Lactose Intolerance

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Persons with lactose intolerance are unable to digest significant amounts of lactose because of a genetically inadequate amount of the enzyme lactase. Common symptoms include abdominal pain and bloating, excessive flatus, and watery stool following the ingestion of foods containing lactose. Lactase deficiency is present in up to 15 percent of persons of northern European descent, up to 80 percent of blacks and Latinos, and up to 100 percent of American Indians and Asians. A sizable number of adults believe they are lactose intolerant but do not actually have impaired lactose digestion, and some persons with lactase deficiency can tolerate moderate amounts of ingested lactose. A diagnosis of lactose intolerance can usually be made with a careful history supported by dietary manipulation. If necessary, diagnosis can be confirmed by using a breath hydrogen or lactose tolerance test. Treatment consists primarily of avoiding lactose-containing foods. Lactase enzyme supplements may be helpful. The degree of lactose malabsorption varies greatly among patients with lactose intolerance, but most of them can ingest up to 12 oz of milk daily without symptoms. Lactose-intolerant patients must ensure adequate calcium intake. (Am Fam Physician 2002;65:1845-50,1855-6. Copyright© 2002 American Academy of Family Physicians.)

A patient information handout on lactose intolerance, written by the authors of this article, is provided on page 1855.

Malabsorption of dietary lactose in the small intestine results in gastrointestinal symptoms such as abdominal pain, bloating, passage of loose, watery stools, and excessive flatus. Lactose intolerance is generally a lifelong inherited condition but can be a temporary result of an infection or other insult to the jejunal mucosa. Recognition of this prevalent condition is important, as it is easily managed by simple dietary adjustments. Accurate diagnosis of lactose intolerance can significantly relieve patient anxiety and avoid inappropriate investigation and treatment.

Pathophysiology

The lactase enzyme is located in the brush border (microvilli) of the small intestine enterocyte. The enzyme splits and hydrolyzes dietary lactose into glucose and galactose for transport across the cell membrane. The enzyme activity and the transit time of lactose through the jejunum mucosa are important for proper absorption. If lactase enzymes are absent or deficient (hypolactasia), unabsorbed sugars osmotically attract fluid into the bowel lumen. The fluid influx into the bowel is approximately triple the predicted amount based on the osmolality of the sugar content alone, because the intestine cannot maintain a high electrochemical gradient between contents and blood.[1]

In addition to increasing the volume and fluidity of the gastrointestinal contents, unabsorbed lactose entering the colon is affected by bacteria. Fermentation produces gas and results in the cleavage of lactose into monosaccharides. These monosaccharides cannot be absorbed by the colonic mucosa, thus increasing osmotic pressure and drawing more fluid into the bowel. In lactase-deficient patients, some of the carbohydrates reaching the colon can be metabolized by bacteria into short-chain fatty acids and absorbed, but the net result of ingestion of lactose is a substantial rise in fluid and gas in the bowel.

Epidemiology and Etiology

Lactose malabsorption is a normal physiologic pattern.[2] The condition occurs in three main types: primary, secondary, and congenital lactase deficiency. The most common form of lactase deficiency is primary adult hypolac-

The amount of ingested lactose required to produce symptoms is usually about 8 to 12 oz of milk.

tasia. Secondary or acquired hypolactasia can follow any gastrointestinal illness that damages the brush border or significantly increases transit time in the jejunum mucosa *(Table 1)*.[3] Lifelong complete absence of lactase (congenital alactasia) is rare.

All land mammals have a dramatic decrease in lactase after weaning. Worldwide, humans lose 90 to 95 percent of birth lactase levels by early childhood, and there is a continuous decline in lactase during the course of a lifetime. However, the prevalence of hypolactasia varies widely among ethnic backgrounds *(Table 2)*.[1] Estimates range from 2 percent in persons from Northern Europe to nearly 100 percent in adult Asians and American Indians. Blacks and Ashkenazi Jews have prevalences of 60 to 80 percent, and Latinos have a prevalence of 50 to 80 percent.

The wide variation in prevalence has caused speculation that lactase deficiency is the "normal" or "natural" state, and the persistence of significant lactase activity into adult life in northern European populations is an "abnormal" mutation that provides a selective advantage to groups using diary products.[1] It is unknown whether the continued use of dairy products after weaning leads to the retention of lactase activity or if the persistence of lactase enables the incorporation of dairy products into the diet.

