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Bariatric surgery among kidney transplant candidates and recipients: Analysis of the United States Renal Data System and literature review[1]

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Abstract

Limited data exist on the safety and efficacy of bariatric surgery (BS) in patients with kidney failure. We examined Medicare billing claims within USRDS registry data (1991–2004) to identify BS cases among renal allograft candidates and recipients. Of 188 cases, 72 were performed pre-listing, 29 on the waitlist, and 87 post-transplant. Roux-en-Y gastric bypass was the most common procedure. Thirty-day mortality after BS performed on the waitlist and post-transplant was 3.5%, and one transplant recipient lost their graft within 30 days after BS. BMI data were available for a subset and suggested median excess body weight loss of 31%-61%. Comparison to published clinical trials of BS in populations without kidney disease indicates comparable weight loss but higher post-BS mortality in the USRDS sample. Given the substantial contributions of obesity to excess morbidity and mortality, BS warrants prospective study as a strategy for improving outcomes before and after kidney transplantation.

Keywords

Bariatric surgery; Kidney transplantation; Medicare; Mortality; Weight loss

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Introduction

Obesity is prevalent among kidney transplant recipients and predicts increased risks of mortality and peritransplant complications including delayed graft function, elevated transplant costs, and allograft loss (1–3). While life-saving benefits of kidney transplantation have been demonstrated among obese dialysis patients (4), registry-based analyses indicate that overweight and obese transplant candidates are less likely to receive an organ offer than candidates with normal body mass index (BMI), and are more likely to be bypassed for an offer when an organ becomes available (5). Obesity treatment may be a strategy for improving transplantation access and posttransplant outcomes.

Meta-analyses support superior efficacy of bariatric surgery (BS) compared to non-surgical therapy in achieving sustained weight loss in morbidly obese patients (6,7). A National Institutes of Health Consensus Development Conference approved clinical indications for BS as BMI ≥40 or BMI ≥35 and obesity-related comorbidities such as sleep apnea, cardiomyopathy or severe diabetes (8). Use of BS has been uncommon among kidney transplant candidates and recipients despite otherwise qualifying indications. To advance understanding of the utilization and outcomes related to BS in this population, we performed a retrospective study of the United States Renal Data System (USRDS) registry. We aimed to identify kidney transplant candidates and recipients who received BS and to describe their clinical characteristics and subsequent patient and allograft survival.

Methods

We performed sample selection, outcomes ascertainment, and covariate determinations using registry data collected by the USRDS that incorporate Organ Procurement and Transplantation Network (OPTN) records and Medicare billing claims (9,10). We identified kidney transplant candidates and recipients with Medicare billing claims with Current Procedural Terminology codes for BS (43644, 43645, 43770, 43771, 43773, 43842, 43843, 43845, 43846, 43847, 43848). Claims with provider-coded obesity (ICD-9 diagnosis codes: 278.00, 278.01, 278.02, V85.35, V85.36, V85.37, V85.38) in the database were sought as a form of sample validation for BS cases. Dates of available claims at the time of the study ranged from January 1991 to December 2004.

Demographic and clinical information were obtained from the Centers for Medicare and Medicaid Studies 2728 ESRD Reporting Form, OPTN Transplant Recipient Registration Form, and OPTN Recipient Follow-up Form (Table 1). Height and weight information are collected by the USRDS at ESRD reporting, and at transplant candidate listing, date of transplantation, and recipient follow-up surveys (requested at six months after transplant, the first post-transplant anniversary, and then annually). We computed BMI (kg/m^2) changes as the difference between closest reported BMIs following and preceding a BS date.

We performed a systematic literature review to frame weight loss and mortality outcomes from the registry in the context of published experience. The MEDLINE electronic database was queried for reports involving adult human subjects published in the English language from January 1, 1991 to June 30, 2008. Our first search, employing the medical subject headings (MeSH) terms “bariatric surgery”, “gastric bypass”, “gastroplasty” “jejunoileal bypass”, “kidney transplantation”, “kidney failure” and “chronic kidney failure”, yielded 14 unique articles. Two articles that focused on lipectomy and lipoinjections were deemed to be irrelevant based on the abstracts. Given our specific outcomes of interest, we excluded four articles that did not report information on either post-operative weight loss or mortality within the full-text. The final sample of eight articles is summarized in Table 2.

