

Nausea Predicts Delayed Gastric Emptying in Children

Hilary Jericho, MD¹, Papa Adams, BA², Gang Zhang, PhD³, Karen Rychlik, MS³, and Miguel Saps, MD²

Objectives To assess whether the gastroparesis cardinal symptom index (GCSI), or any individual symptom, is associated with delayed gastric emptying in children, and to assess understanding of symptoms associated with delayed gastric emptying.

Study design Fifty children (36 F), 5-18 years of age, undergoing gastric emptying scintigraphy (GES) at Lurie Children's Hospital in Chicago, Illinois, completed Likert-type GCSI and symptom comprehension questionnaires. Correlation of GES results (normal or abnormal) with questionnaire results using the Wilcoxon rank sum test.

Results Seventy percent of subjects had a normal GES. Children reported understanding most terms of GCSI (average score 2.59, range 0-3). The GCSI was not associated with delayed gastric emptying. Nausea was associated with delayed gastric emptying only (numerical $P = .04$, word $P = .02$). Results were not altered when poorly understood terms were excluded.

Conclusions The GCSI is not associated with delayed gastric emptying in children. Lack of association does not seem to be related to lack of understanding. Nausea alone was the only symptom that showed an association with delayed gastric emptying on GES. (*J Pediatr* 2014;164:89-92).

Gastroparesis is defined by a delay in gastric emptying in the absence of mechanical obstruction. The clinical presentation of gastroparesis is variable and symptoms can include nausea, vomiting, early satiety, fullness, bloating, and abdominal pain, which are often also present in other common disorders. In pediatrics, gastroparesis is frequently idiopathic or follows an infection or surgery. Postinfectious gastroparesis tends to improve spontaneously over the course of several months,¹ whereas idiopathic disease can be more severe and intractable.² Treatment is usually symptomatic and can include frequent, small, low-fat, low fiber meals, prokinetics, transpyloric feeds, botulinum toxin injections to the pylorus, or gastric electrical stimulation.

Gastric emptying scintigraphy (GES) is considered the gold standard for diagnosing gastroparesis,^{3,4} but exposes patients to radiation, is expensive, time-consuming, and is not readily available at the doctor's office. The identification of one or more symptoms associated with gastroparesis could optimize the use of this test. To date, no studies have investigated the ability of symptoms commonly associated with gastroparesis to predict its diagnosis in children.

The gastroparesis cardinal symptom index (GCSI) is a validated symptom severity score designed to assess the impact of gastroparesis in adults.^{1,2,5-8} No such patient-reported symptom severity scale currently exists for use in the pediatric population. Determining whether the GCSI can predict gastroparesis in children would provide clinicians with a readily available, inexpensive, and noninvasive way to select patients for GES and monitor for symptom improvement.

This cross-sectional survey study evaluated modified versions of the adult GCSI in children with gastrointestinal-related symptoms suggestive of gastroparesis. The main objectives were to identify whether a pediatric version of the GCSI, or any specific gastrointestinal-related symptoms, could be associated with gastroparesis in children, as defined by the results of their GES.

Methods

From March 2011 through July 2012, all children ages 5-18 years, undergoing a GES for presumptive gastroparesis at Children's Memorial Hospital of Chicago (CMH) (currently Ann and Robert H. Lurie Children's Hospital of Chicago) were invited to participate in a prospective pilot study investigating the relationship between symptoms consistent with delayed gastric emptying and results of their GES. Patients were included if they could read and understand English and provide consent/assent. Pregnant, non-communicative, and non-ambulatory patients, and those with a psychiatric disorder or cognitive impairment were excluded.

Potential participants were identified from the nuclear medicine clinic schedule in the CMH electronic database (EPIC). Families were contacted by

BMI	Body mass index
CMH	Children's Memorial Hospital of Chicago
GCSI	Gastroparesis cardinal symptom index
GES	Gastric emptying scintigraphy

From the ¹Department of Pediatrics, Comer Children's Hospital, Chicago, IL; ²Department of Pediatrics; and ³Department of Biostatistics Research Core; Ann and Robert H. Lurie Children's Hospital of Chicago, Chicago IL.

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phone to assess their willingness to participate. Those who expressed interest were met upon arrival for their GES and consent/assent was obtained. Participants completed a series of surveys that included a numerically-based GCSI, a word-based GCSI, and a short questionnaire on symptom terminology comprehension. The study protocol was approved by the Institutional Review Board of CMH.