TABLE 1
Causes of Secondary Hypolactasia

Small bowel
HIV enteropathy
Regional enteritis
Sprue (celiac and tropical)
Whipple's disease (intestinal lipodystrophy)
Severe gastroenteritis
Multisystem
Carcinoid syndrome
Cystic fibrosis
Diabetic gastropathy
Kwashiorkor
Zollinger-Ellison syndrome
Iatrogenic
Chemotherapy
Colchicine-induced in patients with familial Mediterranean fever
Radiation enteritis

HIV = human immunodeficiency virus.

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Clinical Features

Hypolactasia results in up to 75 percent of dietary lactose passing unaltered through the small intestine into the colon, where it is rapidly metabolized by colonic bacteria, pro-

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TABLE 2
Prevalence of Primary Lactase Deficiency in Various Ethnic Groups

Group	*Prevalence (%)*
Northern Europeans	2 to 15
American whites	6 to 22
Central Europeans	9 to 23
Indians (Indian subcontinent)	
Northern	20 to 30
Southern	60 to 70
Hispanics	50 to 80
Ashkenazi Jews	60 to 80
Blacks	60 to 80
American Indians	80 to 100
Asians	95 to 100

Adapted with permission from Sahi T. Genetics and epidemiology of adult-type hypolactasia. Scand J Gastroenterol 1994;29(Suppl 202):7-20.

ducing excessive fluid and gas in the bowel.[4] The symptoms patients experience vary, however, according to the quantity of lactose ingested and patients' ability to digest lactose.

In patients with common adult-type hypolactasia, the amount of ingested lactose required to produce symptoms varies but is reported to be about 12 to 18 g, or 8 to 12 oz of milk. Several factors affect the severity of symptoms after lactose ingestion, including the patient's ethnic origin and age; older patients are more susceptible.[1] Ingestion of small to moderate amounts of lactose usually produces bloating, cramps, and flatulence but not diarrhea. Ingestion of larger amounts of lactose, a faster gastric emptying time, and faster intestinal transit time all contribute to more severe symptoms. Conversely, increased lactase activity in the small intestine reduces symptoms. Other foods and the presence of suitable microflora in the colon can cause patients to be more symptomatic.

Symptoms are directly related to the osmotic pressure of substrate in the colon and occur about two hours after ingestion of lactose. Patients have usually learned to avoid milk products and often have a strong family history of similar problems. Admixtures of dairy products may offer improved tolerance so that some patients may be able to ingest chocolate milk, skim milk, and ice cream. In particular, yogurts with live cultures are usually well-tolerated because they contain bacterial-derived lactases.[5]

Yogurts with live cultures are usually well-tolerated by patients with lactose intolerance.

Consideration of differential diagnoses is important in patients with primary hypolactasia *(Table 3)*.[3] Acquired lactase deficiency or secondary lactose intolerance are present in a variety of gastrointestinal diseases with histologic evidence of mucosal damage. Irritable

TABLE 3
Leading Differential Diagnoses for Lactose Intolerance

Irritable bowel syndrome
Regional enteritis
Ulcerative colitis
Cystic fibrosis
Bowel neoplasm or polyp
Diverticular disease
Iatrogenic: inadvertent ingestion of laxative in nonprescription or alternative medicine, or ingestion of bran
Mechanical bowel compromise from previous endometriosis, adhesions, or gynecologic mass
Celiac disease
Tropical sprue
Viral and bacterial infections
Parasitic disease, such as giardiasis

Information from reference 3.

The measurement of breath hydrogen after ingestion of 25 to 50 g of lactose is more sensitive and specific than the lactose intolerance test.

bowel syndrome (IBS) is a benign gastrointestinal disorder with complex multifactor pathology.[6] Lactose intolerance and IBS have similar symptom complexes and incidences. The difficulty of making a positive diagnosis of either of these conditions has led to misdiagnosis of lactose intolerance in some patients. Establishing a positive diagnosis for either condition is difficult because patients with IBS frequently report intolerance of food, particularly dairy products.[7] Compounding the diagnostic problem is the fact that at least 25 percent of patients with IBS also have lactose malabsorption.[8] Because lactose intolerance is organic rather than functional in nature, it is fundamentally different from IBS. Lactose restriction may result in improvement of symptoms in both groups of patients.

Diagnosis

Diagnosis of lactose intolerance can usually be made on the basis of the history, supported by dietary manipulation. Diagnostic tests range from changes in breath hydrogen levels or serum glucose levels after ingestion of standard doses of lactose to biopsy of the small bowel.