We identified clinical trial experience in the general population without kidney disease using the MeSH terms “bariatric surgery”, “gastric bypass”, “gastroplasty”, “jejunoileal bypass”, “postoperative complications”, “intraoperative complications”, and “randomized controlled study”. Of 34 unique articles, four that did not involve bariatric surgery were deemed to be irrelevant based on the abstracts. After full-text reviews, we excluded one observational study and 12 reports of trial participants that focused on particular aspects of surgical approach, intra-operative management or adjunctive care but that did not report weight loss or mortality beyond the BS hospital stay. The final article sample is summarized in Table 3.

Results

Characteristics of the registry sample

We identified 188 cases of BS among kidney transplant candidates and recipients registered in the USRDS during the study period. Of these, 183 (97.3%) also had claims with ICD-9 diagnosis codes for obesity. Demographic and clinical traits of the USRDS sample are shown in Table 1A. The most common states of residence at ESRD reporting were Ohio (9.6%), Virginia (9.6%) and California (9.0%) but residence at ESRD spanned 40 states. All the BS procedures identified in these data were open surgeries, and predominantly comprised gastric bypass.

Mortality and transplant outcomes in the registry sample

Thirty-day mortality after BS, calculable for listed and transplanted patients, was 3.5% in both groups (Table 1A). An additional 3.5% of the BS cases performed after transplant, but none of cases performed on the waitlist, died within 31–90 days after BS. Reported causes of death included myocardial infarction, cardiac arrhythmia and septicemia. Sixty nine percent (20/29) patients treated with BS on the waitlist proceeded to transplant after BS. One transplant recipient experienced graft failure within 30 days post-BS, with a primary cause of acute rejection.

Weight change in the registry sample

Information on BMI before and after BS was available for 83 cases (Table 1B). Due to the intermittent nature of BMI reporting in the registry, the median time between BMI surveys was 12 months for post-transplant cases but ranged from 22–37 months for cases performed before or during listing. Mean reported pre-BS BMI was classified as morbidly obese (>35) in all groups, but was highest among cases of BS after transplant. This pattern may represent better characterization of peak BMI in the post-transplant period, when BMI is requested with annual follow-up reports. Intermittent reporting may have prevented capture of pre-BS peak and post-BS nadir BMI in the registry, but suggests median excess body weight loss (EBWL) of 31%-61%.

BS-related outcomes in the literature

In 1996 Marterre et al. first described open gastric bypass among three morbidly obese kidney transplant recipients (11) (Table 2). Published BS experience in chronic kidney disease patients by this Ohio group now includes nine pre-transplant and ten post-transplant cases, all accomplished without perioperative mortality or graft loss (12,13). Mean EBWL was 69%-79% by 3 years and sustained at 70% by up to 5 years. From 2000–2006, six cases of laparoscopic adjustable gastric banding (LAGB) in kidney transplant candidates and recipients were reported; there were no perioperative deaths but band migration and erosion complicated LAGB in the transplant recipients (14–16). Recently Takata et al. described laparoscopic gastric bypass in seven ESRD patients without perioperative complications or

death (17). After average 15 months follow-up, mean EBWL was 61% and all were listed for transplant.

Clinical trial experience indicates that BS may achieve EBWL of 25%-85% in patients without kidney disease, and that weight loss is sustained over time (Table 3). The majority of participants (64%-100%) in general population trials are women. Most trials report no perioperative deaths, although two studies employing open procedures and one laparoscopic trial found 2%-4% mortality within 90 days (18,19).

Discussion

This study of the USRDS registry extends description of BS in kidney transplant candidates and recipients beyond selected reports. Important findings from our registry analysis include 30-day mortality after open BS on the waitlist and post-kidney transplant of 3.5%, and mortality in the next 31–90 days of 0%-3.5%. The OPTN mandates patient death and graft loss reporting, affording accurate capture of these events. Most controlled trials of BS in the general population reported no perioperative deaths, but several observed post-surgical mortality of 2%-4% within 90 days. Given the life-shortening consequences of obesity in ESRD we believe that the observed mortality in our population-based sample should not discourage continued evaluation of BS before and after transplant. Further, numerous BS series document a “learning curve” of declining complications with practitioner and center experience (20–22).

