Journal Pre-proof



Pylorus-Preserving Approach in Total Pancreatectomy with Islet Autotransplantation (TPIAT) Is Associated with Lower Patient Readmission Rates

Myriam B. Charron, Anne Eaton, Jaimie D. Nathan, Guru Trikudanathan, Maisam Abu-El-Haija, Syed Ahmad, Timothy B. Gardner, Luis F. Lara, Katherine Morgan, Bashoo Naziruddin, Andrew Posselt, Sri Prakash Mokshagundam, Vikesh K. Singh, Martin Wijkstrom, Piotr Witkowski, Gregory J. Beilman, Melena D. Bellin

PII: S0039-6060(26)00693-8

DOI: https://doi.org/10.1016/j.surg.2026.110768

Reference: YMSY 110768

To appear in: *Surgery*

Received Date: 6 May 2026

Revised Date: 14 September 2026

Accepted Date: 11 October 2026

Please cite this article as: Charron MB, Eaton A, Nathan JD, Trikudanathan G, Abu-El-Haija M, Ahmad S, Gardner TB, Lara LF, Morgan K, Naziruddin B, Posselt A, Mokshagundam SP, Singh VK, Wijkstrom M, Witkowski P, Beilman GJ, Bellin MD, Pylorus-Preserving Approach in Total Pancreatectomy with Islet Autotransplantation (TPIAT) Is Associated with Lower Patient Readmission Rates, *Surgery* (2026), doi: https://doi.org/10.1016/j.surg.2026.110768.

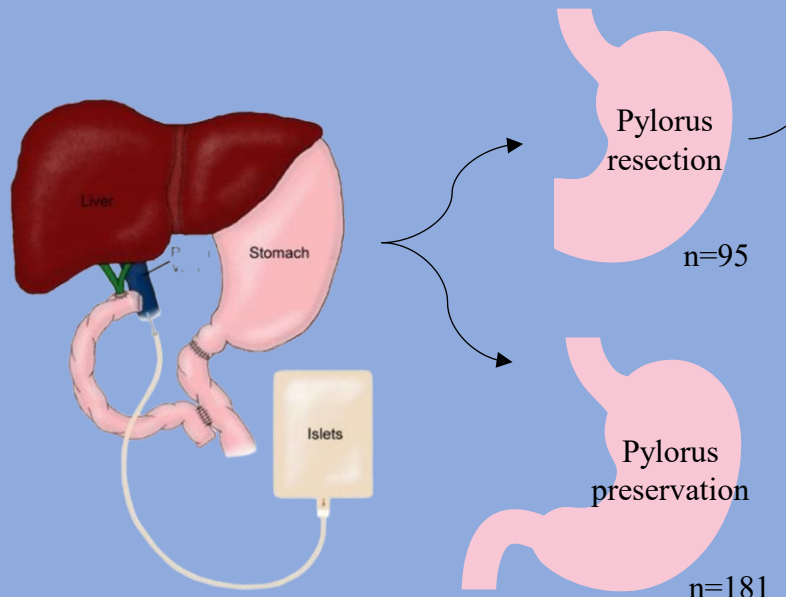
This is a PDF of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability. This version will undergo additional copyediting, typesetting and review before it is published in its final form. As such, this version is no longer the Accepted Manuscript, but it is not yet the definitive Version of Record; we are providing this early version to give early visibility of the article. Please note that Elsevier's sharing policy for the Published Journal Article applies to this version, see: https://www.elsevier.com/about/policies-and-standards/sharing#4-published-journal-article. Please also note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2026 Published by Elsevier Inc.

Journal Pre-proof

Pylorus-Preserving Approach in Total Pancreatectomy with Islet Autotransplantation (TPIAT) Is Associated with Lower Patient Readmission Rates

Observational study of pylorus preservation vs resection in TPIAT patients



Results

Higher 30-day readmission rates in PR
OR 2.91, 95% CI 1.36-6.21

No difference in hospitalizations or number of operations at 1y post-TPIAT

Non-significant difference in LOS (11d in PP vs 9d in PR)

Tendency towards vitamin A deficiency in PR patients.
Non-significant difference following multivariate analysis

Similar outcomes of reconstruction approach in TPIAT

PR participants experienced higher readmission but other short-term outcomes remained similar

Surgeon expertise and preference will continue to guide approach

SURGERY

Charron MB, Eaton A, Nathan JD, et al.

Journal Pre-proof

Pylorus-Preserving Approach in Total Pancreatectomy with Islet Autotransplantation (TPIAT) Is Associated with Lower Patient Readmission Rates

Authors: Myriam B. Charron[1*], Anne Eaton[2], Jaimie D. Nathan[3], Guru Trikudanathan[1], Maisam Abu-El-Haija[4], Syed Ahmad[5], Timothy B. Gardner[6], Luis F. Lara[5,7], Katherine Morgan[8], Bashoo Naziruddin[9], Andrew Posselt[10], Sri Prakash Mokshagundam[11], Vikesh K. Singh[12], Martin Wijkstrom[13], Piotr Witkowski[14], Gregory J. Beilman[1], Melena D. Bellin[1]