GCSI

Children's symptoms were scored using a modified version of the adult GCSI, a validated symptom severity scale (0-5) that utilizes reports of patients' symptoms over the preceding 2 weeks. The GCSI consists of 3 symptom clusters: postprandial fullness/early satiety cluster (4 subscale items): stomach fullness, inability to finish a normal-sized meal, feeling excessively full after meals, loss of appetite; nausea/vomiting cluster (3 subscale items): nausea, vomiting, retching; and bloating cluster (2 subscale items): bloating, stomach or belly visibly larger.^{6,7} The GCSI score is calculated as the average of all the subscale scores (each subscale score is calculated by averaging the items within the subscale). We used a modified version of the GCSI thought to be more child-friendly. The modified version was identical to the adult GCSI with the exception of a reduction from the 6-point Likert-type scale used in adults (0 = none, 1 = very mild, 2 = mild, 3 = moderate, 4 = severe, and 5 = very severe) to a 5-point Likert-type response scale (0 = none, 1 = mild, 2 = moderate, 3 = severe, and 4 = very severe) with the concerns that children would have a difficult time differentiating between the categories "very mild" and "mild." Scores ranged from 0-4, with higher scores reflecting perceptions of worse symptom severity. Although the GCSI does not include the symptom of abdominal pain, we assessed this individually as it is a frequent complaint in children. However, we did not include it in the GCSI calculation. Children completed 2 separate GCSI formats, numerical and word, to identify if they could better classify their symptoms with one over the other.

Symptom Comprehension

Owing to the adult-focused design of the GCSI, we also found it important to identify whether children were able to understand the wording in the questionnaire. We asked children to rank their understanding of the meaning of each individual symptom to assess this further with a score of 0 indicating "no" understanding, 1 "a little" understanding, 2 "mostly" understanding, and 3 "complete" understanding of the term. To assess for deviation of results secondary to poorly understood terms, data was rerun only using results from children who claimed to have a clear understanding of the terms (comprehension scores of 2 or 3).

Gastric Emptying Protocol

All patients were required to be nil per os for 6 hours prior to the GES in accordance to the multi-institutional, standardized protocol established by Tougas et al in 2000.⁸ Following the completion of the survey, children were provided with the stan-

dardized GES meal consisting of 2 large eggs (Eggbeaters; Con-Agra Foods, Omaha, Nebraska) prepared with Tc99m Sulfur Colloid 0.05 mCi/kg (minimum 0.5 mCi, maximum 1 mCi), 2 slices bread and jam, and water (children with egg allergy were offered oatmeal). The patient was required to eat the meal within 10 minutes. After the meal was given, the patient was placed upright and images of the stomach and bowel were obtained at 0, 30, 60, 90, 120, and 240 minutes using a low-energy high-resolution collimator. Patient results were classified as normal or abnormal based on results at 1, 2, and 4 hours after the meal. Gastric emptying scans were classified as "delayed" when there was greater than 90% retention at 1 hour, 60% retention at 2 hours, and/or greater than 10% retention at 4 hours, according to the 2007 Consensus Recommendations for GES from The Society of Nuclear Medicine and The American Neurogastroenterology and Motility Society.^{8,9}

Statistical Analyses

Statistical analysis was conducted using SPSS 20 (IBM Corp, Armonk, New York) and SAS 9.3 (SAS Institute Inc, Cary, North Carolina). Linear correlation between word and numerical charts was assessed using Pearson correlation statistics. The statistical significance of differences in clinical features within each of the GCSI subgroups and total GCSI scores from both charts were analyzed using the Wilcoxon Rank-Sum test. All *P* values were 2-sided if not otherwise stated; a level <.05 is considered as statistically significant.

Results

A total of 50 children (36 females, 72%) completed the surveys and underwent GES. Patients ranged in age from 5-18 years. The mean patient age was 13.2 years with a SD of 3.6 years. The mean body mass index (BMI) was 19.6 with a SD of 4.7 and was not associated with delayed gastric emptying (*P* = .99).

Table I. Delayed gastric emptying scan

Gastric emptying	Delayed gastric emptying scan n = 13	Delayed		
		1 h (>90% retained)	2 h (>60% retained)	4 h (>10% retained)
Female, n (% total sex)	7 (19)			
	1	X	X	
	2	X		
	3		X	X
	4			X
	5	X	X	
	6		X	X
	7		X	X
Male, n (% total sex)	6 (43)			
	1		X	X
	2	X		
	3	X	X	
	4	X	X	
	5			X
	6		X	X

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