Available data from the USRDS provides an image of BMI changes around the time of BS. We found that while EBWL after BS in kidney transplant candidates and recipients may not be consistently as high as that of general population clinical trials, median EBWL was substantial and overlapped general trial estimates. It is notable that nearly 70% of candidates treated with BS on the waitlist in the USRDS sample were ultimately transplanted. Altered immunosuppression absorption and subsequent allograft rejection is a theoretical concern for BS in transplant recipients. Among the transplant recipients treated with BS in the USRDS, there was one early graft loss event. Cyclosporine dosages required to maintain target levels were increased in three published cases of post-transplant gastric bypass describing immunosuppression (11). A recent study of sirolimus, tacrolimus and mycophenolate pharmacokinetics after gastric bypass among two transplant recipients and four dialysis patients found notably lower “area under the plasma concentration curve”-to-dose ratios as compared to published data from non-bypassed populations (23). Routine monitoring of drug levels may prevent adverse consequences of altered pharmacokinetics after BS.

Notably, the BS procedures identified in this study of claims available through 2004 were exclusively open surgical procedures. In more recent years, laparoscopic techniques have been promoted as potentially less morbid approaches. Six cases of LAGB before or after kidney transplant without perioperative deaths have been published (14–16). However, some authors raise concern for technical complications (band slippage, band erosion, obstruction, port malfunction) and high surgical revision rates after LAGB (14,16), and a foreign body may predispose to infection in immunosuppressed patients. Laparoscopic sleeve gastrectomy generally requires shorter operative times and has been advanced in exceptionally high-risk patients such as super-obese (BMI >55) and patients with hepatic cirrhosis (17,24). Laparoscopic sleeve gastrectomy may be particularly beneficial in transplant recipients as it is purely restrictive and does not incorporate a malabsorptive component, minimizing interference with medication absorption, although its irreversibility may potentially harm those who lose too much weight.

Limitations of the retrospective USRDS analysis include the absence of center identifiers and clinical parameters such as blood pressure, glycemia and lipid status. BS before listing was identified among patients known to become listed candidates, and we could not estimate waitlist access or mortality associated with pre-listing BS. BMI capture in the USRDS is incomplete, and reported BMI data may not fully characterize the total sample. Non-surgical therapies for weight reduction are not captured in the registry and we could not compare our findings to modalities for intentional weight loss such as intensive diet. The registry study was limited to Medicare beneficiaries and results may not generalize to patients with other insurance. Further, the BS procedures identified in the USRDS were exclusively open and predominantly malabsorptive, and we believe other approaches warrant investigation in this population. To contextualize our results we summarized clinical BS trial experience in patients without kidney disease.

In conclusion, we found that BS has been performed in a minimum of nearly 200 kidney transplant candidates and recipients in the United States, and appears to yield substantial weight-loss. Peri-operative mortality was not negligible but was comparable to some trials among patients without kidney disease, and risk may decrease with practitioner experience. Given the known contributions of obesity to excess morbidity and mortality in this population, BS warrants prospective study as a strategy for improving outcomes before and after kidney transplantation.

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Table 1

Table 1A. Characterization of kidney transplant candidates and recipients who underwent bariatric surgery based on Medicare claims in the USRDS (1991–2004).

