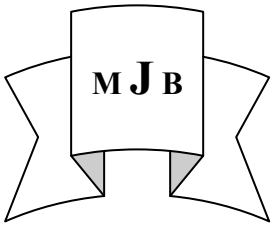
Carbohydrate Malabsorption in Acute Diarrhea

Jasim M. Al-Marzoki Bashar S. Khalaf
Dept. of Pediatrics, College of Medicine, University of Babylon, Hilla, Iraq.



Abstract

Background: Lactose, a disaccharide that comprises the monosaccharaides glucose and galactose, is the primary carbohydrate found exclusively in mammalian milk. Lactose intolerance can occur among infants and young children with acute diarrheal disease, although the clinical significance of this is limited except in more severely affected children.

Aim: to assess the frequency of carbohydrate malabsorption in a group of patients presenting with acute diarrhea.

Patients and Methods: A descriptive cross-sectional study , included 100 patients between 2 -36 months of age who were randomly selected from patients presenting with acute diarrhea to the Babylon Gynecology and Children Teaching Hospital. All those patients were screened for carbohydrate malabsorption by determination of stool pH and reducing substance. Further investigation by microscopy for fat, parasites, leukocytes and screening for rotavirus were performed in their stools.

Results: The study included 100 children 2- 36 months of age with acute diarrhea. Fifty six of them were males. The frequency of carbohydrate malabsorption was 41% and was highest among infants below one year, Mean± SD (10.25± 13.78) months. There was no significant difference regarding baseline and diarrhea characteristics of the study population and carbohydrate malabsorption apart from vomiting.

Conclusion: The frequency of carbohydrate malabsorption is common in infants and children with acute diarrhea.

سوء امتصاص الكربوهيدرات في الإسهال الحاد

الخلاصة

خلفية الدراسة: اللاكتوز سكر ثنائي يشتمل على سكرين أحاديين هما الجلوكوز والجالاكتوز، ينحصر وجوده في حليب الثدييات. يحدث عدم تحمل اللاكتوز بين الرضع والأطفال الصغار الذين يعانون من مرض الإسهال الحاد، على الرغم من محدودية الأهمية السريرية لهذا إلا في الأطفال الأكثر تضررا.

الهدف من الدراسة: لتقييم تردد سوء امتصاص الكربوهيدرات لدى مجموعة من المرضى الذين يعانون من الإسهال الحاد.

المرضى وطريقة العمل: دراسة مقطعية وصفية شملت ١٠٠ مريضا تراوحت أعمارهم بين ٢-٣٦ شهرا تم اختيارهم بطريقة عشوائية من المرضى الذين يعانون من الإسهال الحاد المراجعين لمستشفى بابل التعليمي للنسائية والأطفال. تم فحص جميع هؤلاء المرضى لسوء امتصاص الكربوهيدرات بتحديد درجة حموضة البراز ومواد الاختزال. تم إجراء مزيد من الفحوصات من قبل الفحص ألمجهري للدهون، والطفيليات، الكريات البيض والكشف عن الفيروس الدوار في البراز.

النتائج: شملت الدراسة ١٠٠ طفلا بين ٢-٣٦ شهرا من العمر يعانون من الإسهال الحاد. ست وخمسون منهم من الذكور. كان تواتر سوء امتصاص الكربوهيدرات ٤١٪ وكانت أعلى نسبة بين الرضع دون السنة الواحدة من العمر ،الوسط الحسابي ± الانحراف المعياري (١٠,٢٥ ± ١٣,٧٨) شهرا. لم يكن هناك فارق معنوي حول الخط الأساس والإسهال لخصائص مجتمع الدراسة وسوء الامتصاص من الكربوهيدرات باستثناء التقيؤ.

الاستنتاج: إن تكرار سوء الامتصاص من الكربوهيدرات شائع عند الرضع والأطفال الذين يعانون من الإسهال الحاد.

