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ORIGINAL ARTICLE

Bariatric surgery prior to living donor nephrectomy: a solution to expand the living donor kidney pool – a retrospective study

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SUMMARY

Most transplant centers decline morbidly obese people for living kidney donation. Their inclusion in the living donor pool after weight loss and reversal of comorbidities by bariatric surgery could reverse the downward living donation trend. We investigated whether bariatric surgery in the morbidly obese altered their candidacy for donation, complicated their subsequent donor nephrectomy, and impacted their early postoperative outcomes in a series of 22 donors who had bariatric surgery 0.7–22 years prior to laparoscopic living donor nephrectomy. Eighteen would have been excluded from donation prior to bariatric surgery based on a body mass index (BMI) > 40. Seventeen reached a BMI < 35 after bariatric surgery. One had hypertension that resolved after bariatric surgery. Prior bariatric surgery did not influence port placement and laterality of donor nephrectomy. None required open conversion or blood transfusion. In an exploratory comparison with 37 donors with a BMI 35–40, length of stay and warm ischemic time were shorter, blood loss and postoperative complications were similar, and operative time was longer. We therefore advocate the consideration of bariatric surgery in preparation for donation in morbidly obese people since it positively alters their candidacy without major impact on the subsequent living donor nephrectomy and early outcomes.

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Key words
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Introduction

Living kidney donation has been declining in the U.S. since the mid-2000s [1], while morbid obesity has quadrupled since the 1980s with >15 million Americans having a body mass index (BMI) > 40 [2–4]. Morbidly obese people currently account for <5% of the total living kidney donor pool [1], and are potential candidates to reverse the downward trend in living donation. Morbid obesity, however, is a contraindication for living kidney donation at most U.S. transplant centers due to concerns for an increase in perioperative complications and the known contribution of obesity to the development of chronic kidney disease and its risk factors such as hypertension (HTN) and type 2 diabetes [5]. Bariatric surgery has been shown to provide long-term weight loss and reverse obesity-associated medical comorbidities [6], and could represent a solution to transform morbidly obese

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people into viable living kidney donor candidates. We report a case series of former morbidly obese people who had bariatric surgery prior to living kidney donation at two U.S. centers with the goal of determining whether bariatric surgery: (i) altered the candidacy of morbidly obese people for living kidney donation, (ii) complicated the subsequent laparoscopic living donor nephrectomy, and (iii) impacted the early postoperative outcomes.

Methods

Donor population

Six hundred and seventy-five living donor nephrectomies were retrospectively identified at NewYork-Presbyterian/Columbia University Medical Center (NYP/CUMC) between January 2011 and August 2017. Fifteen donors (2.2%) had bariatric surgery prior to living donor nephrectomy. One hundred and seventy-five donors (25.9%) were obese with a BMI $\geq$ 30, including 37 (5.5%) with a BMI 35–40 and 138 (20.4%) with a BMI 30–35. The remaining 71.9% of the donors (n = 485) had a BMI < 30. Additionally, from a retrospectively identified total of 227 living donor nephrectomies at the University of Cincinnati (UC) between January 2012 and December 2016, seven donors (3.1%) had bariatric surgery prior to living donor nephrectomy.

All living donor nephrectomies from the NYP/CUMC experience were performed using a pure laparoscopic technique, while all living donor nephrectomies from the UC experience were performed using a hand-assisted laparoscopic technique. At both centers, donor evaluation and clearance were done by a multidisciplinary transplant team independent of the recipient, and included a triphasic computed tomography scan of the abdomen/pelvis to determine renal hilar anatomy bilaterally.

