INNOVATIONS IN GASTROENTEROLOGY
AN INTERVAL SAMPLING BREATH TEST FOR CARBOHYDRATE INTOLERANCE

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A simple breath test for carbohydrate intolerance has been developed. It is based on the principle that the exposure of carbohydrates to fermentation by certain intestinal bacteria results in the intraluminal production of H_2 gas. The majority of this H_2 is eliminated per rectum as flatus, but a constant percentage is eliminated by the lungs.[1] An increase in breath hydrogen excretion after carbohydrate ingestion, therefore, indicates some degree of its malabsorption or maldigestion, or bacterial competition for the carbohydrate substrate.

Conventional techniques for performing carbohydrate tolerance tests involve serial sampling of venous or capillary blood. Moreover, supraphysiological doses of sugars are required to register changes in blood glucose. The collection of expired air, however, is inherently less invasive, and we and others[2] have found it sensitive enough to measure malabsorption of physiological doses of carbohydrates, e.g., 12.5 g of lactose, the amount contained in a glass of milk.

The procedure is straightforward and uncomplicated. A baseline sample of end-expiratory breath is collected in a gas-tight syringe or gas-tight foil gas bag. The test carbohydrate, for example, 50 g or 12.5 g of lactose in water, is ingested. Hourly breath samples are analyzed for H_2 over a six-hour period during which the subject remains fasting. Reliable patients can be given the substrate and gas collection apparatus, administer the test at home or at work, and return the samples for later analysis. The analysis of hydrogen concentration in expired air is accomplished by gas-solid chromatography. We used a Model S gas chromatograph which can be purchased with pen recorder and accessories.

A tolerant subject will show less than a 10 ppm rise in H_2 concentration during the six hours following a challenge of lactose. Metz et al[3] have correlated a rise of greater than 20 ppm at two hours with a flat glucose curve using 50 g of lactose in water. As gastric emptying is variable and as different gram amounts of carbohydrates are being used, we prefer to follow the six-hour time course. Moreover, in this way, a semiquantitative approximation of the net excess H_2 production can be made on the basis of the estimated minute ventilation of the patient[4] and the interval change in H_2 concentration, i.e., integration under the curve. *Figure 1* shows the plot of an H_2 breath test, using 12.5 g of lactose in water.

The interval sampling breath test has specific suitability in pediatric gastroenterological practice because of its noninvasive collection techniques. Children, 3 years of age and older can voluntarily inflate collecting bags and the parents can administer the test in the comfortable surroundings of home. Samples from younger children can be collected with a face mask attached to a gas balloon via a one-way Rudolph valve, or by syringe aspiration[5] of a posterior nasal catheter. Besides the painless collection techniques, the interval sampling H_2 breath test has the additional advantage in young children to overcome the problem of variable and irregular gastric emptying and intestinal transit. In such patients, observations can be continued up to 8 to 10 hours using half-hour intervals.

