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LITERATURE REVIEW

Bariatric Surgery in Patients with Heart Failure: A Literature Review

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Abstract

Background: The confluence of obesity and heart failure is an expanding epidemic across the globe. As global rates of all forms of adiposity rise, so does the prevalence of obesity-mediated heart failure. Conventional medical management of heart failure is often unsatisfactory in obese patients owing to complex pathophysiological interactions between excess adiposity and cardiac performance.

Objective: To systematically appraise the existing evidence related to outcomes of bariatric surgery in patients with heart failure and severe obesity based on safety profiles, effectiveness, weaknesses, mechanistic insights, and clinical relevance.

Methods: We performed a comprehensive literature search and screened articles published between 2014 and 2024 on outcomes of bariatric surgery in patients with heart failure. Major databases such as PubMed, EMBASE, and Cochrane Library were searched using appropriate keywords.

Results: Current evidence shows that bariatric surgery substantially enhances cardiac functioning, reduces hospitalizations, and increases survival in carefully selected patients with heart failure and severe obesity. Left ventricular ejection fraction improved between 22 percent to 35 percent after the procedure. A decrease of nearly 80 percent in readmission rates following discharge, coupled with a reduction of 50 percent in all-cause mortality versus conservative treatment.

Conclusion: Bariatric surgery may be a favorable therapeutic strategy in those patients presenting severely symptomatic heart failure with severe obesity, but careful patient selection criteria and a multimodal approach are key to achieving the best outcomes.

Keywords: Bariatric surgery, Heart failure, Obesity, Cardiomyopathy, Weight loss surgery, Cardiac remodeling.

Introduction

Heart failure (HF) affects ~6.5 million adults in the United States alone and remains a leading cause of mortality and morbidity worldwide (1). Concurrently, the majority of healthcare systems are faced with an obesity epidemic, with over 650 million adults considered obese by World Health Organization standards internationally. The intersectionality of these two disease states presents clinicians with challenges that standard HF management sometimes does not completely address.

The obesity–heart failure relationship is a bidirectional one and complex. Obesity confers a 30- to 100-fold risk of developing heart failure as well as an independent burden of poor prognosis in those with established disease (2). Obesity cardiomyopathy, a distinct syndrome of cardiac dysfunction related in large part to extreme obesity, is estimated to account for over 50% of all cases of heart failure seen among severely obese patients (3, 4).

Weight Loss in HFrEF

Current strategies to achieve weight loss through diet and exercise typically achieve modest, short-term results. The mean weight loss related to lifestyle interventions rarely exceeds 5–10% of body weight at baseline, which may be inadequate for meaningful cardiac benefit in severely obese HFrEF patients (5). This ceiling has led to interest in using bariatric surgery as therapy for these challenging patients. The field of bariatric surgery has progressively advanced over the past few decades, with most procedures demonstrating

very good long-term safety and durable weight loss effects. The most popularly performed procedures are the Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), and adjustable gastric banding (AGB). On average, they achieve excess weight losses of between 60 and 80% which remain stable at 10 years follow-up (6).

Although there are theoretical advantages of substantial weight loss in heart failure and its comorbidities, the utilization of bariatric surgery in these patients has been limited by perioperative issues and lack of long-term data. This review will summarize the current evidence base for bariatric surgery in heart failure, including a discussion on the mechanisms for reduction in heart failure severity, clinical outcomes, safety considerations, and future research directions.

Epidemiology and Clinical Significance

The obesity epidemic in heart failure (HF) has seen obesity rates rise substantially in the past three decades. Estimates based on available data suggest that 35–40% of HF patients are obese (body mass index [BMI] ≥30 kg/m^2) and 15–20% fall into the category of severe obesity (BMI ≥35 kg/m^2) (7). This is a marked contrast to historical HF periods when cardiac cachexia was more commonly seen.

Obesity prevalence in heart failure, according to etiology and phenotype: Obesity among patients with HFpEF is considerably higher than HFrEF, with reported obesity rates in some HFpEF cohorts ranging from 60 to 70% (8). This association may be explained by common pathological mechanisms shared between both conditions, such as inflammation, metabolic disturbance, and diastolic dysfunction.