	Before Listing (N= 72)	On the Waitlist (N= 29)	After Transplant (N= 87)
Characteristic	**(%)**	**(%)**	**(%)**
Age at BS (years), mean ± SD	42.3 ± 10.8	47.0 ± 11.1	45.2 ± 11.3
Female sex	63.9	58.6	59.8
Race			
White	56.9	62.1	77.0
Black	40.3	31.0	23.0
Other	2.8	6.9	0
Hispanic ethnicity Cause of ESRD	2.8	10.3	5.8
Diabetes	9.7	13.8	35.6
Hypertension	11.1	17.2	13.8
Glomerulonephritis	13.9	13.8	23.0
Other	68.1	58.6	29.9
Comorbidities at ESRD reporting			
Diabetes Mellitus	29.2	31.0	40.2
Coronary artery disease	5.6	10.3	3.5
Congestive heart failure	13.9	17.2	8.1
Peripheral vascular disease	4.2	6.9	4.6
Chronic obstructive pulmonary disease	5.6	3.5	0
Smoking history	6.9	6.9	1.2
Alcohol abuse history	1.4	3.5	0
College education at transplant			11.5
Employed at transplant			0
BS procedure			
GBP, Roux-en-Y with short limb	68.1	55.2	57.5
GBP with small intestine reconstruction to limit absorption	15.3	27.6	23.0
Vertical-banded gastroplasty	12.5	10.3	11.5
Gastric restrictive without GBP, other than vertical banded gastroplasty	4.2	6.9	6.9
Biliopancreatic diversion with duodenal switch	0	0	1.2
Year of BS Surgery			
1991–1999	34.7	6.9	34.5
2000–2004	65.3	93.1	65.5
Time (months), mean ± SD			
BS to Listing	16.3 ± 13.0		
BS to Transplant (if transplanted)		17 ± 11.0	
Transplant to BS			52.1 ± 31.2
Mortality			

Table 1A. Characterization of kidney transplant candidates and recipients who underwent bariatric surgery based on Medicare claims in the USRDS (1991–2004).

	Before Listing (N= 72)	On the Waitlist (N= 29)	After Transplant (N= 87)
Characteristic	**(%)**	**(%)**	**(%)**
Within 30 days of BS	_ [1]	3.5 [2]	3.5 [3]
31–90 days after BS	_ [1]	0	3.5 [4]

Table 1B. Reported BMI and weight change data for kidney transplant candidates and recipients who underwent bariatric surgery based on Medicare claims in the USRDS, (years).[5]

	Before Listing (N= 29)	On the Waitlist (N= 11)	Post-Transplant (N= 43)
Most recent pre-BS BMI Mean ± SD	38.1 ± 12.4	40.1 ± 9.2	46.6 ± 4.6
Most recent post-BS BMI Mean ± SD	35.1 ± 6.2	35.1 ± 10.8	40.2 ± 7.8
Time between BMI assessments (months) Median (IQR)	36.6 (18.6, 55.7)	22.6 (11.1, 47.2)	12 (12, 12)
Change in BMI Median (IQR)	−6.8 (−12.3, 8.7)	−2.6 (−13.0, 0)	−7.0 (−10.6, −1.6)
Excess body weight loss (%), median (IQR)	60.6 (41.5, 72.4)	60.2 (0, 68.2)	30.8 (8.7, 48.3)

BMI, body mass index; BS, bariatric surgery; GBP, gastric bypass; ESRD, end-stage renal disease

Continuous variables expressed as mean ± standard deviation (SD) or median and IQR (inter-quartile range).

Percentages indicate fractions of patients before listing, on the waitlist or after transplant in a given clinical or procedural category (column percent).

Excess body weight loss (EBWL) is computed as: (weight loss/excess weight) x 100, where weight loss = (pre-BS weight – post-BS weight), and excess weight = (pre-BS weight – weight for ideal BMI of 25)

[1] Sampled from waitlist, and thus known to survive to candidate listing.

[2] Cause of death was septicemia.

[3] Causes of deaths were myocardial infarction, arrhythmia, and unspecified.

[4] Causes of deaths were myocardial infarction and unspecified.

[5] Limited to patients with BMI data at reporting time preceding and following BS.

Table 2

Summary of published case reports and case series describing outcomes and complications of bariatric surgery in patients with chronic kidney disease and kidney transplants.