1. University of Minnesota School of Medicine, Minneapolis, MN

2. University of Minnesota School of Public Health, Minneapolis, MN

3. Nationwide Children's Hospital, Columbus, OH

4. Cincinnati Children's Hospital Medical Center, Cincinnati, OH

5. University of Cincinnati, Cincinnati, OH

6. Dartmouth-Hitchcock Medical Center, Lebanon, NH

7. The Ohio State Wexner University Medical Center, Columbus, OH

8. New York University Langone Health, New York City, NY

9. Baylor Health, Dallas, TX

10. University of California San Francisco, San Francisco, CA

11. University of Louisville, Louisville, KY

12. Johns Hopkins Medical Institutions, Baltimore, MD

13. University of Pittsburgh Medical Center, Pittsburgh, PA

14. University of Chicago, Chicago, IL

* Corresponding author: Myriam B. Charron, MBBCh
Clinical Resident, Department of General Surgery
University of Minnesota
Email: bench017@umn.edu
Phone: 612-625-4686, 612-477-7393, Fax: 612-626-5262
Mailing Address: MMC 391, 420 Delaware St SE, Minneapolis, MN 55455

Journal Pre-proof

Journal Pre-proof

Abstract

Background

In total pancreatectomy with islet autotransplantation (TPIAT) for disabling recurrent acute and chronic pancreatitis, duodenectomy is performed with variable approaches to gastrointestinal reconstruction. Little is known regarding the impact of reconstruction approach on surgical, gastrointestinal, and nutritional outcomes. We compared outcomes after pylorus-preservation (PP) and pylorus-resection (PR) approaches using data from the multicenter Prospective Observation Study of TPIAT (POST) study.

Methods

This is a secondary data analysis for adults (n=276) who underwent TPIAT at 12 centers in POST for an indication of recurrent acute or chronic pancreatitis. Participants were categorized based on pylorus resection status. Outcomes of interest compared between PP (n=181) and PR (n=95) groups included hospital length of stay, nutritional markers, and post-operative complications in the first 1 year after TPIAT.

Results

PR participants were slightly older (median 40 versus 37 years old in PP group, p=0.055). After adjusting for sex, age, feeding tube placement, and type of biliary reconstruction, hospital length of stay was similar between groups, but hospital readmissions were higher within the first month following TPIAT in PR participants (odds ratio 2.91, 95% confidence interval (CI) 1.36-6.21, p=0.006). After multivariate adjustments, there was a non-significant trend towards more vitamin A deficiency in PR participants (OR 2.21, 95% CI 0.91-4.92, p = 0.083).

Conclusion

While PR participants experienced higher early readmission rates, both PR and PP groups experienced similar hospital length of stay, nutritional outcomes and postoperative complication rates. Neither approach showed a clear superiority in the short-term, but long-term data are needed.

Keywords: TPIAT, chronic pancreatitis, pylorus

Journal Pre-proof

Introduction

Patients with chronic and acute recurrent pancreatitis experience significant chronic pain and disability. When medical and endoscopic management fails, surgical interventions may be warranted. Total pancreatectomy with islet autotransplantation (TPIAT) can reduce pain, opioid use, and improve physical and mental quality of life for patients with chronic pancreatitis [1].

Total pancreatectomy with islet autotransplantation involves resection of the entire pancreas with either total duodenectomy (pylorus resection, PR) or partial duodenectomy (pylorus preservation, PP), gastrointestinal (GI) reconstruction (with or without Roux-en-Y) by gastrojejunostomy or duodenojejunostomy, biliary reconstruction, and infusion of islet cells into the portal vein [2]. The decision to resect or preserve the pylorus generally varies between institutions and surgeons, with very limited literature in TPIAT for pancreatitis to determine whether one approach is advantageous over the other.

Studies comparing outcomes from pylorus resection versus pylorus preservation in pancreatoduodenectomy (PD) have focused primarily on surgery performed for pancreatic malignancy or tumors, with mixed findings. In observational, non-randomized, and randomized studies, pylorus preservation has been associated with significant reduction in operating time and intra-operative blood loss compared to pylorus resection [3; 4; 5; 6; 7]. but without differences in postoperative mortality [8; 9]. In contrast, risk for delayed gastric emptying (DGE) may be higher with pylorus preservation [5; 10; 11]. Extrapolating the literature from PD in pancreatic cancer to chronic pancreatitis is challenged by pancreatic cancer's poor prognosis and resultant short follow-up period. However, a randomized controlled trial assessing the long-term outcomes (mean of approximately 34 months) of pylorus preservation versus resection for benign and malignant PD showed no significant differences in morbidity [9].

To date, the literature on TPIAT for pancreatitis has focused primarily on quality of life, pain control, islet graft function, and nutritional status following operation. However, little has been published regarding the effect of GI reconstruction approach on surgical, gastrointestinal, and nutritional outcomes after TPIAT. In the current study, we utilized data from the multicenter Prospective Observational Study of TPIAT (POST) to compare pylorus-preservation versus pylorus-resection surgical approaches during TPIAT operations and their association with surgical complications and 1-year postoperative outcomes, with a focus on hospital readmissions, gastrointestinal

complications, and nutritional markers [12]. We hypothesized that pylorus preservation would be safe and result in a more favorable postoperative nutritional profile.

