Journal of Pediatric Surgery 50 (2015) 963–966

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

The utility of the contrast enema in neonates with suspected Hirschsprung disease

Luke R. Putnam [a,b], Susan D. John [b,c], Susan A. Greenfield [b,c], Caroline M. Kellagher [a,b], Mary T. Austin [a,b], Kevin P. Lally [a,b], Kuojen Tsao [a,b,*]

[a] Center for Surgical Trials and Evidence-based Practice, Department of Pediatric Surgery, The University of Texas Health Science Center at Houston, TX
[b] Children's Memorial Hermann Hospital, 6411 Fannin Street, Houston, TX
[c] Department of Diagnostic and Interventional Imaging, University of Texas Health Science Center at Houston, 6431 Fannin Street, MSB 2.130B, Houston, TX

ARTICLE INFO

Article history:
Received 2 March 2015
Accepted 10 March 2015

Key words:
Hirschsprung disease
Contrast enema
Barium enema

ABSTRACT

Background/purpose: The contrast enema (CE) is commonly utilized for suspected Hirschsprung disease (HD) patients. We set out to determine the utility of the CE in the newborn for clinically suspicious HD.
Methods: All CEs performed for suspicion of HD in neonates from January 2004 to December 2013 were reviewed by two pediatric radiologists who were blinded to the original interpretations and final diagnoses. A standardized scoring sheet was utilized to document essential radiographic findings. Definitive diagnoses were determined by pathology. Descriptive statistics, likelihood ratios, and interrater agreement were determined.
Results: 158 CEs were reviewed. Interrater agreement was 89% with kappa (95% CI) of 0.63 (0.47–0.76). Common indications for CE were similar between non-HD and HD groups. The positive, inconclusive, and negative likelihood ratios (95% CI) were 38 (10–172), 3.2 (1.3–9.1), and 0.15 (0.06–0.47), respectively, leading to posttest probabilities for positive, inconclusive, and negative tests of 83%, 32%, and 2.5%, respectively.
Conclusions: Although radiographic positive CE for HD portends a high probability of HD, inconclusive studies still represent a significant increased risk. In clinically suspicious infants for HD, those with inconclusive studies may benefit from a lower threshold to perform follow-up rectal biopsy.

Hirschsprung disease (HD) occurs in 1/5000 live births and is frequently diagnosed during the neonatal period [1]. Neonates affected with HD commonly present with failure to pass meconium within the first 24–48 hours of birth, abdominal distention, and intolerance to feeds. These signs and symptoms commonly prompt a pediatric surgery consultation and a contrast enema (CE) to help distinguish between HD, meconium plug syndrome, meconium ileus, and other causes of neonatal bowel obstruction. As a noninvasive procedure, the CE is a favorable option prior to performing a rectal biopsy, the gold-standard diagnostic procedure for HD.

Currently, robust evidence regarding the utility of the CE in neonates with suspected HD is lacking. Accordingly, inconclusive or negative results may represent a clinical dilemma as to whether to expectantly manage, to repeat the CE or to proceed with a rectal biopsy. The goal of this study was to investigate the diagnostic utility of the CE for neonates suspected of having HD and to understand the implication of inconclusive studies.

1. Methods

A retrospective cohort study of all neonates (newborns <30 days) at Children's Memorial Hermann Hospital (CMHH) who underwent CEs from January 2004 to December 2013 was conducted. Institutional review board approval was obtained (HSC-MS-13-0628) from the University of Texas Health Science Center at Houston and CMHH, which is a tertiary children's hospital within the Texas Medical Center.

1.1. Subjects

All neonates at CMHH who underwent CEs from January 2004 to December 2013 as identified by Current Procedural Terminology codes 74270 and 74280 were included in the study. Charts were reviewed by a physician to confirm that the indications for CE were based on clinical findings suspicious for HD which included abdominal distention, vomiting or oral intolerance, abnormal stooling and/or the failure to pass meconium within 24 or 48 hours after birth (Fig. 1). Only findings that were documented as positive or negative in patient charts prior to the CE were included. Both inborn and outborn patients were considered.

Pathology reports for all subjects included in this study were reviewed to determine definitive diagnoses. Determination of HD was based on pathology when biopsies were available. Additional negative HD cases were assumed negative based on clinical improvement of symptoms.

1.2. Radiologic evaluation

Two board-certified, pediatric radiologists (SJ and SG) evaluated CEs of all neonates in the study and completed a standardized scoring sheet

* Corresponding author at: The University of Texas Health Science Center, Department of Pediatric Surgery, 6431 Fannin Street, MSB 5.323, Houston, TX 77030. Tel.: +1 713 500 7305; fax: +1 713 500 7296.
E-mail address: kuojen.tsao@uth.tmc.edu (K. Tsao).

http://dx.doi.org/10.1016/j.jpedsurg.2015.03.019
0022-3468/

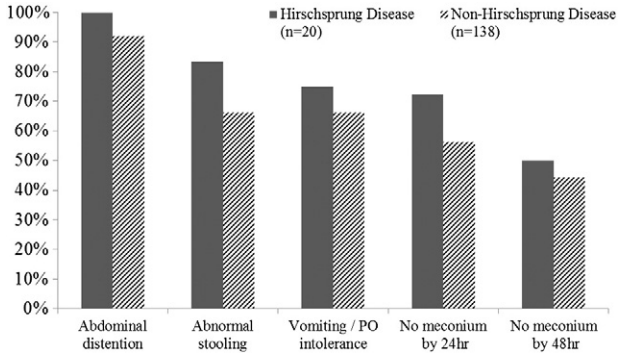

Fig. 1. The clinical indications for neonates undergoing CE. All of the findings were more common among HD patients although none were significantly more common (all $p > 0.05$).

