



## Roux-en-Y reconstruction does not require gastric decompression after radical distal gastrectomy

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Received: June 13, 2011 Revised: September 2, 2011

Accepted: October 28, 2011

Published online: January 21, 2012

### Abstract

**AIM:** To determine whether routine nasogastric (NG) decompression benefitted patients undergoing radical gastric surgery.

**METHODS:** Between January 1998 and December 2008, 519 patients who underwent distal gastrectomy for gastric cancer were retrospectively divided into 2 time-period cohorts; those treated with Billroth II (B II) reconstruction in the first 6 years and those with Roux-en-Y (RY) reconstruction in the last 5 years. In the latter group, the patients were further divided into 2 subgroups; with and without nasogastric decompression.

**RESULTS:** Postoperatively, there were no significant differences in the number of anastomotic leaks between the 3 groups. In the tubeless RY group, time to semi-liquid diet was significantly shorter than in the other 2 groups ( $4.4 \text{ d} \pm 1.4 \text{ d}$  vs  $7.2 \text{ d} \pm 1.3 \text{ d}$  and  $5.9 \text{ d} \pm 1.2 \text{ d}$ ,  $P = 0.005$ ). The length of postoperative stay was significantly increased in patients with B II reconstruction compared with patients with RY reconstruction with/without NG decompression ( $15.4 \text{ d} \pm 4.3 \text{ d}$  in B II group vs  $12.6 \text{ d} \pm 3.1 \text{ d}$  in decompressed RY and  $11.4 \text{ d} \pm 3.4 \text{ d}$  in the tubeless RY group,  $P = 0.035$ ). The postoperative pneumonia rate was lowest in the tubeless group and highest in the B II group ( $1.4\%$  vs  $4.6\%$ ,  $P = 0.01$ ). Severe sore throat was noted in 59 (20.7%) members of the B II group, 18 (17.4%) members of the decompressed RY group and 6 (4.2%) members of the tubeless RY group. Fewer patients in the tubeless group complained of severe sore throat ( $P = 0.001$ ).

**CONCLUSION:** This study provides support for abandoning routine NG decompression in patients undergoing subtotal gastrectomy with Roux-en-Y gastrojejunostomy.

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**Key words:** Nasogastric decompression; Billroth II gastrojejunostomy; Roux-en-Y gastrojejunostomy; Radical distal gastrectomy; Gastric cancer

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Chen CJ, Liu TP, Yu JC, Hsua SD, Hsieh TY, Chu HC, Hsieh CB, Chen TW, Chan DC. Roux-en-Y reconstruction does not require gastric decompression after radical distal gastrectomy. *World J*

## INTRODUCTION

It is a commonly held belief in clinical practice that nasogastric (NG) decompression after gastric surgery is essential to prevent postoperative complications, such as postoperative ileus or anastomotic leakage. Although the necessity of NG decompression following gastric surgery has been increasingly questioned over the last 2 decades, most general surgeons have routinely used NG decompression and recommended patients fast for a period of 3-5 d after surgery. Several prospective studies have suggested that this routine practice does not provide any benefit, but could make patients feel uncomfortable<sup>[1-5]</sup>. However, these studies enrolled gastric cancer patients who underwent a variety of operations.

Recently, to prevent enterogastric reflux into the gastric remnant and decrease biliary gastritis, Roux-en-Y (RY) reconstruction has become widely used after distal gastrectomy. We have previously reported the superiority of RY reconstruction over Billroth II (BII) anastomosis<sup>[6]</sup>. Another study showed that RY reconstruction after distal gastrectomy is a safer form of anastomosis, and could prevent anastomotic leakage<sup>[7]</sup>. Therefore, the safer procedure may dispel the common belief of general surgeons that NG decompression after gastric surgery is essential.

The Tri-Service General Hospital has performed RY reconstruction in all gastric cancer patients with distal gastrectomy since January 2003. Benefits of this approach include the reduction of the amount of drained gastric remnant content *via* NG tube. Additionally, the low incidence of possible complications, including biliary gastritis, gastroesophageal reflux and aspiration pneumonia, has supported our adherence to this technique<sup>[6]</sup>. In January 2005, we therefore decided to abandon the routine use of NG tube decompression postoperatively in patients undergoing distal gastrectomy after success with early discontinuation in a few patients.

