Small bowel diseases causing chronic diarrhea
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CHAPTER 7

ENZYME EXAMINATION:
LACTASE, MALTAPE, SUCRASE OF THE
SMALL BOWEL IN CHRONIC DIARRHEA
ABSTRACT

Background: In Indonesia, the proportion of carbohydrate from the daily intake is about 60-80%. A number of small bowel disorders can result in impairment of absorption and enzyme deficiency. Chronic diarrhea is common in Indonesia.

Material and Method: 34 functional dyspeptic patients with endoscopically normal small bowel as a control group and 17 chronic diarrhea patients of the Division of Gastroenterology University of Indonesia/Cipto Mangunkusumo Hospital were included in this study. All patients underwent gastroduodenoscopy and ileocolonoscopy examination. Biopsies were taken from the jejunum (2 specimens) and the biopsy specimens were examined for enzyme analysis (lactase, maltase, sucrase). The data were analyzed with Kruskal-Wallis or ANOVA.

Results: The lactase of the chronic diarrhea group was significantly lower than the control group (1.941±1.621 µmol/min.mg protein vs 2.502 ± 2.098 µmol/min.mg protein) (p<0.001). The maltase of the chronic diarrhea group was significantly lower than the control group (280.942 ± 148.173 µmol/min.mg protein vs 371.920 ± 250.177 µmol/min.mg protein) (p<0.001). The Sucrase of the chronic diarrhea group was significantly lower than the control group (48.474 ± 28.553 µmol/min.mg protein vs 66.727 ± 49.685 µmol/min.mg protein) (p<0.001).

Conclusion: The enzyme activity concentrations (lactase, maltase, sucrase) were much lower in chronic diarrhea cases.

Key word: Jejunum, chronic diarrhea, lactase, maltase, sucrase.
INTRODUCTION

Carbohydrates provide humans with the majority of their energy requirements. In the average Western diet, approximately 50 per cent of absorbable carbohydrates are ingested as starch with lesser proportions of sucrose, lactose, and fructose. In addition, small amounts of the absorbable sugar trehalose and non-absorbable carbohydrates including stachyose, raffinose and cellulose are ingested. (1) In Indonesia the proportion of carbohydrate in the daily food intake is about 60-80 %. (2,3) Normally, most of an ingested carbohydrate load is completely absorbed before reaching the colon but a number of disorders can result in impairment of absorption by the small intestine. Symptoms of carbohydrate malabsorption include abdominal distension, cramps, flatulence and diarrhea. (4,5) Whether carbohydrate malabsorption produces symptoms depends not only on the absolute intestinal digestive and absorptive capacity, but also on additional factors such as the quantity of the ingested load, the rate of gastric emptying, the response of the small intestine to an osmotic load, the metabolic activity of the colonic bacterial microflora and the compensatory capacity of the colon to absorb excess water and short chain fatty acids. The term carbohydrate malabsorption indicates that ingested carbohydrates are incompletely absorbed by the small intestine. Carbohydrate intolerance refers to symptoms that result from carbohydrate malabsorption. Lactose malabsorption is the most common disorder of carbohydrate absorption. Decreased brush border lactase levels occur in most mammals, including man, during the postweaning period. By adulthood, the majority of humans worldwide are lactase-deficient. A number of objective tests of small bowel biopsies are currently used to study the completeness of carbohydrate absorption for clinical purposes. The term carbohydrate malabsorption frequently refers to an abnormal result of one or more of these tests. The tests are for mucosal disaccharidase activity, and mucosal oligosaccharidase (maltase activity, sucrase activity). In contrast, the mucosal lactase activity test could reveal any abnormalities of lactose absorption. Even in apparently normal individuals, mucosal lactase concentration is the lowest of any of the disaccharidases. In isolated lactase deficiency and in diseases involving damage to the small intestinal mucosa, lactase levels are further diminished and are incapable of completely hydrolysing even moderate lactose loads. (4)

Chronic diarrhea is common in Indonesia. In this study we will examine the concentration level of enzymes of the small bowel in chronic diarrhea cases compared to normal Indonesian people. This study will disclose the lactose or sugar malabsorption in chronic diarrhea sufferers and normal Indonesian people.

