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Original article

Bariatric surgery prior to pancreas transplantation: a retrospective matched case-control study

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Abstract

Background: The clinical impact of bariatric surgery (BS) prior to pancreas transplantation (PTx) is unclear.

Setting: University of Minnesota Hospital, Minneapolis, MN.

Methods: This was a single center retrospective case-controlled study of all patients January 1, 1998 and May 1, 2024 with a history of BS prior to PTx. Patients were matched (1:3) with control patients by recipient age, body mass index (BMI) at PTx, type of transplant, primary versus retransplant, and year of PTx.

Results: Among 1542 transplants, 17 patients had a history of BS prior to PTx, with an overall incidence of 1.1%. Eleven patients underwent roux-en-y gastric bypass, 5 underwent sleeve gastrectomy (SG), and one underwent vertical-banded gastroplasty. Eleven underwent simultaneous pancreas kidney transplant, 5 underwent pancreas transplant alone, and one underwent pancreas after kidney transplant. The median time (interquartile range [IQR]) between BS and PTx was 2.9 yrs (4.6) and ranged from .7 to 20.6 yrs. Compared to the non-BS group, patients in the BS group had similar rates of graft thrombosis (5.9% versus 3.9%, $P = .76$) and rejection (29.4% versus 29.4%, $P > .99$). Length of stay following PTx ($P = .22$), number of 30-day readmissions ($P = .24$), and number of 1-year readmissions ($P = .70$) were not different between the two groups. Median death-censored graft survival (9.4 yrs versus median not reached, $P = .23$) and patient survival (9.4 yrs versus median not reached, $P = .18$) were similar between the BS and non-BS groups. Finally, six patients underwent BS with the specific intention of reaching the acceptable BMI threshold for PTx. Median BMI was reduced from 37.4 prior to BS to 26.4 at time of PTx. Median time from BS to PTx was 2.4 yrs. At 4 yr follow-up, graft and patient survival was 100%.

Conclusions: This represents the largest series of patients with BS prior to PTx. Perioperative complications are not increased in patients undergoing PTx with a history of prior BS and long-term outcomes are equivalent. Patients with a prohibitive BMI for PTx eligibility should be considered for BS without concern for detrimental effect on post-transplant outcomes. (Surg Obes Relat Dis

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The increased prevalence of obesity over the past 20 years has been accompanied by an increase in diabetes mellitus (DM) [1]. As of 2021, 41.9% of U.S. adults were obese, an increase from 30.5% in 2000. For patients with obesity, bariatric surgery (BS) has developed into an effective treatment option for sustained weight loss and has demonstrated a superior impact on long-term glycemic control, renal function, and metabolic syndrome compared to medical management [2–4].

Similarly, the prevalence of DM has increased from 10.3% in the early 2000s to 13.2% in 2020 and is estimated to increase by 54% by 2030 to affect nearly 55 million people in the US.

For patients with insulin dependent diabetes mellitus (IDDM) – both type 1 and type 2, pancreas transplantation (PTx) remains the superior treatment option for achieving long-term glycemic control [5]. Over time, the percentage of candidates with insulin dependent type 2 diabetes mellitus (T2DM) listed for PTx has increased – from less than 10% in 2010 to 22.9% in 2021 [6,7]. Consequently, rates of PTx for insulin dependent T2DM have increased significantly from 8.0% in 2010 to 25.9% in 2021 [6,7]. Compared to type 1 diabetes mellitus (T1DM), recipients undergoing PTx for T2DM are older, have a higher BMI, and have increased comorbidities, which may increase surgical risk [8,9]. In particular, obesity presents both short- and long-term challenges for PTx. In the short-term, obesity is associated with an increase in surgical complications and technical failures following PTx [10,11]. Long-term, obesity is independently associated with worse graft survival and patient survival following PTx [12–15].

One potential strategy to mitigate the increased risk associated with obesity prior to PTx is BS. BS has been shown to improve outcomes among patients with obesity undergoing subsequent surgical operations including orthopedic procedures and kidney and liver transplantation [16–21]. BS in patients with prohibitive body mass indexes (BMIs) for PTx may be a strategy to normalize outcomes to recipients with lower BMIs and increase access to transplant. Conversely, prior abdominal surgery itself may increase the technical complexity of a subsequent pancreas transplant by increasing surgical time and blood loss. These factors may predispose an organ to increased cold ischemia time or episodes of hypotension, which may negatively impact outcomes. Currently, there is limited data on the impact of BS on pancreas transplant outcomes. Herein, we aimed to study the outcomes of patients with a history of BS prior to PTx. Furthermore, we report the results of a prospective pilot program using BS with the intention of reaching the acceptable BMI threshold for PTx in six patients.

