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ORIGINAL ARTICLE

Routine Gastric Decompression after Pancreatoduodenectomy: Treating the Surgeon?

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Abstract

Background The decision to routinely leave a nasogastric tube after pancreatoduodenectomy remains controversial. We sought to determine the impact of immediate nasogastric tube removal versus early nasogastric tube removal (<24 h) on postoperative outcomes.

Methods A retrospective review of our institution's prospective ACS-NSQIP database identified patients that underwent pancreatoduodenectomy from 2015 to 2018. Outcomes were compared among patients with immediate nasogastric tube removal versus early nasogastric tube removal.

Results A total of 365 patients were included in primary analysis (no nasogastric tube, $n = 99$; nasogastric tube removed <24 h, $n = 266$). Thirty-day mortality and infectious, renal, cardiovascular, and pulmonary morbidity were similar in comparing those with no nasogastric tube versus early nasogastric tube removal on univariable and multivariable analyses ($P > 0.05$). Incidence of delayed gastric emptying (11.1 versus 13.2%) was similar between groups. Patients with no nasogastric tube less frequently required nasogastric tube reinsertion ($n = 4$, 4%) compared to patients with NGT <24 h ($n = 39$, 15%) (OR = 3.83, 95% CI [1.39-10.58]; $P = 0.009$).

Conclusion Routine gastric decompression can be safely avoided after uneventful pancreaticoduodenectomy.

Keywords Nasogastric decompression · Pancreatoduodenectomy · Delayed gastric emptying

Introduction

The practice of introducing a tube through the nose, down the pharynx, esophagus, and into the stomach to drain its contents has existed for over a century. This has been used in both therapeutic and prophylactic settings.[1,2] Decreasing stomach distention, postoperative nausea, vomiting, aspiration pneumonia, and wound dehiscence were some of the rationales behind the practice. However, numerous studies evaluating nasogastric tube (NGT) after abdominal surgeries concluded against its systematic use.[1–5] Thus, most enhanced recovery after surgery (ERAS) programs implement NGT removal after routine abdominal procedures.

Pancreatoduodenectomy (PD) remains the standard treatment for patients with resectable periampullary tumors. While mortality has decreased substantially over the last few decades, morbidity remains as high as 40%.[6–8] One of the major morbidities afflicting up to 30% of patients is delayed gastric emptying (DGE).[9] This complication may trigger a chain of negative events including discomfort, nausea, persistent vomiting, increased risk of aspiration pneumonia, longer hospital stays, and higher readmission rates.[10] Due to the high occurrence rate of DGE and the complexity and number of enteric anastomoses involved in PD, many surgeons are reluctant to abandon the routine placement of an NGT postoperatively. The ability to

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detect early intrinsic gastric bleeding as well as avoid the unpleasant experience of reinsertion are some rationales among others.

Previous studies have mostly investigated removal of the NGT between POD-1-3,[11,12] without evaluating the first 24 h. Patients with an NGT left in place >24 h represent a group that falls out of routine NGT practice for our pancreas surgeons. A comparison of outcomes following immediate removal of NGT at the end of the procedure versus early removal of NGT after PD has not been performed before. This dichotomy reflects standard practice of NGT use for the surgeons in our group, i.e., removal at extubation or removal the next morning on rounds.

Hypothesis

We hypothesize that the presence of an NGT in the first 24 h is not necessary to improve patient safety or outcomes. This study aimed to identify the necessity of nasogastric tube placement after PD and determine the safety of immediate versus early removal.

Methods

Assurances

Patients undergoing PD at Indiana University Health, University Hospital between 2015 and 2018 were retrospectively reviewed using our prospectively collected American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database augmented with electronic medical record (EMR) reviews. The data were collected and reported in compliance with the confidentiality guidelines defined by the Indiana University Institutional Review Board.

Patient Population

The ACS-NSQIP database and EMR were reviewed to gather NGT status postoperatively, and monitor reinsertion rates during entire hospital stay. Exclusion criteria consisted of patients with a concurrent gastrostomy tube placed intraoperatively. Patients were categorized into 2 groups: NGT removal within 24 h of surgery (early) or NGT removal immediately after the reversal of anesthesia (immediate). Supplemental analysis included two additional patient groups: NGT removal 24-48 h postoperatively (delayed) or removal >48 h after surgery (late).