Author, year	No. of patients	Age (years)	Gender	Comorbid conditions (%)	Surgery Type	Followup (months), mean	BMI Pre-BS, mean ± SD	BMI Post-BS, mean ± SD[1]	EBWL (%)	Perioperative mortality (%)[2]
Marterre et al, 1996 (11)	1 post-KT	55	Male	HTN	Open GBP	24	46.2	*3*	NR	0
	1 post-KT	34	Male	HTN	Open GBP	24	50.3	*3*	NR	0
	1 post-KT	42	Female	HTN,HL	Open GBP	24	59.2	*3*	NR	0
Weiss et al, 2000 (14)	1 post-KT	39	Male	HTN	LAGB	20	39	NR	30	0
Alexander et al, 2004 (12)[4]	19 CKD	48 ± 11.6	NA	HTN(79), DM(58),HL(32)	Open GBP	36	47.9 ± 6	29.9	79	0
	3 pre-KT	45.5 ± 3.7	NA	HTN(33), DM(33),HL(66)	Open GBP	36	48.2 ± 4	NR	78	0
	8 post-KT	38.4 ± 4.2	NA	HTN(63), DM(25),HL(25)	Open GBP	36	34.3 ± 4.5	NR	69	0
Agnani et al, 2005 (25)	1 CKD	43	Male	HTN,DM,HL	NR	15	46	32	NR	0
Newcombe et al, 2005 (15)	1 pre-KT	28	Male	HTN,DM	LAGB	28	51.4	40	NR	0
	1 pre-KT	38	Male	HTN,DM,HL	LAGB	9	44.4	33.2	NR	0
	1 pre-KT	65	Male	HTN	LAGB	12	38	28	NR	0
Buch et al, 2006 (16)	1 pre-KT	59	Female	DM	LAGB	1	NR	NR	NR	0
	1 post-KT	43	Female	HTN	LAGB	1	45	NR	NR	0
Alexander et al, 2007 (13)[5]	32 CKD	44	NR	NR	Open GBP	60	48	NR	68	0
	9 pre-KT	NA	NR	NR	Open GBP	60	NR	NR	68	0
	10 post-KT	44	NR	NR	Open GBP	60	NR	NR	70	0
Takata et al,2008 (17)	7 ESRD	46	Female	HTN(28),DM(42)	Lap GBP	15.4	50	NR	61	0

CKD, chronic kidney disease; DM, diabetes mellitus; EBWL, excess body weight loss; HTN, Hypertension; HL, hyperlipidemia; KT, kidney transplant; LAGB, laparoscopic adjustable gastric banding; Lap GBP, laparoscopic gastric bypass; NR, not reported; Open GBP, open gastric bypass

[1] Post-BS BMI as measured at reported end of follow-up

[2] Perioperative mortality refers to death within 90 days of BS

[3] Described as 100–150% of ideal body weight

[4] All GBP surgeries were open except for one laparoscopic (patient group not identified)

[5] Report includes 3 patients described in 1996 series (11) and 30 patients described in 2004 series (12), with additional cases and extended follow-up.

Table 3

Summary of published clinical trials (1991–2008) reporting mortality and/or post-hospital weight loss after bariatric surgery in general population samples.

