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BRIEF COMMUNICATION

Impact of Bariatric Surgery on Quality of Life, Functional Capacity, and Symptoms in Patients with Heart Failure

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Abstract Obesity is a risk factor for heart failure (HF), but the benefit of weight loss in HF is unknown. We assessed the effects of bariatric surgery (BSx) compared to non-operative treatment for morbid obesity on overall quality of life (QoL), functional capacity, and symptoms in 13 HF patients undergoing BSx and six HF patients treated without surgery. In the BSx group, median age was 62, body mass index (BMI) was 55 kg/m^2, and 5/13 were males; in the non-operative group, median age was 69, BMI was 42 kg/m^2, and 1/6 were male. Median follow-up was 4.3 and 2.7 years, respectively. At follow-up, BMI was less in the BSx group (35 vs 47 kg/m^2, $p<0.001$); QoL ($p<0.01$), frequency of exertional dyspnea ($p=0.01$), and leg edema ($p=0.04$) improved only in the BSx group. BSx induced weight loss and improved QoL and symptoms in morbidly obese patients with HF.

Keywords Bariatric surgery · Roux-en-Y gastric bypass · Obesity · Heart failure · Quality of life · Functional capacity

Abbreviations

BMI	Body mass index
BSx	Bariatric surgery
HF	Heart failure
NYHA	New York Heart Association
QoL	Quality of life

Introduction

Obesity is a known risk factor for heart failure (HF), and both obesity and HF are independently associated with reductions in quality of life (QoL) and functional capacity [1]. Despite these correlations, little has been documented about the benefits of weight loss in morbidly obese patients with established HF. In addition, the effect of bariatric surgery (BSx) on QoL and cardiac symptoms in HF patients has not been described. Although studies have suggested that overweight and obese patient with HF tend to have a better prognosis (the so-called obesity paradox) [2, 3], no studies have examined the effect of purposeful weight loss on prognosis among patients with HF and grades II and III obesity (body mass index (BMI) ≥ 35 and ≥ 40 kg/m^2, respectively) as a separate group.

Our aim was to assess the effect of BSx on overall QoL, functional status, and symptoms of HF in morbidly obese patients with established HF compared to patients with HF managed non-operatively for obesity.

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Methods

This analysis included 19 patients with HF from a cohort of 849 patients referred for Roux-en-Y gastric bypass at Mayo Clinic, Rochester, MN, USA. This population-based, retrospective study included only residents of Olmsted County referred for BSx between 1990 and 2005.

We identified patients who underwent evaluation for BSx and excluded patients with a BMI <35 kg/m^2, age <18 years, those with an evaluation not intended for BSx, or those without written authorization for research. After these exclusions, 268 operative and 273 non-operative patients were identified. Non-operative patients were managed in our Nutrition Clinic but did not undergo BSx for various reasons (patient volitionally declined BSx, third-party payer denial, or lack of appreciated medical necessity). These patients were co-managed by endocrinologists, cardiologists, and nutritionists. We subsequently mailed a survey to assess baseline (time of BSx/endocrine consultation) and follow-up status. Our cohort comprised 117 BSx patients and 88 non-operative patients who agreed to participate in the survey; the specific details of these patients have been described elsewhere [4].

HF was defined by one of following criteria: documentation of the clinical diagnosis (congestive or right-sided HF, dilated cardiomyopathy, previous episode of pulmonary edema or cardiogenic shock), ejection fraction <50 % measured by echocardiogram/scintigraphy, or echocardiographic evidence of grades II–IV diastolic dysfunction. Baseline and follow-up variables (vital signs, medical history, and medications) were abstracted from the medical records at the time of BSx or initial visit at the Nutrition Clinic and from the most recent visit at the time of survey mailing, respectively.

Overall QoL was assessed by a well-validated single item from the Linear Analogue Self-Assessment Questionnaire, measured on a ten-point Likert scale [5, 6]. A score of 0 to 3 indicates poor QoL, 4 to 6 indicates average QoL, and 7 to 10 indicates a positive QoL [7]. The survey also ascertained frequency of HF symptoms (exertional dyspnea, paroxysmal nocturnal dyspnea, orthopnea, leg edema, and fatigue) using a Likert scale from 1 (never) to 5 (always) and functional capacity using the Specific Activity Scale [8], a measure that parallels the New York Heart Association (NYHA) classification.

Statistical Analysis

Continuous data are presented as medians (range in parentheses) and categorical data are presented as counts (%). Negative values represent loss/decrease when compared to gain/increase. With the small sample size, non-parametric tests were applied. For intra-group comparisons, Wilcoxon signed-rank and McNemar's tests were used for continuous and categorical variables, respectively. Inter-group comparisons at baseline and at follow-up were performed using a Wilcoxon rank-sum test for continuous variables. For categorical variables, we categorized patients according to changes in each variable (same, worse, or better) and applied the Cochran–Armitage trend test to compare groups; p-values <0.05 were considered as statistically significant. Data were analyzed using JMP for SAS (Cary, NC, USA), version 9.0.

