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Risk Stratification of Children Being Evaluated for Intussusception

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WHAT'S KNOWN ON THIS SUBJECT: Intussusception is the most common cause of intestinal obstruction in young children. To date, there have been no prospective studies that have been able to develop a reliable clinical prediction model to determine which patients are at low risk for intussusception.

WHAT THIS STUDY ADDS: This study is the largest prospective cohort study to date to evaluate children with possible intussusception. It includes both univariate and multivariate analyses to develop clinical prediction models for patients at low risk for intussusception.

abstract

CONTEXT: Intussusception is the most common cause of intestinal obstruction in young children, and delayed diagnosis may lead to bowel perforation.

OBJECTIVE: To determine predictive clinical criteria and develop a decision tree to risk-stratify children with possible intussusception.

DESIGN/METHODS: This is a prospective observational cohort study of children aged 1 month to 6 years who presented with possible intussusception. A data-collection form was completed before knowledge of any advanced imaging. Univariate analysis was performed, and decision trees were developed using recursive partitioning.

RESULTS: In the study, 310 patients were enrolled, including 38 (12.3%) with intussusception. The median age was 21.1 months and 61% were male. Univariate predictors of intussusception included age older than 6 months ($P = 0.04$), male gender ($P = .007$), history of lethargy ($P = .001$), and abnormal plain x-ray ($P = .0001$). Multivariate analysis through recursive partitioning identified decision trees (with and without the result of a plain abdominal x-ray) and allowed identification of patients at low risk. The decision tree based on the results of an abdominal x-ray (negative or positive), age ($\leq$5 or $>$5 months), diarrhea (present or absent), and bilious emesis (present or absent) had the best test performance (sensitivity: 97% [95% confidence interval (CI): 86–100]; negative predictive value: 99% [95% CI: 93–100]; negative likelihood ratio: 0.08 [95% CI: 0.01–0.6]).

CONCLUSIONS: Among children who were being evaluated for intussusception, we prospectively determined clinical criteria and developed a decision tree to risk-stratify children with possible intussusception. *Pediatrics* 2011;127:e296–e303

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KEY WORDS

intussusception, abdominal pain, decision rules, ultrasound, diagnostic studies

ABBREVIATIONS

ED—emergency department
CI—confidence interval
NPV—negative predictive value
LR—likelihood ratio
PPV—positive predictive value

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Intussusception is the most common cause of intestinal obstruction in infants and young children.[1–6] Delayed diagnosis may lead to bowel necrosis and perforation.[1,5,7] The diagnosis can be difficult in children because of a nonspecific presentation and physical examination. Although radiologic contrast enema is the standard for diagnosis and treatment of intussusception, it exposes patients to radiation and is not available in all settings. Ultrasound is a secondary diagnostic modality,[2,6–8] but it is also not routinely available in all clinical settings and is highly operator-dependent. Plain x-rays are more readily available but are not usually diagnostic. Ideally, history and physical examination findings, with or without plain x-rays, would determine which patients are at low risk for intussusception.

Many children with intussusception present with atypical signs and symptoms. Multiple studies have revealed that the "classic triad" of abdominal pain, bloody stool, and palpable abdominal mass is present in <40% of cases.[2,4,5,9,10] Previous studies have unsuccessfully attempted to develop a clinical prediction model. [2,4,5] Herein, we prospectively enrolled children who presented to an emergency department (ED) with signs or symptoms suspicious for intussusception. Our goal was to determine predictive clinical criteria and to develop a decision tree to identify low-risk patients who can be safely observed without advanced imaging.

METHODS

Study Design and Participants

This investigation is a prospective observational cohort study conducted at an urban, tertiary care, pediatric emergency department with 58 000 annual visits. From December 2008 through January 2010, we prospectively enrolled children aged 1 month to 6 years with signs and symptoms suspicious for intussusception as determined by the treating physician. All medical care including radiologic studies was determined by the clinical care team. Patients were excluded if they had a previous diagnosis of intussusception, previous abdominal surgery, any chronic gastrointestinal disorder other than gastroesophageal reflux, any chronic medical condition with intestinal manifestations (eg, cystic fibrosis), or any known possible lead point for intussusception (eg, jejunal tube, Henoch-Schönlein purpura, or intestinal polyps).

