

Disaccharidase Activities After Jejunioleal Bypass in Rat

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Digestive enzymatic activities (maltase, lactase and sucrase) have been determined in the intestinal mucosa of rats subjected to a jejunioleal bypass of 45 cm. The weight and protein content of the mucosa (mg/cm) were significantly decreased in the bypassed segment and significantly increased in the unbypassed segment, as compared to control rats. Maltase, lactase and sucrase specific (U/g protein) and total activity (U/cm intestine) were significantly decreased in the bypassed jejunum, compared to sham-operated rats. In the ileum, maltase specific and total activities increased in bypassed animals while the lactase and sucrase activities remained unchanged.

Key words: Bypass, Disaccharidase, Intestinal adaptation.

It has been reported that intraluminal factors are required for adaptative hyperplasia after partial loss of the small bowel in rats (8, 10, 17). Among enteric factors are gastroduodenal secretions, pancreatobiliary secretions, intestinal secretions and food. Food is essential for the maintenance of normal mucosal integrity (2, 16), and has a direct effect on brush border enzyme activity in the rat (3, 5, 19, 22).

To examine the role of intestinal contents as a stimulus for the adaptative response, we evaluated the mucosal mass of the small bowel in rats, after jejunioleal

bypass, comparing these animals to sham-operated controls. To determine the contribution of intestinal contents to variation in enzyme activity, we also evaluated brush border enzymatic activities of disaccharidases in jejunum and ileum of sham operated and bypassed rats.

Materials and Methods

Male Wistar rats weighing 280-300 g maintained on standard rat chow (with 35 % starch) were assigned to one of the following two groups: Transection: (sham-operation) involved division and suturing the small intestine 2 and 45 cm distal to the ligament of Treitz. Bypass: the proximal half of the small bowel (45

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cm) was bypassed as previously described NEMETH *et al.* (20).

The animals were fasted for 24 h prior to surgery and were anesthetized with intraperitoneal pentobarbital (4 mg/100 g body weight). Operations were performed between 8 AM and 11 AM. Intestinal end-to-end anastomoses were performed with 4-0 silk. Animals were permitted to drink, but not to eat, for 24 h thereafter, when food was restored.

After 3 months, both groups of animals were fasted for 24 h with free access to tap water, and were killed by a sharp blow on the head between 9 AM to 10 AM. Jejunal and ileal loops about 15 cm were isolated and rinsed with 0.9 % NaCl solution. Each intestinal segment was suspended under the uniform tension of a 30 g weight and the physiological length obtained multiplying by 0.6 (26), then was opened longitudinally on an ice-glass plate and the mucosa was then scraped with a glass slide in a uniform fashion.

The scrapings were immediately frozen and stored at -20°C for measurement of disaccharidase activity and protein concentration within 1 month. Disaccharidase activity was determined by the method of DAHLQUIST (6), using the 1:50 (maltase), 1:10 (sucrase) and 1:5 (lactase) dilution of the mucosal homogenate. One unit of enzymatic activity hydrolyzes a μmol of disaccharide/min at 37°C .

Protein content was determined by the method of LOWRY with bovine serum albumine as a standard (18). Student's t-test was employed for statistical analysis.

Results and Discussion

Three months after operation an atrophy of the bypassed jejunum and hypertrophy of the continuing ileum were observed (fig. 1). The mucosal protein (mg/cm) decreased by 44 % in the jeju-

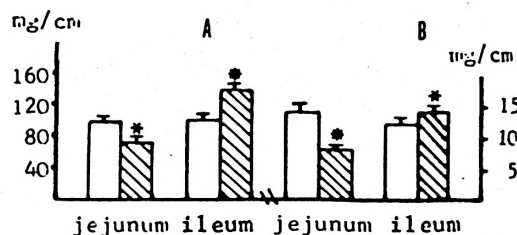


Fig. 1. Effect of jejunoileal bypass on intestinal mucosal mass (A) and mucosal protein (B).

Hatching bars represent bypassed animals. Values shown are mean $\pm$ S.E.M. * $p < 0.001$, * $p < 0.010$.

num and increased by 21 % in the ileum as compared with sham-operated rats. These results are in agreement with previous reports indicating that when the mucosa of the small intestine lacks contact with the chyme, it becomes atrophic, and that when it takes contact with an enriched chyme, it becomes hypertrophic (7, 8).