Results

Thirteen operative patients and six non-operative patients fulfilled the inclusion criteria. Three non-operative patients refused to undergo BSx, and the procedure was not deemed to be medically indicated at the time of endocrine consult for the others. None of the patients were denied surgery due to their cardiac history. In the operative group, five patients had a diagnosis of congestive HF/left ventricular systolic dysfunction, one had dilated cardiomyopathy, one had HF secondary to diastolic dysfunction, two had right-sided HF, and four were identified based on imaging tests; in the non-operative group, one had dilated cardiomyopathy and five were identified based on results of imaging studies. Baseline and follow-up demographic, clinical, and anthropometric characteristics are presented in Table 1. At baseline, systolic blood pressure was less in the BSx group [128 (110–152) vs 149 (132–173) mmHg; p=0.02], but groups were otherwise similar. At follow-up, the operative group showed improvement in the resolution of diabetes (p<0.05) and marked decreases in weight and BMI, whereas the non-operative group had an increase in both (p<0.001); percentage of weight change also markedly favored the operative group (p<0.001).

Both groups demonstrated increases in overall QoL at follow-up (Table 2). The pre–post comparison in the BSx group was statistically significant (p=0.001), while the pre–post difference in controls was not. Between-group analysis of changes in QoL was borderline significant [5 (−1 to 10) in the BSx group vs 0 (0–3) in controls, p=0.06].

Median Specific Activity Scales were similar at baseline between operative and non-operative patients [3 (1–4) vs 3 (1–4), p=0.99]. No statistical differences were seen at follow-up. Five of 13 patients in BSx group improved their class compared to only one of six in the non-operative group. None of the subjects in the BSx group had worsening of their functional capacity, while one worsened in the non-operative group.

In regard to symptoms (Table 2), using a five-point Likert scale, BSx patients had worse baseline exertional dyspnea [4 (1–5) vs 3 (1–3), p=0.02] and leg edema [4 (1–5) vs 3 (1–4), p=0.02] compared to controls. At follow-up, BSx patients

Table 1 Clinical and demographic information at baseline and follow-up

	BSx group (n=13)		Non-operative group (n=6)	
	Baseline	Follow-up	Baseline	Follow-up
Age, years	62 (49–66)	–	69 (55–78)	–
Female sex	8 (62 %)	–	1 (17 %)	–
Follow-up, years	4.3 (1.1–8.9)	–	2.7 (2.5–7.8)	–
Weight, kg	146 (98–210)	99[a] (63–164)	132 (112–147)	140[a] (125–158)
Body mass index, kg/m^2	55 (39–73)	35[a] (22–64)	42 (35–50)	47[a] (34–53)
Weight change, %	–	−42[a] (−27 to −113)	–	7[a] (−2 to 28)
Heart failure	13 (100 %)	–	6 (100 %)	–
Clinical diagnosis	8 (62 %)	–	2 (33 %)	–
Left-sided heart failure	10 (77 %)	–	6 (100 %)	–
LV diastolic heart failure	3 (23 %)	–	4 (67 %)	–
Right-sided heart failure	3 (23 %)	–	0	–
Ejection fraction, %	57 (35–75)	59[b] (41–75)	57.5 (35–65)	62.5[b] (53–65)
Coronary artery disease	4 (31 %)	4 (31 %)	3 (50 %)	4 (67 %)
Diabetes mellitus	10 (77 %)	6 (46 %)[c]	2 (33 %)	3 (50 %)[c]
Hypertension	12 (92 %)	13 (100 %)	6 (100 %)	6 (100 %)
Dyslipidemia	11 (85 %)	8 (62 %)	5 (83 %)	6 (100 %)
Depression	5 (38 %)	6 (46 %)	3 (50 %)	5 (83 %)
Current smoker	4 (30 %)	1 (8 %)	2 (33 %)	0
Number of medications	3 (0–7)	3 (1–5)	3 (2–6)	4 (3–5)
Beta-blockers	6 (46 %)	7 (54 %)	5 (83 %)	4 (67 %)
ACEi/ARB	7 (54 %)	9 (69 %)	3 (50 %)	5 (83 %)
Diuretics	4 (31 %)	2 (15 %)	4 (67 %)	2 (33 %)

Continuous variables are expressed as medians and range (in parentheses); categorical variables are expressed as counts (%). All data were rounded to the nearest integer unless specified

ACEi angiotensin-converting enzyme inhibitor, *ARB* angiotensin-receptor II blocker, *LV* left ventricular

[a]No differences at baseline; at follow-up, $p<0.001$

[b]At follow-up, no echocardiograms were available for three BSx and one non-operative patient. These patients were excluded from intra-group and inter-group analyses

[c]Inter-group analysis showed clinically important changes between baseline and follow-up ($p=0.049$)

reported marked improvements in frequency of exertional dyspnea, whereas non-operative patients had worsening of their symptoms [−2 (−4 to −1) vs 0 (0–3), $p=0.01$]. A decrease in the frequency of leg edema was also observed in the BSx group [−1 (−4 to 1) vs 0 (−2 to 3), $p=0.04$]. There were no differences in the frequency of the paroxysmal nocturnal dyspnea, orthopnea, and fatigue.