In all donors who had bariatric surgery prior to living donor nephrectomy at both centers and donors with a BMI 35–40 at NYP/CUMC, bariatric surgery characteristics when applicable, donor demographics, intra-operative details, and early postoperative outcomes were retrospectively reviewed. Median follow-up was 209 days. With regard to bariatric surgery characteristics, one donor was missing information regarding their pre-bariatric surgery BMI, and another was missing the time interval between their bariatric surgery and living kidney donation. Regarding the intra-operative details, warm ischemia time was not systematically recorded, therefore missing in nine donors who had bariatric surgery prior to living donor nephrectomy and 10 donors with a BMI 35–40.

Statistical analyses

Data are presented as mean $\pm$ standard error of the mean calculated using SPSS 20 (IBM, Armonk, NY, USA). The donors with a BMI 35–40 at NYP/CUMC served as a retrospective control group for exploratory comparisons with donors who had bariatric surgery prior to living donor nephrectomy at NYP/CUMC and UC. Statistical tests of hypotheses were omitted since the analyses would be underpowered (low n) and confounded by selection bias (absence of matching process).

Results

Case series of bariatric surgery prior to living kidney donation

Twenty-two donors had bariatric surgery 0.7–22 years prior to laparoscopic living donor nephrectomy, 15 at NYP/CUMC and seven at UC (Tables 1, Table S1). None of the bariatric operations were performed specifically in preparation for donation. Eight underwent Roux-en-Y gastric bypass (six laparoscopic, two open), seven underwent laparoscopic sleeve gastrectomy, six underwent laparoscopic adjustable gastric band surgery, and one underwent laparoscopic biliary pancreatic diversion (BPD) surgery with duodenal switch.

Of the 21 donors with pre-bariatric surgery BMI information, 18 would have been excluded from donation prior to bariatric surgery based on a BMI > 40 alone. All 18 of these donors lost sufficient weight after bariatric surgery to reach a BMI < 40 prior to donation, and 17 lost sufficient weight to reach a BMI < 35. The only one who did not reach a BMI < 35 still lost significant weight going from a super morbidly obese BMI of 60.7 to a BMI of 37.2 after bariatric surgery. A mean weight loss of 32.6% was achieved after bariatric surgery, with the mean BMI decreasing from 46.2 to 30.6. Only one donor had obesity-associated HTN which resolved after bariatric surgery. None of the donors had type 2 diabetes or other obesity-associated comorbidities. Prior bariatric surgery did not influence standard port placement or laterality of the laparoscopic living donor nephrectomy. The choice of a right nephrectomy in four donors was due to the presence of right-sided nephrolithiasis (n = 2), right kidney mass (n = 1), and vascular anatomical considerations (n = 1).

Table 1. Case series of 22 donors who had bariatric surgery prior to laparoscopic living donor nephrectomy.