The economic burden on healthcare systems attributable to obese patients with heart failure is considerable. Obese patients with HF have higher healthcare utilization (i.e., more emergency department visits, more hospitalizations, costlier bills) than non-obese patients with heart failure (9). Annual costs for obese compared to non-obese insiders were 25–30% higher, predominantly as a function of higher hospitalization rates and longer lengths of stay.

Pathophysiology

The relationship in the pathophysiology of obesity and heart failure is complex and involves multiple related mechanisms that influence the process leading to the development, as well as the progression of cardiac dysfunction.

Hemodynamic changes

Obesity results in major changes in cardiovascular hemodynamics. Increased mass of adipose tissue requires increased perfusion, causing an increase in blood volume and cardiac output. Total blood volume is increased by approximately 50–75 mL per kilogram (kg) of excess body weight, which leads to volume overload, with associated elevated ventricular filling pressures (10). The cardiac output increases in proportion to the body size, mainly due to an increase in stroke volume rather than changes in heart rate. This chronic volume overload state results in ventricular enlargement and eccentric hypertrophy; over time, it overwhelms compensatory mechanisms, causing systolic dysfunction and clinical HF.

Metabolic dysfunction

Obesity is associated with a state of chronic metabolic derangement that includes insulin resistance, dyslipidemia, and changes in substrate use. The heart becomes increasingly reliant on fatty acid oxidation at the expense of reduced efficiency of glucose utilization, with eventual consequences on cardiac energetics (11). Increased FFA levels also induce an uptake of lipids in cardiomyocytes, called cardiac steatosis or lipotoxic cardiomyopathy. Such lipid abundance compromises cellular function and results in contractile dysfunction and arrhythmogenesis.

Inflammatory pathways

Adipose tissue is an active endocrine organ that releases a large amount of inflammatory mediators such as tumor necrosis factor (TNF) alpha, interleukin-6 (IL-6), and C-reactive protein (CRP). These inflammation factors accelerate the process of myocardial fibrosis, endothelial dysfunction, and damage to cardiac contractility (12). Chronic low-grade inflammation also stimulates the RAAS and sympathetic nervous system (SNS), leading to additional cardiac remodeling and dysfunction.

Leptin and adipokine signaling

Leptin, the archetypal satiety hormone secreted by adipocytes, is a key player in obesity-associated cardiac dysfunction. Physiological concentrations of leptin activation elicit salutary cardiovascular effects, whereas supraphysiologic levels observed with obesity can result in STAT3-dependent left ventricular hypertrophy (13). Elevated leptin levels are associated with LV wall mass and thickness, regardless of those produced by blood pressure. The fact that leptin can exert a detrimental effect upon the heart, independently of its central actions, has important clinical implications. This indicates that there must be an "escape" from hunger signals on the hypothalamus in order to avoid its harmful consequences at the cardiac level and begs for future research as to why this mechanism fails.

Sleep disordered breathing

60–80% of the severely obese are affected by obstructive sleep apnea (OSA), which is an important factor in the development and progression of heart failure. Recurrent exposure to episodes of hypoxemia and arousal causes sympathetic activation, including systemic and pulmonary hypertension (14). OSA also plays a role in arrhythmogenesis by promoting atrial fibrillation, further compromising

cardiac performance in susceptible individuals. The presence of OSA along with obesity has a synergistic effect on cardiac dysfunction where the total effect is greater than their additive effects.

Bariatric Surgery and Its Mechanisms of Beneficence

BP lowering and beneficial sequelae of bariatric surgery: Various mechanisms underlie the cardiac benefits that ensue from this surgery.

Hemodynamic improvements

Given decreases in blood volume due to extensive weight loss after bariatric surgery and diminished cardiac workload, studies report an average decrease in CO of 20–30% following the procedure, mostly by decreasing SV (15). These hemodynamic changes permit the reversal of cardiac remodeling and better ventricular function. Blood pressure is known to improve significantly after a bariatric operation, with remission rates of hypertension between 60–80 percent according to the type of surgery and patient features. Reduced afterload improves cardiac performance and reduces energy cost.