In this study, we reviewed our experience with patients undergoing distal gastrectomy to investigate the difference in complication rates between patients without postoperative NG decompression and patients with postoperative NG decompression to determine the necessity of postoperative NG decompression after distal gastrectomy.

## MATERIALS AND METHODS

A retrospective study spanning an 11-year period from January 1998 to December 2008 was performed, and a total of 519 patients who underwent distal gastrectomy for carcinoma of the stomach were identified. Criteria for inclusion in this cohort study were as follows: no previ-

ous chemoradiation treatments, having R0 resection (no macroscopic or microscopic residual tumor) according to the definition of the International Union Against Cancer (UICC), and having the operative procedures described below. Approval for chart review was obtained from the institutional review boards at Tri-Service General Hospital. Each patient's clinic chart was reviewed.

Cases were divided into 2 time-period cohorts; those treated in the first 6 years (TP1, *n* = 283) and those in the last 5 years (TP2, *n* = 236). After distal gastrectomy, gastrointestinal continuity was reconstructed with BII gastrojejunostomy in all patients before January 2003 (TP1). Thereafter, we adapted RY gastrojejunostomy to restore gastrointestinal continuity (TP2). All patients underwent D1 or D2 lymph node dissection. The cancer was staged according to the UICC TNM classification. Preoperatively, all patients in each group were given a normal diet, unless there was gastric outlet obstruction. Patients with symptoms of obstruction were given NG decompression and parenteral nutrition support exclusively for at least 7 d before the operation. No attempt was made to employ gastric lavage in these patients.

In TP1, all patients received insertion of a 16-French single lumen NG tube for postoperative gastric decompression until the passage of flatus and drainage amounted to less than 100 cc per day. They were allowed glucose water to drink the day after the NG tube was removed. Diet was increased in a stepwise fashion from a clear liquid to a semi-liquid diet as tolerated. In TP2, patients were divided into 2 subgroups based on whether NG tube decompression was used or not. In the decompression group (TP2A), the patients received NG decompression and resumed an oral diet in the same way as in the TP1 group. In the tubeless group (TP2B), postoperative oral intake was started with water on the second postoperative day regardless of passage of flatus. Diet was advanced in the same way as in the other groups. Routine radiographic examination using water-soluble contrast material was not done before starting oral intake. The NG tube was reinserted when clinically indicated, such as when severe vomiting or abdominal distension occurred.

The following data were recorded by the attending surgeon: intra-abdominal complications (delayed gastric emptying or Roux stasis syndrome, small mechanical bowel obstruction, gastrojejunostomy leak and duodenal stump leak) and postoperative infection (wound infection, unknown fever, intra-abdominal abscess, and pneumonia). We adopted the 1992 Centers for Disease Control definition for superficial incisional, deep incisional and organ/space surgical site infection for hospital monitoring programs and surgical audits<sup>[7]</sup>. Patients were considered to have postoperative infections if they developed intra-abdominal abscesses, surgical wound infections, unknown fever, or pulmonary infiltrates shown by radiography<sup>[8]</sup>. Postoperative unknown fever was defined as a body temperature over 38 °C for at least 3 d without obvious infection source. Intra-abdominal abscess was defined as an abscess that needed to be resolved by percutaneous or open drainage. Wound infection was defined as a wound