Data Collection

Standardized data collection forms were completed by the physicians responsible for the patient's care. Forms were completed before any advanced diagnostic imaging (ultrasound, air enema fluoroscopy, or computed tomography) or knowledge of final diagnosis. Physicians were introduced to the study forms before the study. Each standardized form consisted of historical and physical examination variables. See Appendix for a sample data form. The forms were either completed by an attending physician or reviewed by the primary attending if completed by a resident.

Plain abdominal x-rays were categorized as "negative," "possible positive," or "positive" on the basis of final radiology report. These coding categories were established by using predefined criteria established by all authors including an attending pediatric radiologist. In this institution, standard order for an abdominal series includes 2 views (supine, upright, or left lateral decubitus). Plain x-rays were coded as positive if the final report indicated a small bowel obstruction, target, or crescent sign, findings consistent with ileocolic intussusception. X-rays were categorized as possible positive if the final report indicated any of the following phrases: abnormal gas pattern, scattered air fluid levels, dilated intestinal loops, findings may be "suspicious" of intussusception, ileus, paucity of bowel gas in a specific quadrant, or ileocolic intussusception cannot be excluded. An x-ray was coded as negative if the report did not indicate any language for positive or possibly positive (as defined above). Inter-rater reliability for coding was measured for 20% of the x-rays. For analysis of predictors, possibly positive and positive x-rays were considered "positive."

To estimate a capture rate, ED records and radiology logs were screened for the first 3 days of every month to determine the proportion of eligible patients who were enrolled.

Outcome Measure

Our primary outcome measure was the presence or absence of intussusception. Intussusception was defined by visualization of intussusception by air enema or by operative diagnosis. The absence of intussusception was defined by negative air enema (primary determinant) or negative ultrasound (secondary), or if neither air enema or ultrasound was performed, a telephone call was placed to the patient's caregiver at least 2 weeks after the index visit (tertiary) to inquire about subsequent medical visits. If a patient could not be reached by telephone, his or her records were reviewed for any repeat ED visits. Coding of the primary outcome was reviewed by 2 authors; any conflicts were discussed and resolved before analysis.

Analysis

The data were analyzed by using SPSS 16 (SPSS Inc, Chicago, IL). Univariate analysis was performed for all candidate predictors. Distributions were provided as mean ± SD or medians

and interquartile ranges. Continuous variables were compared by using a *t* test for independent samples (normal distributions) or Mann-Whitney *U* test (nonnormal distributions), and χ^2 analysis for comparisons of categorical variables. A *P* value of $\leq$.05 was considered significant.

Recursive Partitioning

Tree-structured analysis by CART Pro 6.0 (Salford Systems, San Diego, CA) was used to perform recursive partitioning analysis. All variables with a *P* value of <.2 on univariate analysis and with a ≥90% completion rate were entered as candidate predictors. We decided a priori to limit the use of subjective clinical determinants in the model (eg, reports of vomiting at home was considered objective, but lethargy at home was considered subjective and not a candidate). With CART analysis, splitting rules are developed in a stepwise fashion by analyzing each potential predictor and all possible cut points (if continuous). Splits are made to minimize false-negative or false-positive assignments for the outcome variable. A parameter that represents "cost" can be modified such that the model maximizes sensitivity or specificity. Our objective was to make the most sensitive decision tree and thereby confidently identify low-risk patients; we iteratively assigned a high cost to misclassification of a case of intussusception into a low-risk node.

Sample Size

The sample size was based on the estimated enrollment and the requirements for developing clinical decision rules. In review of data from 2004–2007, ~50 cases of intussusception per year were seen in our ED. We estimated the rate of intussusception to be 15% to 20% of patients being evaluated for intussusception and a capture rate of 70%. With these assumptions, we intended to enroll 200 children with at least 30 cases of intussusception.

This study was approved by the hospital's committee on clinical investigation. Verbal consent was obtained from all participating pediatric emergency medicine physicians. Caregivers were given an informational sheet and asked for verbal consent.

RESULTS

Study Population and Enrollment

Throughout the study period, 339 children were enrolled. Twenty-nine patients were excluded, leaving 310 study patients. On the basis of our audit strategy, 68% of patients with possible intussusception were enrolled. Those patients missed were similar to enrolled patients in age, gender, and final diagnosis.