Methods

Study Design

This is a secondary analysis of data collected prospectively as part of the Prospective Observational Study of TPIAT (POST)[12]. The design and primary pain and diabetes outcomes from POST have been previously published [1; 13]. Briefly, POST is a multicenter prospective observational study that followed adult and pediatric participants who underwent TPIAT at 12 centers [12]. Participants of any age undergoing a total or completion pancreatectomy with islet autotransplantation for an indication of recurrent acute or chronic pancreatitis were eligible for POST. Because nearly all children had the same surgical approach (pylorus preservation), we restricted the current analyses to participants who were ≥18 years old at enrollment. The protocol was reviewed and approved by the institutional review board of each participant center. Informed consent was obtained from all participants.

For the analyses in this study, we classified participants into pylorus preservation (PP) or pylorus resection (PR) groups based on the surgical approach documented in the operative report.

Clinical Data

POST gathered qualitative and quantitative participant and disease data before and after TPIAT through medical records abstraction, participant interview, and participant questionnaires. Pancreatitis history before TPIAT was collected, including details on duration of pancreatitis, risk factors, and prior treatments. Surgical data were collected including surgical approach, length of hospital stay, 30-day hospital readmissions, and targeted complications of interest. Postoperatively, participants completed follow up visits at 6 and 12 months after TPIAT. History was reviewed for hospitalizations and reoperations from participant report and medical records. Hospitalization reasons were firstly classified as gastrointestinal-related (GI) or not. Subsequently, participants admitted for GI-related symptoms were further classified in subcategories defined by what type of GI symptoms they were experiencing (e.g., vomiting, constipation, ulcer disease, small bowel obstruction). Anthropometric measures were recorded for weight and body mass index. Medical and imaging records were reviewed for diagnosis

of gastroparesis (if assessed clinically). Medication use was reviewed for opioids, insulin, pancreatic enzymes, and multivitamins. Results from clinical care laboratory studies for vitamin A, vitamin E, and vitamin D were collected.

Statistical Analyses

Participant demographic data and outcome data comparing PR and PP were reported as medians with interquartile ranges for numeric covariates, and as frequency and percent for categorical covariates. Distributions were compared using the Wilcoxon rank sum test (numeric covariates) and Pearson's chi-squared and Fisher's exact tests (categorical covariates). Multivariate mixed effects linear and logistic regression models were used to further analyze hospital length of stay, readmission within 30 days of TPIAT, and vitamin A deficiency at 12 months post-TPIAT, controlling for potential confounding factors. Specifically, we controlled for sex, age at TPIAT, pre-TPIAT BMI, and type of biliary reconstruction when modelling length of stay and readmission within 30 days, and we controlled for pancreatic specific vitamin supplementation when analyzing vitamin A levels at 12 months. All models included a clinical center random intercept. We defined statistical significance with a p-value <0.05. All statistical analyses were completed in R (R Foundation, Vienna, Austria).

Results

Participant Demographics and Clinical Characteristics

The present study included 276 adult participants, with 181 participants in the PP group and 95 in the PR group (Table 1). Study participants were predominantly Caucasian (89% of PR participants, 92% of PP, p=0.12) and female (65%). Participants with pylorus resection were slightly older (median 40 versus 37 years old, p=0.055) compared to the pylorus preservation group. Median baseline BMI was 26.7 in the PR cohort and 24.6 in the PP cohort. Overweight/obesity was more common in the PR group (64% vs 48%, p=0.025).

Regarding surgical approach, gastrointestinal reconstruction methods differed between participants undergoing pylorus resection versus preservation ($p<0.001$). All participants in the PR group had a gastrojejunostomy anastomosis, either with (72%) or without (27%) Roux-en-Y limb. Comparatively, PP participants most commonly

underwent duodenojejunostomy, either with (62%) or without (25%) Roux-en-Y limb. In both groups, choledochojejunostomy was the most common biliary reconstruction approach (58% in PR and 81% PP, p<0.001). A median of 228,157 islet equivalents (IEQ) was transplanted in PR participants, compared to 228,181 IEQ in PP participants (p=0.5). Lastly, 81% of PR participants had no surgical feeding tube placed at the time of TPIAT, whereas 67% of PP participants did have a surgical feeding tube placed (p<0.001).

Early Postoperative Outcomes

Participants with PP experienced longer hospital length of stay (median 11 days vs 9 days, p<0.001), but a lower rate of hospital readmission within the first month following TPIAT (17% vs 36%, p<0.001). After multivariate regression adjusting for age, sex, baseline BMI, feeding tube placement (surgical and non-surgical), and biliary reconstruction, length of stay was no longer significantly different between treatment groups, but the odds of readmission within 30 days remained significantly higher in PR participants (odds ratio 2.91, 95% confidence interval (CI) 1.36-6.21, p=0.006). More specifically in regard to 30-day readmission rates, PR participants who underwent Roux-en-Y reconstruction appeared to have a stronger risk of readmission (OR 4.77 (95% CI 1.70, 13.4)) compared to PR participants who underwent non Roux-en-Y reconstruction (OR 2.76 (95% CI 0.65, 11.8)).