Introduction

Lactose, a disaccharide that comprises the monosaccharides glucose and galactose, is the primary carbohydrate found exclusively in mammalian milk. Absorption of lactose requires lactase activity in the small intestinal brush border to split the bond linking the 2 monosaccharides. A galactosidase termed lactase accounts for most of the lactase activity in the intestinal mucosa.[1] The first statement on lactose intolerance was published by the American Academy of Pediatrics Committee on Nutrition.[2] Lactose intolerance can occur among infants and young children with acute diarrheal disease, although the clinical significance of this is limited except in more severely affected children.[3] Secondary lactase deficiency implies that an underlying pathophysiologic condition is responsible for the lactase deficiency and subsequent lactose malabsorption. Etiologies include acute infection (e.g. rotavirus) causing small intestinal injury with loss of the lactase-containing epithelial cells from the tips of the villi. The immature epithelial cells that replace these are often lactase deficient, leading to secondary lactose deficiency and lactose malabsorption, although several reports indicate that lactose malabsorption in most children with acute gastroenteritis is not clinically important.[4] Several recent studies and a meta-analysis found that children with rotaviral (and other infectious) diarrheal illnesses who have no or only mild dehydration can safely continue human milk or standard (lactose-containing) formula without any significant effect on outcome, including hydration status, nutritional status, duration of illness, or success of therapy.[5,6] In infants with diarrhea in whom lactose (or other carbohydrate) intolerance is suspected, stool can be screened for malabsorbed carbohydrate by testing fecal pH, which decreases with carbohydrate malabsorption as a result of the formation of volatile fatty acids. Fecal reducing substances can also be measured and become positive by excretion of a reducing sugar in the stools. Reducing sugars include lactose, glucose, fructose, and galactose but not sucrose. Because some patients may only malabsorb enough carbohydrates, such as lactose, to lower the fecal pH but not increase excretion of carbohydrate in the stool, the pH test is a more sensitive test for carbohydrate malabsorption. The manifestations of lactose intolerance are watery acidic stools, abdominal distension and excessive flatus.[7] Perianal skin erosion is also observed frequently and is caused by contact of acidic, watery stools with the skin.[8,9] Lactose intolerance rates are significantly increased in children with a history of recent diarrhea [10] and dehydration due to osmotic diarrhea may be common.[7]

Aim

To assess the frequency of carbohydrate malabsorption in a group of patients presenting with acute diarrhea.

Patients and Methods

A descriptive cross-sectional study, included 100 patients between 2 -36 months of age who were randomly selected from patients presenting with acute diarrhea to the Babylon Gynecology and Children Teaching Hospital. Informed consent was obtained in all patients. Acute diarrhea was defined as 3 or more abundant watery stools per day, of less than 14 days duration. All those patients were screened for carbohydrate malabsorption by determination of stool pH and reducing substance using Universal Indicator Paper (MERCK,

Art. 9526) and clinitest tablets (AMES, Art. 2107). Kelly and Anderson's method and criteria were used in the detection of reducing substance in the stools[9]. According to this method, values under 0.25% are negative, values
between 0.25% and 0.50% indicate suspect cases and those over 0.50% are accepted as increased. Further investigation by microscopy for fat (Sudan 3), parasites (Lugol) and leukocytes (methylene blue staining) were performed in their stools. Slidex Rota kits which were produced by (Bio-Kit) were used to diagnose rotavirus in stool specimens.

Data management and analysis

Data was coded and entered into a computerized database. The analysis was done using the Statistical Package for Social Sciences (SSPS I5) software. Categorical variables were summarized as frequencies and proportions, while continuous variables as means, mode and standard deviations (SD). In the bi-variate analysis, odds ratios, 95% confidence interval (CI), and chi-square test were used to measure the strength of association between the factors considered and the dependent variable, while the student's t-test was used for continuous variables. P-value < 0.05 was considered for statistical significance. Results were summarized in tables and bar graphs.

Results

The study included 100 children 2- 36 months of age with acute diarrhea. Fifty six of them were males. The frequency of carbohydrate malabsorption was 41% and was highest among infants below one year, Mean± SD (10.25± 13.78) months. The baseline characteristics of the study population and carbohydrate malabsorption was mentioned in Table- 1, where no significant difference had been noticed between two groups apart from vomiting, which is more common in those patients with carbohydrate malabsorption. The odd ratio was significant (above one) in the following variables: gender, vomiting, abdominal pain, fever, immunization status, exclusive breast feeding, abdominal distention, thrush and pallor. Table 2 shows the diarrhea characteristics associated with carbohydrate malabsorption, where odd ratio was significant regarding the duration and previous episodes of diarrhea, presence of fat globules in the stool and infection with rotavirus.