			Bariatric surgery							Laparoscopic donor nephrectomy					
								Comorbidity							
Case	Age (years)	Sex	Type	Time interval with donation (years)	Pre-BMI (kg/m^2)	Post-BMI (kg/m^2)	Weight loss %	Type	Reversal	Laterality	OR time (min)	WIT (s)	EBL (cc)	LOS (days)	Complications
NewYork-Presbyterian/Columbia University Medical Center															
1	41	F	Lap Bypass	6	52.7	33.5	36.4	–	–	Right	246	243	50	2	–
2	31	F	Lap Band	2	40.4	28.8	28.5	–	–	Right	281	248	100	2	–
3	33	F	Lap Sleeve	2	34	26.5	22.1	–	–	Left	165	136	100	2	–
4	49	F	Lap Sleeve	1	36.5	25.6	30.0	–	–	Left	174	155	50	2	–
5	58	F	Lap Bypass	5	45.0	20.2	55.1	–	–	Left	225	–	50	2	–
6	50	F	Lap Sleeve	4	44.0	29.2	33.6	–	–	Left	213	–	50	3	–
7	36	F	Open Bypass	21	44.0	32.9	25.3	–	–	Left	313	–	500	4	–
8	50	F	Lap Bypass	3	50.5	30.2	40.2	–	–	Left	223	203	700	3	–
9	31	M	Lap Bypass	9	51.8	33.6	35.1	–	–	Left	285	224	75	3	–
10	51	F	Open Bypass	22	46.4	31.9	31.2	–	–	Left	185	248	75	1	–
11	57	F	Lap Sleeve	2	51.7	26.1	49.5	HTN	Yes	Right	209	270	75	2	–
12	28	M	Lap Band	4	50.1	34.2	31.8	–	–	Left	250	198	100	2	Wound cellulitis
13	40	F	Lap Sleeve	3	42.9	25.4	40.7	–	–	Left	250	–	50	3	–
14	60	F	Lap Band	0.7	40.8	33.7	17.4	–	–	Left	213	273	50	2	–
15	35	F	Lap Band	3	46.9	34.8	25.6	–	–	Left	230	187	50	2	–
University of Cincinnati															
16	29	F	Lap Band	5	44.6	31.8	30.4	–	–	Left	177	142	50	2	–
17	62	F	Lap Bypass	13	43.6	32	26.6	–	–	Left	192	–	200	2	–
18	50	F	Lap Band	–	38.6	33.3	13.8	–	–	Left	177	73	50	1	Incisional hernia
19	43	F	Lap Sleeve	0.8	48.1	32.4	32.6	–	–	Right	251	–	0	2	–
20	64	F	Lap Bypass	8	–	27.4	–	–	–	Left	320	–	0	2	–
21	63	F	Lap BPD	14	54.9	33.5	39.1	–	–	Left	296	–	150	2	–
22	34	F	Lap Sleeve	4	60.7	37.2	38.6	–	–	Left	253	–	0	3	Pancreatitis
Total	Mean ± SEM 45 ± 3	2M 20F	8 Bypasses 7 Sleeves 6 Bands 1 BPD	Mean ± SEM 6.3 ± 1.4	Mean ± SEM 46.2 ± 1.4	Mean ± SEM 30.6 ± 0.9	Mean ± SEM 32.6 ± 2.1	1 HTN 21 No	1 Yes 21 N/A	18 Left 4 Right	Mean ± SEM 233 ± 10	Mean ± SEM 200 ± 17	Mean ± SEM 115 ± 35	Mean ± SEM 2.2 ± 0.1	2 Wound 1 Pancreatitis 19 No

BMI, body mass index; BPD, biliary pancreatic diversion; EBL, estimated blood loss; F, female; HTN, hypertension; Lap, laparoscopic; LOS, length of stay; M, male; min, minutes; OR, operating room; s, seconds; SEM; standard error of the mean; WIT, warm ischemic time.

Asymptomatic nephrolithiasis was present in one donor who had a Roux-en-Y gastric bypass and one donor who had a laparoscopic adjustable gastric band surgery. Information regarding whether the nephrolithiasis occurred prior or following bariatric surgery was not available, and there was no recurrence in the contralateral kidney after donation. None of the donors with prior bariatric surgery required open conversion or blood transfusion.

Exploratory comparison of intra-operative and early postoperative outcomes between donors who had bariatric surgery prior to laparoscopic living donor nephrectomy and obese donors with a BMI 35–40

Thirty-seven obese donors with a BMI 35–40 from the NYP/CUMC experience served as a retrospective control group to donors who had bariatric surgery for exploratory comparisons (Table 2). Demographically, there was more female and less African-American in the group of donors who had bariatric surgery prior to laparoscopic living donor nephrectomy. No gross difference in age at donation was observed. Reflecting the finding that all but one of the donors who had bariatric surgery lost sufficient weight to reach a BMI < 35 (mean: 30.6 ± 0.9), the retrospective control obese donors group had a higher BMI (mean: 36.2 ± 0.2) at the time of donation. There was no gross difference in the number of renal arteries, renal veins, or ureters between the two groups to complicate the donor nephrectomy, as assessed by imaging and intra-operative findings. The ratio of left to right donor nephrectomies was also grossly similar between the groups.