When examining outcomes across individual sites or excluding individual sites, similar trends were seen across the majority of sites (Supplementary Table 1). To account for potential differenecs in nutrition and feeding patterns, we also performed a subanalysis within the subgroup with no enteral feeding tube placed (n=112), and those with a surgical feeding tube placed (n=139). Among those *without* a feeding tube, OR for readmissions in PR vs PP was 5.48 (95% CI 1.65, 18.2, p=0.013) while those with a surgically placed feeding tube had a non-significant OR of 1.92 (95% CI 0.57, 6.43, p=0.2). Excluded from this subanalysis are an additional 25 participants who had a NJ placed post-operatively; OR could not be calculated because 24/25 were in the PP group (Supplementary Table 2).

Bile duct leaks were reported only in the PR group (4.2% vs 0%, p=0.013). The groups did not significantly differ in the rates of other postoperative complications, including abdominal infection requiring percutaneous or surgical drainage, bleeding requiring surgery and/or transfusion of packed red blood cells, bile duct obstruction, portal vein thrombosis, mechanical ventilation, and vasopressor support (Table 2).

Journal Pre-proof

Journal Pre-proof

Nutritional Outcomes at 1 Year

Median BMI was similar in PP and PR participants at 1-year follow-up (22.9 vs 23.5 kg/m2, p=0.9, Table 3), with similar distribution amongst BMI categories (p=0.9). Vitamin A deficiency at one-year post-TPIAT was significantly more common with PR than PP (45% vs 27%, p=0.025). This relationship became non-significantin a multivariable model adjusting for use of a pancreatic-specific multivitamin supplement but still had a fairly large magnitude (odds ratio 2.21, 95% confidence interval 0.91-4.92, p = 0.083). Vitamin D deficiency and low vitamin E did not differ (p=0.3 and p=0.6, respectively).

Diabetes, Pain, and Surgical Outcomes at 1 Year (Table 3)

Insulin independence (p=0.7) and participant-reported occurrence of severe hypoglycemic episodes (p=0.2) were similar in PP and PR groups. Both groups reported similar pain scores (p=0.8) and opioid use (p=0.9) at one-year post-TPIAT. Prevalence of clinically-diagnosed gastroparesis did not significantly differ between groups (PR 11% vs PP 8.3%, p=0.5).

There were no differences in the number of hospitalizations or additional abdominal operations between groups in the first year following TPIAT. Fifty-five percent of the PR group had a hospital admission for any reason, compared to 48% in the PP group (p=0.3, Table 3). Approximately one-third (28%) of PR participants and one-fifth (23%) of PP participants required at least one hospitalization for gastrointestinal symptoms (p=0.4).

Discussion

TPIAT has been effective in improving pain control and quality of life for patients with refractory and painful chronic and acute recurrent pancreatitis. Surgical technique in TPIAT varies among surgeons and institutions. Using data from the multicenter POST cohort, we sought to determine whether preservation or resection of the pylorus at the time of TPIAT had a meaningful impact on nutritional, clinical, and hospitalization outcomes. In this prospective cohort, participants with PP and PR had overall similar postoperative outcomes through 1-year post-TPIAT, except

for a notable 3-fold higher odds of hospital readmission within 30 days of index operation in those with pylorus resection, and a non-significant trend toward vitamin A deficiency in that group. These results suggest a potential small short-term benefit of pylorus preservation, but with minimal difference between PP and PR up to one year post-TPIAT.

TPIAT is a major operation with risks for prolonged admission and hospital readmission for various reasons, including infections and GI symptoms. In our participant population, those who underwent pylorus resection were more likely to be readmitted within 30 days of TPIAT, compared to participants with pylorus preservation. This difference remained statistically significant even when controlling for sex, age, baseline BMI, feeding tube placement, and type of biliary reconstruction. In contrast to our findings, an earlier single center study of TPIAT patients reported higher readmission rates among patients with pylorus preservation [14], and these readmissions were associated with delayed gastric emptying (DGE). DGE is common, noted as affecting up to 36% of patients following TPIAT [15]. In POST, 87% of patients in the PP group had a feeding tube postoperatively (most commonly surgical GJ or J-tube, less often NJ tube), and so the risk for readmission from short-term surgical DGE may be low in PP patients in POST as many patients were not receiving oral or gastric feedings early on. In contrast over 80% of those with PR in POST had no enteral feeding tube placement. Interestingly, all 83 patients in Shahbazov and colleagues' study underwent surgical jejunostomy or nasojejunal tube placement at the time of TPIAT, but frequency of DGE and readmission secondary to DGE remained elevated. In POST, we did not assess whether readmissions were due to delayed gastric emptying specifically (because DGE was not directly measured as part of POST). Within the first year after TPIAT, hospitalizations for gastrointestinal symptoms were common (occurred in 28% and 23% of individuals in the PR and PP groups, respectively, while hospitalization for any reason occurred in 55% and 48%, respectively). However, we lack sufficient detail about the readmissions in the first 30 days to determine if these admissions were related to the surgical approach. A clinical diagnosis of persistent gastroparesis was not significantly different between pylorus-preserved and pylorus-resected groups at 1 year after surgery. Although gastroparesis was assessed at each follow-up visit, the diagnosis relied upon clinical evaluation and clinical testing, which is typically not done following TPIAT unless prompted by clincal concerns and subsequently done at the discretion of clinicians. Thus, an important limitation in this finding is that there may be ascertainment bias in the detection of gastroparesis.

