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Lactose Tolerance Test on Indonesian Newborn Infants

by

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Introduction

It is well accepted that milk is the only source of nutrition for newborn infants. Human milk as well as cow's milk contains a considerable amount of specific carbohydrate, namely lactose. Lactose must be hydrolyzed into its components monosaccharides, glucose and galactose by small intestinal enzyme lactase in order to be utilized.

In infants with lactase deficiency, milk ingestion will lead to diarrhea and vomiting, consequently to dehydration, failure to thrive and possibly to death (Holzel et al., 1950; 1962; Townley, 1966). This condition will often be mistaken for an intestinal infection if lactase deficiency is not considered.

High prevalence of lactose intolerance has been widely reported among Negroes (Bayless and Rosensweig, 1966; Cook and Kajubi, 1966; Welsh et al., 1967; Kretchmer et al., 1971; Luyken et al., 1971) and Asians (Troncale et al., 1967; Davis and Bolin, 1967; Chung and McGill, 1968; Keusch et al., 1969; Santos-Ocampo et al., 1970; Gupta et al., 1971). Hypotheses of ethnic and genetic origin have been suggested (Bayless and Rosensweig, 1967; Ferguson and Maxwell, 1967; McCracken, 1971).

The findings of abnormal lactose tolerance tests on healthy Indonesian children (Suharjono et al., 1971) and adults (Surjono et al., 1972) were 72% and 90,6% respectively.

The aim of this present study is to determine the incidence of abnormal lactose tolerance among Indonesian healthy newborn infants.

Materials and methods

Seventy newborn infants ranging in age from five to nine days were studied during the period of August

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until November 1971. The tests were performed after they regained their birth-weight. Including ten low birth weight infants, the mean body weight of the cases was 2816 grams with a range of 2100 to 3640 grams. Fifty-six infants received breast feeding mainly and the remaining were fed acidified artificial milk and all were clinically well.

Tolerance tests after being given lactose orally (2 gm./kg. body weight) were done after a six-hour fast. Lactose as an approximately 10% solution in water was given by bottle or gastric tube. To ensure gastric passage, the infants were placed lying on their right side.

Fingertip capillary blood was obtained at 0, 30, 60, 90 and 120 minutes. Blood sugar was immediately by using Hagedorn-Jensen method. A maximum rise in blood sugar of 25 mg. per 100 ml or more the fasting value during the 120-minute test was considered normal. A flat sugar curve or abnormal response to lactose tolerance was defined as a rise of less than 25 mg. per 100 ml (Danovitch, 1966; Poley, 1970).

Glucose-galactose (1 gm. glucose + 1 gm. galactose/kg. body weight) and sucrose tests (2 gm./kg. body weight) were performed randomly on cases which had flat sugar curves on lactose tolerance. A clinical follow-up for evidence of diarrhea or other abdominal symptoms was done after the test. In cases with diarrhea, fresh stools were examined for pH and sugar content. Stool pH was measured by pH paper (Johnson of Hendon Ltd.) and sugar content was determined with Clinitest tablets (Ames Co.).

Results

In all the cases the average maximum rise in blood sugar was 35,6 mg. per 100 ml, ranging from 9 to 77 mg. per 100 ml. In 24 infants the maximum rise was observed at 30 minutes, in 35 infants at 60 minutes, in 8 infants at 90 minutes and in 3 infants at 120 minutes.

The response to lactose administered orally is summarized in the following table.

Maximum rise in blood sugar (mg. per 100 ml)	number of cases	associated with abdominal symptoms
less than 10	1	1
10 - 20	12	6
20 - 30	14	1
30 - 40	18	—
40 - 50	15	—
more than 50	10	—

In 22 (31,4%) out of 70 cases response to lactose tolerance was found. Their maximum rise in blood sugar over the fasting levels from 9 to 24 mg. per 100 ml with a mean value of 16,4 ± 4,7 mg. per 100 ml. Eight cases out of 22 in this group developed gastrointestinal symptoms on follow-up, consisting of diarrhea and/or abdominal distention. Their maximum rises in blood sugar were 9, 11 in two cases, 12, 14 in two cases, 16 and 20 mg. per 100 ml respectively. Six infants had watery acid stools as proved by pH paper and sugar content of ½% to 1½%. Of these six cases, five were breast fed.

Glucose-galactose and sucrose tests done randomly in these 22 infants revealed normal response (varying in maximum rise in blood sugar between 28 to 29 mg. per 100 ml in 11 infants of glucose-galactose gorup and of 34 — 84 mg. per 100 ml in sucrose group) without gastrointestinal symptoms.