Definitions and Outcomes

All ACS-NSQIP variables were evaluated. Demographic information included patient age, sex, race, body mass index (BMI), and comorbidities. Preoperative laboratory values were recorded if available within 30 days of the operative date. The NGT status of patients immediately after surgery throughout their hospital stay and NGT reinsertion were manually reviewed and documented. Other perioperative variables of interest included presence of obstructive jaundice with or without biliary stenting, malignancy, laparoscopic versus open operation, use of a wound protector, operative duration, pancreas gland texture, route of gastroenteric reconstruction (antecolic versus retrocolic), and vascular reconstruction. The 2007 and the International Study Group for Pancreatic Surgery (ISGPS) 2016 criteria were used to define DGE and postoperative pancreatic fistula, respectively.[9,13]

Statistics

Chi-squared and *t*-tests were used to examine potential differences in perioperative variables. A difference between groups in regard to identified potential confounders was examined using logistic regression. For 4-group comparison ("Supplementary Information" section), one-way ANOVA and Fisher's exact test were used to investigate potential differences in preoperative and perioperative variables between patient groups. Variables with significant differences between groups and those with significant associations with an outcome, as identified by logistic regression (or negative binomial regression), were included as covariates in a multiple regression model. The biostatistical analysis was performed by Indiana University's Center for Outcomes Research in Surgery (CORES) using R, version 3.5.0 (Vienna, Austria).

Results

In the present study, a total of 505 patients underwent PD between 2015 and 2018. Of these, 140 patients were excluded because of gastrostomy tube placement intraoperatively (n = 12 patients), or because NGT was left in >24 h postoperatively (n = 140) leaving 365 for immediate (n = 99) versus early group (n = 266) analysis. Baseline demographics were comparable between patients with immediate versus early NGT ($\leq$24 h) removal. Mean age of the overall cohort was 64.7 years, with 52% males and 7% non-whites. Comorbidities were similar between groups, Table 1. Perioperative variables were then examined between the two groups. Patients with early NGT removal were twice as likely to undergo preoperative chemotherapy and vascular resection at the time of surgery ($P < 0.05$). The group with immediate postoperative NGT removal had longer operative times, more frequent

Table 1 Univariate baseline comparison between groups

Variable	Immediate removal *n* (%) or mean [SD]	≤24-h removal *n* (%) or mean [SD]	*P*-value
Number of patients	99	266	
Age (years)	65 [11.3]	65 [12.3]	0.7
Male gender	54 (54)	135 (51)	0.5
Race (non-white)	8 (8)	19 (7)	0.8
Diabetes	31 (31)	70 (26)	0.3
Smoking history	23 (23)	79 (30)	0.2
Dyspnea	12 (12)	19 (7)	0.1
COPD	5 (5)	19 (7)	0.5
Hypertension	54 (54.5)	150 (56.4)	0.8
Dialysis	0 (0)	2 (0.8)	0.5
Steroid use	2 (2)	3 (1.1)	0.5
Weight loss >10%	14 (14.1)	59 (22.2)	0.09
Dependent health status	3 (3)	3 (1)	0.2
Bleeding disorder	0 (0)	0 (0)	1
Sepsis	0 (0)	0 (0)	1
Obstructive jaundice	29 (29)	95 (36)	0.3
Neoadjuvant chemotherapy	11 (11)	59 (22)	**0.02**
Neoadjuvant radiation	2 (2)	7 (2.6)	0.7
Perioperative			
Wound protector	72 (98.6)	179 (97.3)	0.5
Malignancy	56 (56.6)	186 (69.9)	**0.02**
Laparoscopic	0 (0)	2 (0.8)	0.475
Soft gland	55 (56)	116 (44)	**0.04**
Dependent functional status	3 (3)	3 (1)	0.2
Retrocolic anastomosis	58 (66)	111 (45)	**0.001**
Procedure length (hrs)	5.01 [1.53]	4.5 [1.38]	**0.004**
Vascular resection	5 (5.1)	33 (12.4)	**0.05**

Bold indicates significance

COPD chronic obstructive pulmonary disease, *hrs* hours, *n* number, *SD* standard deviation

retrocolic gastroenteric anastomosis, less malignant pathology, and softer pancreatic gland texture ($P < 0.05$), Table 1.