The median age was 21.1 months (interquartile range: 10.2–36.5). One-hundred-ninety (61%) patients were male. Thirty-eight (12.3%) of patients were diagnosed with intussusception. Follow-up was completed on all patients. No patient initially discharged returned with intussusception. Of the patients, 257 (83%) had abdominal pain, 174 (56%) had vomitting, and 112 (36%) had lethargy by report; 77% of children had 2 or more of these features. The clinical characteristics of patients enrolled are detailed in Table 1. Although not shown in Table 1, patients who were referred from another medical setting were statistically similar with regard to all presenting characteristics.

TABLE 1 Characteristics and Outcomes of the Study Patients ($N = 310$)

Age, median (IQR), mo	21.1 (10.2–36.5)
Male gender, *n* (%)	190 (61)
History, *n* (%)	
Fever	89 (29)
Abdominal pain	257 (83)
Vomiting	174 (56)
Bilious vomiting	22 (7)
Diarrhea	99 (32)
Bloody diarrhea	36 (12)
Lethargy	112 (36)
Altered mental status	26 (9)
Physical examination, *n* (%)	
Lethargy	71 (23)
Abdominal distension	31 (10)
Abdominal tenderness	115 (37)
Peritoneal findings	10 (3)
Abdominal mass	8 (3)
Rectal examination heme-positive, *n* (%)	54 (17)
Intussusception, *n* (%)	38 (12)
Imaging, *n* (%)	
KUB	299 (96)
Ultrasound	211 (68)
Air enema	37 (12)
Disposition, *n* (%)	
Admitted	94 (30)
Operating room	7 (2)
Leading diagnosis at the time of enrollment, *n* (%)	
Intussusception	79 (26)
Appendicitis	5 (2)
Gastroenteritis	114 (37)
Constipation	55 (18)
Other	52 (17)
Abdominal x-ray results ($N = 299$), *n* (%)	
Positive	8 (3)
Possible positive	74 (25)
Negative	217 (72)

IQR indicates interquartile range; KUB, kidneys, ureter, bladder.

Clinical Course and Disposition

After initial assessment, all patients had abdominal imaging: 299 (96%) had an abdominal x-ray, 211 (68%) had an ultrasound (including the 4% of children who did not have a plain x-ray), and 37 (12%) had an air enema. Eighty-seven (28%) patients had abdominal x-rays alone. Seventy-seven percent of patients with intussusception had a positive (23%) or possible positive (54%) x-ray. Twenty percent of all x-ray results were evaluated by 2 authors independently for inter-rater reliability, with a κ statistic of 0.95. Thirty-six (17%) of ultrasounds were positive. Of the 37 patients who had an air enema, 36 (97%) were positive for intussusception. All the patients with a positive ultrasound had a positive air enema. Thirty-three patients with intussusception were reduced by air enema, and 5 required surgical reduction. Of those