Discussion

Recently several methods of determining lactase deficiency are used e.g. oral lactose tolerance test, intestinal biopsy, stool examinations (pH, Clinitest, chromatography), radiological technique, radioactive labeling, breath hydrogen (McCracken, 1971). The first two methods are commonly applied and analysis of stools are of value only in infants.

On ingestion of 2 gm./kg. body weight of lactose, normal infants will show a blood sugar rise of more than 25 mg. per 100 ml above the fasting level. The peak rises on lactase deficient subjects are less than 25 mg. and frequently less than 15 mg. per 100 ml (Danovitch, 1966; Dahlqvist and Lindquist, 1971).

An abnormal lactose tolerance test (LTT) secondary to lactase deficiency should be accompanied by gastrointestinal symptoms usually diarrhea (McDonagh, 1970). Glucose-galactose tolerance test as a control is used to demonstrate that the monosaccharide transport is unimpaired.

The LTT has been shown to correlate well with lactase enzyme levels as noted on biopsy specimens and this procedure is accepted as a good screening test for lactose intolerance (McMichael et al., 1965; Cook, 1967; Bayless and Rosensweig, 1967; Dahlqvist and Lindquist, 1971).

Considering a peak rise in blood sugar of less than 25 mg. per 100 ml as a flat curve, then 22 (31,4%) out of 70 infants had flat curves. However, only 8 of these infants developed gastrointestinal symptoms, six among them with diarrhea.

Stool pH of the infants with diarrhea was acid with a sugar content varying between ½% — 1½%. These infants had normal blood sugar rises after ingestion of either glucose and galactose or sucrose. These six infants can be considered as lactose intolerant. It is evident that lactose intolerance occurs in breast-fed infants as well as in artificially fed infants. A follow-up study of these infants is required to avoid subsequent effects of lactase deficiency.

The development of jejunal lactase occurs mainly during the last 3 or 4 months of foetal life, reaches a peak at the end of normal gestation. After premature birth development of this enzyme occurs rapidly. A further increase of lactase activity during the first 24 hours of life has been found; it seems to be related to the ingestion of milk (Auricchio et al., 1965).

Cook (1967) studied the lactase activity in the newborn of a population in which lactase deficiency is very common in adult life. Normal rise in blood sugar after oral lactose has been found in infants less than 1 week of age.

It is widely proved in some population groups that the lactase activity falls with increasing age and lactose intolerance develops even if lactose feeding is continued (Bayless et al., 1971).

Lactose deprivation was also not associated with a significant change in lactase activity (Bayless and Huang, 1969; Meeuwisse, 1971). Most researchers favor a genetic basis of the incidence of lactose deficiency. Several evidences can be summoned to support this theory (Cook and Kajubi, 1966; Huang and Bayless, 1968; Bryant et al., 1970; Kretchmer et al., Luyken et al., 1971).

Investigators report having isolated three distinct intestinal lactases (Cook and Dahlqvist, 1968; Gray and Santiago, 1969; Antonowicz and Shwachman, 1971). Two of them are capable of splitting lactose and presumably take part in digesting dietary lactose. Enzyme I is a brush-border lactase, peculiar to the intestines and is responsible for over 90% of the mucosal lactase activity, being depressed or absent in 'lactase deficient' subjects.

Enzyme II, also peculiar to the intestines, is present in normal levels in 'lactase deficient' subjects and seems to be responsible for most of the residual activity. Enzyme III, an obiquitous enzyme found throughout the body, is located in the lysosomes. Its role in digestion of lactose is dubious (McCracken, 1971).

Considering the type of milk for infants with lactase deficiency, a low lactose formula has been reported as satisfactory on growth and development during the infant period

(Sunoto et al., 1971; Varavithya et al., 1971; Surjono, 1972).

Summary

Lactose tolerance test (LTT) was performed on 70 newborn babies in their 5th — 9th. day of life (including 10 with low birth weight) after a 6-hour fast.

The test revealed that 22 out of 70 cases (31,4%) had abnormal response to LTT as shown by a flat sugar curve. Mean peak rise in blood sugar of this group was 16,4 ± 4,7 mgm. per 100 ml (range 9 — 24 mgm. per 100 ml). Six infants out the group were considered to be lactose intolerant as proved by normal response to glucose-galactose or sucrose tests, acid watery stools with positive Clinitest. The authors suggested the findings in favor of a genetic origin.

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