Assessment of postoperative outcomes on univariable analysis between immediate and early NGT removal groups is detailed in Table 2. Multivariable analysis of monitored NSQIP variables showed no significant differences between groups, Table 3. Additional outcomes of interest included NGT reinsertion rate in immediate versus early removal groups (4% ($n = 4$) versus 15% ($n = 39$) respectively; $P = 0.009$), and DGE (11% ($n = 11$) versus 13% ($n = 35$) respectively; $P = 0.3$). Although DGE and reinsertion rates were higher in the group with early NGT removal, only reinsertion rate remained statistically significant on multivariable analysis. For further analysis, two additional cohorts were included—patients with NGT removal 24-48 h (delayed, $n = 67$) or >48 h after surgery (late, $n = 73$) (Supplemental Tables 1 and 2). No significant difference in outcomes between early and delayed NGT removal groups was observed on multivariable analysis. In contrast, patients in the late group demonstrated significantly ($P < 0.05$) poorer postoperative outcomes than the early group.

Discussion

The present study is an analysis of 3 years of PD surgeries at a high-volume center, assessing NGT removal after PD. In this series of patients that underwent uncomplicated PD, outcomes were compared between those with immediate removal of NGT following surgery or early removal within 24 h of the operation. There were no significant differences in NSQIP-monitored postoperative outcomes between the two groups. Of the additional outcomes of interest, NGT reinsertion rate was significantly higher in those with early removal. Further

Table 2 Univariable analysis comparing the outcomes of immediate removal versus early (<24 h) NGT removal postoperatively

Outcomes	Immediate removal *n* (%) or mean [SD]	≤24-h removal *n* (%) or mean [SD]	*P*-value
30-day mortality	1 (1)	1 (0.4)	0.46
Superficial SSI	4 (4)	5 (2)	0.26
Deep SSI	2 (2)	4 (2)	0.66
Deep organ SSI	12 (12)	25 (9)	0.44
DGE	11 (11)	35 (13)	0.72
Pancreatic fistula	12 1(2)	38 (14)	0.73
Postop sepsis	6 (6.1)	8 (3)	0.21
NGT reinsertion	4 (4)	39 (15)	**0.003**
Septic shock	4 (4)	4 (2)	0.22
Reintubation	4 (4)	6 (2.3)	0.46
Pneumonia	1 (1)	5 (2)	1.0
LOS (days)	9.8 [10.1]	9.5 [7.1]	0.38
Readmission	18 (18)	32 (12)	0.17

Bold indicates significance

DGE delayed gastric emptying, *LOS* length of stay, *n* number, *SD* standard deviation, *SSI* surgical site infection

analysis including patients with delayed (24-48 h) or late NGT removal (>48 h) after surgery showed no significant differences in NSQIP-monitored postoperative outcomes between immediate, early, and delayed groups. However, those with late removal had significantly worse monitored postoperative outcomes.

Similar to our findings in the present study, prophylactic decompression of the stomach using an NGT has not been shown to improve outcomes after abdominal surgeries. Initially documented in a meta-analysis[4,14] and then confirmed in a randomized controlled trial, an earlier return of bowel function was more likely to occur when the systematic use of an NGT was avoided.[10] Perhaps one of the most studied areas was colorectal surgery in which NGT omission was associated with faster return of bowel functions,[15–17] and this practice became a core component of guidelines for enhanced recovery programs.[18] The value of the tube was thought to be uniquely different after foregut surgery such as gastrectomy and PD. However, recent prospective series have emerged, concluding that routine NGT after gastrectomy and PD does not offer benefit[19,20] and potentially increases length of stay.[21, 22] These reports were followed by another prospective study analyzing both total and partial gastrectomy which produced similar findings.[23] Unlike other studies, our work focusses on the impact of an NGT mainly during the first 24 h.

