

## Gastrojejunostomy in patients with unresectable pancreatic head cancer - the use of Roux loop significantly shortens the hospital length of stay

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### Abstract

**AIM:** To evaluate the use of the Roux loop on the postoperative course in patients submitted for gastroenteroanastomosis (GE).

**METHODS:** Non-jaundiced patients ( $n = 41$ ) operated on in the Department of General and Transplant Surgery in Lodz, between January 2010 and December 2011 were enrolled. The tumor was considered unresectable when liver metastases or major vascular involvement were confirmed. Patients were randomized to receive Roux ( $n = 21$ ) or conventional GE ( $n = 20$ ) on a prophylactic basis.

**RESULTS:** The mean time to nasogastric tube withdrawal in Roux GE group was shorter ( $1.4 \pm 0.75$  vs  $2.8 \pm 1.1$ ,  $P < 0.001$ ). Time to starting oral liquids, soft diet and regular diet were decreased ( $2.3 \pm 0.86$  vs  $3.45 \pm 1.19$ ;  $P < 0.001$ ;  $3.3 \pm 0.73$  vs  $4.4 \pm 1.23$ ,  $P < 0.001$  and  $4.5 \pm 0.76$  vs  $5.6 \pm 1.42$ ,  $P = 0.002$ ; respectively). The Roux GE group had a lower use of prokinetics (10 mg thrice daily for  $2.2 \pm 1.8$  d vs  $3.7 \pm 2.6$  d,  $P = 0.044$ ;

total  $62 \pm 49$  mg vs  $111 \pm 79$  mg,  $P = 0.025$ ). The mean hospitalization time following Roux GE was shorter ( $7.7$  d vs  $9.6$  d,  $P = 0.006$ ). Delayed gastric emptying (DGE) was confirmed in 20% after conventional GE but in none of the patients following Roux GE.

**CONCLUSION:** Roux gastrojejunostomy during open abdomen exploration in patients with unresectable pancreatic cancer is easy to perform, decreases the incidence of DGE and lowers hospitalization time.

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**Key words:** Unresectable pancreatic cancer; Roux and conventional gastroenteroanastomosis; Gastroenteroanastomosis; Delayed gastric emptying; Hospital length of stay

**Core tip:** The lower rate of delayed gastric emptying, which determines lower use of prokinetics after Roux compared to conventional antegastric gastroenterostomy (GE) suggested that prophylactic Roux GE should be performed during surgical exploration of patients with unresectable pancreatic head tumors. The length of hospital stay is shorter following palliative Roux GE, thus the treatment costs of these patients are likely to be smaller. Further research is needed on the cost-effectiveness of prophylactic Roux GE in unresectable pancreatic cancer.

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## INTRODUCTION

Adenocarcinoma of the pancreas is a serious public health problem. It accounts only for 2% of new cancer diagnoses in both men and women, but it ranks as the fourth leading cause of cancer-related deaths in the United States<sup>[1]</sup>. Despite recent developments in new imaging techniques and improved staging studies, the incidence rate of early pancreatic cancer has changed little over the last decades. Nonetheless, the surgical treatment of pancreatic cancer is palliative in more than 80%, with median overall survival of 6 mo when diagnosed at the metastatic stage<sup>[2]</sup>.

Nowadays, with increasing incidence of pancreatic cancer, annual costs for therapy have risen rapidly<sup>[3-6]</sup>. The average monthly cost of treatment of a patient with pancreatic cancer is almost \$7000; in patients with terminal disease this can rise to as much as \$65557<sup>[7]</sup>. New anti-cancer agents are the largest expenditure, although the greater part of the costs comes from palliative surgical procedures and postoperative hospitalization care<sup>[8]</sup>. Pancreatic surgeries in high-volume centers are associated with low mortality, but high morbidity<sup>[9-12]</sup>. Postoperative complications increase the duration of the hospital stay and treatment costs.

Limited survival benefit and unfavorable cost-effectiveness make surgery for later stages of pancreatic cancer controversial. From this perspective, the optimal method of palliation is uncertain when tumor unresectability is determined at exploration. Shortening of the length of postoperative hospital stay and associated direct costs is an important part of the development of the new palliative procedures.

The aim of our study was to evaluate the influence of two different surgical techniques for creating gastroenterostomy on the postoperative delayed gastric emptying (DGE) rate and the length of hospital stay in non-jaundiced patients with unresectable pancreatic head cancer.

