Case Report

Is jejunostomy output nutrient or waste in short bowel syndrome? Experience from six cases

Ming-Yi Liu PhD[1,2], Hsiu-Chih Tang MD[3], Hui-Lan Yang BSc[4], Sue-Joan Chang PhD[2]

[1]*Department of Nutrition, Tainan Sin-Lau Hospital, Tainan City, Taiwan*
[2]*Department of Life Sciences, College of Bioscience and Biotechnology, National Cheng Kung University, Tainan City, Taiwan*
[3]*Department of Surgery, Tainan Sin-Lau Hospital, Tainan City, Taiwan*
[4]*Department of Nursing, Tainan Sin-Lau Hospital, Tainan City, Taiwan*

Background and Objectives: Certain patients who undergo proximal jejunum resection are unable to undergo primary anastomosis and require exteriorization of the proximal jejunum. These patients usually have major problems with short bowel due to the high output of the stoma. The output of a proximal jejunostomy contains abundant amounts of enzymes and electrolytes. Therefore, it is a feasible approach to re-infuse jejunostomy output to regain homeostasis. To evaluate the effects of proximal jejunostomy output reinfusion into the distal small bowel for patients with short bowel syndrome, and to determine whether reinfusion could avoid long-term parenteral nutrition (PN). **Methods and Study Design:** PN was initiated immediately after surgery. When patients started enteral nutrition, we started the proximal jejunostomy output reinfusion protocol. Proximal jejunostomy output reinfusion was performed by the patients, and continued by them after discharge. When proximal jejunostomy output reinfusion could be performed stably, PN was stopped. **Results:** The median length of the proximal jejunum was 20 cm and of the distal small bowel was 77.5 cm in patients who could stably receive proximal jejunostomy output reinfusion alone. Three patients did not require home PN; they only required PN during hospitalization. Four patients successfully underwent stoma takedown with intestinal anastomosis after 6-7 months without any nutritional or metabolic complications. **Conclusion:** Short bowel syndrome patients with an adequate length of small bowel and functional colon could avoid long-term PN by receiving reinfusion of proximal jejunostomy output into the distal small bowel.

Key Words: proximal jejunostomy output, reinfusion, short bowel syndrome, stoma takedown, parenteral nutrition

INTRODUCTION

Resection of a large portion of the small bowel may cause severe malabsorption, electrolyte imbalance, and malnutrition.[1,2] The prognosis depends on the amount of intestine remaining and the specific section resected as well as the preservation of colonic length or the existence of the ileocecal valve.[1] Immediately after the operation, parenteral nutrition (PN), anti-secretory agents[3] and promotion of gut adaptation by oral nutrition are commonly used.[4] How long can patients depend on PN? The minimal absorptive area of the small intestine necessary to sustain life varies from individual to individual.

Patients who have had mainly the jejunum and ileum removed receive an end jejunostomy with more than 10 cm of terminal ileum and the colon remaining.[5,6] Patients with a residual jejunum of <100 cm will lose more water and electrolytes through their stoma than they take in (usual stomal output may be 4-8 kg/day). Jejunostomy patients have major problems with dehydration and sodium and magnesium depletion due to the large volume of stoma output. It is important for these patients to take medications before food. These drugs are used to reduce jejunostomy output through inhibition of intestinal motility or secretions. Patients who undergo primary anastomosis with temporary stoma undergo enterotomy takedown procedures, at around 6 months after the first operation.

In 1972, a technique was developed by which succus entericus from high output small bowel stomas could be efficiently re-infused into the distal enterostomy. Lévy et al reported a clinical study of 30 patients who experienced significant reduction in the output of the proximal stoma by collecting the proximal intestinal effluent and re-infusing it into the distal small bowel.[7] The stoma secretions contain enzymes and electrolytes. Therefore, it is a feasible approach to use reinfusion to maintain electrolyte and fluid status without the inherent risks and expense of intravenous infusion.[8] However, there are few reports of the clinical benefits for patients with short

Corresponding Author: Dr Sue-Joan Chang, Department of Life Sciences, College of Bioscience and Biotechnology, National, Cheng Kung University, No 1, University Rd, Tainan City 701, Taiwan.
Tel: 886-6-2757575 ext. 65542; Fax: 886-6-2742583
Email: sjchang@mail.ncku.edu.tw
Manuscript received 01 January 2015. Initial review completed 13 January 2015. Revision accepted 12 April 2015.
doi: 10.6133/apjcn.2016.25.2.18

bowel syndrome from re-infusing stoma output into the distal small bowel.