In terms of surgical outcomes, operative time was on average 20 min longer in the group of donors who had bariatric surgery (233 ± 10 min) compared to the retrospective control obese donors group (210 ± 6 min). Conversely, warm ischemic time (WIT) was on average 20 s shorter in the group of donors who had bariatric surgery (200 ± 17 s) compared to the retrospective control obese donors group (223 ± 11 s), implying that prior bariatric surgery did not hinder extraction of the kidney. Estimated blood loss was similar between the two groups. No transfusions were required in any of the

Table 2. Comparison of peri–operative outcomes between donors who had bariatric surgery and donors with a BMI 35–40 without bariatric surgery.

	Bariatric surgery group	Obese (BMI 35–40) group
n	22	37
Age (years)	45 ± 3	43 ± 2
Male:Female	2:20	19:18
African–American:Other races	1:21	9:28
Pre-bariatric surgery BMI (kg/m^2)	46.2 ± 1.4	–
BMI at time of donation (kg/m^2)	30.6 ± 0.9	36.2 ± 0.2
Donor hilar anatomy		
Renal artery (Single:Multiple)	19:3	29:8
Renal vein (Single:Multiple)	19:3	36:1
Ureter (Single:Multiple)	22:0	37:0
Laterality of donor nephrectomy (Left:Right)	18:4	35:2
OR time (min)	233 ± 10	210 ± 6
WIT (s)	200 ± 17	223 ± 11
EBL (cc)	115 ± 35	113 ± 22
Transfusion	0	0
Conversion	0	0
LOS (days)	2.2 ± 0.1	3.2 ± 0.8
Peak serum creatinine (mg/dL)	1.18 ± 0.08	1.62 ± 0.14
Serum creatinine at hospital discharge (mg/dL)	1.18 ± 0.08	1.41 ± 0.08
Serum creatinine at last follow-up (mg/dL)	1.15 ± 0.05	1.28 ± 0.06
Postoperative complications	3	2
Clavien I	2	0
Clavien II	0	0
Clavien III	1	2
Clavien IV	0	0

EBL, estimated blood loss; LOS, length of stay; min, minutes; OR, operating room; s, seconds; WIT, warm ischemic time.

donors. None of the donors in either group necessitated open conversion.

Postoperatively, the length of stay (LOS) in the hospital was on average 1 day longer in the retrospective control obese donors group (3.2 ± 0.8 days) compared to the group of donors who had bariatric surgery (2.2 ± 0.1 days). Peak serum creatinine after donor nephrectomy was higher in the retrospective control obese donors group, but this difference diminished on the day of discharge from the hospital or at their last follow-up. Postoperative complications consisted of one wound cellulitis, one conservatively managed pancreatitis, and one incisional hernia requiring operative repair in the donors who had bariatric surgery group, while the two postoperative complications observed in the retrospective control obese donors group both mandated an exploratory laparotomy due to peritonitis. One had a small bowel injury while the other had a pancreatic injury.

Discussion

To the best of our knowledge, we present the largest case series of morbidly obese people who had bariatric surgery prior to living kidney donation. Three other cases of bariatric surgery performed specifically in preparation for laparoscopic living donor nephrectomy were previously described [7,8]. Branco *et al.* [7] reported on two donors who had laparoscopic Roue-en-Y gastric bypass surgery 4 and 7 months prior to laparoscopic donor nephrectomy. Koshy *et al.* [8] reported on one donor who had a laparoscopic adjustable gastric band surgery 7 months prior. All three aforementioned donors lost sufficient weight to decrease their BMI from >40 to <35 prior to donation, one had HTN that resolved after bariatric surgery, and none had a deviation from the standard operative course [7,8]. Our findings are consistent with the above. All of our 22 morbidly obese donors who had bariatric surgery lost sufficient weight to subsequently become candidates for living kidney donation. They all underwent a safe laparoscopic donor nephrectomy without open conversion, blood transfusion, or life-threatening postoperative complications.