Within 30 days following TPIAT, we noted no significant difference in postoperative complications between PP and PR groups, except for bile duct leaks which occurred in only 4 participants in the PR group. Because this is event was rare, we suspect this may be a spurious finding and not representative of a true difference between PP and PR approaches. We also saw no evidence for hypoglycemia from dumping syndrome in PR, nor a benefit of PR versus PP on insulin independence or pain symptoms at 1-year post-TPIAT.

Because participants who undergo TPIAT have both altered gastrointestinal anatomy and exocrine insufficiency, they are at risk for macronutrient and micronutrient deficiencies. Nevertheless, it is unclear whether pylorus resection may exacerbate these nutritional deficiencies. Downs et al. reported vitamin deficiencies in an early partial cohort of children and adults from the POST study, most notable for low vitamin A and vitamin D [16]. This earlier paper suggested that pylorus resection with a Roux-en-Y gastrojejunostomy had higher prevalence of low vitamin A at 12 months. We suspect this may be due to rapid transit time and malabsorption secondary to pylorus resection, reducing absorption of these fat-soluble vitamins in the setting of pancreatic exocrine insufficiency. In this current POST analysis, which included more participant data, limited only to adults, low vitamin A at 12 months post-TPIAT was higher with pylorus resection. Notably, this lost statistical significance after controlling for pancreatic-specific vitamin use and including study site as a random effect, suggesting that at least some of the difference between PR and PP groups may result from differences in patient management and vitamin supplementation. All TPIAT patients are encouraged to remain on multivitamin supplements following operation, regardless of PP or PR approach. At 1 year postoperatively, overall BMI and risk of underweight status were similar between groups. Except for this trend in vitamin A, no other differences in fat soluble vitamins and BMI were identified that would support a nutritional advantage of PP over PR, at least in the first year after TPIAT. Longer-term follow-up is required to determine nutritional differences after 1 year post-TPIAT.

Because this is an observational study, surgical approach was not randomized. The goal of this work was firstly to collect data on TPIAT as it is currently being conducted in the United States. As such, the decision to undertake pylorus resection versus preservation was dependent on center and surgeon preference and expertise, resulting in potential biases. The PR group was generally older, with higher BMI, and less frequently had feeding tube placements at the time of surgery. Although multivariate analyses were adjusted for center effect and these patient factors, there may be unmeasurable differences between the groups such as enteral feeding protocols and rapidity of

introducing diet that could have impacted differences in rehospitalization rates. To further address these limitations, we evaluated site-specific odds (see Supplement) which showed an overall similar pattern of greater odds of readmission in PR. In addition, we performed subgroup analyses by those without a feeding tube or with a surgical feeding tube, which showed similar patterns of higher odds for readmission with PR in both groups, but the odds ratio was only significant in the group *without* a feeding tube, with this subgroup having a ~5-fold higher odds of readmission with PR vs PP approaches. We hypothesize that in the absence of enteral feeding, those with PR may have been more susceptible to caloric deficits and dehydration causing or exacerbating post-operative symptoms and complications, but further study would be required to assess this. Additionally, because there is a lack of granularity on reasons for 30-day hospital readmissions, we are unable to determine if admissions in the PR versus PP groups were directly related (e.g. GI or nutritionally-related admissions).

Our study has other limitations. Firstly, as previously noted, clinical diagnosis of gastroparesis was collected but routine gastric emptying studies were not a component of this study. As a result, we do not have specific assessments of] gastric emptying time. Delayed gastric emptying has been reported as a potential concern with PP in cancer operations. More detailed and rigorous study of gastric emptying times would be required to provide further insight. Secondly, while we compared postoperative outcomes of pylorus resection versus preservation, GI reconstruction approaches and biliary reconstruction approaches (e.g. choledochoduodenostomy, choledochojejunostomy, and hepaticojejunostomy) are confounded with PP or PR approach. Controlling for these surgical techniques would prove difficult as these depend on patient characteristics including individual patient anatomy, size, and length and caliber of bile duct and small bowel at the time of reconstruction, as well as surgeon expertise and preference. Thirdly, the increased odds for readmission in the PP group was an association, and we cannot determine if the PP approach directly contributed to these admissions. Lastly, the current analyses are limited to 1-year outcomes, and do not provide data on potential risks or benefits of PP versus PR on BMI, malnutrition, hospitalizations, dumping syndrome, anastomotic ulcers, and hypoglycemia outcomes long-term.

Conclusion

The advantages of TPIAT are multifaceted including improved pain control, reduced opioid use, and significantly improved quality of life. Our study results suggest that pylorus-resection participants may have significantly higher

rates of early readmission postoperatively. Nevertheless, participants in both pylorus-resection and pylorus-preservation groups demonstrated similar hospital length of stay, nutritional outcomes and postoperative complication rates. Our findings indicate that, in the short-term post-operative period, surgical reconstructive approach has a limited impact on TPIAT outcomes.However, long-term data are needed to better understand the long-term impact of surgical approaches on TPIAT outcomes for chronic pancreatitis patients.

