

# Consequence alimentary reconstruction in nutritional status after total gastrectomy for gastric cancer \*

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**Subject headings** stomach neoplasms; gastrectomy; nutritional status; nutrition disorders; esophagitis

## Abstract

**AIM** To investigate the effect of gastroenteric reconstruction on the nutritional status of patients with gastric cancer after total gastrectomy.

**METHODS** From 1989-1994, nutritional status was studied in 24 patients, including 12 patients with the gastric reservoir and pyloric sphincter reconstruction (GRPS), 7 with Braun's esophago-jejunostomy (EJ) and 5 with Lawrance's Roux-en-Y reconstruction (RY). The ability of these patients to ingest and absorb the amount of nutrients was examined and compared, and metabolic balance test was performed to compare the efficiency of those patients to accumulate and use the absorbed nutrients.

**RESULTS** In the controlled hospital situation, the amount of food ingested by all the patients was greater than that required for maintenance of ideal body weight. In direct contrast, food intake in most patients with EJ or RY reconstruction significantly decreased when the patients returned home and that in EJ patients it was the lowest. The overgrowth of anaerobic bacteria was found in the jejunum in the patients with EJ and RY, due mainly to food stasis in the duodenum or in the Roux limb, caused by the operative procedure itself. In patients with GRPS, because of restoring of the alimentary continuity accord-

ing to the normal digestive physiologic characters, all the nutritional parameters could fall in the normal range.

**CONCLUSION** The most common mechanism responsible for postoperative malnutrition was inadequate food intake. Having solved the problem of alkaline reflux esophagitis, it is imperative to preserve the duodenal food passage to reduce malabsorption and other complications after total gastrectomy.

## INTRODUCTION

To investigate the nutritional consequences of gastroenteric reconstruction in patients with gastric cancer after total gastrectomy, nutritional status was studied among patients undergoing the gastric reservoir and pyloric sphincter reconstruction (GRPS), Braun's esophago-jejunostomy (EJ) and Lawrance's Roux-en-Y reconstruction (RY) from 1989 to 1994, and the metabolic balance test was performed to compare the patients' efficiency to accumulate and use the absorbed nutrients.

## MATERIALS AND METHODS

### Subjects

All the patients studied were free from malignant recurrence or metastasis confirmed by CT for more than 6 months after the study. They were divided into 3 groups: (I) those with GRPS (12 patients, 9 men and 3 women, mean age, 47 years, range, 32-61 years); (II) those with EJ (7 patients, 5 men and 2 women, mean age, 51 years, range 42-60 years); and (III) those with RY (5 patients, 3 men and 2 women, mean age, 48 years, range 35-57 years).

### Methods

Each patient stayed in hospital for 18 days which were divided into 4 periods.

**The smorgasbord period** From 1-3 days, according to "the Table of the Nutrition amount Supplied in Meals per Day" (published in "Food Elements Table" by the China Nutrition Research Institute in

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1997), the standard diet was supplied to patients based on each one's dietary habits, and total caloric intake and the proportion of calories from protein, fat and carbohydrate were recorded accurately and calculated.

**The equilibration period** From 4 - 6 days, all patients were supplied the balance diet of 80g protein, and 100g fat, except the fat amount for those with steatorrhea reduced to 50g in the last 3 days.

**The metabolic balance period** From 6-12 days, the intake-output balance test period consisted of two consecutive 3-day periods, stool and 24h urine samples were collected for fat, nitrogen, Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>, P<sup>2+</sup>, Ca<sup>2+</sup> and Mg<sup>2+</sup> analyses.

**The special tests period** From 13-18 days, the Schilling test, D-xylose absorption test, glucose tolerance test and barium small intestinal transit time were made respectively. On the day of admission, while no treatment applied, serum specimens were drawn for various biochemistry examinations, and gastroscopy was performed to examine the esophagus carefully to discover if reflux esophagitis occurred. On the morning of the fourth day, via the guidance of fluoroscopy, a sterile tube was inserted through nose to jejunum to collect jejunal aspirate for culture and identification of anaerobes under sterile and anaerobic conditions. The aspirate was cultured and the anaerobic organisms were further classified according to procedures stipulated by "Bergey's Manual of Determination Bacteriology".

**Follow-up** Upon leaving the hospital, the patients were given the format designed according to "Nutritional Manual for Hospitalized Patients"<sup>[1]</sup>, and food intake was recorded accurately for 7 consecutive days at home environment for analysis later.