TABLE 2 Univariate Analysis of Predictors of Intussusception

Predictor[a]	Positive for Intussusception ($N = 38$)	Negative for Intussusception ($N = 272$)	*P*	Sensitivity % (95% CI)	Specificity % (95% CI)	LR-Negative (95% CI)	LR-Positive (95% CI)
Age[b]							
Mean ± SD, mo	30 ± 18	24 ± 18	.07				
≤6 mo, *n*[b]	1	41	.04[b]	3 (0.14–15)	85 (80–89)	1.1 (1.1–1.2)	0.17 (0.02–1.2)
≤12 mo, *n*	6	87	.06	16 (6.5–32)	68 (62–73)	1.2 (1.1–1.4)	0.5 (0.2–1.1)
Male gender[b]	31	159	<.01[b]	82 (65–92)	42 (36–48)	0.4 (0.2–0.9)	1.4 (1.2–1.7)
History							
Fever	8	81	.34	21 (10–38)	70 (64–76)	1.1 (1.0–1.3)	0.7 (0.4–1.3)
Vomiting	26	148	.12	68 (51–82)	46 (40–52)	0.7 (0.4–1.1)	1.3 (1.0–1.6)
Bilious vomiting[b]	8	14	.002[b]	21 (10–38)	95 (91–97)	0.8 (0.7–1.0)	4.0 (1.8–9.0)
Diarrhea[b]	7	92	.06[b]	18 (8.3–35)	66 (60–72)	1.2 (1.1–1.4)	0.5 (0.3–1.1)
Bloody diarrhea	5	31	.79	13 (4.9–29)	89 (84–92)	1.0 (0.9–1.1)	1.15 (0.5–2.8)
Abdominal pain	32	225	.82	86 (70–95)	17 (13–22)	0.8 (0.3–1.8)	1.0 (0.9–1.2)
Lethargy[b]	23	89	.001[b]	64 (46–79)	67 (61–73)	0.5 (0.3–0.8)	1.9 (1.4–2.6)
Physical examination							
Lethargy[b]	13	58	.098[b]	34 (20–51)	79 (73–83)	0.8 (0.7–1.1)	1.6 (1.0–2.6)
Abdominal distension	4	27	.99	11 (3.4–26)	90 (86–93)	1.0 (0.9–1.1)	1.0 (0.4–2.9)
Abdominal tenderness	16	99	.593	42 (27–59)	63 (57–69)	0.9 (0.7–1.2)	1.1 (0.8–1.7)
Peritoneal	3	7	.114	8 (2–22)	97 (94–99)	0.9 (0.9–1.0)	3.0 (0.8–11.0)
Abdominal mass	1	7	.99	3 (0.14–15)	97 (95–99)	1.0 (0.9–1.0)	1.0 (0.1–8.0)
Rectal heme positive	9	45	.36	33 (17–54)	75 (68–81)	0.8 (0.7–1.2)	1.3 (0.7–2.4)
Imaging[b]							
KUB-positive[c]	27/35	55/264	<.001[b]	77 (59–89)	79 (74–84)	0.3 (0.2–0.5)	3.7 (2.6–5.0)

KUB indicates kidneys, ureter, bladder.

[a] All predictors had a >90% completion rate.

[b] Statistically different between those with and without intussusception.

[c] Positive x-ray includes positive and possibly positive per study definitions.

patients with negative evaluation for intussusception in the ED, 209 patients were discharged for outpatient follow-up, 61 were admitted for observation, and 2 went to the operating room for diagnoses other than intussusception. All patients with intussusception were admitted after reduction. Patient outcomes are detailed in Table 1.

Univariate Analysis

The univariate analysis is detailed in Table 2. Significant findings among patients with intussusception included male predominance ($P < .007$), age older than 6 months ($P = .04$), presence of bilious vomiting ($P = .002$), and lethargy by history ($P = .001$). Patients with positive or possible positive abdominal x-rays were more likely to have intussusception ($P < .001$).

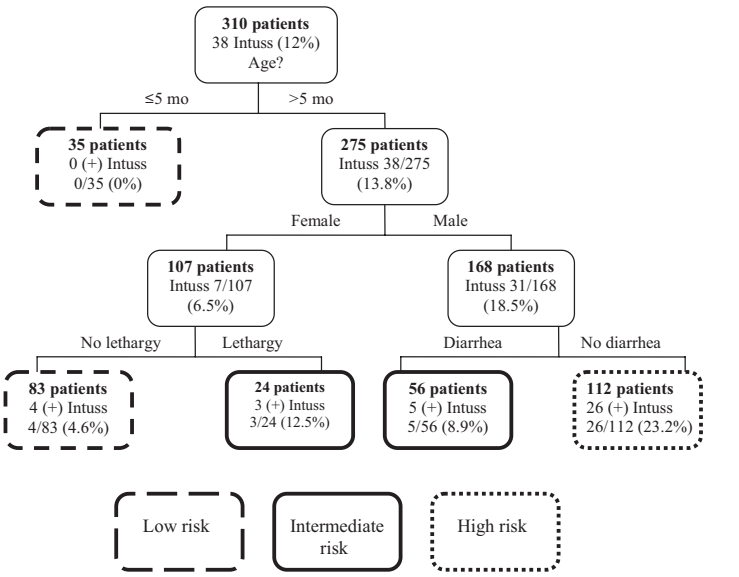
Multivariate Analysis

Seven variables met criteria for entry into the recursive partitioning model (age, gender, vomiting, bilious vomiting, diarrhea, lethargy on physical examination, and plain x-ray). Recursive partitioning developed a low-risk decision rule using age, gender, and lethargy by examination (Fig 1). Patients 5 months old or younger were at low risk; none of these patients had intussusception (0 of 35 [95% confidence interval (CI): 0.0–0.1]). Of the patients older than 5 months, another low-risk subgroup included children who were female and without lethargy on physical examination. Overall, this tree misclassified 4 patients with intussusception into a low-risk node (sensitivity: 89% [95% CI: 74–96]; negative predictive value [NPV]: 97% [95% CI: 91–99]; negative likelihood ratio [LR]: 0.25 [95% CI: 0.1–0.6]).