for each exam. The radiologists have 26 and 9 years of experience as full time pediatric radiologists. The scoring sheet was developed through consensus among the pediatric radiologists and pediatric surgeons at CMHH and allowed documentation of the following items: rectosigmoid index (RSI), transition zone, rectal contractions or "sawtooth" pattern, extent of colon visualized, percentage of contrast evacuation during the CE and on subsequent abdominal radiographs, and final radiographic diagnosis. The RSI was calculated using the widest diameter of the rectum divided by the widest diameter of the sigmoid colon and was considered abnormal if <1. A transition zone represented an abrupt change in colonic caliber, and a "sawtooth" pattern was identified as spiculations in the rectum. The radiologists were blinded to the CEs' original interpretations and to the patients' final diagnoses.

A final radiographic diagnosis was considered positive for HD when two or more of the radiographic findings were positively identified on a single study by both radiologists. Diagnoses were considered inconclusive when a radiologist could not clearly rule-in or rule-out abnormal findings (Fig. 2), when lateral films were not obtained to more accurately measure the RSI, or when the radiologist determined the exam was inadequate owing to poor visualization of the entire colon/rectum. For cases in which the two radiologists differed in the final diagnoses, cases were reviewed by both radiologists together for consensus and a final diagnosis was determined.

1.3. Statistical analysis

The diagnostic utility of the CE administered in neonates with suspicious HD was assessed by determining the likelihood ratios (LR) with 95% confidence intervals (CI) for positive, negative, and inconclusive interpretations. Additionally, the accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were determined for positive and negative radiographic impressions, which do not take into account inconclusive results. Interrater reliability between the two pediatric radiologists was calculated using Cohen's kappa with 95% CIs. Chi-square and Fisher's exact tests were utilized for categorical variables and Wilcoxon rank-sum for continuous variables; p-values <0.05 were considered significant. Statistical testing was performed with STATA 13 (College Station, TX).

2. Results

2.1. Patient cohort and demographics

A total of 158 CEs were ordered owing to clinical suspicion of HD during the study period. Of these 158 neonates, 20 (13%) were diagnosed with HD and 138 (87%) were found to have other diagnoses or no disease at all. Mean follow-up for the HD and non-HD patients was 5.1 ± 2.2 years and 6.0 ± 2.7 years, respectively. Neonates with HD had a significantly higher mean gestational age (38 ± 1.7 vs 32 ± 5.3 weeks, $p < 0.01$) and birth weight (3.1 ± 0.6 vs 2.0 ± 1.0 kg, $p < 0.01$) than non-HD neonates, but age at the time of CE (8.5 ± 7.7 vs 4.4 ± 4.8 days, $p = 0.07$) was not significantly different between groups. A greater proportion of males were found to have HD (80% vs 50%, $p = 0.01$).

2.2. Diagnostic outcomes

Thirty-seven (23%) of the original impressions suggested meconium plug syndrome. Eight (22%) of the 37 patients underwent biopsies of which 3 were diagnosed with HD. A total of 36 (23%) biopsies were performed for the entire cohort; twenty (56%) were positive for HD while 16 (44%) were negative.

Of the 158 neonates who underwent CEs, 129 (82%) impressions were determined as negative for HD, 14 (9%) as positive, and 15 (9%) as inconclusive. Interrater agreement for diagnostic impression was 89% with kappa (95% CI) of 0.63 (0.47–0.76).

To determine likelihood ratios, a pretest probability was calculated based on the prevalence of HD at CMHH. Using our study cohort of neonates, the prevalence was determined to be 13%. Subsequently, the positive, inconclusive, and negative LRs (95% CI) were calculated and yielded 38 (95% CI 10–172), 3.2 (95% CI 1.3–9.1), and 0.2 (95% CI 0.1–0.5), respectively. Based on the likelihood ratio nomogram, a neonate who undergoes a CE at our institution for suspicion of HD has a

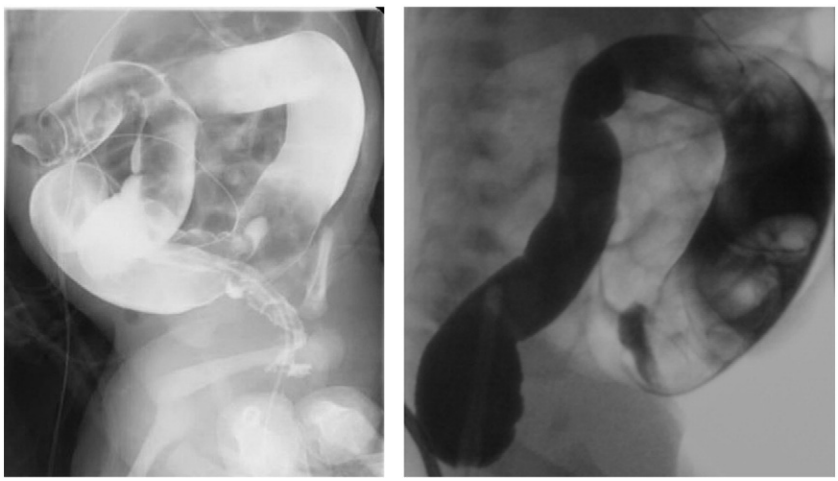

Fig. 2. The image on the left clearly demonstrates an RSI < 1 and was read as a positive CE. The image on the right does not clearly demonstrate an RSI < 1, but has a questionable transition zone in the sigmoid colon and a questionable rectal "sawtooth" pattern; the exam was read as inconclusive. Both neonates were subsequently diagnosed with HD.