**Statistical analysis** The results were expressed as  $\bar{x} \pm s$ , and statistical analyses were made using Student's *t* test.

## RESULTS

### *Clinical data*

**Body weight** The average preoperative body weight of 3 groups all reached their ideal body weight (IBW). On the day of admission, group I patients achieved IBW, groups II and III weighted 10% and 20% less than their IBW respectively. The individual body weight of group I patients exceeded more than 5% - 10% of their pre-operative weight with one exception, in group III only 2 patients achieved their pre-operative weight, the others weighed 5%

- 15% less than their pre-operative weight, in group II all the patients weighted 10% - 20% less than their pre-operative weight.

**Dietary history** In the controlled hospital situation, the average caloric intake by all the patients reached or exceeded the Recommended Dietary Allowance (RDA). After returning to the home environment, the average daily caloric intake in group I was 100% of the RDA for the maintenance of IBW, and 75% in group II and 85% in group III, the largest decrease was noted in one patient of group II, only 63% of the RDA.

### *Absorption studies*

**Glucose tolerance and D-xylose absorption tests** Early hyperglycemia (> 11.01 mmol/L at 30min) and delayed hypoglycemia (< 3.92 mmol/L) were found by glucose tolerance test in 7 patients of group III and 4 patients of group II. Low D-xylose value in urine specimen was lowered in 2 patients of group II and 1 patient of group III.

**Fecal nitrogen examination** The nitrogen intake-output balance tests showed that the average value for fecal nitrogen in group I was less than 0.14mmol/d, and more than 0.14mmol/d in 4 patients of group II and 3 patients of group III, the most serious nitrogen wasting was noted in the azotorrhea patients of group II, whose average value was more than 0.16mmol/d. The loss rate for fecal nitrogen was 18.5% ± 3.2% in 4 patients of group II, and 17.4% ± 4.1% in 3 patients of group III. Low values of serum albumin were noted in 3 patients of group II and 2 patients of group III whose fecal nitrogen exceeded 0.15mmol/d.

**Fecal fat examination** Steatorrhea occurred in 6 patients of group II and 4 patients of group III. In those patients, the fecal fat loss rates averaged 16.1% ± 4.5% in 6 of group II and 17.5% ± 3.8% in 4 of group III. When the fat intake was reduced to 50g, the steatorrhea condition showed no alleviation. Fecal fat excretion of group I was less than 6g/d, while that in steatorrhea patients of group II and group III was more than 6g/d (range 8g/d - 21g/d). Serum carotene was low in steatorrhea patients (< 0.711 mmol/L), and serum cholesterol was low (< 2.84mmol/L) in 5 of group II steatorrhea patients and 3 of group III. Low values of serum albumin, serum carotene, serum cholesterol and D-xylose occurred only in the patients suffering from malabsorption of fat or protein.

**Caloric loss** In the patients with malabsorption of

protein and fat, the caloric loss was 351KJ on a standard diet due to fat and protein malabsorption. The highest caloric loss of 1966KJ occurred in one patient of group II.

**Water soluble vitamins** Normal serum values of Na, K, Cl, Mg, Ca, alkaline phosphatase, and prothrombin time, hemorrhagic phenomena and tetany and osteomalacia were not noted, all these serve as indirect evidence of adequate levels of vitamins D and K. Shelling test showed declined B12 absorption in all the patients.

**Gastroscopic examination and small intestinal transit time** Gastroscopic evidence of reflux esophagitis was noted in 7 patients of group II, and none in groups I and III. Barium small bowel transit time in group I was  $3.2 \text{ h} \pm 1.22 \text{ h}$  (normal time  $3.4 \text{ h} \pm 2.3 \text{ h}$ ). There was no significant difference, while there were significant differences between  $1.6 \text{ h} \pm 1.2 \text{ h}$  of group II, and  $2.3 \text{ h} \pm 1.3 \text{ h}$  of group III and the normal time.

**Bacterial culture** Anaerobes presented in the jejunal aspirate of one patient in group I, its count being  $10^7/\text{L}$ . Anaerobes were also found in the jejunal aspirate of 6 patients in group II and 4 patients in group III. Those were identified mainly as lactobacilli, yeasts, bacteroides, veillonella and clostrida.

**Balance studies** In the controlled hospital period, the data collected from the intake-output tests and repeated tests of serum samples showed that each element of N, P, Cl,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ , and  $\text{K}^+$  was in positive average daily balance, and there were no significant differences among the 3 groups.