This study aimed to evaluate the influence of proximal jejunostomy output (PJO) reinfusion into the distal small bowel for short bowel syndrome (SBS) patients, and to assess whether it can help to avoid long-term PN in some cases of SBS.

SUBJECTS AND METHODS

Subjects

We analyzed cases of SBS following massive resection of the small bowel between 2000 and 2012. All patients had undergone a previous resection of their ileum and part of their jejunum, retaining the ileocecal valve and the whole colon. Owing to intra-abdominal and other general conditions, primary anastomosis was not possible. We first explained the practices of PJO reinfusion to the patients and their families, and if they decide to accept it and continue care after discharge, we performed this care approach. This retrospective study was approved by the ethical committee of the Tainan Sin-Lau Hospital. Patient information was anonymized and de-identified prior to analysis.

Nutrition administration and PJO reinfusion

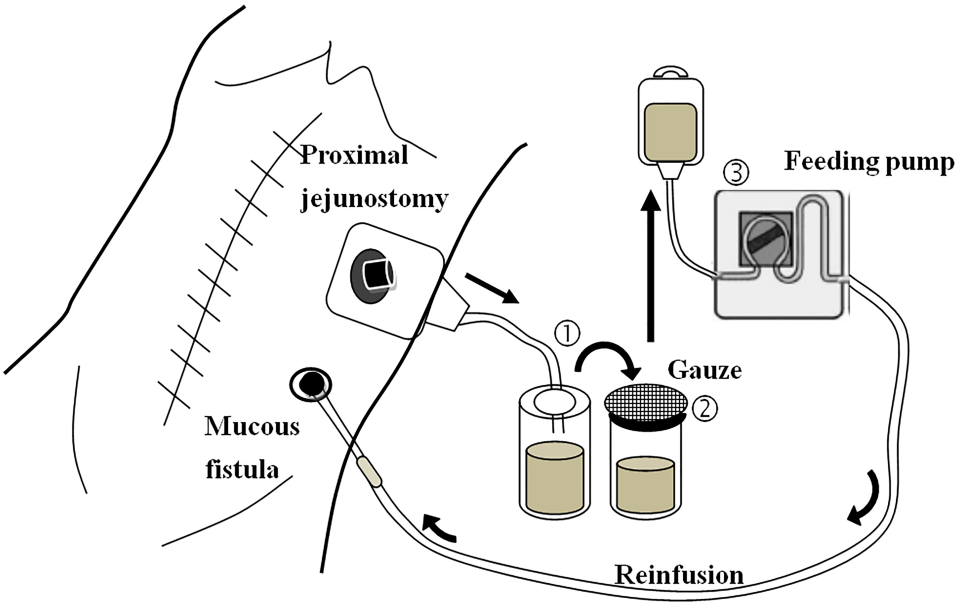
PN support was performed immediately after the operation depending on whether the patient was hemodynamically stable. The proximal end of the remaining segment of the small bowel was brought out as a mucous fistula through creation of another stoma. After PN was initiated, enteral nutrition was then started. On postoperative day 1 with stable hemodynamic status, full-strength elemental diet was given at 10 mL/h through the mucous fistula, with the rate increasing as tolerated to a goal of 75 mL/h over 24 hours. When the intestinal content could be collected from the proximal jejunostomy effluent in a sterile karaya gum-sealed stoma appliance, the feeding formula was altered to include the jejunal effluent on around postoperative day 3 under the consultation of the hospital nutrition service. Patients were fed a low-residue and soft oral diet. Oral rehydration solutions (ORS) with 90-120 mEq/L sodium (Na) were used to enhance fluid absorption for the purpose of decreasing dehydration. Patients were advised to avoid consumption of plain water and encouraged to drink ORS when thirsty. Our patients started oral intake once stable, and we started the protocol for PJO reinfusion (Figure 1). In the first step, we collected the PJO into a clean bottle. Step two was to filter out the food residuals with gauze. In step three, the PJO was set to drip continuously into the mucous fistula as jejunostomy feeding. The patients received PJO reinfusion six times per day, and about ≤350 mL of PJO was collected each time for filtration.

