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## Brief Report

### COMPARISON OF LACTIC ACID LEVELS IN CHILDREN WITH SUSPECTED AND CONFIRMED INTUSSUSCEPTION

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**Abstract—Background:** Currently, no laboratory test can identify children with intussusception. Lactic acid is a marker of ischemia in gastrointestinal emergencies. **Objectives:** We present a case series comparing lactic acid levels in children with suspected and confirmed intussusception. **Methods:** This is a prospective single case series of 39 patients who had suspected intussusception. Patients were eligible if they underwent abdominal ultrasound screening for suspected intussusception. Blood collected at the time of peripheral intravenous line placement was analyzed for lactic acid levels before ultrasound. **Results:** Thirty-nine patients were enrolled; 16 were diagnosed with intussusception. Mean ( $\pm$  standard deviation) lactic acid levels were not significantly different between children with suspected ( $1.7 \pm 0.69$  mmol/L) and confirmed intussusception ( $1.93 \pm 1.13$  mmol/L). **Conclusions:** Lactic acid levels cannot identify children with intussusception. © 2017 Elsevier Inc. All rights reserved.

**Keywords—**intussusception; ischemia; lactic acid; pediatric; ultrasound

#### INTRODUCTION

Although intussusception is a common abdominal emergency in young children, it can be difficult to diagnose. The classic presentation of intermittent abdominal pain, vomiting, and bloody stools is present in <25% of patients

(1,2). Diagnosis may be delayed, leading to intestinal ischemia, bowel necrosis, and ultimately perforation.

Imaging studies are used to identify patients with intussusception. Abdominal radiographs are insensitive, with a sensitivity ranging from 62% to 80%, specificity ranging from 58% to 87%, and a false negative rate of 25% (3–6). Ultrasound is a superior imaging study, with a sensitivity and specificity near 100% (3,7). However, this is limited by sonographer experience and availability.

Currently no laboratory test can identify children with intussusception. Lactic acid is used as a marker of intestinal ischemia in other conditions. Elevated lactic acid levels identify mesenteric ischemia in adults and is used as a predictor of necrotizing enterocolitis in neonates (8–11). We present a case series of children with suspected intussusception in whom lactic acid levels were measured to assess if lactic acid can identify children with intussusception.

#### METHODS

We assembled a prospective case series of a convenience sample of patients in a pediatric emergency department who underwent abdominal ultrasonography for suspected intussusception at a tertiary care children's hospital with approximately 70,000 visits per year. Enrollment occurred between December 2011 and March 2013. The institutional review boards of the affiliated university and children's hospital approved this study.

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A convenience sample of patients between 6 months to 6 years of age who were undergoing ultrasound for suspected intussusception were approached for enrollment by a single investigator. Patients were identified as possible study subjects if the treating attending pediatric emergency physician ordered an ultrasound with the specific intent of identifying intussusception. Subjects were excluded if they had any of the following conditions: renal disease, metabolic disorders, including diabetes mellitus, ventriculoperitoneal shunt placement, seizure disorder, hepatic disease, history of blunt abdominal trauma within the past 2 weeks, a recent diagnosis of Henoch–Schönlein purpura, and a history of abdominal surgery within the past 6 months. Children with Henoch–Schönlein purpura were excluded because of the concern that lactic acid levels could be falsely elevated from vasculitis and nephritis.

Department protocol for patients with suspected intussusception was to perform abdominal ultrasonography as a screening examination in the department of radiology. Before the ultrasound examination, department protocol required placement of an intravenous line. Blood for lactic acid analysis was obtained at time of peripheral venous line placement, and blood was obtained without use of a tourniquet and before the administration of intravenous fluids. The main hospital laboratory analyzed the lactic acid levels using the VITROS LAC slide method (Ortho Clinical Diagnostics, Rochester, NY). Clinicians were not blinded to the lactic acid results, although these results were not typically available before completion of the ultrasound examination. Ultrasonography was performed at all hours in the radiology department and interpreted by attending pediatric radiologists. Ultrasound technicians were required to be present within 30 min of order placement.

Other laboratory analyses were ordered at the discretion of the clinician. Parents completed a questionnaire regarding presence of fever, abdominal pain, bloody stools, vomiting, and diarrhea. Data were obtained from the questionnaire and upon chart review using a formalized data collection sheet. Data compiled included demographics, symptoms, presence of grossly bloody stools, and results of imaging studies.

Patients discharged from the emergency department received a phone call within 3 to 7 days by an investigator who was not blinded to the final discharge diagnosis. An ultrasound was considered a true positive if confirmed by enema (air or Gastrografin [Bracco Diagnostics, Monroe Township, NJ]). An ultrasound was considered a true negative if the patient had no further symptoms at time of telephone follow-up.

Demographic data were summarized with standardized frequencies. The Student's *t* test was performed on continuous variables and the Chi square or Fisher's exact tests were used for categorical variables.  $p < 0.05$  was considered statistically significant.

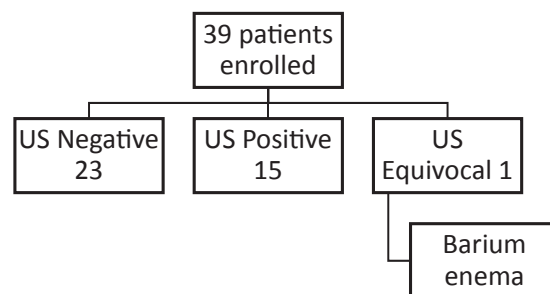


Figure 1. Patient enrollment. US = ultrasound.

## RESULTS

Thirty-nine children were enrolled, 16 of whom were diagnosed with intussusception—15 by positive ultrasound and 1 with an equivocal ultrasound and positive contrast enema (Figure 1). Twenty-three patients tested negative for intussusception by ultrasound. There were no significant differences between the populations in terms of age, sex, or reported symptoms (Table 1). The final diagnoses of patients who did not have intussusception were viral gastroenteritis ( $n = 15$ ), fussiness ( $n = 3$ ), allergic colitis ( $n = 2$ ), hematochezia ( $n = 2$ ), bacterial colitis ( $n = 1$ ), mesenteric adenitis ( $n = 1$ ), and abdominal pain ( $n = 1$ ).

Lactic acid levels were not significantly different between children with intussusception (mean  $\pm$  standard deviation  $1.93 \pm 1.13$  mmol/L) and patients without intussusception ( $1.70 \pm 0.69$  mmol/L;  $p = 0.29$ ; Figure 2).

Following reduction, 14 of 16 patients with intussusception were discharged from the emergency department. Two patients were admitted—1 child with concomitant appendicitis and 1 ill appearing patient. This patient, who had a large degree of rectal bleeding and a lactic acid value of 5.4 mmol/L, was discharged the following day; a repeat lactate measurement was not obtained.

Table 1. Demographics and Symptom Frequency

	Intussusception (N = 16)	No Intussusception (N = 23)	<i>p</i> Value
Months of age (mean)	25 (17)	20 (12)	0.17
Male sex, n (%)	12 (75)	15 (65)	0.73
Abdominal pain (hours)	24.2 (29.9)	20.3 (25.9)	0.98
Fever, n (%)	4 (25)	8 (35)	0.73
Bloody stools, n (%)	3 (19)	8 (35)	0.47
Vomiting, n (%)	11 (69)	20 (95)	0.24
Diarrhea, n (%)	5 (31)	11 (48)	0.34
Lethargy, n (%)	2 (13)	2 (9)	1.0

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