## DISCUSSION

Protein, fat, carbohydrate, vitamins and minerals are the 5 major food elements required for proper nutrition. So it is important to ingest and absorb these 5 elements to keep good nutritional state of the post-operative patients.

### *Effect of reconstruction on body weight*

The major clinical manifestation of malnutrition is weight loss. Previous studies reported that the average postoperative weight loss was 24% as compared with preoperative one and only one-third patients achieved IBW<sup>[2]</sup>. Some studies indicated that a major contributing factor to weight loss and failure to gain weight was inadequate caloric intake of food<sup>[3]</sup>. The most serious complication leading to such state was alkaline reflux esophagitis<sup>[4]</sup>. The

most serious clinical symptoms caused by reflux esophagitis were found in group II patients in this study, and caloric intake was the lowest among the three groups after returning to home environment. In group III patients, although the Roux-en-Y reconstruction has solved the problem of esophagitis, the Roux-en-Y syndrome occurring in most post-operative patients also affects normal intake of food. Caloric loss is another factor contributing to malnutrition in groups II and III patients suffering from malabsorption of fat and protein.

### *Effect of reconstruction on digestion and absorption*

Besides adequate intake of the 5 food elements, good digestion and absorption are important as well. The duodenum plays an important role in the process of food digestion and absorption, and in controlling chyme emptying through a mechanism of immediate brake<sup>[5]</sup>, being the main site of cholecystokinin and gastric secretion stimulated by food after total gastrectomy. When the duodenum passage of digested food was excluded, secretion of bile and pancreatic enzymes could not coordinate and synchronize with emptying of chyme, therefore proper mixing of them could not precede within the time necessary for physiologic digestion. Without emulsification and specific hydrolysis of pancreatic peptidase and lipase, and without adequate biological re-action of conjugated bile salts, malabsorption of fat and protein would occur, and azotorrhea and steatorrhea ensued. In II and group III patients whose reconstruction excluded the passage of food through the duodenum, the barium small intestinal transit time was faster than that of normal control group, the glucose tolerance tests were abnormal in 7 patients of group II and 4 patients of group III, 6 patients of group II and 4 patients of group III experienced steatorrhea, and azotorrhea occurred in 4 and 3 patients of the two groups respectively. Because malabsorption of fat would result in malabsorption of some fat-soluble vitamins, the serum carotene level was low in those patients with steatorrhea. In group I patients, those parameters mentioned above could fall within normal biological range due to the maintenance of duodenal passage of food.

### *Effect of reconstruction on bacterial overgrowth*

The results of this study showed that anaerobes were cultured out of the jejunal aspirate in one patient of group I, 6 of group II and 4 of group III. Six hours after barium examination, barium residue was found in the jejunal loop and Roux limb in the corresponding patients of groups II and III respectively, imply-

ing that the ingested food would stay in the segment of reconstruction for rather a long time after intake of food stuff by those patients. The residual food would be an ideal place for microorganism overgrowth without sterilization of gastric acid after total gastric resection. Based on the results of this study, there is direct correlation between the reconstruction and bacterial overgrowth in the small bowels. Anaerobes proliferating in the small intestine, especially bacteroides, are able to change the structures of bile salts, to reduce water-soluble fat absorption impaired with inadequate concentration of conjugated bile salts. Anaerobes are also able to diversify ingested protein nitrogen to urea by deamination, resulting in impaired protein absorption. Meanwhile, bacterial consumption and toxins produced by bacterial metabolism would aggravate B12 deficiency of the postoperative patients.

#### ***Effect of reconstruction on nutritional balance and dietary habits.***

Patients in the controlled period of hospitalization, the food caloric intake by groups II and III could exceed RDA. The results of balance studies showed that all these patients could maintain positive balance of N, P and electrolytes. It was observed in this study that the abnormal nutritional status was mainly caused by gastrointestinal continuity altered by reconstruction after total gastrectomy for gastric

cancer, inducing abnormal changes of gastrointestinal dynamics and digestive environment, but the reconstruction exerted little influence on the absorption capacity of the small intestine, and the nutritional status could be improved by strict control. But in the home environment, especially for those with financial difficulties, it would not be easy, thus leading to malnutrition. However, the patients of group I could achieve normal nutritional state in daily life without any dietary control. Therefore, for maintenance of good nutritional status of postoperative patients, it is imperative to preserve the duodenal food passage, on the basis of having solved the problem of alkaline reflux esophagitis.

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