Positive x-ray alone identified a group of 90 patients, 30 with intussusception. The sensitivity and specificity of plain x-ray were 77% (95% CI: 60–89) and 79% (95% CI: 7–84), respectively, with an NPV of 96% (95% CI: 93–98) and negative LR of 0.29 (95% CI: 0.16–0.53). When plain abdominal x-ray was added as a predictor, a decision tree was created with the x-ray result as the root (primary) node followed by additional classification using age, presence of bilious vomiting, or diarrhea (Fig 2). This tree identified 85 low-risk patients. Among children with a negative x-ray and age of 5 months or younger, none (0 of 31) had intussusception (sensitivity: 100% [95% CI: 89%–100%]). Among 54 patients older than 5 months of age with a negative x-ray without bilious vomiting but with diarrhea, only 1 had intussusception. Overall sensitivity of this tree is 97% (95% CI: 86–100), NPV is 99% (95% CI: 93–100), and negative LR is 0.08 (95% CI: 0.01–0.60).

DISCUSSION

Previous investigations have tried to identify clinical predictors of intussusception; the individual predictors were



	Positive intussusception	Negative intussusception
High/intermediate risk	34	158
Low risk	4	114

Decision tree 1:
Sensitivity: 89% (95% CI: 74-96)
NPV: 97% (95% CI: 91-99)
LR-negative: 0.25 (95% CI: 0.1-0.6)
LR-positive: 1.5 (95% CI: 1.3-1.8)

FIGURE 1
Low-risk decision tree using recursive partitioning (using clinical predictors, without abdominal x-ray). Intuss indicates intussusception.

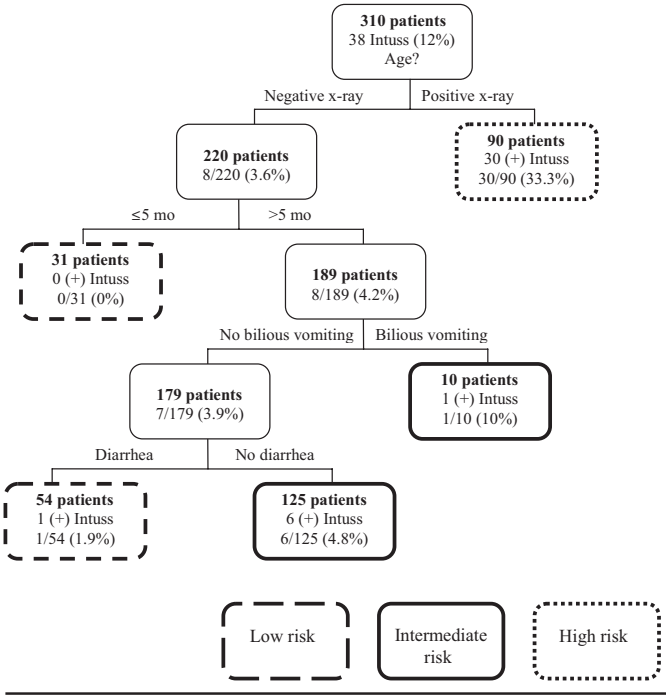
not strong discriminators and are therefore not routinely applied in clinical practice. The goal of our study was to determine predictive clinical criteria and develop a decision tree to risk-stratify children with possible intussusception.

There have been a number of studies in which the clinical factors associated with intussusception are investigated.[2,4,5] Kuppermann et al[5] retrospectively investigated 115 patients who had already undergone a contrast enema, and 59% of subjects had intussusception. Multivariate analysis revealed that patients without rectal bleeding (history of rectal bleeding, or gross/occult blood on examination) and without a highly suggestive x-ray had a low probability of intussusception. Of the 17 patients without either highly suggestive x-ray or rectal bleeding, none had intussusception (95% CI: 0%–16%). Klein et al[4] conducted a similar retrospective study with patients who underwent contrast enema for intussusception. Of the 215 children studied, 58 (27%) had intussusception. Logistic regression analysis was unable to create a prediction model to reliably identify patients with intussusception. The variables used in the final model were abdominal mass, radiographsic findings of a soft tissue mass, a small amount or no stool in the transverse colon, and a small amount or no air in the transverse colon. On the basis of the derivation group, the model had an NPV of 100 (95% CI: 52–100), respectively. This model has never been studied prospectively.