Two formal tests are commonly used in patients suspected of having lactose intolerance. The lactose tolerance test consists of administering an oral dose of approximately 1 to 1.5 g of lactose per kg of body weight and obtaining serial blood samples for measurement of blood glucose levels. The test is positive if intestinal symptoms occur and the blood glucose level increases less than 20 mg per dL (1.1 mmol per L) above the fasting level. However, false-positive and false-negative test results occur in 20 percent of normal subjects because of the influence of variable gastric emptying and glucose metabolism.

The measurement of breath hydrogen after ingestion of 25 to 50 g of lactose is more sensitive and specific than the lactose tolerance test. The breath hydrogen test has become widely available and is often used rather than the lactose tolerance test. The breath hydrogen test is based on the principle that carbohydrate in the colon is detectable in pulmonary excretion of hydrogen and other gases.[9] A rise in breath hydrogen concentration greater than 20 ppm over baseline after lactose ingestion suggests hypolactasia.

The lactose breath hydrogen test is positive in 90 percent of patients with lactose malabsorption. The amount of lactose used for the breath hydrogen test is not physiologic.[10] Many physicians reduce the dose to a physiologic or dietary range, such as the 12 g of lactose present in an 8-oz glass of cow's milk. False-negative results occur in cases of absence of bacterial flora, recent use of oral antibiotics, or recent high colonic enema. Sleep, exercise, previous use of aspirin, and smoking may increase breath hydrogen secretion unrelated to lactose.

Adult Dietary Management

Patients should be informed that having lactose malabsorption does not mean they are allergic to milk, dairy products, or dairy foods. A milk allergy is related to the proteins in milk rather than the lactose. The degree of lactose malabsorption varies widely among patients, but most patients do not require a totally lactose-free or severely restricted diet.[11,12] Dairy products should not be totally eliminated because they provide key nutrients such as calcium, vitamins A and D, riboflavin, and phosphorus.[12]

Dairy products provide approximately 75 percent of the calcium available in the U.S. food supply.[13] Adult patients with lactose intolerance should maintain a calcium intake

of 1,200 to 1,500 mg per day, including actual dairy products up to their individual threshold for symptoms. Milk intake commonly has to be limited to less than 250 to 375 mL (8 to 12 oz) per day. Patients should consider drinking lactose-reduced milk or taking calcium supplements. Patients should also be advised to avoid medications that contain lactose as filler and certain food products that may contain unrecognized lactose *(Table 4)*. Patient education is usually highly useful in patients with lactose intolerance *(see patient information handout)*.

Patients with mild lactose malabsorption may benefit from using lactase enzyme supplements, such as Dairy Ease. The incubation of milk with lactase enzymes may also be helpful. However, patients should be warned that the lactase enzymes might not completely relieve the symptoms because the digestion of lactose is incomplete or because it is difficult to determine the effective dose of lactase enzyme. Therefore, enzyme supplementation should be an adjunct to, not a substitute for, dietary restriction. Nondairy synthetic drinks, such as Coffee-Mate, are a useful substitute for milk. Soy milk and rice milk are also well-tolerated.

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Recent evidence[2,14-16] suggests that patients with medically confirmed lactose malabsorption can ingest the number of servings of milk and dairy products recommended by the American Dietetic Association without experiencing gastrointestinal discomfort. Some patients increase their tolerance to lactose with repeated intake.[2,17]

Patients with secondary lactose intolerance require further investigation to identify the primary problem. Effective treatment of the underlying condition, such as administration of metronidazole (Flagyl) for treatment of giardiasis or a gluten-free diet for management of celiac disease, may not only ameliorate symptoms but also improve lactose intolerance. Patients with bacterial overgrowth may benefit from antibiotics such as tetracycline, metronidazole, or ciprofloxacin (Cipro).

TABLE 4
"Hidden" Sources of Lactose in Food Products

Although milk and foods made from milk are the only natural sources, lactose is often added to prepared foods. People with very low tolerance for lactose should know about the many food products that may contain even small amounts of lactose, including the following:

- Bread and other baked goods
- Processed breakfast cereals
- Mixes for pancakes, biscuits, and cookies
- Instant potatoes, soups, and breakfast drinks
- Margarine
- Nonkosher luncheon meats
- Salad dressings
- Candies and other snacks

NOTE: *Some products labeled nondairy, such as powdered coffee creamer and whipped toppings, may include ingredients that are derived from milk and therefore may also contain lactose.*

Information from Lactose intolerance. National Institute of Diabetes and Digestive and Kidney Diseases. Retrieved on June 1, 2001 from www.niddk.nih.gov/health/digest/pubs/lactose/lactose.htm.

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