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

Dariusz Szymanski, Adam Durczynski, Michal Nowicki, Janusz Strzelczyk

Dariusz Szymanski, Adam Durczynski, Michal Nowicki, Janusz Strzelczyk, Department of General and Transplant Surgery, Barlicki University Hospital, Medical University of Lodz, 0-153 Lodz, Poland.

Author contributions: All authors contributed equally to this work.

Correspondence to: Adam Durczynski MD, PhD, Department of General and Transplant Surgery, Medical University of Lodz, Barlicki University Hospital, Kopcinskiego Street 22, 90-153 Lodz, Poland. a.durczynski@interia.pl
Telephone: +48-42-6776755 Fax: +48-42-6791091
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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 ± 0.75 vs 2.8 ± 1.1, P < 0.001). Time to starting oral liquids, soft diet and regular diet were decreased (2.3 ± 0.86 vs 3.45 ± 1.19; P < 0.001; 3.3 ± 0.73 vs 4.4 ± 1.23, P < 0.001 and 4.5 ± 0.76 vs 5.6 ± 1.42, P = 0.002; respectively).

The Roux GE group had a lower use of prokinetics (10 mg 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). 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.

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.
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[9]. 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[10].

Nowadays, with increasing incidence of pancreatic cancer, annual costs for therapy have risen rapidly[3-4]. 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[11]. New anti-cancer agents are the largest expenditure, although the greater part of the costs comes from palliative surgical procedures and postoperative hospitalization care[8]. Pancreatic surgeries in high-volume centers are associated with low mortality, but high morbidity[5-12]. 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 gastro-jejunostomy. 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[13], 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 ± SD.

Statistical analysis

All statistical calculations were performed using SigmaPlot 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 ± SD.

RESULTS

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.

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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-
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 palliative 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 \(^{[14]}\); therefore, it is necessary to decrease the incidence of DGE.

The occurrence of DGE after gastroenterostomy varies from 9% to 26% \(^{[15]}\). These differences may reflect considerable variations in DGE definition in previous
Studies. However, we used the strict definition of DGE suggested by the International Study Group of Pancreatic Cancer[1].

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[13-20]. 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[21, 22]. It is technically feasible[23, 24] for Roux gastrojejunostomy to be utilized for laparoscopic approach[25-28]. Thus, it may reveal new perspectives in prophylactic gastrojejunalostomy 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.

### REFERENCES

1. Jemal A, Murray T, Samuels A, Ghafoor A, Ward E, Thu N. Cancer statistics, 2003. CA Cancer J Clin 2003; 53: 5-26 [PMID: 12568441]
2. Quiros RM, Brown KM, Hoffman JP. Neoadjuvant therapy in pancreatic cancer. Cancer Invest 2007; 25: 267-273 [PMID: 17612937 DOI: 10.1080/07357900701206356]
3. O’Neill CB, Atoria CL, O’Reilly EM, LaFemina J, Henman MC, Elkin EB. Costs and trends in pancreatic cancer treatment. Cancer 2012; 118: 5132-5139 [PMID: 22415469 DOI: 10.1002/cncr.27480]
4. Bardou M, Le Ray I. Treatment of pancreatic cancer: A narrative review of cost-effectiveness studies. Best Pract Res Clin Gastroenterol 2013; 27: 881-892 [PMID: 24182608 DOI: 10.1016/j.bpcg.2013.09.006]
5. Tam VC, Ko YJ, Mittmann N, Cheung MC, Kumar K, Hasan S, Chan KK. Cost-effectiveness of systemic therapies for metastatic pancreatic cancer. Curr Oncol 2013; 20: e90-e106 [PMID: 23559890 DOI: 10.3747/co.20.1223]
6. Ishii H, Funuse J, Kinoshita T, Konishi M, Nakagohri T, Takahashi S, Gotohda N, Nakachi K, Suzuki E, Yoshino M. Treatment cost of pancreatic cancer in Japan: analysis of the difference after the introduction of gemcitabine. Jpn J Clin Oncol 2005; 35: 526-530 [PMID: 16120621 DOI: 10.1093/jjco/hyi144]
7. Ogdie AR, Lee BC, Li J, Maglaris D, Siddiqi A, Marshall J. The cost of treating pancreatic cancer: A pilot study. J Clin Oncol 2006; 24: 16004
8. Janes RH, Niederhuber JE, Chmiele JS, Winchester DP, Ocwieja KC, Kamell JS, Clive RE, Menck HR. National patterns of care for pancreatic cancer. Results of a survey by the Commission on Cancer. Ann Surg 1996; 223: 261-272 [PMID: 8604906 DOI: 10.1097/00000658-199603000-00006]
9. Ho CK, Kleeff J, Friess H, Büchler MW. Complications of pancreatic surgery. HPB (Oxford) 2005; 7: 99-108 [PMID: 15975968]

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

| Postoperative course                              | Roux GE mean ± SD | Roux GE Median | Conventional GE mean ± SD | Conventional GE Median | Differences in the Roux and conventional GE (P value) | Power analysis1 |
|---------------------------------------------------|-------------------|----------------|---------------------------|------------------------|------------------------------------------------------|---------------|
| 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         |