Methods

Patients and methods

The Institutional Review Board at the University of Minnesota approved this study. All adult pancreas transplants performed between January 1, 1998 and May 1, 2024 at the University of Minnesota were reviewed, including pancreas transplant alone (PTA), simultaneous pancreas kidney (SPK) transplants, and pancreas after kidney (PAK) transplants. Seventeen patients had BS prior to PTx. For every patient in the "case" group, three "control" patients were chosen by matching for recipient age (±5 years), BMI at time of pancreas transplant, type of transplant (SPK, PAK, PTA), primary versus retransplant, and year of transplant (±2 years) [22]. There was no statistical program used to match patients and the control group did not represent propensity matching.

Pancreas transplant technique

PTx was performed as previously described [23,24]. In brief, the PTx is performed through a lower midline laparotomy with the pancreas allograft placed intraperitoneal in the right iliac fossa and, in the case of SPK, the kidney allograft placed intraperitoneal in the left iliac fossa. The pancreas is typically placed in the "head-down" position. The Y-graft is anastomosed to the recipient common iliac artery with systemic venous drainage to the recipient common iliac vein or inferior vena cava. Exocrine drainage in the majority of cases has transitioned over the years from bladder drainage to enteric drainage to the proximal jejunum (2-layered hand-sewn duodenojejunostomy, with more stapled anastomoses historically) without a Roux limb. In the case of prior roux-en-y gastric bypass (RYGB), enteric drainage was performed via a side-to-side duodenojejunostomy between the graft duodenum and either a proximal segment of jejunum, distal to the jejuno-jejunal anastomosis or, in one case, the biliopancreatic limb.

Enteric conversion

Conversion of pancreatic exocrine drainage from bladder to enteric drainage was performed as previously described

[25]. In patients with prior RYGB, enteric drainage was performed via a side-to-side duodenojejunostomy between the graft duodenum and a proximal segment of jejunum, distal to the jejuno-jejunal anastomosis.

Outcome variables

Outcome variables measured included rates of pancreatic allograft thrombosis, acute rejection, length of stay following PTx, number of 30-day readmissions, number of 1-year readmissions, as well as graft and patient survival. BMI and weights at time of BS, PTx, and up to 5 years post-transplant were also recorded.

Statistical analysis

Descriptive statistics for each variable are reported. A significance level (alpha) of .05 was specified for two-tailed tests. Comparative analysis included chi-squared or Fisher exact tests for discrete variables and Student's *t*-test or Mann-Whitney tests for continuous variables. Kaplan-Meier log-rank analysis was performed for survival and incidence curves. Statistical analysis was conducted with GraphPad Prism and R version 4.3.2.

Results

Recipient characteristics

A total of 1542 pancreas transplants were performed during the study period, of which 17 patients had prior BS (1.1%) (Table 1). The majority of patients were female (76.5%). Eleven out of 17 (64.7%) underwent RYGB, 5/17 (29.4%) underwent laparoscopic sleeve gastrectomy (SG), and 1/17 (5.9%) underwent vertical banded gastroplasty. Among RYGB patients, 5/11 (45.5%) were performed open and 6/11 (54.5%) were performed minimally invasive. All RYGB done prior to 2006 were performed in an open fashion while all RYGB done beginning in 2006 were performed laparoscopically. One patient required RYGB reversal 10 years following initial creation (9 years following PTx) for significant malnutrition.

Regarding PTx, 11/17 (64.7%) underwent SPK, 5/17 (29.4%) underwent PTA, and 1/17 (5.9%) underwent PAK. A total of 23.5% underwent initial bladder drainage of pancreatic exocrine secretions, and 76.5% underwent enteric drainage. Three of 4 patients who initially underwent initial exocrine bladder drainage eventually required enteric conversion.

Overall, the median time (interquartile range [IQR]) between BS and PTx was 2.9 yrs (4.6) and ranged from .7 to 20.6 yrs. Among those undergoing RYGB, the median time between BS and PTx was 3.1 yrs (5.7), while the median time for those undergoing SG was 2.6 yrs (1.7).