**Table 1** Patients' clinicopathologic characteristics<sup>1</sup>

	TP1 ( <i>n</i> = 283)	TP2A ( <i>n</i> = 102)	TP2B ( <i>n</i> = 134)	<i>P</i> value
Median age (range)	59 (26-80)	62 (30-79)	60 (35-82)	0.542
Sex (M/F)	195/88	67/35	75/59	0.23
Type of reconstruction				0.001
Billroth II	283	0	0	
Roux-en-Y	0	102	134	
Lymphadenectomy				0.153
D1	24 (8.4)	5 (5.2)	14 (10.4)	
D2	259 (91.6)	97 (94.8)	120 (89.6)	
AJCC tumor stage				0.116
I	41 (14.5)	12 (11.3)	20 (15.2)	
II	80 (28.4)	31 (30.4)	45 (33.4)	
III	133 (46.9)	51 (50.2)	58 (43.1)	
IV	29 (10.2)	8 (8.1)	11 (8.3)	
Type of pain control				0.731
Nil	18 (6.3)	5 (4.8)	11 (8.2)	
Epidural form	70 (24.9)	22 (21.3)	22 (16.5)	
Intravenous form	189 (68.8)	73 (71.9)	101 (75.3)	
Operation time	241 ± 53.8	253 ± 59.6	251 ± 63.3	0.821

<sup>1</sup>Data are medians with ranges in parentheses, numbers with percentages in parentheses or mean ± SD. AJCC: American Joint Committee on Cancer (6th edition).

**Table 2** Postoperative clinical parameters (mean ± SD)<sup>1</sup>

	TP1 ( <i>n</i> = 283)	TP2A ( <i>n</i> = 102)	TP2B ( <i>n</i> = 134)	<i>P</i> value
Persistent decompression > 7 d or reinsertion of NG tube, number of patients	19 (6.7%)	3 (2.9%)	5 (3.7%)	0.001
Duration of gastric decompression (d) <sup>1</sup>	5.3 ± 3.3	3.6 ± 2.2	–	0.023
Amount of gastric decompression (mL/d)	465 ± 241	58 ± 47	–	0.001
Days to passage of flatus	5.1 ± 1.7	4.4 ± 1.3	4.7 ± 1.2	0.618
Days to semi-liquid diet	7.2 ± 1.3	5.9 ± 1.2	4.4 ± 1.4	0.05
Length of postoperative hospital stay (d)	15.4 ± 4.3	12.6 ± 3.1	11.4 ± 3.4	0.035

<sup>1</sup>Average amount of nasogastric drainage in the first three postoperative days. NG: Nasogastric.

that needed to be laid open. Mechanical small bowel obstruction was defined as an obstruction that needed to be resolved by surgical intervention. Delayed gastric emptying or Roux stasis syndrome was defined arbitrarily as the failure to intake food orally after the 7th postoperative day. The postoperative days until the first passage of stool was observed, when semi-liquid diet was permitted, and the length of postoperative hospital stay (LOS) were also recorded.

### Statistical analysis

Results were expressed as mean ± SD. Statistical analysis was performed using the one-way analysis of variance test for continuous variables and the  $\chi^2$  test for categorical

variables, when appropriate, respectively. *P* values less than 0.05 were considered statistically significant. Statistical analysis was carried out with the SPSS software package, version 13.0 (SPSS, Inc., Chicago, IL).

## RESULTS

Of the 519 eligible patients, 283 (54.5%) were enrolled in TP1, 102 (19.7%) were in TP2A and 134 (25.8%) in TP2B. The characteristics of the 3 groups of patients are showed in Table 1. There was no significant difference with respect to age, gender, extent of lymphadenectomy, tumor stage, analgesic use or operation time except for type of reconstruction.

Five of the 134 (3.7%) tubeless patients (TP2B) who did not receive NG tube decompression developed vomiting or abdominal distension, and needed insertion of an NG tube for decompression (Table 2). Nineteen patients (6.7%) in the decompression group with BII (TP1) and 3 patients (2.9%) in the decompression group with RY (TP2A) reconstruction required persistent NG decompression or reinsertion of an NG tube for vomiting or abdominal distension. More patients in the TP1 group needed persistent NG decompression or reinsertion of an NG tube (*P* = 0.001). In the decompression groups (TP1 and TP2A), the NG tube was removed after a mean of 5.3 d and 3.6 d, and the mean amounts of NG drainage were 465 cc and 58 cc per day in the first 3 operative days, respectively. The duration of NG decompression and the amount of NG drainage in the RY group were significantly less than in the BII group (*P* = 0.023 and *P* = 0.001, respectively). Time to passage of flatus was no different for the 3 groups. However, in the tubeless RY group, time to semi-liquid diet and length of postoperative hospital stay were significantly shorter than in the other 2 groups (*P* = 0.001 and *P* = 0.035). The LOS was significantly increased in patients with BII reconstruction compared with patients with RY reconstruction with/without NG decompression (15.4 ± 4.3 d in BII group *vs* 12.6 d ± 3.1 d in decompressed RY and 11.4 ± 3.4 d in the tubeless RY group, *P* = 0.035). The 27 patients who required persistent NG decompression or NG tube reinsertion were carefully examined for factors that might lead to predictive criteria for postoperative NG decompression. No factors, including analgesics use, preoperative gastric outlet obstruction, and history of diabetes, could be determined to be predictive of the need for postoperative NG decompression (data not shown).