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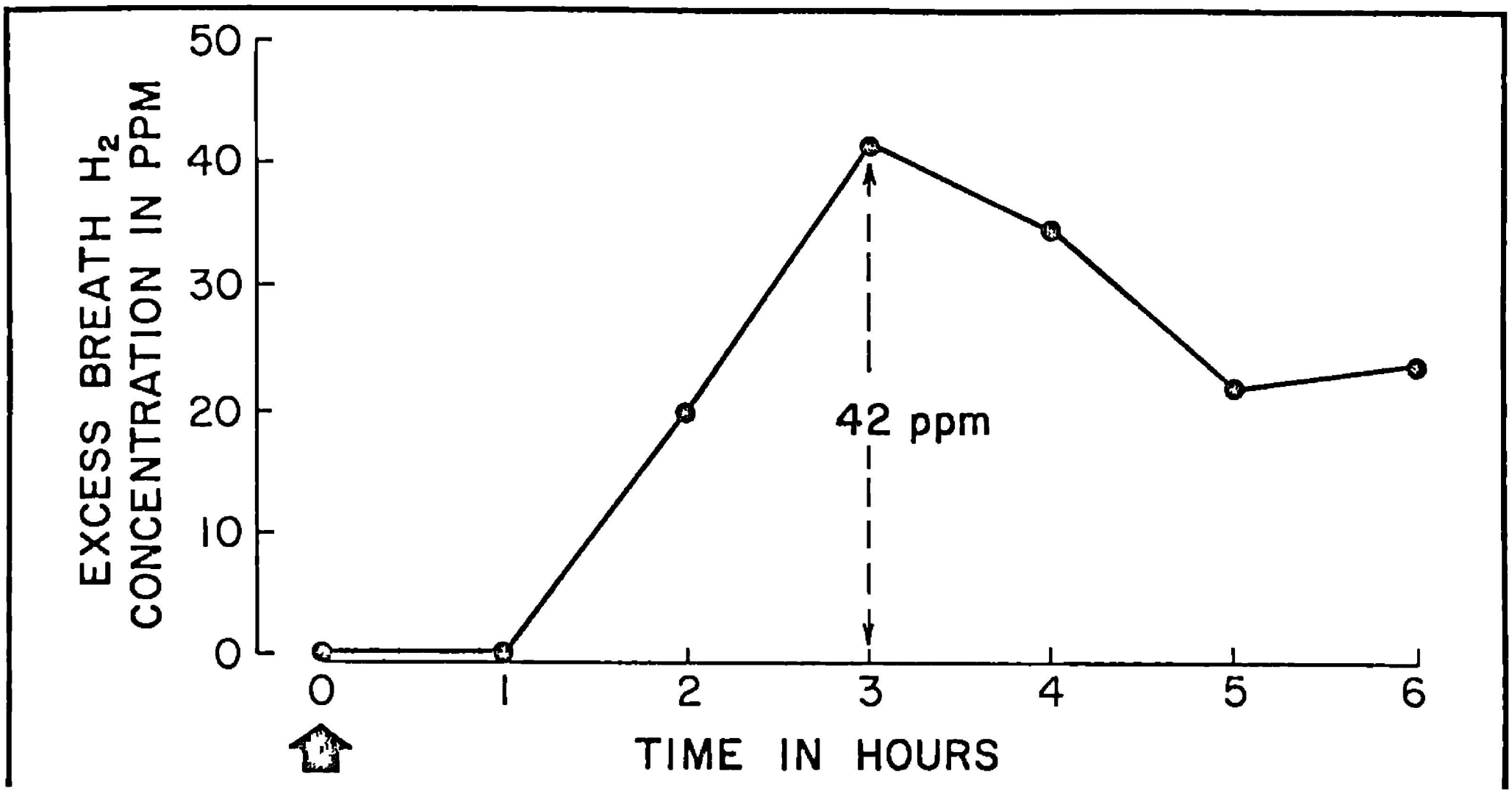

FIGURE 1: The increase in breath H_2 concentration above baseline over a six-hour observation period in a lactose intolerant indigenous Guatemalan who received a dose of 12.5 grams of lactose at zero time, indicated by the arrow. 12.5 g of lactose is a physiological dose equivalent to the amount contained in a glass of whole milk.

The prior use of antibiotics, particularly oral broad-spectrum antibiotics, can obliterate the flora required to ferment the carbohydrate. A careful history of recent antibiotic usage should be obtained for all patients.

The clinical application of interval sampling breath tests to date includes the diagnosis of upper intestinal overgrowth,[6] hyposucrasia,[7] as well as lactose intolerance. The interval sampling H_2 breath test is potentially useful for a clinical test of D-xylose absorption (Rosenberg III — personal communication). We have had promising results with the use of whole milk as a vehicle for lactose administration, a procedure, which further approaches the physiological situation.

References

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Announcement

Dr. J. Edward Berk, M.A.C.P., Member of the Editorial Board of *Current Concepts in Gastroenterology*, was recipient of the Distinguished Achievement Award of the Jefferson Medical Alumni Association. This honor, the highest bestowed on an alumnus, was presented by Henry L. Bockus, M.A.C.P.