MATERIALS AND METHODS

34 functional dyspeptic patients with endoscopically normal small bowel and 17 patients with chronic diarrhea in the Division of Gastroenterology, Department of Internal Medicine, University of Indonesia/Cipto Mangunkusumo hospital were included in this study. We used the PCF-10 Olympus to perform gastro-duodeno-jejunoscopy and the CF-200 Olympus to do the ileo-colonoscopy examination. Biopsies were taken from the small bowel (jejunum), 2 specimens. Normally the lactase or other enzyme activity is highest in the jejunum. (6,7) The 34 small bowel specimens (jejunum) from normal people and 17 small bowel specimens (jejunum) from chronic diarrhea patients were wrapped in plastic and stored at -40 °C and were then sent to AMC Amsterdam (Department of Clinical Chemistry) for the enzyme analysis to be carried out. The enzyme analysis was for: lactase, maltase, sucrase, acid phosphatase and alkaline phosphatase for each kind of biopsy. The enzyme analysis was done with spectrophotometry examination, using COBAS FARA spectrophotometer.

The data of the normal group and the chronic diarrhea group were compared and analyzed statistically (Kruskal-Wallis or Analysis of Variance/ANOVA).
RESULTS

Since 1997 until 2000, we obtained 34 specimens of the small bowel (jejenum) from normal people and 17 specimens biopsy of the small bowel (jejenum) from chronic diarrhea patients. In this study the enzyme analyzes of the jejunum in chronic diarrhea cases to normal were compared.

The lactase concentration was significantly lower in the chronic diarrhea group than in the normal group (p < 0.001). (Figure 1 and table 1)

The maltase concentration was significantly lower in the chronic diarrhea group than in the normal group (p < 0.001). (Figure 2 and table 1)

The sucrase concentration was significantly lower in the chronic diarrhea group than in the normal group (p < 0.001). (Figure 3 and table 1)

Table 1. Enzyme Concentration in Jejunal Biopsy Specimens

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Mean Concentration of Control Group (µmol/min.g.protein) (n=34)</th>
<th>Mean Concentration of Chronic Diarrhea Group (µmol/min.g.protein) (n=17)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactase</td>
<td>2.50 ± 2.09</td>
<td>1.94 ± 1.62</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Maltase</td>
<td>371.92 ± 250.17</td>
<td>280.94 ± 148.17</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sucrase</td>
<td>66.72 ± 49.68</td>
<td>48.47 ± 28.55</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Figure 1. The comparison of lactase enzyme activity concentration in jejunal biopsy specimens between chronic diarrhea and normal
Enzyme Examination: Lactase, Maltase, Sucrase of the Small Bowel in Chronic Diarrhea

**Figure 2.** The comparison of maltase activity concentration in jejunal biopsy specimens between chronic diarrhea and normal

**Figure 3.** The comparison of Sucrase activity concentration of jejunal biopsy specimens between chronic diarrhea and normal

**DISCUSSION**

Indonesian adults usually have lower lactase concentrations in their small bowel than European/American adults due to ethnicity/geographical differences. (8)

The normal range of lactase concentration in the European is between 13.5 – 63.5 (mean: 38.5 ± 12.5) μmol/min.gr.protein. In this study, we found low lactase concentration most likely due to the ethnic or geographical difference or technical problems in transporting the specimens etc. Interestingly, the result of lactase concentration in the chronic diarrhea group is statistically much lower than the control/normal group. So, in the chronic diarrhea group, damage to the small bowel mucosa might lower the concentration of lactase, which may play a role in the chronic diarrhea mechanism.

The maltase concentration in the chronic diarrhea group was statistically much lower than in the normal/control group. This may be caused by many processes or mechanisms playing a role in the mucosal damage in chronic diarrhea.

The maltase activity concentration in the normal/control group in this study is the same as the normal activity concentration in Europeans at 99 – 395 (mean: 247 ± 74) μmol/min.gr.protein.

The result of sucrase (saccharase) activity concentration in the chronic diarrhea group is also statistically much lower than in the normal/control group. We suspect this may be due to many processes or mechanisms in the pathogenesis of mucosal damage of the small bowel in
chronic diarrhea. The sucrase (saccharase) activity concentration in normal/control group in this study is the same as the normal activity concentration in Europeans at 35 - 179 (mean:107 ± 36) µmol/min.gr.protein.

The causes of lactase deficiency in chronic diarrhea were variable, including infection, inflammation, Celiac disease, congenital etc(9,10,11)

The low concentrations of lactase, sucrase and maltase in these chronic diarrhea patients were the same as in malnutrition (12,13). It has been demonstrated that in malnourished rats there is a significantly low concentration of lactase, sucrase and maltase, compared to normal rats.

CONCLUSION

Some enzyme (lactase, maltase, sucrase) concentrations of the small bowel specimens were much lower in chronic diarrhea cases.

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