Table 1 Baseline characteristics of the study population and carbohydrate malabsorption

Variables	**carbohydrate malabsorption** (41)	**No carbohydrate malabsorption** (59)	OR	95% CI	P-Value
Age in months:					
< 12 months	30 (73.17%)	43 (72.88%)	1.01	0.41-2.49	0.58
> 12 months	11 (26.82%)	16 (27.11%)			
Gender: Male	24 (58.53%)	32 (54.23%)	1.19	0.53-2.66	0.67
Female	17 (41.46%)	27 (45.76%)			
Residence: Urban	24 (58.53%)	35 (59.32%)	0.96	0.43-2.17	0.92
Rural	17 (41.46%)	24 (40.67%)			
Vomiting: Yes	31(75.60%)	31(52.54%)	2.8	1.16- 6.7	0.01
NO	10 (24.39%)	28 (47.45%)			
Abdominal Pain: Yes	31 (75.60%)	39 (66.10%)	1.58	0.65-3.88	0.30
NO	10 (24.39%)	20 (33.89%)			
Fever: Yes	25 (60.97%)	29 (49.15%)	1.61	0.71-3.62	0.24
NO	16 (39.02%)	30 (50.84%)			
Immunization:					
Up to date	32 (78.04%)	42 (71.18%)	1.43	0.56-3.64	0.44
Not up to date	9 (21.95%)	17 (28.81%)			
Measles in last 3 mo.					
Yes	1 (2.43%)	2 (3.38%)	0.71	0.06-8.12	0.63
NO	40 (97.56%)	57 (96.61%)			
Exclusive Breast Feeding (months)					
< 6 months	31(75.60%)	41(69.49%)	1.36	0.55-3.35	0.50
> 6 months	10 (24.39%)	18 (30.50%)			
Abdominal Distention: Yes	10 (24.39%)	11 (18.64%)	1.40	0.53-3.70	0.48
NO	31 (75.60%)	48 (81.35%)			
Thrush: Yes	11 (26.82%)	9 (15.25%)	2.03	0.75-5.48	0.15
No	30 (73.17%)	50 (84.74%)			
Excoriation: Yes	16 (39.02%)	16 (27.11%)	0.87	0.38-1.96	0.20
NO	25 (60.97%)	43 (72.88%)			
Pallor: Yes	14 (34.14%)	14 (23.72%)	1.66	0.69-4.02	0.25
NO	27 (65.85%)	45 (76.27%)			
Edema: Yes	1 (2.43%)	2 (3.38%)	0.71	0.06-8.12	0.63
NO	40 (97.56%)	57 (96.61%)			

Table 2 Diarrhea characteristics associated with carbohydrate malabsorption

Variables	**carbohydrate malabsorption** (41)	**No carbohydrate malabsorption** (59)	OR	95% CI	P-Value
Duration in days:					
< 7 days	32 (78.04%)	44 (74.57%)	1.21	0.47-3.11	0.68
> 7 days	9 (21.95%)	15 (25.42%)			
Type: Watery	39 (95.12%)	56 (94.91%)	1.04	0.16-6.54	0.66
Bloody	2 (4.87%)	3 (5.08%)			
Antibiotics Use:					
Yes	22 (53.65%)	35 (59.32%)	0.79	0.35-1.77	0.57
NO	19 (46.34%)	24 (40.67%)			
Herbs Use: Yes	2 (4.87%)	4 (6.77%)	0.70	0.12-4.04	0.52
NO	39 (95.12%)	55 (93.22%)			
Previous Episode: Yes	17 (41.46%)	16 (27.11%)	1.90	0.81-4.43	0.13
NO	24 (58.53%)	43 (72.88%)			
Fat globules: Yes	20 (48.78%)	24 (40.67%)	1.38	0.62-3.10	0.42
NO	21 (51.21%)	35 (59.32%)			
Yeast: Yes	9 (21.95%)	16 (27.11%)	0.75	0.29-1.92	0.55
NO	32 (78.04%)	43 (72.88%)			
Pus Cells: Yes	10 (24.39%)	15 (25.42%)	0.94	0.37-2.38	0.92
NO	31 (75.60%)	44 (74.57%)			
RBC: Yes	5 (12.19%)	7 (11.86%)	1.03	0.30-3.50	0.59
NO	36 (87.80%)	52 (88.13%)			
Rota Virus:					
Positive	6 (14.63%)	6 (10.16%)	1.51	0.45-5.07	0.35
Negative	35 (85.36%)	53 (89.83%)			