## MATERIALS AND METHODS

This prospective, randomized study comprised non-jaundiced patients with unresectable pancreatic head tumor ( $n = 41$ ), hospitalized in the Department of General and Transplant Surgery of Medical University in Lodz, who received solitary gastroenterostomy on a prophylactic basis from January 2010 to December 2011. Patients were randomized to receive either antecolic Roux ( $n = 21$ ), or conventional antegastric hand-sewn side-to-side gastroenterostomy ( $n = 20$ ). Before surgery, each patient was allotted a code (Roux or conventional group). Blinded investigators performed all postoperative assessments.

All patients gave signed, written, informed consent for the study. Most of the patients ( $n = 37$ ) originally presented with jaundice in the endoscopic units, where the biliary stents have been inserted. As endoscopic retrograde cholangiopancreatography in Roux-en-Y gastric bypass patients is challenging, anastomoses was performed without the stomach being transected or divided.

Therefore, blockage of the biliary stents causing recurrent jaundice could easily have been managed with stent replacement, without the need of percutaneous drainage. The risk of occlusion of stents increased in our group after 3 mo, thus elective stent exchange at 3-6 mo was performed using the standard technique. Changing a stent was available for the Roux and conventional GE group.

The tumor was considered unresectable when the presence of distant metastases or major vascular involvement was confirmed. Conventional GE was performed in a standard side-to-side antecolic fashion, 20 cm from the ligament of Treitz. Roux GE was constructed as follows. A Roux-en-Y intestinal loop, 60 cm long, was prepared by transecting the jejunum 20 cm from the ligament of Treitz, which was then anastomosed to the stomach in an antecolic fashion to construct a latero-lateral gastrojejunostomy. The intestinal continuity was restored by a jejuno-jejunal, hand-sewn anastomosis. In all cases, the Tru-cut biopsy of the tumor was obtained. All patients without microscopic diagnosis of the cancer were excluded from the study. Eventually, 21 patients with pancreatic cancer confirmed by pathological report received Roux gastroenterostomy and 20 received the conventional GE. Experienced pancreatic surgeons performed all surgeries. All patients provided written informed consent for the study.

The postoperative course of every patient was documented retrospectively, with special regard to the length of hospital stay as a primary endpoint, as well as prokinetic therapy duration, the number of days of nasogastric tube decompression (NGT), the start of oral fluids, soft diet and solid diet (secondary endpoints). According to recent studies<sup>[13]</sup>, DGE was defined as (1) the nasogastric decompression lasting more than 3 postoperative days (POD) or the need for reinsertion of NGT for persistent nausea and vomiting after POD 3; (2) the inability to tolerate a solid diet by POD 7; or (3) the need for prokinetic agents after POD 10. All data were shown in the text and tables as means  $\pm$  SD.

### Statistical analysis

All statistical calculations were performed using Sigma-Plot version 12.0 (Systat Software Inc., San Jose, CA, United States) with the level of statistical significance set at  $P < 0.05$ . To compare the differences in mean length of hospital stay, time to the postoperative nasogastric tube withdrawal, liquids, liquid diet and full regular diet following Roux and conventional GE, we applied the parametric *t* test and non-parametric Mann-Whitney test. In the *t*-test, equal variance tests were performed to demonstrate differences in the use of prokinetics. All data were shown in the text and tables as means or medians  $\pm$  SD.

## RESULTS

Figure 1 is a flow chart of patient enrollment, randomization and progress through the study. The demographics of the patients from both groups are summarized in Ta-