Since none of our morbidly obese donors had bariatric surgery specifically for living kidney donation, the interval between bariatric surgery and laparoscopic living donor nephrectomy was highly variable. It therefore remains unknown what would be the ideal timing of bariatric surgery (before, jointly, after) in relation to donation. Even if reversal of type 2 diabetes and HTN occur within days after bariatric surgery, maximal weight loss of 20–40% depending on the type of bariatric surgery is usually achieved between 6 months and 1 year [6]. In 5–15% of the cases, weight loss is inadequate in the first year after bariatric surgery and may require diet modifications, behavioral changes, and revisional bariatric surgery [9,10]. Moreover, complication rates early after bariatric surgery such as gastric leaks, anastomotic leaks, and bleeding vary between 8 and 20%, and can lead to renal dysfunction [11]. Pending further prospective investigations, we believe that laparoscopic donor nephrectomy should be performed 6 months to 1 year following bariatric surgery to ensure an uncomplicated post-bariatric surgery course and the benefits of sufficient and maximal weight loss. Since insufficient weight loss and early complications after bariatric surgery could lead to the failure to progress to living kidney donation, the primary purpose of bariatric surgery should be for overall health improvement and not solely donation. Bariatric surgery is not only a proven effective method for sustained weight loss that is clinically indicated in patients with a BMI > 40 or a BMI ≥ 35 with obesity-related comorbidity, but has also been shown to decrease HTN, type 2 diabetes, cardiovascular events, sleep apnea, cancer incidence, and possibly early mortality [12].

The ideal type of bariatric surgery to be performed in morbidly obese people who wish to become living kidney donors also needs to be determined. Four types of operations are performed in contemporary bariatric surgery: the Roue-en-Y gastric bypass, the sleeve gastrectomy, the adjustable gastric band, and the BPD with duodenal switch. The mechanism of weight loss is a combination of malabsoprtion and restriction for the Roue-en-Y gastric bypass and BPD with duodenal switch, while the sleeve gastrectomy and adjustable gastric band are purely restrictive [13]. The Roue-en-Y gastric bypass is considered the gold-standard weight loss operation as it has proven success at durable weight reduction and reversal of obesity-associated comorbidities [13]. Due to its malabsorptive nature, the Roue-en-Y gastric bypass is, however, associated with the potential of long-term nutritional and metabolic derangements. In the particular context of kidney donation, these metabolic derangements can alter the urinary milieu, leading to an approximately twofold increase risk of calcium oxalate nephrolithiasis and the rare possibility of developing oxalate nephropathy [14]. The BPD with duodenal switch, which leads to even more malabsorption as well as nutritional and metabolic derangements than the Roue-en-Y gastric bypass, carries

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the similar increased risk of nephrolithiasis and oxalate nephropathy [14,15]. Due to the higher complication rates and technical complexity compared to the Roue-en-Y gastric bypass, the BPD with duodenal switch is rarely performed and usually reserved for morbidly obese patients with a BMI > 50 [13]. As opposed to procedures causing malabsorption, the purely restrictive sleeve gastrectomy and adjustable gastric band have not been associated with an increase risk of nephrolithiasis or the development of oxalate nephropathy [15]. Since the sleeve gastrectomy results in durable weight reduction approaching the Roue-en-Y gastric bypass while leading to less complications and being technically less complex, it has now supplanted the Roue-en-Y gastric bypass as the most commonly performed bariatric procedure [13]. Meanwhile, the use of the adjustable gastric band has largely declined secondary to lower weight loss in comparison to other bariatric procedures as well as its high rate of late band-related complications such as slippage and erosion [13]. Overall, the sleeve gastrectomy might be the bariatric procedure of choice prior to living kidney donation due to its risk-benefit profile.