Matched cohort and clinical outcomes

The 17 patients with prior BS were matched with 51 patients without BS prior to PTx as described in the methods (Table 2). Additionally, there were no significant differences in recipient sex ($P = .09$), donor age ($P = .34$), or indication for PTx ($P = .17$). All patients underwent PTx from brain dead donors.

Table 1
Characteristics of patients with bariatric surgery and pancreas transplantation

Patient	PTx year	BS year	BMI at time of BS	BS	Time between BS and PTx (yr)	Technique	BMI at time of PTx	Pancreas transplant	Initial exocrine drainage
1	1998	1978	NA	RYGB	20.6	Open	NA	SPK	Bladder
2	2001	2001	NA	RYGB	0.7	Open	28.6	PTA	Bladder
3	2004	1997	NA	Vertical-banded gastroplasy	7.8	Open	28.6	PTA	Bladder
4	2004	2003	NA	RYGB	1.6	Open	34.7	PAK	Enteric
5	2005	2003	NA	RYGB	2.1	Open	21.5	PTA	Bladder
6	2012	2002	NA	RYGB	12.9	Open	24.8	PTA	Enteric
7	2013	2006	46.5	RYGB	6.7	Laparoscopic	27.7	SPK	Enteric
8	2013	2010	38.3	RYGB	3.3	Laparoscopic	27.7	SPK	Enteric
9	2013	2007	NA	RYGB	6.2	Laparoscopic	29.7	PTA	Enteric
10	2017	2014	35.9	RYGB	2.9	Laparoscopic	21.7	SPK	Enteric
11	2017	2016	37.9	SG	1.3	Laparoscopic	25.7	SPK	Enteric
12	2018	2016	36.9	SG	2.6	Laparoscopic	29.0	SPK	Enteric
13	2019	2009	44.4	RYGB	10.5	Laparoscopic	31.0	SPK	Enteric
14	2020	2020	41.0	RYGB	0.8	Laparoscopic	27.3	SPK	Enteric
15	2020	2018	39.0	SG	2.9	Laparoscopic	25.5	SPK	Enteric
16	2021	2019	36.2	SG	2.3	Laparoscopic	28.4	SPK	Enteric
17	2024	2018	36.5	SG	6.3	Laparoscopic	30.0	SPK	Enteric

BS = bariatric surgery; BMI = body mass index; PTx = pancreas transplant; SPK = simultaneous pancreas kidney; PTA = pancreas transplant alone; PAK = pancreas after kidney; SG = sleeve gastrectomy; RYGB = roux-en-y gastric bypass.

Table 2
Characteristics of patients with bariatric surgery and pancreas transplantation

Characteristic	Bariatric cohort (n = 17)	Non bariatric cohort (n = 51)	*P* value
Age at PTx, yr (IQR)	49.4 (12.4)	48.5 (14.4)	.97
Sex, n (%)			.09
Male	4	25	
Female	13	26	
BMI at time of PTx, yr (IQR)	28.0 (3.4)	27.5 (3.8)	.93
Time between BS and PTx, yr (IQR)	2.9 (4.6)	N/A	
Type of PTx, n (%)			>.99
SPK	11 (64.7)	33 (64.7)	
PTA	5 (29.4)	15 (29.4)	
PAK	1 (5.9)	3 (5.9)	
Donor age, yr (IQR)	26.4 (11.2)	22.3 (16.1)	.34
Primary PTx, n (%)	17 (100)	51 (100)	>.99
Indication for PTx			.17
Type 1 DM	9 (52.9)	39 (76.5)	
Type 2 DM	6 (35.3)	10 (19.6)	
Native pancreatectomy	2 (11.8)	2 (3.9)	

PTx = pancreas transplantation; SPK = simultaneous pancreas kidney; PTA = pancreas transplant alone; PAK = pancreas after kidney; BMI = body mass index; BS = bariatric surgery; DM = diabetes mellitus; IQR = interquartile range.

Perioperative and postoperative complications are shown in Table 3. Rates of graft thrombosis (5.9% versus 3.9%, $P = .76$) and rejection (29.4% versus 29.4%, $P > .99$) were not different between the BS and non-BS groups. Similarly, length of stay following PTx ($P = .22$), number of 30-day readmissions ($P = .24$), and number of 1-year readmissions ($P = .70$) were not different between the two groups.