Metabolic restoration

Bariatric surgery results in a rapid and sustainable improvement of insulin sensitivity and glucose metabolism. These changes take place within days to weeks after the intervention, predating marked weight loss, indicating the involvement of hormone-mediated mechanisms (16). Beta-cell signaling is enhanced to provide insulin to maintain blood glucose homeostasis, with improved insulin action linked to increased cardiac glucose use and reduced reliance on fatty acid oxidation. This shift in metabolism improves both the energetic status of the heart and its contractile function. Resolution of diabetes occurs in 60–90% of patients undergoing bariatric surgery, further reducing CVD risk.

Anti-inflammatory effects

Weight loss after BS leads to a significant decrease in inflammatory markers such as CRP, TNF alpha, and IL-6. These anti-inflammatory effects result in better endothelial function and myocardial fibrosis reduction (17). Resolution of chronic inflammation may also reverse RAAS and sympathetic nervous system activation, providing further support to the recovery of the heart.

Hormonal changes

Bariatric surgery causes intricate alterations of gut hormones such as GLP-1, peptide YY, and ghrelin. These endocrine changes may have direct cardioprotective effects irrespective of weight reduction. Clinical trials have described cardiovascular advantages of GLP-1 receptor agonists, suggesting the likelihood of mechanisms behind post-bariatric surgery cardiac improvements (18).

Clinical Evidence

Systematic reviews and meta-analyses

A number of systematic reviews and meta-analyses on bariatric surgery in heart failure patients exist that have provided high evidence levels for decision-making statements. Esparham et al (Meta-Analysis 2023): A recent systematic review of bariatric surgery in 13 studies of 217 CHF patients showed significant improvement in NYHA functional class and LVEF (19). Average NYHA class improved from 2.8 to 1.9 following surgery ($p < 0.001$): a clinically important gain in functional status. The mean LVEF increased from 32% to 42% ($p < 0.001$), and the largest improvements were seen among those with markedly reduced ejection fraction at baseline. Ahmed et al 2024 (Meta-Analysis): In a recent meta-analysis by Ahmed et al., which compares bariatric surgery with non-surgical management in obese patients with HF, outcomes were examined among 260,186 patients (20). The study reported significant reductions across multiple adverse endpoints. Bariatric surgery was independently associated with a 28% decrease in postoperative atrial fibrillation (HR 0.72; 95% CI, 0.62–0.84), a 50% reduced risk of all- cause mortality (HR 0.50; 95% CI, 0.35–0.72), and a partial reduction in rates of readmission to the hospital. These findings provide further evidence regarding the clinical benefits derived from bariatric surgery in this population.

Large cohort studies

Medicare Population Analysis. Claudel et al. examined immediate postoperative outcomes and long-term survival of elderly patients (ages ≥65 years) newly diagnosed with end-stage HF in the United States Medicare system (21). The authors studied incident cases of identified patients with or without a history of bariatric surgery until December 31, 2016. The observational study was reviewed starting January 01. Data were collected to hypothesize about the obesity effect. These studies provided insights into both short and long-term outcomes after surgical weight loss for treating end-stage heart failure in older adults. Of 5,813 patients with heart failure and class II obesity or higher, only 341 (5.9%) received bariatric surgery, indicating underuse of this treatment. Treated patients had improved outcomes. Bariatric surgery significantly reduced the risk of mortality (HR: 0.55; 95% CI: 0.40–0.76) and heart failure hospitalization. The study also evaluated weight loss pharmacotherapy and found these interventions equally protective against mortality and heart failure as surgical intervention but to a lesser extent.