Our case series of morbidly obese donors who had bariatric surgery prior to living kidney donation is also limited by the lack of long-term follow-up. We were unable to monitor the long-term durability of weight loss after living kidney donation in the donors who had bariatric surgery. Since the majority of our donors had a long interval between their bariatric surgery and their subsequent laparoscopic donor nephrectomy during which they maintained durable weight loss, we do not suspect that they would have significant weight gain in the long run following donation. Although we cannot ascertain whether the same durable weight loss would be obtained in morbidly obese people who have bariatric surgery specifically in preparation for living kidney donation from our series, the literature suggests that a weight reduction of 15–25% is overall maintained at 10 years following bariatric surgery depending on the type of procedure [6]. We expect that the same weight loss outcome would be obtained with the addition of living kidney donation. We did not observe any development of obesity-associated comorbidities, *de novo* or recurrent nephrolithiasis, or renal failure in our donors who had bariatric surgery following living kidney donation, but these medical conditions may manifest only years later. In particular, donors who had bariatric procedures causing malabsorption are at higher risk of developing enteric hyperoxaluria and calcium oxalate nephrolithiasis. We did not routinely perform a lithogenic risk assessment with 24-hour urine collection in our donors who had bariatric procedures causing malabsorption since these tests are severely limited by their high variability, diet dependency, and arbitrary cut-off values [16]. It would, however, be interesting to routinely perform the 24-hour urine collection in the future to determine whether it can predict *de novo* or recurrent nephrolithiasis in donors who undergo bariatric procedures causing malabsorption, and whether correction of urinary metabolic abnormalities if present (usually hyperoxaluria and hypocitriuria) prevents nephrolithiasis. We also did not have experience with morbidly obese donors who have reversal of type 2 diabetes after bariatric surgery in our series. Although bariatric surgery results in the remission of type 2 diabetes in 40–80% at 1 year, more than a third relapse at 3 years. Risk factors known to be associated with relapse of type 2 diabetes after bariatric surgery include a long duration of type 2 diabetes, insulin use, and poor diabetes control prior to bariatric surgery as demonstrated by high HbA1C levels [17]. In that context, we would only carefully consider type 2 diabetic morbidly obese people as candidates for living kidney donation if they have reversal of type 2 diabetes after bariatric surgery in the absence of the aforementioned risk factors.

We used a retrospective control of 37 obese donors with a BMI 35–40 for exploratory comparisons with our series of 22 donors who had prior bariatric surgery. With regards to intra-operative outcomes, our exploratory comparisons suggest that operative time was on average 20 min longer while WIT was 20 s shorter in the donors who had bariatric surgery. These differences are not clinically significant. With regard to postoperative outcomes, our exploratory comparisons suggest that hospital LOS was 1 day shorter in donors who had bariatric surgery. Moreover, the severity of postoperative complications may be higher in the retrospective control obese donors with a BMI 35–40. When examining Grade III Clavien-Dindo surgical complications [18], an incisional hernia repair occurred in one donor after bariatric surgery. On the other hand, two obese donors with a BMI 35–40 required an exploratory laparotomy in the early postoperative period for peritonitis related to a small bowel injury and a pancreatic injury. A future prospective study with a larger number of donors who underwent bariatric surgery and a matched control group will be needed to have adequate power to test whether hospital LOS and surgical complications after living donor nephrectomy are positively influenced by bariatric surgery. Long-term follow-up will also be necessary to ensure the durability of weight loss as well as the absence of *de novo* or recurrent chronic medical

conditions associated with the development of chronic kidney disease after a morbidly obese person undergoes bariatric surgery and living kidney donation.

Conclusion

In conclusion, our study demonstrates that bariatric surgery allows morbidly obese people who would be discouraged from kidney donation to become candidates without complicating their subsequent laparoscopic living donor nephrectomy or affecting their early postoperative outcomes. Based on our findings, we advocate the consideration of bariatric surgery prior to laparoscopic living donor nephrectomy in morbidly obese people who are highly motivated to donate and without significant co-morbidities. Further studies will be required to assess the long-term impact of bariatric surgery on obesity-associated medical conditions that increase the risk for lifetime renal failure and the durability of weight loss after living kidney donation. Furthermore, the ideal timing and type of bariatric surgery to be performed prior to donation remain to be determined.