Figure 2 gives the data for specific (U/g protein) and total activities of brush border disaccharidases of jejunum and ileum of bypassed and sham rats. In the jejunum disaccharidases specific activity decreased after the operation compared to control rats, the decrease being lower for lactase.

This might be the lactase assay measuring lysosomal acid- β -galactosidase activity (12), and the observed values may not solely reflect brush-border enzyme activity. When the enzymatic activity is expressed as U/cm of intestine, the differences between bypassed and control animals were larger. The decrease in disaccharidases activities in the bypassed intestine agrees with previous reports (21, 22) and supports the view that luminal nutrition is necessary for the growth, development and maintenance of the normal structure and enzymatic activity of the gastrointestinal tract.

That the enzymatic activities were re-

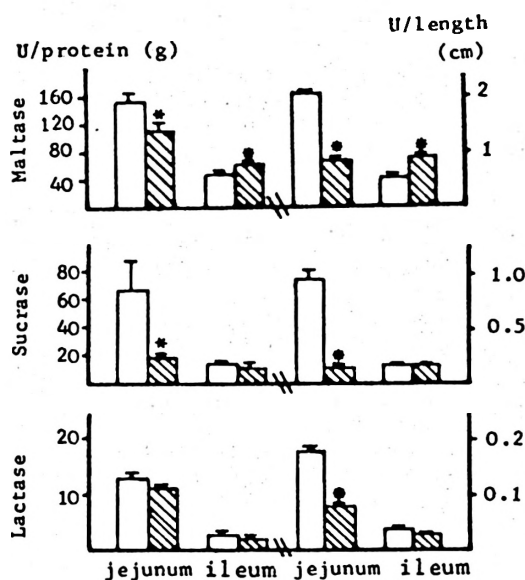


Fig. 2. Effect of jejunoileal bypass on disaccharidase activities in control (sham) and bypassed animals (hatching bars).

Values shown are mean $\pm$ S.E.M. * $p \leq 0.001$, * $p \leq 0.05$.

duced but not abolished after the operation, indicates that the enzyme synthesis in the bypassed jejunum must be also mediated by other factors in addition to luminal nutrition. Nutrients have been reported to have an indirect effect on unexposed regions of bowel, which may be hormonally mediated (9, 24). In fact, the stimulation of the ileum with nutrient-rich chyme would be expected to alter both neural and hormonal signals arising from it.

After jejunoileal bypass an increased plasma level of enteroglucagon and a decreased plasma level of gastrin, GIP, glucose and insulin have been described (14). Since enteroglucagon has been shown to have a trophic effect (1), it could be responsible for the residual enzymatic activity in the bypassed jejunum.

In the continuing ileum, sucrase and lactase activities were not different after the operation compared to sham rats, regardless of the reference chosen (fig. 2). In contrast specific activity and total activity of maltase increased after the operation. These results show that the regulation of the activity of these enzymes is not necessarily related.

Changes in dietary food composition (13), and starvation (15), elicit different responses in disaccharidase activities. Although there is a conflict in the literature lactase and sucrase appear to change in parallel, whilst maltase behaves differently (13), which agrees with our results. The increased ileal maltase activity after bypass surgery might be interpreted as an effect induced by the diet composition, although other factors like exocrine pancreatic secretions cannot be discarded (4, 25). It has been reported that pancreatic enzymes participate in the degradation of brush-border disaccharidases (23), and in rats that sucrase is degraded first (11).

Acknowledgements

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Resumen

Se determinan las actividades de maltasa, lactasa y sacarasa en la mucosa intestinal de ratas sometidas a una operación de bypass yeyunoileal de 45 cm. El peso y la proteína mucosal son significativamente menores en el yeyuno y significativamente mayores en el íleon de las ratas operadas. La actividad específica y actividad total de maltasa, lactasa y sacarasa son significativamente menores en el yeyuno de los animales operados con respecto a controles. En el íleon, la actividad específica y total de maltasa aumentan en animales operados, y no cambian las actividades de lactasa y sacarasa.

Palabras clave: Bypass, Disacaridasas, Adaptación intestinal

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