

Diagnostic Value of a Peroral Sucrose Permeability Test in Children with Recurrent Upper Abdominal Pain

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ABSTRACT

The access of ingested sucrose into blood and urine indicates the presence of mucosal lesions in the upper gastrointestinal tract. The study involved 42 children, aged 5–15, having recurrent upper abdominal pain and 43 peers with minor extra-abdominal complaints. Sucrose in urine was determined by thin layer chromatography. The test was positive in 27 out of 42 children having recurrent abdominal pain (64.3%) and in none of the control children ($\chi^2 = 37.6$, $p < 0.0001$). When correlated with endoscopic findings it was falsely negative in 12 out of 38 patients with endoscopically verified lesions of the stomach or duodenum and falsely positive in 1 out of 4 without lesions. Sensitivity of the test was 68.4%, specificity 97.9%, positive predictive value 96.3%. The test cannot be used as an alternative to endoscopy, but may serve for screening of candidates for it.

Key words: recurrent abdominal pain, child, sucrose permeability, endoscopy

Introduction

Recurrent abdominal pain is one of the most frequent complaints in pediatric practice. The causes range from lesions and dysfunctions of the bowel and other intraabdominal organs to the psychogenic and emotional problems^{1–4}. Mucosal

lesions of the upper gastrointestinal tract – esophagitis, gastritis, gastric and duodenal ulcers can be verified by endoscopy, but endoscopy has its price, both literally and figuratively⁵. It requires an expensive equipment and a competent operator,

in small children it has to be performed in general anesthesia, and generally imparts discomfort and anxiety. In regard to the manpower, cost and other restrictions, it is practically impossible to perform endoscopy in all children in order to establish an accurate diagnosis as soon as possible and, on the other hand, the likelihood of finding a lesion that changed the management should be weighed against the costs, discomforts and potential hazards of the procedure (*cit.* 5).

A convenient screening tool that would help recognize mucosal lesions in the upper gastrointestinal tract in children prior to gastroduodenoscopy has been propounded by Vera et al⁶. The test, originally described by Meddings, Sutherland and co-workers⁷⁻⁹, measures the permeability of gastric and duodenal mucosa to sucrose. That disaccharide passes normally without absorption through the stomach and duodenum, and in the intestines it is degraded into absorbable monosaccharides glucose and fructose by the brush border sucrase-isomaltase. Inflammatory and ulcerative lesions of gastric and duodenal mucosa permit diffusion of intact sucrose molecules into the bloodstream and from there to urine. Detection of sucrose in urine denotes a defect of the mucosal layer in the esophagus, stomach and duodenum. The test has been used by several authors to detect gastric lesions due to

peptic ulcers, carcinoma or portal hypertension^{10,11}, lesions induced by non-steroid anti-inflammatory drugs¹²⁻¹⁵ and inflammation of gastric mucosa due to *Helicobacter pylori* infection^{6,16-19}.

Our aim was to obtain additional data on the feasibility and reliability of the sucrose permeability test as a diagnostic tool in the management of children complaining of recurrent abdominal pain.

Subjects and methods

The study involved 42 children having recurrent upper abdominal pain and 43 age-matched peers having minor extra-abdominal symptoms and signs, such as mild upper respiratory tract infections (8 children), behavioral problems (6), headache (4), enuresis (2), obesity (2), constipation (2) etc. Their median ages were 11 and 10 years, respectively (Table 1). The youngest subject was 4 and the oldest 15. All children were hospitalized in the Department of Pediatrics, Clinical Hospital Osijek. Their participation in the study was endorsed by informed consent of the parents. The consent agreement of each child was solicited in an appropriate manner. The Hospital's Ethical Committee approved the study.