There was no significant difference in the occurrence rate of each of the classified intra-abdominal complications in the 3 groups except for delayed gastric emptying or Roux stasis syndrome (Table 3). There were 18, 3 and 4 patients who developed delayed gastric emptying or Roux stasis syndrome in the TP1, TP2A and TP2B groups, respectively. All 25 patients were able to tolerate a normal diet from the 12th to the 43rd postoperative day without surgical treatment. The reoperation rate for early postoperative mechanical small bowel obstruction was



**Table 3** Comparison of postoperative complications *n* (%)

	TP1 ( <i>n</i> = 283)	TP2A ( <i>n</i> = 102)	TP2B ( <i>n</i> = 134)	<i>P</i> value
Perioperative mortality	1 <sup>1</sup>	0	0	NS
Intra-abdominal complications				
Delayed gastric emptying or Roux stasis syndrome	6 (2.1)	3 (2.9)	3 (2.2)	NS
Mechanical small bowel obstruction	1 (0.4)	0	1 (0.7)	NS
Gastrojejunostomy leakage	3 (1.1)	1 (1.0)	1 (0.7)	NS
Duodenal stump leakage	2 (0.7)	0	1 (0.7)	NS
Postoperative infection				
Wound infection	10 (3.5)	3 (2.9)	4 (3.0)	NS
Unknown fever	9 (3.2)	4 (3.9)	3 (2.2)	NS
Intra-abdominal abscess	1 (0.4)	0 (0)	0 (0)	NS
Pneumonia	13 (4.6)	4 (3.9)	2 (1.4)	0.01
Severe sore throat	59 (20.7)	18 (17.4)	3 (2.1)	0.001

<sup>1</sup>Mortality is associated with aspiration pneumonia-related sepsis. NG: Nasogastric.

0.4% in the TP1 and 0.7% in the TP2B group. Omitting NG decompression did not increase the risk of gastrojejunostomy and duodenal stump leakage. Three patients in the TP1 group leaked from a B II gastrojejunostomy and one of them developed an intra-abdominal abscess, which was treated by CT-guided percutaneous drainage. Two patients in the 2 RY groups who developed gastrojejunostomy leaks recovered spontaneously without further percutaneous drainage and did not develop intra-abdominal abscesses. Even though there were no differences in major life-threatening complications among the 3 groups, 1 patient died of aspiration pneumonia-related sepsis in the TP1 group. The postoperative pneumonia rate was lowest in the tubeless group (1.4%) and highest in the B II group (1.4% *vs* 4.6%, *P* = 0.01). Fewer patients in the tubeless group complained of severe sore throat (*P* = 0.001). Severe sore throat was noted in 59 (20.7%) members of the TP1 group, 18 (17.4%) members of the TP2A group and 6 (4.2%) members of the TP2B group.

## DISCUSSION

For the past century, NG decompression has been commonly thought to be necessary for patients undergoing gastric operation to protect against gastric or intestinal distension with subsequent anastomotic failure<sup>[9]</sup>. Even today, most general surgeons still follow the routine procedure<sup>[10]</sup>. Our study has demonstrated that NG decompression is not routinely required postoperatively after distal gastrectomy with RY reconstruction in patients with gastric cancer. Patients can be discharged more rapidly while tolerating semi-liquid diets without increasing postoperative complications.