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

### 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.

### NOTES

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10 Hwang SI, Kim HO, Son BH, Yoo CH, Kim H, Shin JH. Surgical palliation of unresectable pancreatic head cancer in elderly patients. World J Gastroenterol 2009; 15: 978-982 [PMID: 19248198 DOI: 10.3748/wjg.15.978]

11 Lesur et al, Dehni N, Tirtel E, Parc R, Paye F. Palliative surgery for unresectable pancreatic and periampullary cancer: a reappraisal. J Gastrointest Surg 2006; 10: 286-291 [PMID: 16455463 DOI: 10.1016/j.giss.2005.01.011]

12 Singh SM, Longmire WP, Reber HA. Surgical palliation for pancreatic cancer. The UCLA experience. Ann Surg 1990; 212: 132-139 [PMID: 1695834 DOI: 10.1097/00000658-199008000-00003]

13 Wenten MN, Bassi C, Dervenis C, Fingerhut A, Gouma DJ, Izbricki JR, Neoptolemos JP, Padbury RT, Sarr MG, Traverso LW, Yeo CJ, Büchler MW. Delayed gastric emptying (DGE) after pancreatic surgery: a suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). Surgery 2007; 142: 761-768 [PMID: 17981197 DOI: 10.1016/j.surg.2007.05.005]

14 Hüser N, Michalski CW, Schuster T, Friess H, Kleeff J. Systematic review and meta-analysis of prophylactic gastroenterostomy for unresectable advanced pancreatic cancer. Br J Surg 2009; 96: 711-719 [PMID: 19526616 DOI: 10.1002/bjs.6629]

15 Horstmann O, Kley CW, Post S, Becker H. 'Cross-section gastroenterostomy' in patients with irresectable periamplillary carcinoma. HPB (Oxford) 2001; 3: 157-163 [PMID: 18332918 DOI: 10.1080/136518201317077170]

16 Shyr YM, Su CH, Wu CW, Lui WY. Prospective study of gastric outlet obstruction in unresectable periamplillary adenocarcinoma. World J Surg 2000; 24: 60-4; discussion 64-5 [PMID: 10594205]

17 Lillemoe KD, Cameron JL, Hardacre JM, Sohn TA, Sauter PK, Coleman J, Pitt HA, Yeo CJ. Is prophylactic gastrojejunostomy indicated for unresectable periamplillary cancer? A prospective randomized trial. Ann Surg 1999; 230: 322-38; discussion 322-38 [PMID: 10495479]

18 van der Schelling GP, van den Bosch RP, Klinkenbij JH, Mulder PG, Jeekel J. Is there a place for gastroenterostomy in patients with advanced cancer of the head of the pancreas? World J Surg 1993; 17: 128-32; discussion 132-3 [PMID: 7680712]

19 Jacobs PP, van der Sluis RF, Wobbes T. Role of gastroenterostomy in the palliative surgical treatment of pancreatic cancer. J Surg Oncol 1989; 42: 145-149 [PMID: 2478834 DOI: 10.1002/jso.2904203]

20 Sarr MG, Cameron JL. Surgical management of unresectable carcinoma of the pancreas. Surgery 1982; 91: 123-133 [PMID: 617929] DOI: 10.1007/BF01656022

21 Park JM, Chi KC. Unresectable gastric cancer with gastric outlet obstruction and distant metastasis responding to intraperitoneal and folfox chemotherapy after palliative laparoscopic gastrojejunostomy: a report of a case. World J Surg Oncol 2010; 8: 109 [PMID: 21167074]

22 Zevin B, Aggarwal R, Grantcharov TP. Simulation-based training and learning curves in laparoscopic Roux-en-Y gastric bypass. Br J Surg 2012; 99: 887-895 [PMID: 22511220 DOI: 10.1002/bjs.8748]

23 Kendrick ML. Laparoscopic and robotic resection for pancreatic cancer. Cancer 2012; 118: 571-576 [PMID: 23187844 DOI: 10.1097/POGO.0b013e3182788e86]

24 Kim SC, Song KB, Jung YS, Kim YH, Park do H, Lee SS, Seo DW, Lee SK, Kim MH, Park KM, Lee YJ. Short-term clinical outcomes for 100 consecutive cases of laparoscopic pylorus-preserving pancreaticoduodenectomy: improvement with surgical experience. Surg Endosc 2013; 27: 95-103 [PMID: 22752284 DOI: 10.1007/s00464-012-2427-9]

25 Palanivelu C, Jani K, Senthilnathan P, Parthasarathi R, Rajapandian S, Madhankumar MV. Laparoscopic pancreaticoduodenectomy: technique and outcomes. J Am Coll Surg 2007; 205: 222-230 [PMID: 17660068 DOI: 10.1016/j.jamcollsurg.2007.04.004]

26 Muniraj T, Barve P. Laparoscopic staging and surgical treatment of pancreatic cancer. J Nat Med Sci 2013; 5: 1-9 [PMID: 23579948 DOI: 10.4103/0947-2714.106183]