Harrington et al[2] conducted a prospective study to identify the predictive value of clinical characteristics of intussusception. They enrolled 88 patients, all of whom underwent both ultrasound and air enema; 35 (40%) were positive for intussusception. Three clinical predictors were found to be significant: right upper quadrant abdominal mass (positive predictive value [PPV]: 94%), gross blood in the stool (PPV: 80%), and gross blood on rectal examination (PPV: 78%). The combination of these 3 predictors brought the PPV to 93% ($P < .0001$), but no significant negative clinical predictors were identified.

The added benefit of abdominal x-ray in diagnosing intussusception also has been investigated with mixed results. Even with expert review by pediatric radiologists, abdominal x-rays had a sensitivity of only 29% to 50% in previous studies.[7,11,12] Findings on plain x-ray thought to be helpful in the diagnosis of intussusception included paucity of gas in the right lower quadrant, intracolonic soft tissue mass, absence of cecal gas, and stool.[6,11–15] In a study by Hernandez,[11] 2 pediatric radiologists evaluated the specificity of plain film findings in patients with proven intussusception. Reviewing 80 x-rays, they noted that intestinal obstruction was found in 54% of patients, paucity of gas in the right lower quadrant in 10%, and soft tissue mass in 23%. Overall, a diagnostic radiographsic finding was present in only 29% of cases. Twenty-four percent of those patients with intussusception had a normal x-ray.

Our study is the largest prospective study in which both clinical predictors and the addition of an abdominal x-ray to develop a decision tree to risk-stratify children with possible intussusception are evaluated. The prospective nature of the study allowed for a >90% completion rate for all our potential predictors and complete follow-up on all patients. All patients had an abdominal x-ray and/or ultrasound as a part of their evaluation. Unlike the previous investigations, this population included a full clinical spectrum of children with possible intussusception rather than just those who underwent contrast enemas.



	Positive intussusception	Negative intussusception
High/intermediate risk	37	188
Low risk	1	84

Decision tree 2:
Sensitivity: 97% (95% CI: 86-100)
NPV: 99% (95% CI: 93-100)
LR negative: 0.08 (95% CI: 0.01-0.6)
LR positive: 1.4 (95% CI:1.3-1.5)

FIGURE 2
Low-risk decision tree using recursive partitioning (using clinical predictors, with abdominal x-ray). Intuss indicates intussusception.

Our univariate analysis indicated male gender as a significant predictor of intussusception (LR: 1.4). Although intuitively difficult to understand, this finding is similar to other studies that have reported that 60% to 75% patients with intussusception were male.[3–5,8,11,16–18] Age also was a significant predictor; patients 5 months and younger were less likely to have intussusception. Our data also revealed bilious vomiting, lack of diarrhea, and history of lethargy as significant univariate predictors. Abdominal pain, abdominal mass, and guaiac-positive stools were not determined to be significant, which differed from previous studies.[4,5,17]

In our study, the abdominal x-ray proved to be a valuable discriminator with an NPV of 96%; previous studies have reported a NPV between 65%[5] and 96%.[12] This variation is likely because of differences in the x-ray definitions. With our focus on identifying low-risk patients, we used a conservative definition of a positive study to include both positive and possibly positive x-rays. The success of the restrictive, high-defined coding strategy for x-ray interpretation is evident in the high inter-rater reliability.

Multivariate analysis through recursive partitioning identified decision trees (with and without plain abdominal x-ray) that identified low-risk patients; the decision to include or exclude the x-ray result was chosen to reflect the different practice settings in which x-rays are not always available. One low-risk decision tree was created with 3 variables: age, gender, and lethargy. Children who are either 5 months or younger, or older than 5 months and female without lethargy are less likely to have intussusception (4 of 118 [95% CI: 0.01%–0.08%]). The sensitivity of this decision tree in determining a low-risk group was 89% with an NPV of 97% and a negative LR of 0.25.