Concerns regarding greater risks of anastomotic leak associated with distended gastric remnant and postoperative ileus are obstacles to the abandonment of postgastrectomy NG decompression. Historically, surgeons believed that a 3-5-d gastric decompression and fast after a

gastric operation could prevent anastomotic leak resulting from increased intraluminal pressure of the postoperative atonic gastric remnant and physiologic ileus of the intestine. For radical gastrectomy, it is unavoidable that most autonomic nerve fibers controlling the upper gastrointestinal tract in the abdomen are destroyed by skeletonization of the celiac axis and lesser curvature during radical lymph node dissection. This may interfere with the motility of the gastrointestinal tract postoperatively. In addition, the bowel is much more extensively manipulated in gastric cancer surgery than in lower gastrointestinal tract surgery and may be a potential risk factor for the development of functional ileus during the early postoperative period. For these reasons, prophylactic NG decompression after operations for gastric cancer seems to be reasonable and very important. Until recently, therefore, NG intubation for gastric decompression has been a routine part of perioperative care after radical gastrectomy. However, the necessity of NG decompression after gastric surgery has been increasingly questioned over the past 2 decades. Studies regarding gastric decompression after gastric cancer surgery are very rare, because surgeons are concerned that swallowed saliva and gastric secretion can make direct contact with the anastomotic wound and consequent anastomotic disruption. Anastomotic disruption is a potentially fatal complication, and may lead to severe morbidity and mortality when it happens. Four prospective studies from Taiwan<sup>[1,2]</sup> and South Korea<sup>[3,4]</sup> have suggested that it is unnecessary to decompress the gastric remnant after gastrectomy for gastric cancer. Another European multicenter prospective study has also been performed to assess the use of a nasojejunal tube after total gastrectomy and the authors recommended that no use of postoperative NG decompression decrease postoperative fever and pulmonary problems, and improved patient comfort by decreasing sore throat and nausea<sup>[5]</sup>. However, these studies enrolled gastric cancer patients undergoing a variety of operations, such as total and subtotal gastrectomy. Our study focused on distal gastrectomy with B II or RY reconstruction for gastric cancer and tried to abandon the routine use of NG decompression after distal gastrectomy. It did not increase the rates of intra-abdominal morbidities such as anastomotic leakage compared with the decompression group. Moreover, in our study, 5 of the 134 patients without NG decompression required reinsertion of the NG tube due to vomiting or abdominal distension. None developed anastomotic leaks. Temporary gastric remnant distension did not seem to disrupt anastomosis in patients receiving distal gastrectomy with RY reconstruction.

Interestingly, 2 patients in the RY groups who suffered from gastrojejunostomy leaks healed spontaneously with the drains placed during the operation and did not develop intra-abdominal abscesses, which means RY reconstruction may lower the risk of intra-abdominal abscess after anastomotic leakage. This may be due to a decreased amount of leaked fluid from the gastric remnant immediately following distal gastrectomy with RY reconstruction, which reduced the amount of gastric remnant content.

The magnitude of gastric remnant secretory output immediately following distal gastrectomy is unknown. In lower digestive tract surgery, the average volume of gastric juice in patients with gastrointestinal decompression was 200 mL daily postoperatively<sup>[11]</sup>. Normally, the daily secretion of gastric juice and saliva ranges between 2300 and 3000 mL<sup>[12]</sup>. Secretion of saliva and gastric juice is under the control of the autonomic nervous system. Surgical transection of the vagus nerve during radical subtotal gastrectomy may decrease salivatory and gastric secretion postoperatively. Our results showed that after distal gastrectomy with B II reconstruction and RY reconstruction, the average daily outputs of gastric remnant drainage were 465 cc and 58 cc, respectively. Therefore, with RY reconstruction, the reason for the decreased drainage amount from the gastric remnant is that not only the salivatory and gastric remnant secretions decrease, but the pancreatic and biliary secretions could be diverted from the gastric remnant<sup>[6]</sup>. This is why there is no need for NG decompression in the patients with RY reconstruction compared with those with B II reconstruction.