The 42 children included into the study were selected from 620 children referred by pediatricians or general practitio-

TABLE 1
CHILDREN INVOLVED IN THE STUDY

	Children complaining of abdominal pain	Controls (children with minor extra-abdominal symptoms)*
Total number	42	43
Girls	26	26
Boys	16	17
Age (months)		
Median	132	121
Range	60–180	50–174

* See text for details

ners to the Gastroenterology service of our Department during two consecutive years because of abdominal pain. Selection for the study was based on Appley's criteria²⁰: age 3 or more years, at least 3 episodes of intermittent or nearly continuous abdominal pain, duration of the episodes 3 months or longer, last episode occurred in the year of examination, pain intensity disturbing normal activity of the child. Majority of the 42 children were seen in the Gastroenterology service several times prior to the test (and gastro-duodenoscopy). Excluded were children having diarrhea or intestinal parasites.

Endoscopy was performed as indicated by usual clinical criteria^{1-4,21}. It was carried out a few days after the sucrose test, during the same hospital stay. The child was sedated and examined by skilled gastroenterologist without general anesthesia. Control children did not undergo endoscopy. Common, internationally adopted diagnostic criteria for endoscopic findings were observed^{22,23}.

The sucrose test was carried out as originally described by Sutherland et al⁸. Briefly, the child fasted overnight. In the morning it was asked to take 100 g of laboratory-grade sucrose (Merck, Germany) dissolved in 400 mL of water, and to pass three samples of urine during the next 5–10 hours. For the first 5 hours, the child had to refrain from eating and, if possible, from drinking. Compliance with the test was satisfactory. Urine was kept at 4 °C and analyzed on the same day or frozen at –20 °C and analyzed later. Suc-

rose was determined by thin-layer chromatography²⁴. Chromatographic spots were arbitrarily graded from 1 to 3 (weak to strong) and the test was considered »positive« if at least a grade 1 spot was detected in at least one sample of urine. The results were read by a biochemist who did not know whether the samples were from patients or from control children. χ^2 -test was used for statistical analysis and $p < 0.05$ was set as the level of significance.

Results

As seen in Table 2, the sucrose test was positive in 27 out of 42 children having recurrent upper abdominal pain (64,3%) and negative in 15 (35,7%). None of the control children had a positive test ($\chi^2 = 37,6$ with Yates' correction, $p < 0.0001$).

Correlation of the sucrose test to the gastroduodenoscopy is presented in Table 3. Concordance of positive findings (sucrose vs. endoscopy) obtained in 26 out of 42 patients and of negative ones in 3, thus the overall concordance was 29/42 or 69%. The test was falsely negative in 12 out of 38 patients with endoscopically verified lesions of the stomach or duodenum and falsely positive in 1 out of 4 without visible lesions. Thus the overall discordance was 13/42 or 31%. On the basis of these data, sensitivity of the test was 68.4%, specificity 97.9%, and the positive predictive value 96.3%.

Endoscopic diagnoses included: 6 examples of esophagitis, 4 hiatal hernias, 36 examples of gastritis, 4 of gastroduo-

TABLE 2
RESULTS OF THE SUCROSE TEST

Outcome of the test	Children complaining of abdominal pain	Controls (children with minor extra-abdominal symptoms)*	Total
Positive	27	0	27
Negative	15	43	58
Total	42	42	85

TABLE 3
CORRELATION OF THE SUCROSE TEST
AND GASTRODUODENAL ENDOSCOPY
IN CHILDREN HAVING ABDOMINAL PAIN

Sucrose test	Endoscopy		Total
	Positive	Negative	
Positive	26	1	27
Negative	12	3	15
Total	38	4	42

*See text for details

denitis and 3 duodenal ulcers. The number of findings (53) exceeded the number of children (42) because some lesions occurred together, e.g. esophagitis with gastritis.

The test was more sensitive to the lesions involving the stomach (or both the stomach and duodenum) than to the lesions restricted to the esophagus or duodenum (without the stomach). It was positive in 17 out of 23 examples of mild gastritis (73.9%) and in 7 of 8 examples of severe gastritis (87.5%), as opposed to 2 out of 6 examples of esophagitis (33.3%), 2 out of 4 hiatal hernias (50%) and 2 out of 3 duodenal ulcers (67%). Apparently, sucrose passes into the bloodstream more readily the larger the mucosal surface of a bowel segment and the longer its contact with ingested bolus. A limited number of observations, however, do not permit valid conclusions.