Author, year	No. of patients	Mean age (years)	Female (%)	Comorbid conditions (%)	Surgery Type	Followup (months), mean ± SD	BMI Pre-BS, mean ± SD	BMI Post-BS, mean ± SD[1]	EBWL (%)	Perioperative mortality (%)[2]
MacLean et al, 1993 (26)	52	40	NA	NA	Open GBP	33 ± 12	50 ± 7	*3*	*3*	0
	54	38	NA	NA	Open VBG	39 ± 8	48 ± 7	*3*	*3*	0
Nguyen et al, 2001 (27)	76	42	88.2	HTN(41), DM(18), HL(18)	Open GBP	9.6 ± 6	48 ± 5	NR	62 ± 14	0
	79	40	91.1	HTN(33), DM(10), HL(16)	Lap GBP	9.6 ± 6	48 ± 5	NR	68 ± 15	0
Weiss et al, 2002 (28)	28	40	85	NR	LAGB	23	42.5	25	≥25	NR
	26	36	88	NR	LAEGB	24	41.8	23	≥25	NR
Blanco et al, 2003 (29)	30	32	86	NR	LAGB (Lapband)	12	43	NR	42 ± 3	NR
	30	34	80	NR	LABG (Heliogast)	12	41	NR	28 ± 2	NR
Miller et al, 2003 (30)	64	34	81	NR	Open VBG or AGB + Ursodiol	24	44	*4*	NR	NR
	60	36	85	NR	Open VBG or AGB	24	43	*5*	NR	NR
Lujan et al, 2004 (18)	51	38	74.5	NR	Open GBP	23	52.2	*6*	NR	1.9 *7*
	53	37	81.1	NR	Lap GBP	23	48.5	*6*	NR	3.7 *8*
Kirchmayr et al, 2004 (31)	20	37	75	NR	LAGB	9	44	34	>30	NR
	20	36	85	NR	LAGB (bolus band filling)	9	41	35	>30	NR
Inabnet et al, 2005 (32)	25	36	92.0	NA	Lap GBP (short limb)	24	45 ± 3	26	84	0
	23	34	100.0	NA	Lap GBP (long limb)	24	45 ± 3	29 ± 4	65	0
Suter et al, 2005 (33)	90	39.5	NR	Comorbidities (82)	LAGB (Lap band)	39	42.6	NR	50	0
	90	36.3	NR	Comorbidities (84)	LAGB (SAGB)	39	43.6	NR	50	0
Van Dielen et al, 2005 (19)	50	39	80.0	HTN(20), DM(14), HL(4)	Open VBG	24	47 ± 6	NR	70 ± 6	4 *7*
	50	37	80.0		LAGB	24	47 ± 6	NR	55 ± 3	0
Lee et al, 2005 (34)	40	31	70.0	Metabolic syndrome (57)	Lap GBP	24	43.8	30	59	0
	40	31	67.5	Metabolic syndrome (55)	Mini Lap GBP	24	44.8	28	64	0
Silecchia et al, 2005 (35)	24	59	75.0	HTN(41), DM(33), HL(20)	LAGB	24	42 ± 4	34	NR	0
	24	41	75.0	HTN(41), DM(20), HL(29)	LAGB	24	42 ± 4	33	NR	0
Puzziferri et al, 2006 (36)	57	50	89.5	HTN(49), DM(14), HL(25)	Open GBP	39 ± 8	49	NR	67 ± 21	0
	59	47	94.9	HTN(31), DM(8), HL(14)	Lap GBP	39 ± 8	48	NR	77 ± 22	0
Selicchia et al,2006 (37)	93	42.9 ± 11	78	NR	Lap GBP + glue	12	46.9 ± 6.4	30 ± 5	NR	0

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	111	39 ± 11.6	82	NR	Lap GBP	12	46.4 ± 8.2	30 ± 5	NR	0
Angrisani et al, 2007 (38)	24	34	83.0	HTN(4), DM(4), HL(8)	Lap GBP	60	44 ± 4	NR	84 ± 9	0
	27	34	81.0	HTN(11)	LAGB	60	43 ± 4	NR	83 ± 9	0
Alami et al, 2007 (39)	50	42	88.5	HTN(66), DM(51)	Lap GBP after wt loss	6	49 ± 7	35 ± 7	54 ± 15	0
	50	45	80.0	HTN(57), DM(45)	Lap GBP	6	49 ± 6	36 ± 6	51 ± 10	0
Bessler et al, 2007 (40)	46	41	64.0	HTN(50), DM(26), HL(31)	Open GBP with Band	36	59.5	NR	73.4	0
	44	43	73.9	HTN(46), DM(26), HL(30)	Open GBP	36	56.5	NR	57.7	0

DM, diabetes mellitus; EBWL, excess body weight loss; HTN, Hypertension; HL, hyperlipidemia; LAGB, laparoscopic adjustable gastric banding; LAEGB, laparascopic adjustable esophagogastric banding; Lap GBP, laparoscopic gastric bypass; NR, not reported; Open GBP, open gastric bypass; SAGB, Swedish adjustable gastric band; VBG, vertical banded gastroplasty

[1] Post-BS BMI as measured at reported end of follow-up

[2] Perioperative mortality refers to death within 90 days of BS.

[3] Success, defined as 50%–100% EBWL and re-operation not required, occurred in 58% open GBP arm and 39% open VBG arm

[4] Mean body weight 85 ±13 kg

[5] Mean body weight 86 ± 14 kg

[6] BMI 32–35

[7] Deaths within 30 days after BS

[8] Deaths 31–90 days after BS