The median follow-up period was similar between the BS and non-BS groups (6.5 yrs versus 6.0 yrs, $P = .40$). Median graft survival was similar between the BS and non-BS groups (9.4 yrs versus median not reached, $P = .23$) (Fig. 1A). The 1-year mortality in both groups was 5.9% ($P > .99$). Median patient survival was similar between the BS and non-BS groups (9.4 yrs versus median not reached, $P = .18$) (Fig. 1B). During the follow-up period, there were five deaths in the BS group, one occurring in the first-year post-transplant and the other four deaths occurring between seven-ten years post-transplant. Three patients died as a result of infection, one patient died as a result of stroke, and one patient died secondary to malignancy.

BS for pancreas transplant eligibility

Of the 17 patients in this series, 6 underwent BS with the specific intention of reaching the acceptable BMI threshold PTx at our institution (BMI < 32) (Table 4). All six patients were initially denied eligibility for PTx based on a prohibitive BMI and were referred for weight reduction. Median pre-BS weight and BMI were 123 kg and 37.4, respectively. Two underwent RYGB and 4 underwent SG. The decision to pursue RYBG versus SG was left to the discretion of the bariatric team/surgeon. Median time from BS to PTx was 2.4 yrs. Median weight and BMI at time of PTx was 78.1 kg and 26.4, respectively. All six patients underwent SPK with enteric drainage performed via a side-to-side duodenojejunostomy between the graft duodenum and a proximal segment of jejunum (distal to the jejuno-jejunal anastomosis in the case of prior RYGB). At median follow-up of 4.0 years post-PTx, all six patients are alive with functioning kidney and pancreas allografts. Post-transplant weights and BMI are provided in Fig. 2.

Table 3
Postoperative outcome comparison

Characteristic	Bariatric cohort (n = 17)	Non bariatric cohort (n = 51)	*P* value
Graft thrombosis, n (%)	1 (5.9)	2 (3.9)	.76
Reversible acute rejection episodes, n (%)	4 (29.4%)	15 (29.4)	>.99
1-yr mortality	1 (5.9%)	3 (5.9%)	>.99
Length of stay post-PTx, d (IQR)	7 (3)	8 (3.8)	.22
30-d readmissions, median (IQR)	0 (1.0)	1.0 (1.0)	.24
1-yr readmissions, median (IQR)	1.0 (2.0)	1.0 (3.0)	.70

PTx = pancreas transplantation; IQR = interquartile range.

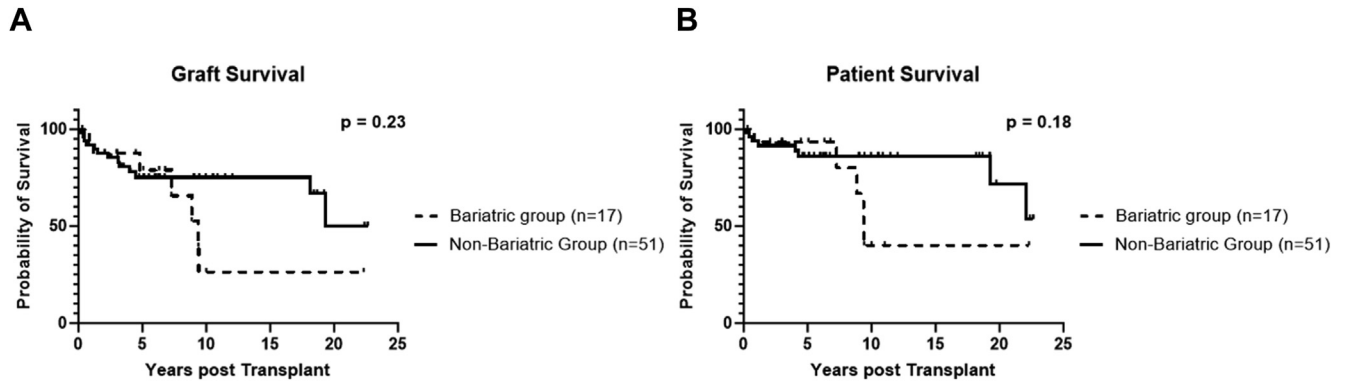

Fig. 1. Graft and patient survival. (A) Median graft survival was similar between the bariatric surgery (BS) and non-BS groups (9.4 yrs versus median not reached, $P = .23$). (B) Median patient survival was similar between the BS and non-BS groups (9.4 yrs versus median not reached, $P = .18$).