Authorship

MTJPN designed the study, collected data, analyzed data, and wrote the paper. DC, JT, AM, and PRS collected data. SW collected data and contributed to critical feedback. TD collected data, contributed to critical feedback, and supervised the project. LER designed study, collected data, contributed to critical feedback, and supervised the project.

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Conflict of interest

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Comparison of demographics, bariatric surgery characteristics, intra-operative factors, and postoperative outcomes between donors who had bariatric surgery prior to laparoscopic donor nephrectomy at NYP/CUMC and UC.

REFERENCES

1. Hart A, Smith JM, Skeans MA, *et al.* OPTN/SRTR 2015 annual data report: kidney. *Am J Transplant* 2017; **17**(S1): 21.
2. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA* 2006; **295**: 1549.
3. Keidar A. Bariatric surgery for type 2 diabetes reversal: the risks. *Diabetes Care* 2011; **34**(Suppl 2): S361.
4. Gonzalez RD, Canales BK. Kidney stone risk following modern bariatric surgery. *Curr Urol Rep* 2014; **15**: 401.
5. Lafranca JA, Hagen SM, Dols LFC, *et al.* Systematic review and meta-analysis of the relation between body mass index and short-term donor outcome of laparoscopic donor nephrectomy. *Kidney Int* 2013; **83**: 931.
6. Sjöström L, Lindroos A-K, Peltonen M, *et al.* Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. *N Engl J Med* 2004; **351**: 2683.
7. Branco AW, Branco Filho AJ, Kondo W. Laparoscopic live donor nephrectomy in patients surgically treated for morbid obesity. *Int Braz J Urol* 2007; **33**: 377, discussion 379.
8. Koshy AN, Wilkinson S, Coombes JS, Fassett RG. Laparoscopic adjustable gastric band in an obese unrelated living donor prior to kidney transplantation: a case report. *J Med Case Rep* 2010; **4**: 107.
9. Campos GM, Rabl C, Mulligan K, *et al.* Factors associated with weight loss after gastric bypass. *Arch Surg* 2008; **143**: 877, discussion 884.
10. Yilmaz H, Ece I, Sahin M. Revisional surgery after failed laparoscopic sleeve gastrectomy: retrospective analysis of causes, results, and technical considerations. *Obes Surg* 2017; **27**: 2855.
11. Montravers P, Augustin P, Zappella N, *et al.* Diagnosis and management of the postoperative surgical and medical complications of bariatric surgery. *Anaesth Crit Care Pain Med* 2015; **34**: 45.
12. Sjöström L. Review of the key results from the Swedish Obese Subjects (SOS) trial - a prospective controlled intervention study of bariatric surgery. *J Intern Med* 2013; **273**: 219.
13. Nguyen NT, Varela JE. Bariatric surgery for obesity and metabolic disorders: state of the art. *Nat Rev Gastroenterol Hepatol* 2017; **14**: 160.
14. Espino-Grosso PM, Canales BK. Kidney stones after bariatric surgery: risk

assessment and mitigation. *Bariatr Surg Pract Patient Care* 2017; **12**: 3.
15. Lieske JC, Mehta RA, Milliner DS, Rule AD, Bergstralh EJ, Sarr MG. Kidney stones are common after bariatric surgery. *Kidney Int* 2015; **87**: 839.
16. Hsi RS, Sanford T, Goldfarb DS, Stoller ML. The role of the 24-hour urine collection in the prevention of kidney stone recurrence. *J Urol* 2017; **197**: 1084.
17. Shah A, Laferrère B. Diabetes after bariatric surgery. *Can J Diabetes* 2017; **41**: 401.
18. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004; **240**: 205.