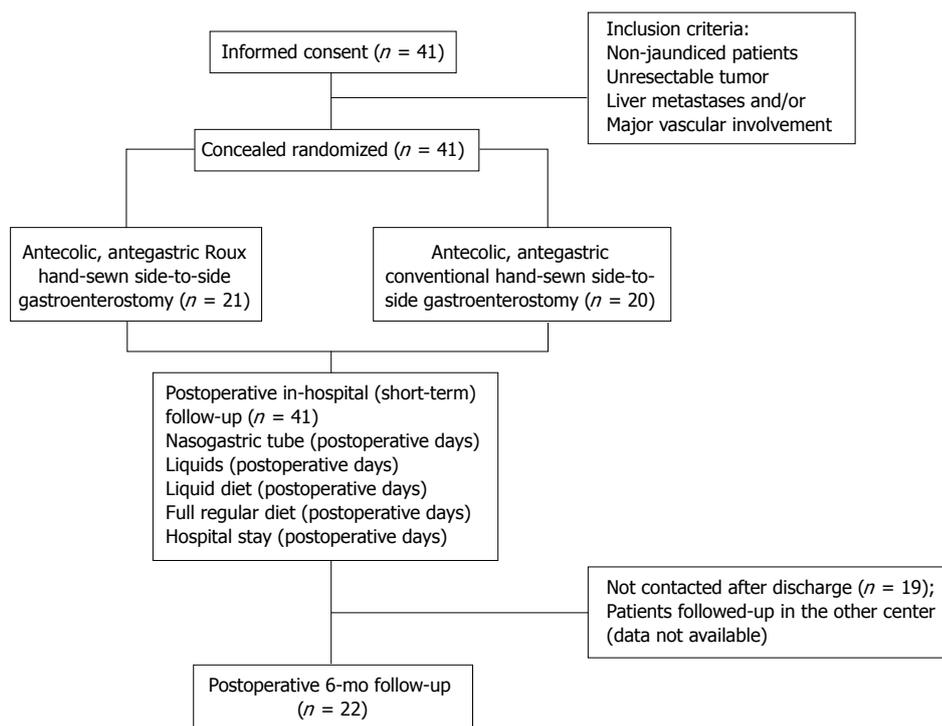


Figure 1 Flow chart of patient enrollment, randomization and progress through the study.

**Table 1 Characteristics and demographics of patients with pancreatic cancer undergoing Roux and conventional gastroenteroanastomosis**

Patients characteristics and demographics	Roux GE	Conventional GE
Age (yr)	60.2 ± 10.6	61.6 ± 8.5
Gender		
Female	10 (50)	8 (40)
Male	10 (50)	12 (60)
Reason for unresectability		
Local	15 (75)	14 (70)
Liver metastases	5 (25)	6 (30)
Indication	Prophylactic	Prophylactic
Reconstruction	Antecolic	Antecolic
Position	Antegastric	Antegastric

Data are expressed as absolute numbers (percentage) or mean ± SD. GE: Gastroenteroanastomosis.

ble 1. The mean operative time of Roux GE was 55 ± 25 min *vs* 48 ± 36 min for conventional GE. Shorter mean time to the postoperative nasogastric tube withdrawal (by 50%,  $P < 0.001$ ), liquids (by 33.3%,  $P < 0.001$ ), liquid diet (by 25%,  $P < 0.001$ ) and full regular diet (by 19.6%,  $P = 0.002$ ) following Roux in contrast to conventional GE was demonstrated (Table 2). No patients required reinsertion of the nasogastric tube. Delayed gastric emptying did not occur after Roux GE, whereas it was confirmed in four cases after conventional GE (20%). The Roux GE group had a lower use of prokinetics compared with conventional GE (10 mg of metoclopramide iv thrice daily for 2.2 ± 1.8 d *vs* 3.7 ± 2.6 d,  $P = 0.044$ ; total 62 ± 49 mg *vs* 111 ± 79 mg,  $P = 0.025$ ; respectively). The mean length of hospital stay was shorter following pallia-

tive Roux GE (7.7 d *vs* 9.6 d;  $P = 0.006$ ). The recurrence of jaundice and cholangitis (23% of patients) and mean survival were comparable in both groups during 6-mo follow-up.

## DISCUSSION

The palliative treatment of patients with unresectable pancreatic cancer is a significant economic burden to public healthcare. As limited survival is expected and the total costs of treatment per incident case are high, there are general concerns about the necessity of palliative procedures, which most frequently surgical in patients with pancreatic cancer. Biliary stents or biliary bypass in patients with jaundice have a definite role because they decrease morbidity; however, performing prophylactic gastroenterostomy is still a matter of debate for several reasons. First, it is difficult to predict the number of patients who will develop duodenal obstruction. Second, delayed gastric emptying is a frequent complication after gastroenterostomy. It is usually not a life-threatening condition and can be treated conservatively, although it compromises quality of life, prolongs the hospital stay and adds to hospital costs in patients with a very limited life expectancy. Recent reports have proved that prophylactic gastroenterostomy should be constructed in patients that are found to have unresectable pancreatic cancer at exploration<sup>[14]</sup>; therefore, it is necessary to decrease the incidence of DGE.