Journal Pre-proof

Table 1. Baseline characteristics

Characteristic	Pylorus resection	Pylorus preservation	p-value*
n	95	181	
Age (y)	40 (32, 51)	37 (25, 48)	0.055
Sex			0.9
Male	33 (35%)	63 (35%)	
Female	62 (65%)	118 (65%)	
Race			0.12
White/Caucasian	85 (89%)	167 (92%)	
Asian	2 (2.1%)	4 (2.2%)	
Black/African American	5 (5.3%)	3 (1.7%)	
Native Hawaiian/Pacific Islander	2 (2.1%)	0 (0%)	
American Indian/Alaska Native	0 (0%)	1 (0.6%)	
Mixed Race	1 (1.1%)	6 (3.3%)	
Hispanic or Latino	7 (7.4%)	17 (9.4%)	0.6
BMI pre-TPIAT	26.7 (22.9, 29.8)	24.6 (21.9, 28.9)	0.063
BMI category pre-TPIAT			**0.025**
Normal weight	31 (33%)	88 (49%)	
Overweight	61 (64%)	86 (48%)	
Underweight	3 (3.2%)	7 (3.9%)	
Opioid Use (any)**	59 (71%)	131 (76%)	0.4
Average Pain Score**	6.00 (4.00, 7.00)	5.00 (4.00, 7.00)	0.5

Journal Pre-proof

Insulin Use**	9 (11%)	22 (13%)	0.7
Any Severe Hypoglycemia Episodes in the Past Year**	3 (3.8%)	15 (8.7%)	0.2
Nutrition Method (last 14 days)			0.8
Multiple methods	14 (15%)	29 (16%)	
Oral only	80 (85%)	152 (84%)	
Unknown	1	0	
Vitamin A, low* **	11 (15%)	17 (10%)	0.3
Vitamin D, deficient (<20 ng/ml)* **	19 (22%)	29 (17%)	0.3
Vitamin E, low* **	4 (5.2%)	16 (9.5%)	0.3
Gastroparesis[†]			0.2
No/Not Assessed	89 (94%)	160 (88%)	
Yes	6 (6.3%)	21 (12%)	
Gastrointestinal reconstruction			**<0.001**
Roux-en-Y duodenojejunostomy	0 (0%)	112 (62%)	
Roux-en-Y gastrojejunostomy	69 (73%)	14 (7.7%)	
Duodenojejunostomy	0 (0%)	45 (25%)	
Gastrojejunostomy	26 (27%)	10 (5.5 %)	
Biliary reconstruction			**<0.001**
Choledochoduodenostomy	2 (2.1%)	8 (4.4%)	
Choledochojejunostomy	55 (58%)	146 (81%)	
Hepaticojejunostomy	38 (40%)	27 (15%)	
IEQ transplanted	228,157 (119,457, 348,081)	228,181 (132,800, 367,000)	0.5
IEQ/kilogram transplanted	2,992 (1,401, 4,797)	3,189 (1846, 5,014)	0.3
Enteral Feeding Tube Placement at time of TPIAT			**<0.001**
No feeding tube placement	77 (81%)	35 (19%)	

Journal Pre-proof

Surgical feeding tube placement	17 (18%)	122 (67%)	
NJ tube (not including NG tube placement)	1 (1.1%)	24 (13%)	

Table cells are n (%) or median (IQR).

BMI: Body mass index, IEQ: islet equivalents, IQR: interquartile range, NG: nasogastric, NJ: nasojejunal, TPIAT: total pancreatectomy with islet autotransplantation

* Between-group differences were tested using Wilcoxon rank sum test (numeric covariates) and Pearson's chi-squared test or Fisher's exact test (categorical covariates)

** Opioid use, pain score and insulin use were missing in 12 participants in the pylorus resection group and 9 participants in the pylorus preservation group. Hypoglycemia episodes were missing in 15 and 9 participants, respectively.

*** Vitamin A levels were missing in 20 participants in the pylorus resection group and 14 participants in the pylorus preservation group. Vitamin D levels were missing in 10 and 10 participants, respectively, and vitamin E levels were missing in 18 and 12 participants, respectively.

†Charts were reviewed at each follow-up and data abstracted for diagnosis of gastroparesis.

Journal Pre-proof

Table 2. Postoperative outcomes by pylorus-preserving status within 30 days of TPIAT.

Outcome	Pylorus resection, n=95	Pylorus preservation, n=181	p-value*
Hospital length of stay (days)	9 (7, 11)	11 (9, 15)	**<0.001**
Readmission within 30 days	34 (36%)	30 (17%)	**<0.001**
Post-operative complications within 30 days of TPIAT			
Abdominal infection requiring operative drainage	1 (1.1%)	7 (3.9%)	0.3
Abdominal infection requiring interventional radiology drainage	5 (5.3%)	5 (2.8%)	0.3
Bleeding requiring surgery	3 (3.2%)	6 (3.3%)	0.9
Bleeding requiring transfusion of pRBC	15 (16%)	30 (17%)	0.9
Bile duct obstruction	1 (1.1%)	1 (0.6%)	0.9
Bile duct leak	4 (4.2%)	0 (0%)	**0.013**
Portal vein thrombosis (partial or complete)	11 (12%)	15 (8.3%)	0.4
Mechanical ventilation beyond 24h after surgery	2 (2.1%)	4 (2.2%)	0.9
Vasopressor support beyond 24h after surgery	2 (2.1%)	5 (2.8%)	0.9
Additional surgeries within 30 days of TPIAT	8 (8.4%)	20 (11%)	0.5
Primary reason for surgery within 30 days of TPIAT			
Bleeding	3	6	
Infection	1	6	
Small bowel obstruction	1	2	
Bile leak	0	0	
Anastomotic leak	1	2	
Other**	2	4	

