reduced, and surgical reduction was recommended.

Ask

- We wondered if we could have performed ultrasound-guided intussusception reduction in the above case. This would have avoided radiation exposure to this young child.
- We were aware that this technique is used increasingly in several European and Asian countries. We were not aware of the success rates of sonographic-guided reduction compared to fluoroscopic-guided reduction of intussusception in children.
- This led us to formulate the following question using the evidence based practice PICO (patient, intervention, comparison, and outcomes of interest) format: In children with intussusception, how does ultrasound-guided intussusception reduction compare with fluoroscopic-guided reduction? [1, 2].

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Search

- We searched the literature for both primary literature (scientific articles) and secondary literature (evidence based reviews) on this topic [2].
- A search for secondary evidence was performed in the Cochrane Collaboration website and the American College of Physicians journal club. No systematic review was retrieved on this topic, though search of the Cochrane collaboration did yield the protocol of an ongoing systematic review comparing the various non-surgical management techniques for intussusception in infants and young children [3].
- The National Library of Medicine (NLM) database, MEDLINE, was searched using the PubMed search engine for primary evidence. Articles were retrieved using the following medical subject headings (MeSH) terms that applied to the clinical question: intussusception, ultrasound, sonography, fluoroscopy, enema, and reduction (Fig. 1). This resulted in 69 articles. The following limits were applied to restrict the focus of our search: humans, English language, and all child. This decreased the number of articles to 52. Review of the titles and abstracts resulted in a total of 17 articles that seemed most appropriate to our clinical question.

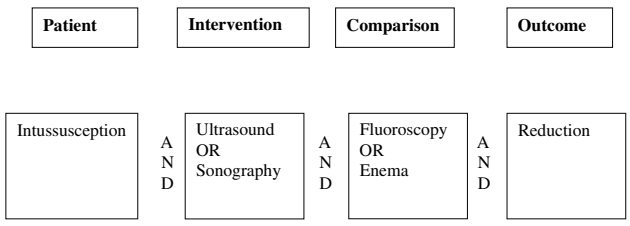

Fig. 1. Search strategy using the PICO (patient, intervention, comparison, outcome) format.

The bibliographies of these articles were also reviewed to identify any other relevant papers.

Appraise

The abstracts and materials and methods sections of the 17 retrieved publications were reviewed and graded according to the levels of evidence described by the Centre of Evidence-Based Medicine, University of Oxford [4]. The 17 selected publications were classified into the following levels of evidence: one publication level 1 [5], 3 publications level 2 [6–8], 1 publication level 3 [9], and 11 publications level 4. One paper could not be retrieved in any form through our institute's library.

The level 1 and level 2 articles were appraised critically in detail. Hadidi et al. performed a randomized controlled trial of 3 reduction methods: ultrasound-guided hydrostatic reduction with saline (US), fluoroscopy-guided air reduction (AR), and fluoroscopy-guided barium enema reduction (BE). The study was conducted over a 3-year period and 147 children were enrolled. 50 were randomized to the AR group, 50 to the BE group and 47 to the US group. The AR was performed by a pediatric surgeon, while a pediatric radiologist performed the US and BE. A maximum of three attempts was used for each technique. There was no significant difference between the three groups in terms of age, gender, or duration of symptoms. AR had a higher success rate (90%) than US (67%) or BE (70%), *P* value 0.01. The average duration of procedure for AR was less than 15 min, while BE and US took longer than 15 min on average. There was no difference in the risk for complications (perforation) between the three groups. The authors concluded that AR is more effective and faster than ultrasound-guided hydrostatic reduction.

The three level 2 papers were cohort studies in which children with intussusception were prospectively recruited for ultrasound-guided reduction. One study used ultrasound-guided hydrostatic reduction using Hartmann's solution resulting in 76% reduction rate with the average time of reduction at 18 min [8]. The other two studies used ultrasound-guided air reduction, both resulting in a success rate of 95% [6, 7]. These success rates are comparable to success rates with fluoroscopic guidance [10].

The success of non-surgical intussusception reduction is affected by several factors, including duration of symptoms, presence of obstruction, age less than 3 months, intussusception encountered in the rectum, use of sedation, the contrast media used, and the operator [10]. This makes comparison across studies, and even within a study, somewhat difficult. For example, in the paper by Hadidi et al. while a pediatric surgeon performed the air reduction, hydrostatic reduction using fluoroscopic or ultrasound guidance was performed by a pediatric radiologist. The experience of these two operators is not clearly defined in the paper, making comparison across modalities/operators difficult. In addition, the difference in success rate maybe related to the different media used (air vs. hydrostatic) rather than because of a difference in the imaging-guidance modality (flouroscopy vs. ultrasound). In fact, two reports suggest the superior reduction rate using air is due to higher intraluminal pressures compared to liquid reduction [11, 12]. Also perforations occurring during air enema are smaller and associated with less peritoneal contamination [13, 14]. Regardless, the main advantage of using sonographic guidance remains the avoidance of radiation exposure in young children.

Apply

We as pediatric radiologists should familiarize ourselves with this technique to conform to the ALARA (as low as reasonably achievable) principle of radiation exposure in our practice. As any new technique has a learning curve, one might even consider performing sonographic-guided reduction followed by fluoroscopic guided reduction if attempts at the former fail. An excellent pictorial review that highlights the technique for sonographic-guided hydrostatic reduction may be useful during the initial introduction of this technique to local practice [15].

Evaluate

The next step after incorporation of this new therapeutic strategy would be to evaluate its efficacy and effectiveness. This may be done by comparing the success of ultrasound-guided reduction in a prospective cohort with a historical control of fluoroscopic-guided reduction. Alternatively, a randomized trial could be performed comparing these two techniques but it would likely require a multi-center design to obtain adequate sample size.

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