Discussion

Our study demonstrates that patients with HF undergoing BSx had marked weight loss and an impressive improvement in overall QoL compared to non-operatively managed patients. It is important to note that, at baseline, BSx patients scored a median QoL in the *poor* QoL range (median of 3), and not only did they demonstrate a clinically relevant increase of at least one point on the ten-point Likert scale, but at follow-up the median score of 7 puts them in the *positive* QoL range, as defined in the literature. BSx subjects also reported improvements in exertional dyspnea and leg edema. To our knowledge, this is the first study showing that BSx has clinically relevant and important improvements in QoL and symptoms in morbidly obese patients with established HF.

Several studies as well as our own [4] have demonstrated improved QoL in obese patients after BSx. The Swedish Obese Subjects Study is the largest study reporting improvements in QoL for up to 10 years in patients who underwent BSx [9]; however, no prior study has evaluated the impact of BSx on QoL in the subset of patients with HF.

Two small studies have evaluated the impact of BSx on functional capacity and cardiac function. In the study by Ramani and colleagues [10], the BSx group had improvements in left ventricular ejection fraction and in NYHA class after a 12-month follow-up. Another study from the same group [11] reported improvement in left ventricular ejection fraction and in NYHA class in 14 patients with severe cardiomyopathy undergoing BSx. Differently from our study, those did not assess symptoms as one of their outcomes.

Our results may be explained by different mechanisms. Obesity is associated with several hemodynamic and structural changes [12]; some of the structural changes observed in morbidly obese patients, such as increased left atrial size and cardiac mass, can be stabilized or even reversed partially after BSx [13]. Our group also reported that BSx may increase myocardial performance as measured by 2D-speckle tracking echocardiography, even in the absence of changes in left ventricular ejection fraction [14]. Therefore,

Table 2 Quality of life and symptoms at baseline and follow-up (median follow-up was 4.2 years in the BSx group and 2.4 years in the non-operative group)

	BSx group (n=13)	Non-operative group (n=6)	p-value[2]
Overall quality of life			
Baseline	3 (0–6)	4.5 (3–8)	0.06
Follow-up	7 (7–10)	6 (3–8)	
Paroxysmal nocturnal dyspnea			
Baseline	2 (1–5)	1 (1–3)	0.27
Follow-up	1 (1–2)	1 (1–2)	
Orthopnea			
Baseline	3 (1–5)	2.5 (1–5)	0.60
Follow-up	1 (1–5)	1 (1–4)	
Exertional dyspnea			
Baseline	4 (1–5)	3 (1–3)	0.01
Follow-up	2 (1–5)	3 (3–4)	
Leg edema			
Baseline	4 (1–5)	3 (1–4)	0.04
Follow-up	3 (1–5)	3.5 (1–5)	
Fatigue			
Baseline	5 (1–5)	2.5 (1–5)	0.07
Follow-up	3 (1–5)	3 (2–4)	

Overall quality of life was measured on a ten-point Likert scale; symptoms were measured on a five-point Likert scale

[a] P-values related to inter-group differences between baseline and follow-up

weight loss should decrease many of the deleterious effects of obesity on the cardiovascular system, resulting in improvements that are not necessarily reflected by ejection fraction.

The clinical implications of the current results are important. Pharmacologic interventions for patients with HF have shown improvements in survival and rates of hospitalization, but their effect on QoL and HF symptoms had been modest at best. Therefore, a much more aggressive approach to weight loss, even considering BSx, may be justified in patients with obesity of grade II or greater, provided that patients are safe operative candidates. Ramani et al. [10] suggested that BSx could be safely performed even in patients with severe systolic HF (zero in-hospital mortality) and could also reduce readmission rates compared to controls. In 38 HF patients undergoing BSx, identified by their Charlson's comorbidity index, we did not see any in-hospital deaths after the surgical procedure (unpublished data). However, larger comparative studies are needed to confirm our results and assess the safety of BSx in patients with HF and advanced degrees of obesity.

A major strength of this current study is its population-based nature, minimizing selection and referral biases which are common in studies from tertiary care centers. In addition, our control group was comprised obese patients evaluated by the same multidisciplinary team in the same Nutrition Clinic and who received optimal, non-operative treatment for obesity, making comparisons between groups closer to real practice.

The main limitation of our study is the relatively small sample size. We were unable to compare different etiologies and types of HF on our outcomes or to determine whether differences existed between type of HF, QoL, and amount of weight lost. Although no differences were seen in the number of HF medications at baseline and follow-up, changes in doses (possibly reflecting a more optimized regimen) could not be evaluated. We acknowledge that our outcomes were retrospective, self-reported, and thus subject to bias. Furthermore, the inherent risk of nonresponder bias in surveys cannot be avoided, although we attempted to minimize this possibly by multiple mailings and phone contacts. Lastly, those with severe HF may not have been considered for BSx.

In conclusion, our results provide encouraging data showing that BSx leads to long-lasting improvements in QoL and symptoms in morbidly obese patients with established HF. However, due to our small sample, larger studies in morbid obese patients with HF are needed to confirm and expand these observations.

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Conflict of interest The authors have no conflict of interest.

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