The size of chromatographic spots and/or the number of positive urinary samples per patient were not correlated with the extent of endoscopically verified lesions. It should be noted that both sets of data were expressed in ordinal scales.

Discussion

Under our conditions, the sucrose permeability test appeared to be a feasible and helpful diagnostic tool. It recognized 26 out of 38 (68.4%) endoscopically veri-

fied lesions of the upper gastrointestinal tract and 3 out of 4 (75%) endoscopically normal findings. Lesions involving gastric mucosa were detected more frequently than the lesions in the duodenum or esophagus (74.3% versus 33.3% and 66.7%, respectively). That might be attributed to respective surface areas and contact times with the sucrose solution⁸. Indeed, absorption of sucrose through gastric mucosa has been shown to diminish as the gastric motility increases (and the emptying time shortens)²⁵.

Our study confirms and extends the observations of Vera et al.⁶, but a few differences in methods deserve a comment. Vera et al. found only 9 children with endoscopically verified lesions of the upper gastrointestinal tract (6 with mild gastritis, and 3 with erosive duodenitis) in their group of 40 children with recurrent abdominal pain, whereas we found 38 out of 42. As previously explained, our indications for admission to the study were based on Appley's criteria and therefore were likely to select patients who had lesions of the upper gastrointestinal tract. Vera et al. were primarily interested in *Helicobacter* infection. Second, we have determined sucrose in urine by thin-layer chromatography and expressed the results as »positive« or »negative«, while Vera et al. used gas chromatography and expressed the excretion quantitatively, as a percentage of the ingested amount. Finally, we did not tackle the question of *Helicobacter* infection. In spite of those differences, the results are quite congruent. According to Vera et al.⁶, the positive predictive value of the sucrose test in detecting gastric damage was 62.5% and its sensitivity to duodenitis was 33.3%. It detected infection with *Helicobacter* insofar as it caused mucosal lesion.

The issue of *Helicobacter* infection was not specifically addressed since *Helicobacter* apparently increases permeability to sucrose if accompanied by inflamma-

tion and neutrophil activation^{6,16,17,19}. Fukuda et al.¹⁸, however, assert that *Helicobacter* infection may increase the gastric permeability by itself, without mucosal lesions.

The sucrose permeability test, of course, cannot be used as an alternative to endoscopy in children having recurrent ab-

dominal pain. For that purpose it is not sensitive enough. But under the circumstances of limited access to endoscopic services, it may serve as a screening tool for selection of candidates for endoscopy. In patients with endoscopically verified lesions, it might help monitor the course of the disease and the effects of treatment.

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DIJAGNOSTIČKA VRIJEDNOST TESTA PERORALNE PERMEABILNOSTI SAHAROZE KOD DJECE S REKURENTNIM BOLOVIMA U GORNJEM ABDOMENU

S A Ž E T A K

Prijelaz saharoze iz hrane u krv i mokraću ukazuje na prisutnost lezije gornjeg dijela probavnog trakta. U ovu studiju uključeno je 42 djece, starosti od 5 do 15 godine, koji su imali rekurentnu bol u gornjem dijelu abdomena i 43 vršnjaka s manjim ekstra-abdominalnim problemima. Saharozu u urinu mjerili smo kromatografijom u tankom sloju. Test je bio pozitivan kod 27 od 42 djece (64,3 %), dok niti jedno dijete iz kontrolne skupine nije imalo pozitivan test (Chi square = 37,6, $p < 0,0001$). Korelacija s endoskopskim nalazima bila je lažno negativna kod 12 od 38 pacijenata s endoskopski potvrđenom lezijom želuca ili duodenuma, te lažno pozitivna kod jednog od četiri pacijenta bez lezija. Senzitivnost testa bila je 68,4 %, a specifičnost 97,9 %, dok je pozitivna prediktivna vrijednost iznosila 96,3 %. Ovaj test ne može se koristiti kao alternativa endoskopiji, ali može služiti za probir.