Daily recommended energy and protein requirements ranged from 25 to 30 kcal/kg and 1.2 to 1.5 g/kg for the ideal body weight.[9] Diet was in accordance with the dietitian-recommended low-residue diet. We gradually reduced PN based on increased PJO reinfusion.

The implementation of home PJO reinfusion

Patients re-infused the succus into the mucous fistula through a silicone Foley catheters and feeding pump during hospitalization. When patients were discharged, the Foley catheters were changed to a silicone tip cone catheter inserted into the distal limb of the stoma and patients were instructed to re-infuse the succus into the mucous fistula as a bolus.

When PJO reinfusion could be performed stably on its own, PN was stopped. The patients were discharged and instructed to perform home PJO reinfusion for several months. The patients and their families were told to record the volume of oral intake, PJO, and reinfusion.



Step 1: Collect proximal jejunostomy output into a clean bottle.
Step 2: Filtering the food residuals with gauze.
Step 3: Drip the PJO (infusate) continuously into the mucofistula as jejunostomy feeding.

Figure 1. Proximal jejunostomy output reinfusion protocol

RESULTS

Five cases with malignant tumors and one with ischemic small bowel received PJO reinfusion postoperatively. The median length of the proximal jejunum was 20 cm (range 15-22 cm) and that of the distal small bowel was 77.5 cm (range 65-100 cm) (Table 1). All patients had retained ileocecal valve and the whole of the colon.

PN support was performed immediately postoperatively. On postoperative day 1 or 2 with stable hemodynamic status, a full-strength elemental diet was given through the mucous fistula. Oral intake started 3-5 days after the operation, and PJO reinfusion was started a few days later. Diarrhea was usually noted at 2-3 days after infusion of jejunostomy effluent was initiated. The frequency of this was around 4 to 6 times daily. The median daily diarrhea frequency in the initial 2 weeks with PJO is shown in Table 2. Usually those patients had regular bowel movements and/or formed stool two to three weeks later. PN support was maintained for many days and gradually reduced based on increased PJO reinfusion and restoration of normal bowel movements. Once patients could stably receive PJO reinfusion alone and urine output and electrolyte levels were stable, PN was stopped. Patients continued PJO reinfusion after discharge and recorded the volume of PJO and reinfusion (Table 2). Four patients successfully received stoma takedown with intestinal anastomosis after 6 to 7 months.

Three of the four patients who underwent successful anastomosis only required PN during hospitalization. Patient W performed 85 days of home PN because the PJO was unstable and his family was not able to help him with reinfusion (Table 2). None of the participants developed electrolyte imbalance or dehydration during home PJO reinfusion. The body weight of all four patients increased between discharge and admission for stoma takedown (Table 2).

In this study, two of our patients expired postoperatively. Patient L was aged 83 years and had coronary artery disease for more than 10 years. She died of multiple organ failure at 36 days after surgery secondary to a pulmonary infection and cardiopulmonary failure without a persisting intra-abdominal source of infection. Patient K, a 63-year-old woman, had initially undergone surgery for obstructive sigmoid colon cancer with massive liver metastasis and poor liver function. She could not tolerate intensive chemotherapy and expired at 137 days after surgery.

DISCUSSION

Although we lost two patients, all six patients successfully carried out PJO reinfusion. In past studies, duration of PN in SBS patients with the whole colon present was about 6 months; with a short bowel <70 cm, a longer period of 12 months may have been required.[6] Our study showed that PJO reinfusion into the distal small bowel could validly decrease the number of days on PN. Furthermore, having the ileocecal valve preserved can effectively increase the absorptive capacity. PJO reinfusion into the distal small bowel not only increased nutrient absorption but also protected the integrity of the intestinal mucosa. It was beneficial for intestinal anastomosis and bowel normal function restoration. There were further physiological commitment; the patients could eat through the mouth without nutritional and metabolic complications (such as jaundice).