Table cells are mean (SD), n (%), or median (IQR).

pRBC: packed red blood cells, TPIAT: total pancreatectomy and islet autotransplantation

* Between-group differences were tested using Wilcoxon rank sum test (numeric covariates) and Pearson's chi-squared test or Fisher's exact test (categorical covariates)

** Other reasons for additional surgery included: abdominal distention (n=1), abdominal washout (n=1), biliary obstruction and revision of biliary anastomosis (n=1), gastroparesis (n=1), laparoscopic vertical sleeve gastrectomy (n=1), and right colectomy and abdominal closure (n=1)

Table 3. Postoperative outcomes by pylorus-preserving status 1-year after TPIAT.

Outcome	Pylorus resection, n=95*	Pylorus preservation, n=181*	p-value**
Vitamin A low	25 (45%)	31 (27%)	**0.025**
Vitamin E low	6 (11%)	15 (13%)	0.6
Vitamin D deficiency (< 20 ng/mL)	14 (23%)	20 (17%)	0.3
BMI at 12 months post-TPIAT	23.5 (20.4, 25.4)	22.9 (20.1, 27.1)	0.9
BMI category post-TPIAT, 12 months			0.9
Normal weight	37 (56%)	74 (55%)	
Overweight/Obese	22 (33%)	49 (36%)	
Underweight	7 (11%)	12 (8.9%)	
Opioid Use (any, within the last 14 days)	25 (35%)	49 (34%)	0.9
Average Pain Scores (within the last 4 weeks)* **	3.00 (0.00, 5.00)	2.00 (0.00, 5.00)	0.8
Insulin Use	63 (89%)	124 (87%)	0.7
Severe Hypoglycemia Episodes within last 12 months	8 (12%)	25 (18%)	0.2
Gastroparesis			0.5
No / workup not completed	64 (89%)	143 (92%)	
Yes	8 (11%)	13 (8.3%)	
Office visits related to TPIAT or other abdominal/GI symptoms in previous 3 months, 12-month visit	2.00 (1.00, 3.00)	2.00 (0.00, 3.50)	0.3
Emergency department visits related to TPIAT procedure or other abdominal/GI symptoms in previous 3 months, 12-month visit	19 (29%)	37 (27%)	0.8

Journal Pre-proof

Hospitalizations, within 12 months of TPIAT ***organized by reason for hospitalization***[†]			
Any reason	37 (55%)	65 (48%)	0.3
Malnutrition	3 (4.5%)	9 (6.6%)	0.8
Gastrointestinal[¶]	19 (28%)	31 (23%)	0.4
Number of additional abdominal surgeries after index TPIAT, up to 12 months			0.8
0	57 (79%)	128 (82%)	
1	11 (15%)	19 (12%)	
2	3 (4.2%)	6 (3.8%)	
3	0 (0%)	1 (0.6%)	
4	1 (1.4%)	2 (1.3%)	

Table cells are mean (SD), n (%), or median (IQR).

BMI: Body mass index, GI: gastrointestinal, TPIAT: total pancreatectomy and islet autotransplantation

* N differs across outcomes due to missing data points. For the PR group, the number of missing data points ranged from 23 to 39 for each outcome, and from 25 to 69 for the PP group

** Between-group differences were tested using Wilcoxon rank sum test (numeric covariates) and Pearson's chi-squared test or Fisher's exact test (categorical covariates), and chi-squared test for trend (number of additional abdominal surgeries after index TPIAT, up to 12 months)

*** Average pain scored from 0 (none) to 10 (unbearable)

[†] Unknown values of hospitalizations for 28 participants in the pylorus resection group and 45 participants in the pylorus preservation group

[¶] Hospitalizations were grouped under "gastrointestinal" when participants were admitted for one or more of the following reasons: vomiting, constipation, cholangitis, ulcer, GI bleed, gastritis, intra-abdominal abscess, bowel perforation, gastroparesis, small bowel obstruction, intussusception, small bowel anastomotic stricture, and/or gastrocutaneous fistula. There was no statistically significant difference between the PP and PR groups for any of the aforementioned subcategories.

Journal Pre-proof

Conflicts of Interests and Disclosures

MDB declares consulting or advisory board roles for Gondola Bio, Sana, Sernova, and DSMB membership for Insulet and Vertex. The remainder of the authors have no conflicts of interest to disclose or relevant financial disclosures.

Funding and Financial Support

Source of funding: NIH Grants R01-DK109124 and R01-DK138809.

References

1. Trikudanathan G, Eaton A, Freeman ML, Singh VK, Schwarzenberg SJ, Nathan JD, et al. Total Pancreatectomy With Islet Autotransplantation for Chronic Pancreatitis. Gastroenterology. 2025; 169(7): 1499-1509.

