

Short Paper

Faecal fat and body weight changes following Roux-en-Y and jejunal loop interposition reconstructive technique in total gastrectomized dogs

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Summary

Total gastrectomy is one of the most common operative procedures for gastric malignancy, but the recommended method of gastrointestinal reconstruction after gastrectomy is still controversial. Significant weight loss has been noted by many observers following gastrectomy. The Roux-en-Y method is the most frequent reconstructive technique performed after gastrectomy. This technique is easy to perform and prevents reflux esophagitis, but the major disadvantage of the technique is bypassing of the duodenum from the transit of food. This study was performed to compare two reconstructive techniques (the standard Roux-en-Y and jejunal loop interposition) after gastrectomy, considering post operative body weight loss in 10 healthy dogs. In group A, Roux-en-Y, following gastrectomy end to side anastomosis was performed between the distal jejunal end and remained part of the stomach. In group B, jejunal loop interposition, a 20 cm section of jejunal loop was resected and interposition of the loop was performed between the remaining part of the stomach and the duodenum. The patients were weighed before and after surgery until 30 days postoperatively and their weights were recorded daily. Also, faecal fat was measured on day 28 postoperatively. No fat was detected in faecal samples in group B, however different amounts of fat were measured in group A. Mean of preoperative weight was 28 ± 3 kg. Data indicates a significant difference in mean of body weights in both groups pre and post operatively ($P < 0.05$). Mean percentage of body weights was significantly lower $67.18\% \pm 4.4$ in group A compared to group B ($73.05\% \pm 3.9$) ($P = 0.04$), which can indicate the importance of duodenal passage in reduction of post operative body weight loss.

Key words: Gastrectomy, Weight loss, Faecal fat, Dog

Introduction

Gastrectomy is a total or partial surgical removal of the stomach performed in gastric cancers, malignant lymphoma and benign stomach ulcers (McCorkle and Harper, 1954). In the case of gastric cancer, it is one of the most frequent malignancies. Satisfactory results are obtained when the ability of removal of the cancerous portion is increased. Today, progress in the surgical treatment of gastric cancer has resulted in the marked decrease in mortality rate (Lahey

and Marshall, 1950; Morii *et al.*, 2000). In spite of the decreasing mortality rate following total gastrectomy, severe nutritional problems still remain unsolved (Unver Saraydin and Koptagel, 2005). Post operative symptoms such as dysphagia, pyrosis, heartburn, decreased appetite and food intake, diarrhea, esophageal reflux, vomiting and other gastric signs are developed in many patients who undergo total gastrectomy. Despite nutritional supports these complications are followed by body weight loss (Nakane *et al.*, 1995;

Unver Saraydin and Koptagel, 2005). Different bowel reconstructive techniques have been introduced to improve nutrition in these patients and efforts are continued to introduce an ideal reconstructive technique following total gastrectomy (Schlatter, 1987). More than 50 reconstructive methods have been suggested following gastrectomy, but limited clinical trial studies have been conducted and there is no general agreement with regard to the ideal reconstructive method (McCorkle and Harper, 1954; Schwarz *et al.*, 1996). Food passage can be restored by an esophagojejunostomy simply, but resistant weight loss, esophageal reflux and sometimes severe dumping syndrome which occurs in 13-58% of patients can seriously affect quality of life. Most of the reconstructive methods are accompanied by duodenal bypass, which causes malnutrition because of inappropriate hormonal response to the food and insufficient mixing with biliopancreatic secretions (Min *et al.*, 1995). Preventing these complications, restoring duodenal transition and creating a reservoir substitute for the stomach are the main purposes of the reconstructive technique (Morii *et al.*, 2000; Lehnert and Buhl, 2004; Neto *et al.*, 2005). The Roux-en-Y, a procedure that includes the creation of a small proximal gastric pouch and the bypass of the duodenum is the most frequently reconstructive technique performed after total gastrectomy. The technique is easy to perform and prevents reflux esophagitis, which is the most common complication after gastrectomy. The major disadvantage of this technique is bypassing of the duodenum from the transit of food (Schwarz *et al.*, 1996; Sakamoto *et al.*, 1997; Rubino *et al.*, 2004). In order to preserve the duodenal food passage to improve compensation of digestive activities and absorption, jejunal interposition between the esophagus and the duodenum has been suggested. This procedure has been used following gastrectomy since 1994 (Tono *et al.*, 2003). The purpose of this experimental study was to compare Roux-en-Y and jejunal loop interposition, the two reconstructive techniques used following total gastrectomy, considering post operative body weight loss and faecal fat changes in canine.