Pancreatoduodenectomy is notorious for an exceptionally high rate of DGE, causing surgeons to be more resistant to the immediate removal of an NGT following surgery. DGE is

Table 3 Multivariable analysis comparing the outcomes of immediate NGT removal versus ≤24-h removal

Postoperative outcome	Adjusted OR	95% CI upper	95% CI lower	*P*-value
Acute renal failure	1.00	0.01	101.96	1
Myocardial infarction	0.43	0.07	2.66	0.4
Cardiac arrest	0.48	0.04	5.26	0.6
Cerebral vascular accident	1.00	0.01	101.34	1
Unplanned reintubation	0.57	0.16	2.00	0.4
Pancreatic fistula	1.00	0.01	104.21	1
Pneumonia	1.69	0.25	11.35	0.6
Sepsis	0.42	0.14	1.25	0.1
Septic shock	0.39	0.10	1.52	0.2
Superficial surgical site infection	0.38	0.10	1.44	0.2
Deep surgical site infection	0.77	0.15	3.82	0.7
Organ space infection	0.84	0.40	1.76	0.6
Clostridium difficile	1.67	0.25	11.22	0.6
Urinary tract infection	0.77	0.15	3.88	0.7
Deep venous thrombosis	2.46	0.37	16.22	0.4
Pulmonary embolism	1.39	0.20	10.04	0.7
Wound disruption	1.24	0.16	9.63	0.8
Nasogastric tube reinsertion	3.83	1.39	10.58	**0.009**
Delayed gastric emptying	1.44	0.69	2.98	0.3
Length of stay (days)	1.01	0.88	1.16	0.9
30-day readmission	0.62	0.33	1.16	0.1
30-day mortality	0.48	0.04	5.24	0.5

Bold indicates significance

estimated to occur in 15-30% of patients undergoing PD; the rates are influenced by many factors.[12,24–26] The ability to detect early gastric bleeding, compromised nutrition, alleviate abdominal distention leading to nausea and vomiting and a potential aspiration event, or the potential need for NGT reinsertion are reasons for NGT use. However, the routine use of NGT after PD has evolved in the same direction as that observed in other surgical specialties.[18,27,28] Some series even demonstrate reduced rates of DGE and LOS in those with immediate removal of NGT after surgery.[12,29] In the present study, rates of DGE were similar between immediate, early, and delayed NGT removal groups, supporting results of prior literature above.

At the time of this study, there were five operating surgeons at our institution with comparable operative techniques for the critical steps of the procedure. The pylorus can either be removed or left in place during the extirpative phase of the procedure. Resecting the pylorus, also known as classic Whipple, may increase the operative time, intraoperative blood loss, marginal ulcers, diarrhea secondary to dumping syndrome, and bile reflux gastritis, and its routine use does not offer oncological benefit.[25] Therefore, the structure is typically spared at our institution. In addition, there is data to suggest that it does not impact rates of DGE or the reinsertion rates of NGTs.[30] Another technical factor that might influence the rates of DGE is the orientation of the jejunal limb in the gastroenteric anastomosis. An antecolic reconstruction is expected to have lower rates of DGE based on more than one recent systematic review.[9,31–34] Despite being disadvantaged with higher rates of retrocolic reconstruction, those with immediate NGT removal in our study had similar rates of DGE compared to other groups.

Aside from the retrospective nature of this study, additional limitations exist. Nasogastric decompression after abdominal surgery has been common practice for decades. Although the present study suggests decompression in the early postoperative period may not be necessary, the decision of when to remove the NGT after surgery is often based on inherent or unconscious practice patterns that become habit, introducing a potential bias. After postoperative day 1 (> 24 h) at our institution, clinical factors almost exclusively dictate delayed removal or reinsertion of NGT.

Conclusion

The aim of this study was to provide support for or against the necessity of the "prophylactic" NGT in the early postoperative period after PD. The findings of this study suggest immediate removal is generally safe in elective PD patients. Despite the findings of our study, there is no substitute for good clinical judgment to determine the appropriate use of NGT use in the early postoperative course after PD. When it is simply habit and not clinically supported, immediate removal of the NGT is reasonable. Furthermore, these data support the performance of a randomized controlled trial. This would minimize any potential bias introduced in this retrospective analysis of NGT practice patterns in our single institution study.

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Author Contribution KFF and MS were involved in the conception of the project, acquisition, analysis, and interpretation of data, and drafting and revising the work. CMS serves as the mentor and corresponding author for the work and was involved in the conception, interpretation, revision, and final approval of the work; CMS agrees to be accountable for the work. RES, CLC, MTY, EPC, TKN, MGH, NJZ, and AN were involved in the conception of the project, revision of the work, and final approval.

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