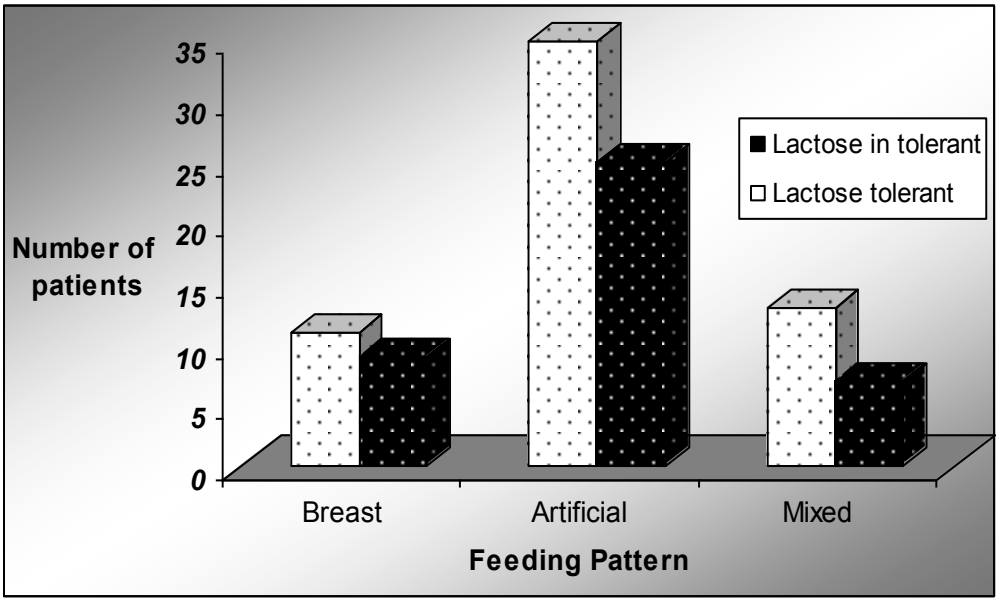


Figure 1 Distribution of patients according to feeding pattern

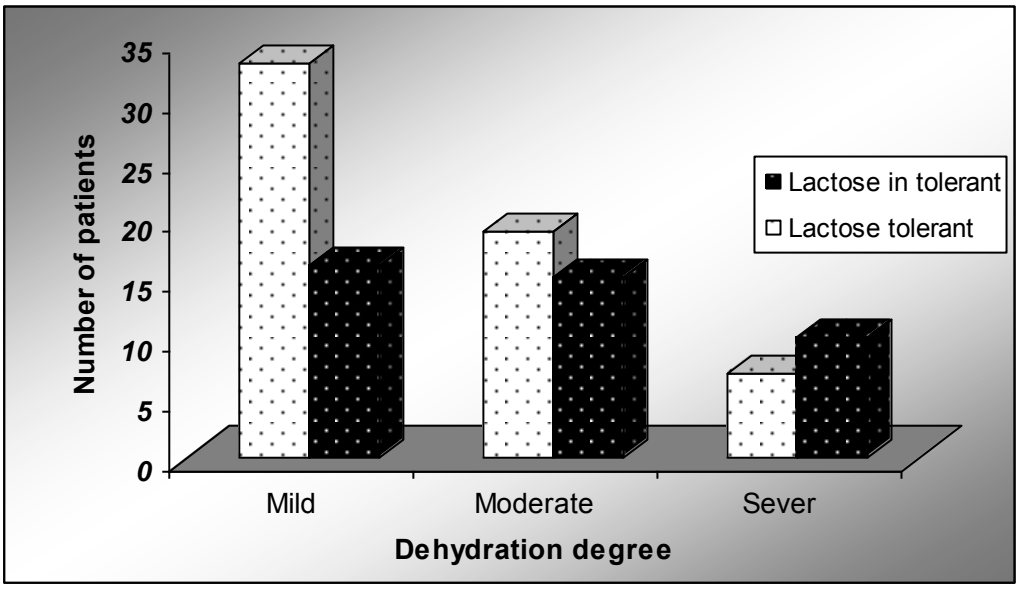


Figure 2 Distribution of patients according to dehydration degree

Discussion

This study shows that in children with acute gastroenteritis severe enough to merit hospital admission, carbohydrate malabsorption is a common complication, affecting 41% of children in this study, which was more than other studies done in Poland, (13%)[11], in Turkey(11%)[12] and in London (15.5%).[13] This difference may be explained by difference in the diagnosis of carbohydrate malabsorption, which was depending only on stool pH and reducing substance, while other studies had used other tests like H_2 breath testing and some times direct enzyme determination from biopsy material. Clinically those patients with carbohydrate malabsorption were prone to vomiting, abdominal pain and

