

Diarrhea Caused By Carbohydrate Malabsorption

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KEYWORDS

• Lactose • Fructose • Antibiotics • Colonic transit • Dietary fiber • Intestinal gas

KEY POINTS

- Diarrhea in carbohydrate malabsorption is due to acceleration of colonic transit and the osmotic load of carbohydrates, short chain fatty acids, and electrolytes.
- Short chain fatty acids inhibit colonic transit, and their effect on transit deserves further evaluation for a possible clinical role in slow-transit constipation.
- Diarrhea associated with antibiotics may result from inhibition of colonic salvage of incompletely absorbed carbohydrates.
- In patients with lactose malabsorption, the association between malabsorption and abdominal symptoms has to be established.
- If lactose intolerance symptoms persist on a lactose restricted diet, other substrates for colonic bacterial metabolism, like dietary fibers or fructose, have to be restricted as well.

INTRODUCTION

The term carbohydrate malabsorption is used to describe conditions in which carbohydrates escape digestion and/or absorption in the small intestine and reach the colon. Although this is usually considered to be a consequence of a malabsorptive disease of the pancreas or small intestine, carbohydrates also reach the colon in physiologically incomplete carbohydrate absorption. This is due to ingestion of carbohydrates for which the healthy gastrointestinal (GI) tract of the human has a limited digestive or absorptive capacity. Carbohydrate malabsorption may result in symptoms due to complete or incomplete bacterial metabolism of carbohydrates in the colon. These symptoms are bloating, abdominal cramping, passing of gas, flatulence,

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and diarrhea (carbohydrate intolerance). It is important for physicians and for patients to remember that carbohydrate intolerance does not necessarily imply that a malabsorptive disease is present, but may be the result of individual dietary habits or intolerances, probably related to increased intestinal sensitivities.

Symptoms of carbohydrate intolerance may result from

1. Inborn or acquired defects of luminal or membrane bound pancreatic or intestinal enzymes that are needed for digestion of polysaccharides, oligosaccharides, or disaccharides
2. Decreased absorption of monosaccharides due to primary defects in mucosal absorptive mechanisms or secondary to extensive reduction of small intestinal absorptive surface area due to small bowel diseases or extensive resections
3. Ingesting carbohydrates for which there is a physiologically limited or totally absent digestive and/or absorptive capacity, like fructose, mannitol, sorbitol, or dietary fibers
4. Adverse effects of therapy or dietary intervention with nonabsorbable carbohydrates (lactulose, lactitol), drugs interfering with carbohydrate absorption (acarbose, metformin), or sugar exchange products (sorbitol, fructose)
5. Antibiotics interfering with colonic salvage of malabsorbed or physiologically incompletely absorbed carbohydrates

This article will focus on the role of the colon in the pathogenesis of diarrhea in carbohydrate malabsorption or physiologically incomplete absorption of carbohydrates, and on the most common manifestation of carbohydrate malabsorption, lactose malabsorption. In addition, incomplete fructose absorption, the role of carbohydrate malabsorption in other malabsorptive diseases, and congenital defects that lead to malabsorption will be covered. The article concludes with a section on diagnostic tools to evaluate carbohydrate malabsorption.

METHODS FOR ESTABLISHING THE ROLE OF CARBOHYDRATE MALABSORPTION FOR THE PATHOGENESIS OF DIARRHEA

Carbohydrates that are not absorbed in the small intestine are metabolized by colonic bacteria to organic acids. These organic acids are lactic acid and the short chain fatty acids respectively their salts acetate, propionate and butyrate. Most of the organic acids are absorbed across the colonic mucosa.^{1,2} Carbohydrates that are not metabolized by colonic bacteria to organic acids, and organic acids that escape absorption by the colon, remain in the colonic lumen and lead to osmotic diarrhea and fecal calorie loss.^{3,4}

Whether carbohydrates exert osmotic activity in the colon, thereby resulting in colonic water and electrolyte accumulation and diarrhea, depends on their molar concentration (expressed in mmol/L). For assessment of their osmotic activity, products of bacterial carbohydrate metabolism, that is organic acids, have to be taken into account. Lastly, for calculation of the osmotic activity of malabsorbed or incompletely absorbed carbohydrates, also the cations, which are bound by anionic salts of organic acids, have to be considered. The authors have previously established that 1 mmol of fecal organic acids obligates an average of 0.6 mmol cations (0.30 mmol Na, 0.21 mmol Ca, 0.07 mmol K, and 0.02 mmol Mg).^{3,4}

A comprehensive picture of the magnitude of carbohydrate malabsorption and its significance for the pathogenesis of diarrhea in malabsorptive diseases was gained in studies in which fecal outputs of carbohydrates and organic acids were measured in normal subjects with diarrhea induced by ingestion of lactulose, and in patients with severe malabsorption.^{3,4} Carbohydrates were assayed in 24-hour stool collections

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