Materials and Methods

Ten adult healthy male mixed breed dogs weighing 28 ± 3 kg were divided randomly into two equal groups. After approval was received by the University Research Committee, University of Tehran, the procedure was started according to animal ethics guidelines. The food was restricted for 12 h in all patients before the surgery. Under general anesthesia, the following gastrectomy reconstruction was performed using either Roux-en-Y or jejunal loop interposition in all dogs in the following order:

In group A (Roux-en-Y): the left gastroepiploic vessel and its branches were ligated and resected. Then gastroepiploic ligament and right gastroepiploic vessels were resected precisely. The stomach was freed from all its attachments and gastrectomy was performed. The stomach was resected cranially close to the cardia and caudally close to the pylorus, so that only 1/5th of the total size of the stomach remained. After gastrectomy the duodenal end was closed in a two layer inverting suture pattern. Then a loop of jejunum 20 cm distal to the Treitz ligament was identified and resected and end to end jejunojejunal anastomosis was performed. End to side anastomosis was performed between the distal jejunal end and the remained part of the stomach. The proximal jejunal end was end to side anastomosed to the rest of the jejunum (Figs. 1 and 2).

In group B (JLI): gastrectomy was done in the same manner. Then jejunal loop interposition was used to reconstruct the bowel. The 20 cm section of jejunum was resected from a 20 cm distance to Treitz ligament and brought through the stomach. The proximal end of the jejunal loop was end to side anastomosed to the remained part of the stomach and the distal end was anastomosed to the proximal duodenum. Finally, anastomosis was performed between the two remained parts of the jejunum (Fig. 3). The abdomen was lavaged and closed in a routine manner. The food restriction continued for three days after the surgery. Intravenous fluid was administered to support the patients' nutritional status

postoperatively. Four days following the surgery, the patients started feeding with a low volume of soft blended food. The body weights before and after surgery until 30 days postoperatively were recorded daily. Faecal samples were collected on day 28 after surgery in a container and the quality of stool fat was staminate in both groups using saponification technique. SPSS was used to compare data. Statistical significant was analyzed by Student's t-test and paired t-test. Differences with a p-value less than 0.05 were considered significant.

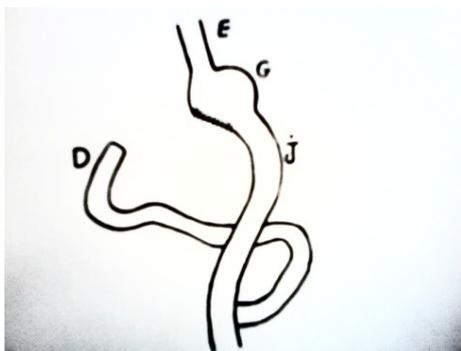


Fig. 1: Roux-en-Y technique



Fig. 2: The proximal jejunal end was end to side anastomosed to the rest of the jejunum

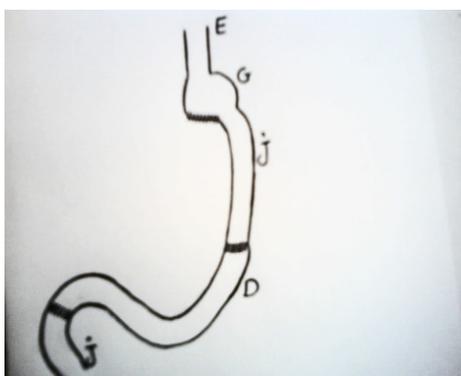


Fig. 3: Jejunal loop technique

Results

There were no complications during the surgeries and recovery from anesthesia. There was no evidence of wound infection or dehiscence in patients. All patients started oral intake of food at the fourth post operative day and there was no clinical sign of regurgitation in patients. No serious postoperative complications occurred. Although the dogs had an appetite to take food, less food was taken by patients compared to pre operative days. Signs of dumping syndrome including premature vasomotor disturbances, such as dizziness, faintness, weakness and signs regarding alimentary were insignificant, except one patient in group A, that showed symptoms consistent with the dumping syndrome, epigastric fullness, nausea, vomiting and regurgitation.