Normal endogenous secretions of fluid within the gastrointestinal (GI) tract include both salivary and gastric secretions amounting to 2500-4000 mL per day.[10] These secretions are essentially recycled within the GI tract and contribute to the individual's hydration. Saliva and gastric secretions are stimulated by the cephalic phase of eating and by protein digestion in the stomach. If significant gastric secretions are lost, then dehydration and hypochloremic metabolic alkalosis can result from excessive loss of acid, chloride, and fluid. The benefits of PJO reinfusion into the distal small bowel include simplified control of fluid and electrolyte balance for SBS patients. PN support maintains the nutritional requirements for SBS patients. However, some important components could not be supplied by PN in such patients. The PJO contained a variety of nutrients from the patients' foods, as well as pancreatic enzymes, bile salts, buffers, trace elements, intrinsic factor, and gut hormones. Intrinsic factor is a glycoprotein produced by the parietal cells in the stomach that binds to vitamin B-12 in the duodenum. It is necessary for the absorption of vitamin B-12. The majority of dietary vitamin B-12 is absorbed in the distal ileum through a complex with intrinsic factor. The reinfusion of PJO into the distal small bowel can promote the absorption of vitamin B-12 and avoid pernicious anemia.

Massive small bowel resection is associated with a transient gastric hypergastrinemia and hypersecretion during the initial first 6 months after surgery. H2 receptor antagonists and proton pump inhibitors may be beneficial, particularly during the first year following resection.[11] Severe gastric ulceration due to hyperacidity and hypersecretion has been reported in SBS. This complication did not occur in any of our patients. This could be related to the usage of the distal small bowel, meaning that there was no decrease in gastric inhibition from the small bowel. Previous studies have found inhibition of upper GI secretions by reinfusion of succus entericus into the distal small bowel. Furthermore, the gut hormone Peptide YY (PYY), a member of the PP-fold peptide family,[12] is secreted from enteroendocrine L-cells in the GI tract (mainly the ileum and colon). When dissolved food enters the end of the GI tract, L-cells stimulated by the nutrients transmit the signal through the vagal afferent to the appetite-regulating center. PYY in SBS patients with a retained colon may slow gastric emptying of liquid and contribute to the "colonic brake".[13] Therefore, reinfusion of PJO into the distal small bowel was important for patients' intestinal adaptation. The role of enterohepatic recycling for trace elements, especially zinc, is important. PJO reinfusion maintains enterohepatic recirculation, which increases the absorption of fat-soluble nutrients, trace elements, and electrolyte balance. Zinc is especially important for postoperative wound healing. Major amounts of endogenous zinc are secreted from the pancreas and reabsorbed in the ileum and colon by the enterohepatic circulation.[14] Short chain fatty acids (SCFAs) are produced in the distal gut by bacterial fermentation of prebiotics that are aimed at improving GI mucosal structure and function. Dietary carbohydrates, specifically

Table 1. Patient details

	Patients					
	Y	T	L	K	S	W
Age (years)	68	53	83	63	57	68
Sex	M	F	F	F	M	M
Underlying diagnosis	Jejunal lymphoma	Rectal cancer/ Pelvic endometriosis	Ischemic small bowel	Sigmoid cancer/ Liver metastasis	Rectal Ca/ LAR leakage	Rectal Ca
Proximal small bowel (cm)	20	22	15	18	21	20
Distal small bowel (cm)	100	85	80	65	75	65
Ileocecal valve	+	+	+	+	+	+
Colon	+	+	+	+	+	+
Indication	Perforation	Perforation	Gangrene	Obstruction	Perforation	Perforation
APACHE II	12	10	22	16	20	16

LAR: low anterior resection; "+": preserved; M: male; F: Female; Ca: cancer; APACHE II: Acute Physiology and Chronic Health Evaluation II.