distension, fever and thrush with significant odd ratio. Shepherd first reported transient sugar intolerance as a complication of rotavirus infection in 2 of 30 children[14], but Manuel et a1[15] suggested that the problem was rather more common, rotavirus was identified in six of nine children with transient monosaccharide intolerance. Active glucose absorption from the small intestinal lumen is coupled with that of sodium [16] and depends on the sodium pump, that is the enzyme Na^+-K^+-ATPase. Deficient intracellular activity of this enzyme has been shown in the ileum of piglets infected with coronavirus. [17] The same mechanism, with impairment of active sodium transport is thought to explain the transient glucose malabsorption in infants with rotavirus infection. In our study rotavirus seemed not to predispose to carbohydrate malabsorption. It is well recognized that breastfeeding increases resistance to gastroenteritis, and our study suggests that it gives significant protection against carbohydrate malabsorption, odd ratio (1.35). Feeding pattern showed that most patients with carbohydrate malabsorption were on artificial formula (Figure 1), which may be related to cow milk protein intolerance.[18] The current study showed that those patients who had sever dehydration were more prone to carbohydrate malabsorption (Figure 2), which could be related to sample collection from wards of the hospital.

Conclusion and Recommendation

- Carbohydrate malabsorption is common in acute diarrhea, so those patients must be send for detection of this problem.
- Other tests for detection of carbohydrate malabsorption like H_2 breath testing and direct enzyme determination from biopsy material should be available in the hospital to decrease the bias in this diagnosis.
- Other extended studies were needed in this field.

References

1- Semenza G. Anchoring and biosynthesis of stalked brush border membrane proteins: glycosidases and peptidases of enterocytes and renal tubuli. Annu Rev Cell Biol. 1986;2:255–313

2- American Academy of Pediatrics, Committee on Nutrition. The practical significance of lactose intolerance in children. Pediatrics. 1978;62:240–245

3- American Academy of Pediatrics, Committee on Nutrition. Hypoallergenic infant formulas. Pediatrics. 2000;106:346–349

4- Sandhu BK, Isolauri E, Walker-Smith JA, et al. A multicentre study on behalf of the European Society of Pediatric Gastroenterology and Nutrition Working Group on Acute Diarrhea. Early feeding in childhood gastroenteritis. J Pediatr Gastroenterol Nutr. 1997;24:522–527

5- Bhatnagar S, Bhan MK, Singh KD, et al. Efficacy of milk-based diets in persistent diarrhea: a randomized, controlled trial. Pediatrics. 1996;98:1122–1126

6- Brown KH, Peerson JM, Fontaine O. Use of nonhuman milks in the dietary management of young children with acute diarrhea: a meta-analysis of clinical trials. Pediatrics. 1994;93: 17–27

7- Melvin BH: Lactose intolerance in infants, children, and adolescents. Pediatrics 2006, 118(3):1279-1286.

8-Chandrika R, Anurag T, Radhakrishna H, et al .Thin layer chromatography in children with sugar intolerance in acute diarrhea. Indian Journal of Gastroenterology 2006 , 25:103.

9-Shaw AD, Davies GJ: Lactose intolerance: problems in diagnosis and treatment. J Clin Gastroenterol 1999 , 28:208

10-Brown KH, Parry L, Khatun M, et al . Lactose malabsorption in Bangladeshi village children: relation with age, history of recent diarrhea, nutritional status, and breast feeding. Am J Clin Nutr 1979 , 32(9):1962-9.

11- Szajewska H, Kantecki M, Albrecht P, Antoniewicz J. Carbohydrate intolerance after acute gastroenteritis- a disappearing problem in Polish children. Acta Paediatr. 1997 Apr;86(4):347-50.

12- Karaböcüoglu M, Sökücü S, Gökçay G, Uçsel R, Neyzi O. Carbohydrate malabsorption in acute diarrhea. Indian Pediatr. 1994 Sep;31(9):1071-4.

13- J Q Trounce, J A Walker-Smith. Sugar intolerance complicating acute gastroenteritis. Archives of Disease in Childhood 1985; 60: 986-990.

14- Shepherd RW, Truslow S, Walkcr-Smith JA, et al. Infantile gastroenteritis: a clinical study of coronavirus-like agent infection. Lancet 1975;ii: 1082-4.

15- Manuel PD, Lucas D, Walker-Smith JA. Transient monosaccharide intolerance in infants with acute and protracted diarrhoea. J Pediatr Gastroenterol Nutr 1984;3:41-5.

16- Crane RK. Sodium dependent transport in the intestine and other animal tissues. Fed Proc 1965;24:1000-6.

17- Shepherd RW, Gall DG, Butler DG, Hamilton JR. Determinants of diarrhea in viral enteritis. The role of ion transport and epithelial changes in the ileum in transmissible gastroenteritis in piglets. Gastroenterology 1979;76:20-4.

18- Harrison M. Sugar malabsorption in cows' milk protein intolerance. Lancet 1974;i:360-1.