2. Nathan JD, Yang Y, Eaton A, Witkowski P, Wijkstrom M, Walsh M, et al. Surgical approach and short-term outcomes in adults and children undergoing total pancreatectomy with islet autotransplantation: A report from the Prospective Observational Study of TPIAT. Pancreatology. 2022; 22(1): 1-8.

3. Diener MK, Knaebel HP, Heukaufer C, Antes G, Büchler MW, and CM Seiler A systematic review and meta-analysis of pylorus-preserving versus classical pancreaticoduodenectomy for surgical treatment of periampullary and pancreatic carcinoma. Ann Surg. 2007; 245(2): 187-200.

4. Karanicolas P, Davies E, Kunz R, Briel M, Koka HP, Payne DM, et al. The pylorus: take it or leave it? Systematic review and meta-analysis of pylorus-preserving versus standard whipple pancreaticoduodenectomy for pancreatic or periampullary cancer. Ann Surg Oncol. 2007; 14(6): 1825-34.

5. Wu W, Hong X, Fu L, Liu S, You L, Zhou L, et al. The effect of pylorus removal on delayed gastric emptying after pancreaticoduodenectomy: a meta-analysis of 2,599 patients. PLoS One. 2014; 9 (10): e108380.

6. Taher MA, Khan ZR, Chowdhury MM, Nur-E-Elahi M, Chowdhury AK, Faruqye MS, et al. Pylorus Preserving Pancreaticoduodenectomy vs. Standard Whipple's Procedure in Case of Carcinoma head of the Pancreas and Periampullary Carcinoma. Mymensingh Med J. 2015;24(2): 319-25.

7. Hüttner FJ, Fitzmaurice C, Schwarzer G, Seiler CM, Antes G, Büchler M, et al. Pylorus-preserving pancreaticoduodenectomy (pp Whipple) versus pancreaticoduodenectomy (classic Whipple) for surgical treatment of periampullary and pancreatic carcinoma. Cochrane Database Syst Rev. 2016; 2(2): CD006053.

8. Hackert T, Probst P, Knebel P, Coerr-Harim C, Bruckner T, Klaiber U, et al. Pylorus Resection Does Not Reduce Delayed Gastric Emptying After Partial Pancreatoduodenectomy: A Blinded Randomized Controlled Trial (PROPP Study, DRKS00004191). Ann Surg. 2018; 267(6): 1021-1027.

Journal Pre-proof

9. Klaiber U, Probst P, Hüttner FJ, Bruckner T, Strobel O, Diener MK, et al. Randomized Trial of Pylorus-Preserving vs. Pylorus-Resecting Pancreatoduodenectomy: Long-Term Morbidity and Quality of Life. J Gastrointest Surg. 2020; 24(2): 341-353.

10. Rebelo A, Kresse R, Sunami Y, Ronellenfitsch U, Kleeff J, and J Klose. How to Reduce Delayed Gastric Emptying After Pancreatoduodenectomy: A Systematic Literature Review and Meta-Analysis. Ann Surg Open. 2024; 5(3): e458.

11. Huang W, Xiong JJ, Wan MH, Szatmary P, Bharucha S, Gomatos I, et al. Meta-analysis of subtotal stomach-preserving pancreaticoduodenectomy vs pylorus preserving pancreaticoduodenectomy. World J Gastroenterol. 2015; 21(20): 6361-73.

12. Bellin MD, Abu-El-Haija M, Morgan K, Adams D, Beilman GJ, Chinnakotla S, et al. A multicenter study of total pancreatectomy with islet autotransplantation (TPIAT): POST (Prospective Observational Study of TPIAT). Pancreatology. 2018; 18(3): 286-290.

13. Witkowski P, Eaton A, Porter S, Abu-El-Haija M, Ahmad SA, Mokshagundam SP, et al. Predictors of Diabetes Outcomes at 1 Year After Islet Autotransplantation: Data From a Multicenter Cohort Study. Diabetes Care. 2025;48(9): 1493-1501.

14. Shahbazov R, Naziruddin B, Yadav K, Saracino G, Yoshimatsu G, Kanak MA, et al. Risk factors for early readmission after total pancreatectomy and islet auto transplantation. HPB (Oxford). 2018;20(2):166-174.

15. John GK, Singh VK, Pasricha PJ, Sinha A, Afghani E, Warren D, et al. Delayed Gastric Emptying (DGE) Following Total Pancreatectomy with Islet Auto Transplantation in Patients with Chronic Pancreatitis. J Gastrointest Surg. 2015;19(7): 1256-61.

16. Downs E, Eaton A, Witkowski P, Wijkstrom M, Walsh M, Trikudanathan G, et al. Nutritional Risks in Patients Undergoing Total Pancreatectomy Islet AutoTransplantation in the POST Consortium. J Gastrointest Surg. 2023; 27 (9): 1893-1902.

Journal Pre-proof

Journal Pre-proof

Ethics declaration

Informed consent and patient details

Written informed consent to take part in the study and to publish the article has been obtained from all participants or their legal representatives. The privacy rights of participants have been observed.

Studies in Human

This study was performed in compliance with relevant laws, regulatory frameworks and guidelines where the research took place.

This study was approved by the University of Minnesota.

(Approval No. 1512M81750)

Journal Pre-proof