Table 2. Patient outcomes

	Patients					
	Y	T	L	K	S	W
Stoma takedown (days)	208	231	-	-	215	261
Failure (days)	-	-	MOF/36	Liver/137	-	-
PN (days)	12	10	22	16	20	120 (including 85 days home PN)
Start of mucous fistula feeding elemental diet (days)	1	1	2	1	1	1
Start of intake of foods (days)	3	4	5	4	3	2
Start PJO (days)	9	10	8	11	13	34
PJO (mL, mean±SD)	2240±250	2135±288	2415±520	2048±435	2012±165	1744±479
Infusate (mL, mean±SD)	1925±221	1840±239	2004±469	1847±331	2148±342	500±185
Daily frequency of diarrhea in initial 2 weeks with PJO (median)	3	3	5	4	4	2
Home PJO reinfusion (days)	207	230	-	-	214	260
Weight at discharge (kg)	50.0	45.5	-	-	54.0	43.0
Weight at takedown (kg)	58.0	52.0	-	-	60.5	55.8

PN: parenteral nutrition; PJO: proximal jejunostomy output; MOF: multiple organ failure.
Patient L, an 83-year-old woman, died after 36 days with multiple organ failure.
Patient K, a 63-year-old woman, died after 137 days with massive liver metastasis, sepsis, and hepatic failure.

resistant starches and dietary fiber, are prebiotic substrates for fermentation that produce SCFAs, primarily acetate, propionate, and butyrate, as end products. SCFAs, which are particularly important as the fuel for the colonocytes, are readily absorbed and stimulate colonic blood flow and electrolyte uptake.[15] The PJO reinfusion provided dietary fiber to the colon and maintained mucosal structure.

Based on the experience of these six cases, we conclude that PJO contains essential nutrient factors, and that the PJO "stool" from jejunostomy should not be presumed to be waste. We recommended creating a distal mucofistula if possible, with no closure. PJO reinfusion into the distal mucofistula is a cheap, safe, and easy approach to SBS patient care. Although the concept is very easy for medical staff to understand, re-infusing intestinal secretions, or stool, can be difficult for patients and their families to accept as equivalent to nutrition. Therefore, obtaining the patients' trust and cooperation is crucial. It is necessary to explain the benefits, which include a reduction in the number of hospital days, reduced retention of the venous catheter thus preventing infection, no continuous injections, small intestine protection, and diversion colitis prevention.

Conclusion

In summary, SBS patients with an adequate length of small bowel and functional colon who receive PJO infusion into the distal small bowel can avoid long-term PN. The PJO and GI secretions contain nutrients and gut hormone to enhance intestinal adaptation.

ACKNOWLEDGMENTS

The authors would like to thank the staff in the nutrition support team of Tainan Sin-Lau hospital for their cooperation and support.

AUTHOR DISCLOSURES

Authors declare no conflicts of interest or funding disclosure.