Discussion

Obesity is associated with insulin resistance and impaired beta cell function which contribute to the development of IDDM. BS has emerged as the preferred treatment option for selected patients with obesity to help promote sustained weight loss and improve glycemic control. Similarly, PTx has long been considered the gold standard for achieving glycemic control in patients with IDDM [5]. Data regarding the impact of BS on patients undergoing PTx is scarce [26]. Here, we present a series of 17 patients with BS prior to PTx and compare clinical outcomes to 51 case-matched patients undergoing PTx without prior BS. Further, we report on our initial experience of six patients who underwent BS with the intention of reaching the acceptable BMI threshold for PTx.

Although rates of PTx have decreased since their peak in the mid-2000s, recipient selection criteria have expanded to include increasing numbers of patients waitlisted and transplanted for T2DM. This has resulted in an increase in median age and BMI along with the incidence of metabolic syndrome in patients undergoing PTx. Ironically, obesity is associated with inferior graft and patient survival following PTx [12,13]. Bedat et al. analyzed 21,075 pancreas transplant recipients from the SRTR and demonstrated recipient BMI was an independent risk factor for short term graft loss and patient death [14]. Similarly, Owen et al. evaluated 1452 pancreas transplant recipients from the UK Transplant registry and reported that higher recipient BMI was independently associated with worse patient survival after transplantation, and specifically patients with obesity with concomitant renal failure had the worst survival [13]. The association between recipient obesity and inferior outcomes after PTx are likely multifactorial. Recipient obesity has been previously linked to factors contributing to graft loss including graft thrombosis, graft pancreatitis, and poorer wound healing, while obesity is a known risk factor for increased cardiovascular complications and infection, the two leading causes of death in pancreas transplant recipients [27–29].

BS has become an increasingly utilized strategy as part of the prehabilitation process to improve surgical outcomes or establish eligibility for subsequent surgical operations. In the orthopedic literature, BS has been shown to improve outcomes prior to shoulder and knee arthroplasty [19–21]. Similarly to PTx, obesity is a major risk factor for negative outcomes in kidney transplantation including delayed graft function, graft survival, and patient survival [30]. Hajjar et al. reported the feasibility of laparoscopic SG prior to kidney transplantation in a cohort of 31 patients with a median BMI of 42.1 kg/m^2 who underwent laparoscopic SG[31]. Candidates achieved a median weight loss of 31.7 kg and underwent kidney transplant a median of

Table 4
Bariatric surgery to allow for pancreas transplantation

Patient	IDDM	BS	Pre-BS weight/BMI	Weight/BMI at PTx	BMI difference*	Time between BS and PTx (yr)	Pancreas transplant
10	T2DM	RYGB	127.0 kg/35.9	74.9 kg/21.7	14.2	2.9	SPK
11	T1DM	SG	95.8 kg/37.9	69.5 kg/25.6	12.3	1.3	SPK
12	T2DM	SG	121.7 kg/36.9	97.6 kg/29.0	7.9	2.6	SPK
14	T1DM	RYGB	94.0 kg/41	61.3 kg/27.3	13.7	0.8	SPK
15	T2DM	SG	126.7 kg/39	81.3 kg/25.5	13.5	2.9	SPK
16	T2DM	SG	124.4 kg/36.2	95.3 kg/28.3	7.9	2.3	SPK

T1DM = type 1 diabetes mellitus; T2DM = type 2 diabetes mellitus; BS = bariatric surgery; PTx = pancreas transplantation; BMI = body mass index; RYGB = roux-en-y gastric bypass; SG = sleeve gastrectomy; SPK = simultaneous pancreas kidney.

* Prebariatric surgery BMI – BMI at pancreas transplant.