The mean body weights ratio during one month after the operation was compared with pre-operative body weights between and within groups. Mean of body weights before the operation was 26.6 ± 4.2 kg in group A and 27.6 ± 3.6 kg in group B. Mean of body weights one month after operation in group A and B were 18 ± 4.1 kg and 20 ± 3.1 kg, respectively. Data indicates a significant difference in the means of body weights in both groups pre and post operatively ($P=0$) (Fig. 4 and Table 1). Mean percentage of postoperative body weights per preoperative days ratio was significantly lower $67.18\% \pm 4.4$ in group A compared to group B ($73.05\% \pm 3.9$) ($P=0.04$). The result of faecal fat examination indicated that from +, ++ to trace quantities of faecal fat was measured in all dogs in group A. Although trace to minor quantities of fat were detected in group A, no fat was measured in dogs in group B.

Discussion

Despite different suggested techniques for reconstruction of the bowel following gastrectomy, the best reconstructive method still remains controversial among surgeons. Furthermore, the quality of life after surgery is one of the most important issues that, in different aspects, especially emotionally,

Table 1: Percentage of postoperative body weights per preoperative days ratio during 30 days

Day after surgery	Weight in ROUX-EN-Y group	Weight in JLI group	Day after surgery	Weight in ROUX-EN-Y group	Weight in JLI group
1	100	100	16	83	86
2	98.8	99	17	82.5	85.2
3	97.2	97.2	18	81.7	84.9
4	96.05	96.9	19	80.2	84.1
5	95.1	94.2	20	79	83
6	93.7	93.9	21	77	82
7	92.1	93.8	22	76.1	81.5
8	91	93	23	75.84	80.3
9	90	92	24	73	78.9
10	88	91	25	71.9	77
11	88.3	90.8	26	71.4	76.6
12	87.8	90	27	70	75
13	86	89.8	28	69.2	74.8
14	85	88.6	29	68.6	74.1
15	84.5	87.6	30	67.18	73.05

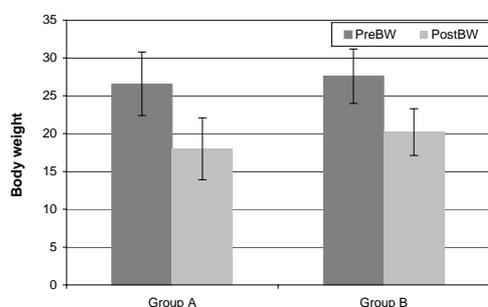


Fig. 4: Mean Body percentage changes during the 30 days of the study shows significant weight loss in Roux-en-Y group compare to jejunal loop interposition group (P=0.04)

have great influence over the gastrectomized patients. Significant body weight loss after total gastrectomy is expected and has been confirmed in many studies (Bradley *et al.*, 1975; Neto *et al.*, 2005). In this study all dogs in both groups suffered from significant body weight loss after total gastrectomy. This finding is consistent with the above mentioned findings. Kelly and Wangenstein (1954) and Adams (1963) reported that only one-third and 10.5% of the patients were able to achieve ideal body weight after the surgery, respectively (Kelly and Wangenstein, 1954; Adams, 1963). The effectiveness of gastric bypass inducing remarkable weight loss is nowadays a method of choice in treatment of patients affected with morbid obesity. Also, weight loss is a matter of concern in patients who have pathologic diseases such as gastric malignancies and ulcers who are candidates for gastrectomy. Although significant weight

loss due to malnutrition in 40-90% of patients has been regarded as a consequence of total gastrectomy, frequency and the exact cause of malnutrition after the operation are still controversial (Bradley *et al.*, 1975; Min *et al.*, 1995; Kalmar *et al.*, 2006).

In the present study, all animals had appetite except one patient in group A, that suffered from malnutrition, diarrhea, regurgitation and vomiting. It suggests the obvious weight loss and malnutrition is the result of inadequate calorie intake rather than mal-digestion or mal-absorption (Min *et al.*, 1995; Nakane *et al.*, 1995). Whatever the exact cause of malnutrition is, it is necessary to restore nutrition postoperatively in patients who have undergone gastrectomy regarding the expected weight loss. Intensive care in the management of feeding in these patients is highly recommended.