We also developed a low-risk decision tree with the incorporation of a plain abdominal x-ray. Patients with a negative plain x-ray and 5 months or younger are less likely to have intussusception (0 of 31 [95% CI: 0.0–0.1]). In patients with negative x-ray who are older than 5 months, those without bilious vomiting and with diarrhea are at lower risk of intussusception. Overall, this tree missed 1 patient with intussusception with a sensitivity of 97%, an NPV of 99%, and a negative LR of 0.08.

On the basis of this investigation, we believe the decision tree that used abdominal x-ray outperformed the tree using clinical predictors alone. We would recommend obtaining an x-ray if there is any suspicion of intussusception after the initial history and physical examination; positive x-rays should proceed to ultrasound or directly to air enema. For those with a negative x-ray, 3 clinical features (age older than 5 months, absence of bilious emesis, and presence of diarrhea) should be considered low risk. These low-risk patients can be observed for improvement, or if worsening signs develop, proceed with additional diagnostics or surgical consultation.

Despite being the largest prospective investigation of children with possible intussusception, the study was limited by use of a nonvalidated questionnaire. In addition, analysis was constrained by having only 38 cases of intussusception. Enrollment depended on consideration of intussusception as

determined by the treating faculty physician; this judgment has the potential for enrollment bias. In addition, radiographsic readings were recorded retrospectively, and the radiologists were not blinded to clinical data at the time of their report. It should also be noted that all x-rays were read by experienced pediatric radiologists at a tertiary care center; this diagnostic precision may not exist in a non–children's hospital setting. Lastly, our capture rate was only 68%. It is fortunate that the characteristics of the patients missed were similar to those enrolled in the study.

CONCLUSIONS

We were able to determine predictive clinical criteria and develop a decision tree to risk-stratify children with possible intussusception. We would recommend an abdominal x-ray for all children with possible intussusception. Patients younger than 5 months with a negative abdominal x-ray are at low risk for intussusception, as are those older than 5 months who have a negative abdominal x-ray, absence of bilious emesis, and presence of diarrhea.

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APPENDIX

PLEASE CHECK HERE IF:

☐ ***pt has had any imaging (including KUB) prior to completing this form***

☐ ***you have either reviewed prior imaging or have knowledge of the results prior to completing this form***

HISTORICAL INFORMATION:

Fever at home? ☐ yes: (***if yes,*** Tmax: _____) ☐ no ☐ unsure

Vomiting? ☐ yes: (***if yes,*** # of episodes in last 24 hrs: _____) ☐ no ☐ unsure

Diarrhea? ☐ yes: (***if yes,*** # of episodes in last 24 hrs: _____) ☐ no ☐ unsure

Apparent abd pain? ☐ yes: (***if yes,*** length of time in hrs: _____) ☐ no ☐ unsure

description of pain: ☐ episodic/colicky ☐ constant ☐ other (please specify):_____

Lethargy/fatigue? ☐ yes ☐ no ☐ unsure

Bilious vomiting? ☐ yes ☐ no ☐ unsure

Bloody diarrhea? ☐ yes ☐ no ☐ unsure

Altered mental status? ☐ yes, *episodic* ☐ yes, *persistent* ☐ no ☐ unsure

PHYSICAL EXAM: Does the patient *currently* have:

Lethargy/fatigue? ☐ yes ☐ no

Altered mental status? ☐ yes ☐ no

Abdominal distention? ☐ yes ☐ no

Abdominal tenderness? ☐ yes ☐ no
If yes: location (circle all that apply): RLQ LLQ RUQ LUQ Epig Umbilical Diffuse

Peritoneal signs? ☐ yes ☐ no

If yes (check all that apply): ☐ rebound ☐ guarding ☐ pain with percussion

Palpable abdominal mass? ☐ yes ☐ no
If yes: location (circle one): RLQ LLQ RUQ LUQ

Rectal exam? ☐ heme negative ☐ heme positive ☐ gross blood ☐ not performed

MANAGEMENT: What is *your* plan for the next step in patient's work-up (*check one*)?

☐ Observe or discharge with no further imaging ☐ KUB first, then US regardless of KUB result

☐ KUB first, then decide if further eval required ☐ KUB followed by air enema

☐ US first, then decide if further eval required ☐ Other _____