REFERENCES

1. Sundaram A, Koutkia P, Apovian CM. Nutritional management of short bowel syndrome in adults. J Clin Gastroenterol. 2002;34:207-20. doi: 10.1097/00004836-200203000-00003.
2. Donohoe CL, Reynolds JV. Short bowel syndrome. Surgeon. 2010;8:270-9. doi: 10.1016/j.surge.2010.06.004.
3. Norholk LM, Holst JJ, Jeppesen PB. Treatment of adult short bowel syndrome patients with teduglutide. Expert Opin Pharmacother. 2012;13:235-43. doi: 10.1517/14656566.2012.644787.
4. Weale AR, Edwards AG, Bailey M, Lear PA. Intestinal adaptation after massive intestinal resection. Postgrad Med J. 2005;81:178-84. doi: 10.1136/pgmj.2004.023846.
5. Carbonnel F, Cosnes J, Chevret S, Beaugerie L, Ngo Y, Malafosse M, Parc R, Le Quintrec Y, Gendre JP. The role of anatomic factors in nutritional autonomy after extensive small bowel resection. JPEN J Parenter Enteral Nutr. 1996; 20:275-80. doi: 10.1177/014860719602000427 5.
6. Gouttebel MC, Saint-Aubert B, Astre C, Joyeux H. Total parenteral nutrition needs in different types of short bowel syndrome. Dig Dis Sci. 1986;31:718-23. doi: 10.1007/BF01296449.
7. Levy E, Palmer DL, Frileux P, Parc R, Huguet C, Loygue J. Inhibition of upper gastrointestinal secretions by reinfusion of succus entericus into the distal small bowel. A clinical study of 30 patients with peritonitis and temporary enterostomy. Ann Surg. 1983;198:596-600. doi: 10.1097/00000658-198311000-00006.
8. Parrish CR, Quatrara B. The art of reinfusing intestinal secretions. J Support Oncol. 2010;8:92-6.
9. McClave SA, Martindale RG, Vanek VW, McCarthy M, Roberts P, Taylor B, Ochoa JB, Napolitano L, Cresci G. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). JPEN J Parenter Enteral Nutr. 2009;33:277-316. doi: 10.1177/0148607109335234.
10. Parrish CR. The clinician's guide to short bowel syndrome. Practical Gastroenterology. 2005;29:67.
11. DiBaise JK, Young RJ, Vanderhoof JA. Intestinal rehabilitation and the short bowel syndrome: part 2. Am J Gastroenterol. 2004;99:1823-32. doi: 10.1111/j.1572-0241.2004.40836.x.
12. Keire DA, Kobayashi M, Solomon TE, Reeve JR, Jr. Solution structure of monomeric peptide YY supports the functional significance of the PP-fold. Biochemistry. 2000; 39:9935-42. doi: 10.1021/bi992576a.
13. Nightingale JM, Kamm MA, van der Sijp JR, Ghatei MA, Bloom SR, Lennard-Jones JE. Gastrointestinal hormones in short bowel syndrome. Peptide YY may be the 'colonic brake' to gastric emptying. Gut. 1996;39:267-72. doi: 10.1136/gut.39.2.267.
14. Oberleas D. Mechanism of zinc homeostasis. J Inorg Biochem. 1996;62:231-41. doi: 10.1016/0162-0134(95)00157-3.
15. Wong JM, de Souza R, Kendall CW, Emam A, Jenkins DJ. Colonic health: fermentation and short chain fatty acids. J Clin Gastroenterol. 2006;40:235-43. doi: 10.1097/00004836-200603000-00015.

Case Report

Is jejunostomy output nutrient or waste in short bowel syndrome? Experience from six cases

Ming-Yi Liu PhD[1,2], Hsiu-Chih Tang MD[3], Hui-Lan Yang BSc[4], Sue-Joan Chang PhD[2]

[1]*Department of Nutrition, Tainan Sin-Lau Hospital, Tainan City, Taiwan*
[2]*Department of Life Sciences, College of Bioscience and Biotechnology, National Cheng Kung University, Tainan City, Taiwan*
[3]*Department of Surgery, Tainan Sin-Lau Hospital, Tainan City, Taiwan*
[4]*Department of Nursing, Tainan Sin-Lau Hospital, Tainan City, Taiwan*

短腸症病人的空腸造口排出物是營養素還是廢棄物？六個病人的經驗

背景與目的：術前營養不良的病人術後積極持續靜脈營養是必需的。但是對於接受近端空腸切除而無法馬上吻合的病人需要將近端的空腸外化（*exteriorization*）形成造口。這些病人通常有因造口液體的高排出量而造成有短腸症的問題。近端空腸造口的排出物（proximal jejunostomy output；PJO）包含豐富的酶和電解質。因此，PJO 重新回灌入遠端小腸來維持體內生理的平衡是一條可行途徑，並且評估是否能避免長期依賴靜脈營養（parenteral nutrition；PN）的問題。**方法與研究設計**：PN 在手術後立即開始。當患者開始腸內營養，我們開始了 PJO 回灌遠端小腸。回灌的技巧需訓練由病人及其照顧者進行，出院後繼續進行。如果可以穩定地進行 PJO 回灌，PN 就停止。**結果**：病人近端空腸的平均長度為 20 公分，遠端小腸為 77.5 公分，6 名病人當中 3 名出院後不需要居家靜脈營養（Home PN）；他們只在住院期間需要 PN。四名病人 6-7 個月後成功地進行小腸吻合術，沒有任何營養或代謝並發症。**結論**：針對有足夠長度的小腸和功能正常的結腸的短腸症病人，進行近端 PJO 回灌進入遠端小腸可避免長期的 PN。

關鍵字：近端空腸造口輸出、回輸、短腸綜合征、腸造口移除、腸外營養