Mean body weight loss in group A (Roux-en-Y) and B (JLI) were 8.6 kg and 7.4 kg, respectively. Body weight loss was significantly lower in the group that jejunal loop interposition was used compared to Roux-en-Y group. It is reported that to preserve a better quality of life after total gastrectomy, pouch restoration with preservation of the duodenal passage should be performed (Schwarz *et al.*, 1996). These findings would suggest the jejunal loop interposition instead of Roux-en-Y as a standard reconstructive technique following gastrectomy, considering the lower loss of body weight. Morii *et al.* (2000), by comparing the Billroth II procedure with

jejunal loop interposition reported that jejunal interposition should be the standard reconstruction following gastrectomy. He also suggested comparing Roux-en-Y with this technique (Morii *et al.*, 2000).

The rapid passage of food in jejunal loop interposition technique sometimes caused a dumping syndrome because of the lack of reservoir function. To solve this problem, jejunal pouch interposition, which has been reported advantageous in compensating body weight loss after total gastrectomy is suggested (Brunner and Kempf, 1997; Tono *et al.*, 2003). In this procedure a jejunal pouch is used as a substitute for stomach. Schwarz *et al.* (1996) in a clinical study over 60 patients concluded that all patients with a postoperative life expectancy of at least 6 months should undergo pouch reconstruction with preservation of duodenal passage, while Mochiki *et al.* (2004) reported that the interposed jejunum with a pouch shows marked disturbances of a jejunum and these abnormalities may be responsible for insufficient food intake in these patients. So there is no need to have reservoir as a pouch (Mochiki *et al.*, 2004).

In this research faecal fat was observed only in animals from group A (Roux-en-Y technique) and was not reported in group B (JLI technique). Min *et al.* (1995) reported no significant difference of faecal fat in the esophagojejunostomy group than the control, and its amount in the Roux-en-Y esophagojejunostomy group was much higher than in the esophagojejunoduodenostomy and control group ($P < 0.05$). Pancreaticobiliary insufficiency and the lack of its mixing with chime is represented as a possible mechanism of malabsorption in Roux-en-Y gastrectomized patients (Bradley *et al.*, 1975; Morii *et al.*, 2000). Bypass of duodenum impairs the mixing of ingested nutrients with bile acids and pancreatic enzymes leading to maldigestion. The combination of malabsorption and maldigestion, while resulting in significant weight loss, predisposes to malnutrition (Wade *et al.*, 2010). It was showed that the absorption of carbohydrate in the GI tract is high after gastrectomy, whether the duodenum was bypassed or not, but the difference in protein and fat absorption is significant. In cases with duodenal food

passage, post-operative protein and fat absorption rate were 85 and 93%, respectively, whereas in duodenal bypass cases they were slightly lower, 80 and 78% for protein and fat absorption, respectively. According to the obtained results in this study, no presence of fat in faecal samples in group B indicates the superior effectiveness of the jejuna pouch interposition technique in the prevention of malabsorption compared to the Roux-en-Y technique. This shows the importance of the duodenal passing role in food absorption, especially for fat absorption (Min *et al.*, 1995). These results inspire the hypothesis that if the duodenal passage of food is restored and the pancreaticobilliray secretions are preserved it is not necessary to create a pouch as a reservoir substitute for stomach. To prove the value of jejunal loop interposition, and to evaluate other aspects of postoperative issues, further works and long term follow up need to be launched to confirm this finding.

Significant weight loss was observed in both Roux-en-Y and jejunal loop interposition reconstructing technique following total gastrectomy. However, body weight loss was significantly lower in jejunal loop interposition technique compared to Roux-en-Y. Also, the lower presence of fat in faecal samples of dogs that underwent jejunal loop interposition indicated the importance of duodenal passing of food and, especially, fat absorption. As a conclusion, jejunal interposition technique is superior to Roux-en-Y in body weight loss and the presence of less fat in faeces in dogs following total gastrectomy.