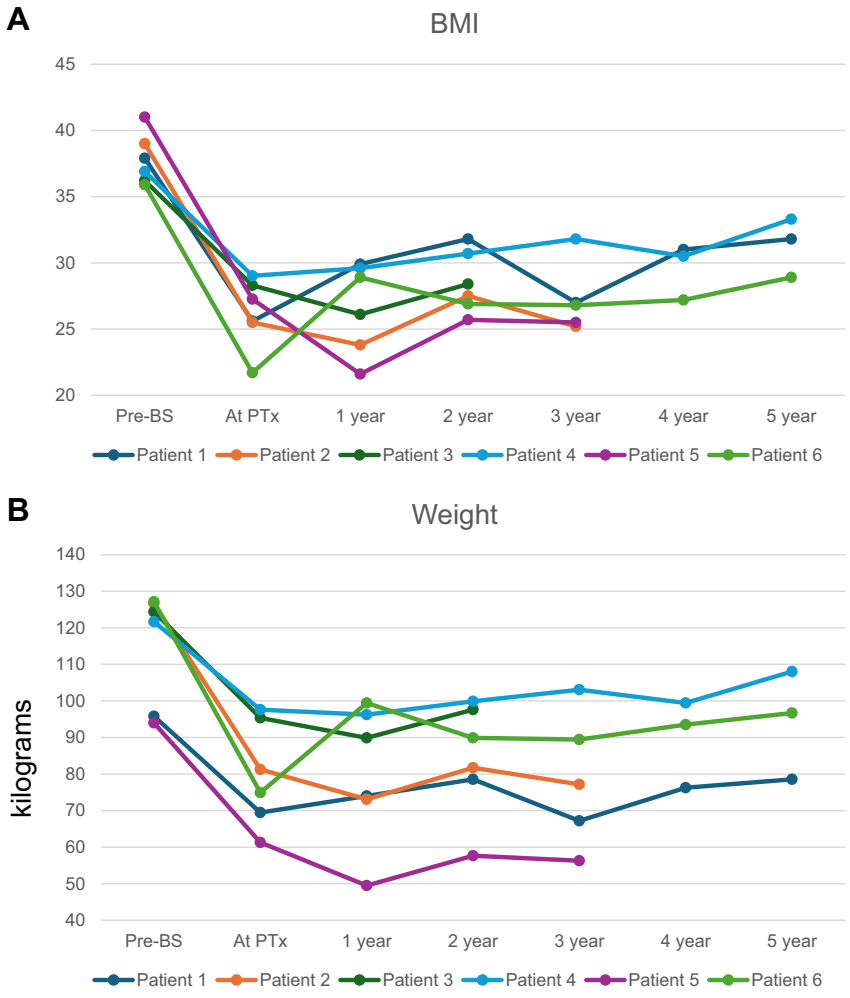

Fig. 2. Patient weight and body mass index (BMI). Weights (A) and BMI (B) of the six patients who underwent bariatric surgery with the intention of establishing eligibility for pancreas transplant. Year 1 – 5 represent years postpancreas transplant.

16.7 months following SG with favorable outcomes. To avoid the concern of two separate surgical operations in a high-risk patient population, Spaggiari et al. demonstrated the feasibility of combined robotic SG and kidney transplantation [32]. Similarly, in liver transplantation, BS has not only been used as a strategy to treat the underlying disease process in patients undergoing LT for Metabolic Dysfunction Associated Fatty Liver Disease (MAFLD), but BS prior to liver transplantation is associated with decreased post-transplant metabolic complications [16,33]. Serano et al. demonstrated that antecedent BS did not increase postliver transplant complications and long-term survival was similar compared to those without BS [34]. Finally, BS has been used prior to living kidney donation as a strategy to increase the donor pool by allowing morbidly obese donors to reach an acceptable weight for kidney donation without compromising outcomes [35,36].

In our series, we report on six patients who were initially denied for PTx upon initial evaluation due to a prohibitive BMI and were referred to a multidisciplinary weight management clinic. The decision was made to pursue BS to meet our center's criteria for pancreas transplant (BMI $<$ 32). This BMI threshold for pancreas transplant was initially derived over time from multiple retrospective studies that demonstrated a recipient BMI $>$ 30 was associated with inferior post-transplant outcomes. As the national trend in PTx has shifted to include a growing number of patients with T2DM on the waitlist, we allotted an extra 2 BMI points (30 + 2) to balance our post-transplant outcomes without being overly restrictive in access to transplant for those with a BMI $>$ 30. All six patients in the study achieved a BMI $<$ 30 at time of PTx. Patients ultimately underwent PTx between .8 and 2.9 years following BS, with 100% graft and patient survival at median 4 year follow-up. Moving forward, BS appears to be a viable strategy for well selected patients with IDDM with a borderline or prohibitive BMI to establish eligibility for PTx.