The avoidance of complications associated with NG decompression is another potential benefit of our approach. Most patients complained of discomfort secondary to NG intubation. This discomfort included sore throat, hoarseness, dysphagia, nasal trauma, sinusitis, and psychological problems<sup>[13,14]</sup>. Use of NG decompression also increased the risk of respiratory complications. Several studies indicated that NG intubation increased the risk of atelectasis and pneumonia<sup>[15,16]</sup>. The ability of patients to cough and breathe deeply after surgical intervention is severely compromised by discomfort from an NG tube. In addition, NG intubation causes gastroesophageal reflux, increasing the risk of postoperative pneumonia<sup>[17]</sup>. In our study, the difference in postoperative pneumonia (1.4% without NG *vs* 3.9% and 4.6% with NG,  $P = 0.05$ ) and severe sore throat (2.1% without NG *vs* 20.7% and 17.4% with NG,  $P = 0.01$ ) reached statistical significance.

In Taiwan, the use of the NG tube to decompress the gastric remnant after distal gastrectomy is still in widespread use by most general surgeons. It is well known that changing common practice in hospitals is difficult and at all levels resistance is usually abundant. In fact, our study showed that a minimal percentage of patients with distal gastrectomy with RY reconstruction required gastric decompression for relieving gastric distension, and the vast majority of patients with RY anastomosis did not need NG decompression after distal gastrectomy and could avoid the discomfort and morbidity associated with NG intubation. The data from the present study not only confirmed that placement of an NG tube can be safely omitted in distal gastrectomy with RY anastomosis, but also demonstrated that routine NG decompression may increase postoperative complications, such as pulmonary infection and pharyngolaryngitis. Our study comprises the largest reported series of patients undergoing a single type of gastrojejunal anastomosis, which provides a large enough series to support the avoidance of NG decompression after distal gastrectomy with RY reconstruction

as a safe and effective modification of standard surgical practices.

There are several limitations to this study that are inherent in the source of our data. First, the retrospective nature of this study analysis limits the ability to attribute causality. Second, the comparison of B II and Roux-Y is within different time periods. There could have been several events during such long periods. Third, the comparison between the nasal decompression group and non-decompression group in the latter phase was not randomized. However, our data show that the magnitude of gastric remnant content decreases immediately following subtotal gastrectomy with RY reconstruction. NG decompression offers no benefit for patients and increases patient discomfort and potential NG intubation-related morbidity, and it can therefore be omitted as a routine procedure in gastric cancer patients with distal gastrectomy and RY anastomosis. Further larger-scale properly designed prospective studies, ideally having validated data collections, will enable us to clearly determine the risks and/or benefits in naso-decompression after gastric cancer surgery.

## COMMENTS

### Background

The nasogastric (NG) decompression after gastric surgery is essential to prevent postoperative complications conventionally. However the necessity of NG decompression following gastric surgery has been increasingly questioned over the last 2 decades.

### Research frontiers

Several prospective studies have suggested that the routine NG decompression after gastric surgery does not provide any benefit. Roux-en-Y (RY) reconstruction has become widely used after distal gastrectomy to prevent enterogastric reflux into the gastric remnant and decrease biliary gastritis.

### Innovations and breakthroughs

The authors' hospital has performed RY reconstruction in all gastric cancer patients with distal gastrectomy since January 2003. Benefits of this approach include the reduction of the amount of drained gastric remnant content via NG tube. In January 2005, the authors abandoned the routine use of NG tube decompression postoperatively in patients undergoing distal gastrectomy.

### Applications

The data show that the magnitude of gastric remnant content decreases immediately following subtotal gastrectomy with RY reconstruction. NG decompression offers no benefit for patients and increases patient discomfort and potential NG intubation-related morbidity, and it can therefore be omitted as a routine procedure in gastric cancer patients with distal gastrectomy and RY anastomosis.

### Terminology

Nasogastric decompression: placement of a tube into the stomach through the nose to remove stomach contents; Roux-en-Y gastrojejunostomy: distal limb of jejunum is brought up through the mesocolon in a retrocolic fashion, and an end-to-side gastrojejunostomy is made, using a running inner layer of 3-0 absorbable suture and an interrupted outer layer of 3-0 silk Lambert sutures.

### Peer review

The manuscript on the whole is well written. This study focused on the possibility of omitting nasogastric tubes in Roux-en-Y reconstruction after gastric cancer operation. It is well organized and very practical.

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