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References

- Adams, JF (1963). The clinical and metabolic consequences of total gastrectomy, 3 notes on metabolic functions, deficiency states,

- changes in intestinal histology, and radiology. *Scand. J. Gastroenterol.*, 58: 25-36.
- Bradley, EL; Isaacs, J; Hersh, T; Davidson, ED and Millikan, W (1975). Nutritional consequence of total gastrectomy. *Ann. Surg.*, 182: 415-429.
- Brunner, H and Kempf, P (1997). Jejunal interposition after radical gastrectomy. Report of 51 cases. *Deutsch. Med. Wochenschr.*, 19: 1044-1077.
- Kalmar, K; Nemeth, J; Kelemen, A and Horvath, OP (2006). Postprandial gastrointestinal hormone production is different, depending on the type of reconstruction following total gastrectomy. *Ann. Surg.*, 243: 465-471.
- Kelly, WD and Wangenstein, OH (1954). Experimental studies on total gastrectomy influence of type of anastomosis and creation of artificial stomach on nutrition. *AMA Arch. Surg.*, 69: 616-622.
- Lahey, F and Marshall, SF (1950). Should total gastrectomy be employed in early carcinoma of the stomach, experience with 139 total gastrectomies. *Ann. Surg.*, 132: 540-560.
- Lehnert, T and Buhl, K (2004). Techniques of reconstruction after total gastrectomy for cancer. *Br. J. Surg.*, 91: 528-539.
- McCorkle, HJ and Harper, HA (1954). The Problem of nutrition following complete gastrectomy. *Am. Surg. Assoc.*, 140: 467-473.
- Min, JS; Choi, SH; Noh, SH and Kim, MW (1995). Nutritional effects according to reconstructive methods after total gastrectomy. *Yonsei Med. J.*, 36: 9-14.
- Mochiki, E; Kamiyama, Y; Aihara, R; Nakabayashi, T; Kamimura, H; Asao, T and Hiroyuki, K (2004). Postoperative functional evaluation of jejunal interposition with or without a pouch after a total gastrectomy for gastric cancer. *Am. J. Surg.*, 187: 728-735.
- Morii, Y; Arita, T; Shimoda, K; Yasuda, K; Matsui, Y; Inomata, M and Kitano, S (2000). Jejunal interposition to prevent post-gastrectomy syndromes. *Br. J. Surg.*, 87: 1576-1579.
- Nakane, Y; Okumura, S; Akehira, K; Okamura, S; Boku, T; Okusa, T; Tanaka, K and Hioki, K (1995). Jejunal pouch reconstruction after total gastrectomy for cancer, a randomized controlled trial. *Ann. Surg.*, 222: 27-35.
- Neto, TA; Cavalcante, JF; Neto, JB; Filho, IA; Almeida, MG; Rezende, AA; Egito, ES; Azevedo, IM; Pinheiro, LM; Medeiros, VB and Medeiros, AC (2005). Total gastrectomy with substitution of stomach by jejunal pouch with and without duodenal passage, study in rats. *Acta Cir. Bras.*, 20: 107-111.
- Rubino, F; Gagner, M; Gentileschi, P; Kini, S; Fukuyama, S; Feng, J and Diamond, E (2004). The early effect of the Roux-en-Y gastric bypass on hormones involved in body weight regulation and glucose metabolism. *Ann. Surg.*, 240: 236-242.
- Sakamoto, T; Fujimaki, M and Tazawa, K (1997). Ileocolon interposition as a substitute stomach after total or proximal gastrectomy. *Ann. Surg.*, 226: 139-145.
- Schlatter, CA (1987). A unique case of complete removal of the stomach with successful esophagoenterostomy recovery. *Med. Res.*, 52: 909-912.
- Schwarz, A; Buchler, M; Usinger, K; Rieger, H; Glasbrenner, B; Friess, H; Kunz, R and Beger, HG (1996). Importance of the duodenal passage and pouch volume after total gastrectomy and reconstruction with the Ulm pouch: prospective randomized clinical study. *World J. Surg.*, 20: 60-67.
- Tono, C; Terashima, M; Takagane, A and Abe, K (2003). Ideal reconstruction after total gastrectomy by the interposition of a jejunal pouch considered by emptying time. *World J. Surg.*, 27: 1113-1118.
- Unver Saraydin, S and Koptagel, E (2005). Early morphological changes after total gastrectomy in the rat pancreas. *Turk. J. Vet. Anim. Sci.*, 29: 119-126.
- Wade, AN; Dolan, JM; Cambor, CL; Boullata, JI and Rickels, M (2010). Fetal malnutrition 6 years after gastric bypass surgery. *Arch Int. Med.*, 170: 993-995.