The occurrence of DGE after gastroenterostomy varies from 9% to 26%<sup>[15]</sup>. These differences may reflect considerable variations in DGE definition in previous

**Table 2 Postoperative course following Roux and conventional gastroenteroanastomosis**

Postoperative course	Roux GE		Conventional GE		Differences in the Roux and conventional GE ( <i>P</i> value)	Power analysis <sup>1</sup>
	mean ± SD	Median	mean ± SD	Median		
Nasogastric tube (postoperative days)	1.4 ± 0.75	1	2.8 ± 1.1	3	< 0.001	0.962
Liquids (postoperative days)	2.3 ± 0.86	2	3.45 ± 1.19	3	< 0.001	0.86
Liquid diet (postoperative days)	3.3 ± 0.73	3	4.4 ± 1.23	4	< 0.001	0.853
Full regular diet (postoperative days)	4.5 ± 0.76	4	5.6 ± 1.42	5	0.002	0.784
Hospital stay (postoperative days)	7.7 ± 3.01	7	9.6 ± 2.79	10	0.006	0.499

<sup>1</sup>Power *t*-test analysis was performed to justify the sample size. DGE: Delayed gastric emptying; GE: Gastroenteroanastomosis.

studies. However, we used the strict definition of DGE suggested by the International Study Group of Pancreatic Cancer<sup>[13]</sup>.

DGE is a multifactorial problem, which has been linked to tumor involvement of the coeliac axis and interruption of splanchnic innervations, as well as the technique of gastroenterostomy<sup>[15-20]</sup>. Our study confirmed that construction of a gastrojejunal anastomosis with an isolated Roux loop was beneficial (Table 2). The incidence of postoperative DGE was reduced. The procedure was technically simple and convalescence was rapid. Success may depend on already known parameters. Roux anastomosis remains mechanically efficient; however, postoperative gastric motility is temporarily impaired.

The development of laparoscopic surgical methods offers further reduction in costs associated treatment of unresectable pancreatic cancer. Laparoscopic gastric bypass is an effective and safe procedure for patients with gastric outlet obstruction. The hospital stay is shorter than after open surgery and recovery is more rapid<sup>[21]</sup>. It is technically feasible<sup>[22]</sup> for Roux gastrojejunostomy to be utilized for laparoscopic approach<sup>[23-26]</sup>. Thus, it may reveal new perspectives in prophylactic gastrojejunostomy in patients with unresectable pancreatic cancer. If curative resection is not possible, the response to chemotherapy is expected. Minimally invasive laparoscopic Roux GE may enable the patient to receive postoperative chemotherapy earlier. However, until now, the laparoscopic approach in pancreatic cancer has remained limited.

In conclusion, Roux gastroenterostomy should be performed routinely during open abdomen exploration in patients with unresectable pancreatic head carcinoma, because it is easy to perform, is free of specific complications, decreases incidence of DGE, and reduces the length of hospital stay and associated health care costs.

## COMMENTS

### Background

The surgical palliation is an important component of the treatment of pancreatic head cancer. However, the optimal method of palliation is uncertain when tumor unresectability is determined at exploration.

### Research frontiers

Prophylactic gastroenterostomy should be constructed in patients who are found to have unresectable pancreatic cancer at exploration. Nevertheless, delayed gastric emptying is a frequent complication after gastroenterostomy. This research evaluated the use of different surgical techniques for creating gastroenterostomy on the postoperative delayed gastric emptying (DGE) rate and the

hospital length of stay in non-jaundiced patients with unresectable pancreatic head cancer.

### Innovations and breakthroughs

This is the first paper to precisely describe differences in the postoperative course between antecolic Roux and conventional antegastric hand-sewn side-to-side *gastroenterostomy* in patients with unresectable pancreatic head cancer.

### Applications

The study results suggest that Roux instead of conventional antegastric gastroenterostomy should be performed routinely during open abdomen exploration in patients with unresectable pancreatic head carcinoma, because it is easy to perform, is free of specific complications, decreases incidence of DGE, and reduces the length of hospital stay and associated health care costs.

### Peer review

The results evaluate the influence of two different surgical techniques of creating gastroenterostomy on the postoperative delayed gastric emptying rate and the length of stay hospital in non-jaundiced patients with unresectable pancreatic head cancer. This is an interesting randomized study, though it suffers from many vulnerabilities.

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