Despite the abundance of literature reporting on the effects of antecedent BS on kidney and liver transplantation, data regarding the clinical impact of antecedent BS on PTx outcomes is lacking [26,34,37–39]. Fridell et al. reported a case series of four patients undergoing BS prior to successful PTx [26]. Three patients underwent RYGB, and one patient underwent gastric banding with favorable outcomes. No patients underwent SG, and the authors concluded that laparoscopic gastric banding should be the procedure of choice in potential pancreas transplant candidates. Similarly, our data suggests that a history of BS does not portend worse perioperative or postoperative outcomes in patients undergoing PTx. Furthermore, no patients in the BS group died of obesity related causes, such as metabolic syndrome. Since the publication of the report by Fridell et al., SG has emerged as the most common BS performed in the United States, while gastric banding has largely been abandoned. Our series include the first report of five patients with a history of SG prior to PTx. Given the increasing expertise in SG and the desire to avoid RYGB in the setting of a planned pancreas transplant due to the anatomical and malabsorptive concerns, SG appears to be the ideal bariatric procedure of choice in patients who are potential candidates for PTx, although RYGB is still feasible. Ultimately, the bariatric procedure of choice should be made via a multidisciplinary discussion including the patient, bariatric team, and transplant teams and should incorporate the typical assessments including the presence or absence of reflux, degree of weight loss desired, and presence of obesity related comorbidities.

In patients with prior RYGB, drainage of pancreatic exocrine contents may be challenging given the altered anatomy. In our series, in the case of either initial enteric drainage or conversion from bladder to enteric drainage, the allograft duodenum was anastomosed in a side-to-side fashion with a proximal segment of jejunum distal to the jejuno-jejunal anastomosis in all cases but one, likely with the intention of minimizing anastomotic tension. No patients developed signs or symptoms consistent with pancreatic exocrine insufficiency (diarrhea), suggesting this technique is a feasible option. One theoretical benefit to using the biliopancreatic limb for exocrine drainage of the pancreas allograft could be the option for nonoperative management in the case of an anastomotic leak due to the exclusion of enteric contents.

The limitations of this study include its single-center, retrospective nature as well as the heterogenous nature of the population with regard to transplant type (SPK versus PAK versus PTA), exocrine pancreatic drainage, and time from BS to PTx. Second, although this represents the largest series of patients to undergo BS prior to PTx, the sample size is small. Third, our institutional BMI threshold of <32 for PTx is partly subjective; future work may focus on identifying more objective criteria to assess obesity including waist circumference, visceral fat based on imaging, and fat free mass. Fourth, there is potential for implicit selection bias in the control group. Finally, given that some bariatric procedures were performed at other institutions or prior to the emergence of electronic medical record systems, complete documentation regarding pre-BS BMI and postoperative weight trends are missing.

Conclusion

In summary, this is the largest series of patients undergoing BS prior to PTx. The results of this study suggest that 1) perioperative complications are not increased in patients undergoing PTx with a history of prior BS and long-term outcomes are equivalent, and 2) patients with prohibitive BMI for PTx eligibility should be considered for BS without concern for detrimental impact on subsequent PTx outcomes.

CRediT authorship contribution statement

Abraham J. Matar: Methodology, Conceptualization, Formal analysis, Writing – original draft. **Matthew Wright:** Formal analysis. **Michael Megaly:** Formal analysis, Writing – original draft. **Michael Dryden:** Formal analysis, Writing – original draft. **Karthik Ramanathan:** Writing – original draft, Data curation. **Vanessa Humphreville:** Writing – original draft, Data curation. **David V. Mathews:** Writing – original draft, Data curation. **Heidi Sarumi:** Writing – original draft, Data curation. **Kristi Kopacz:** Writing – original draft, Data curation. **Daniel Leslie:** Writing – original draft, Data curation. **Sayeed Ikramuddin:** Writing – original draft, Data curation. **Erik B. Finger:** Writing – original draft, Data curation, Validation. **Raja Kandaswamy:** Methodology, Writing – original draft, Data curation, Validation.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Disclosures

The authors have no commercial associations that might be a conflict of interest in relation to this article.

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