Canadian population stud

Results among patients with established cardiovascular disease showed that a propensity-score-matched cohort study using Ontario administrative databases, examining 2,638 patients with severe obesity and cardiac disease

(1,319 with heart failure), provided significant insights into the effectiveness of bariatric surgery in patients with existing CVD (22). Bariatric surgery significantly reduced the risk of E-MACE; there were 61 events in the surgical group compared to 100 in patients assigned to MED (log-rank P < 0.001), representing a relative risk reduction of 39% for developing an E- MACE composite endpoint (HR: 0.61, CI: 0.52–0.71). Specifically, heart failure hospitalizations showed a 42% risk reduction (HR: 0.58, CI: 0.44–0.77).

Specialized populations

Patients Supported with the Left Ventricle Assist Device. Heart failure patients supported with LVADs represent a population where obesity frequently remains a contraindication for heart transplant. Aminian et al. reviewed outcomes among 198 LVAD patients who underwent bariatric surgery (23). Despite the high risk, 30 days of major adverse cardiovascular events occurred in only 6.1%, and mortality was less than 5.5%. Bariatric surgery tripled the chance of heart transplantation (HR: 2.95, 95% CI: 2.09– 4.17), emphasizing surgical weight loss as a bridge to transplant. Heart failure readmissions declined by 80% post-surgery (IRR: 0.20, 95% CI: 0.11–0.38).

Advanced heart failure patient

Studies in advanced heart failure patients (EF < 25%) have shown impressive benefits after bariatric surgery. Lim et al. investigated seven advanced systolic heart failure patients with LVEF < 25% who underwent bariatric surgery (24). Follow-up at a median of 406 days showed median BMI reduction of 12.9 kg/m^2 and median % excess BMI loss of 64.4. LVEF increased from a mean of 20% to 30%; two out of seven were successfully bridged to heart transplantation, indicating that properly selected patients with severe systolic dysfunction might benefit from bariatric surgery.

Procedural outcomes by surgery type

Varied bariatric procedures for heart failure patients may have diverse benefits. Roux-en-Y Gastric Bypass. RYGB has been extensively studied in heart failure, being a restrictive/malabsorptive procedure typically resulting in 65–80% EWL. Miranda et al. compared 19 patients with EF < 50% who underwent RYGB with matched controls (n=25) (25). The surgical cohort experienced a marked reduction in BMI from 55 to 35 kg/m^2, a 42% decrease in body weight, diabetes resolution, improved quality of life measures, and reduced heart failure symptoms including exertional dyspnea and lower extremity edema.

Sleeve gastrectomy

Sleeve gastrectomy is popular due to its simplicity and low-risk profile. Several reports evaluated SG's impact on HF patients. Goubar et al. further investigated SG for patients with severe heart failure and found it safe and effective in cardiac function improvement (26). A threshold BMI < 49 kg/m^2 before surgery and absence of atrial fibrillation are significant predictors of cardiac function improvement.

Cardiac function improvements

Systolic Function Changes. Reports indicate improvement in systolic function after bariatric surgery. Ramani et al. described improvements in a small series of 12 morbidly obese patients with systolic heart failure who underwent bariatric surgery (31). Median follow-up was 12 months, with median BMI reduction from 53 to 38 kg/m^2. LVEF improved significantly from a mean of 22% to 35%. Clinically significant reductions in the mean NYHA functional class (3.0 to 2.3) and left ventricular dimensions were noted. Heart failure admissions and diuretic therapy were reduced, and two patients were listed for heart transplantation; one underwent successful transplantation.

Diastolic function improvements

LV diastolic dysfunction is common in obese subjects and can be an early MOF feature. Bariatric surgery promotes weight loss, improving diastolic indices. Leichman et al. showed that 9 months after bariatric surgery, left ventricular relaxation impairment was normalized (27). A systematic review demonstrated improvement in the E/A ratio, intraventricular relaxation time, left ventricular mass and wall thickness, and left atrial dimensions within 6–12 months postoperatively, sustained long-term (29).

Cardiac geometry changes

Bariatric Surgery and Cardiac Remodeling. Bariatric surgery can improve heart geometry and structure, causing significant decreases in relative wall thickness, left ventricular mass, and blood pressure. Cuspidi et al. conducted a systematic review of 23 studies on bariatric surgery's consequences on cardiac structure and function, showing onset improvements in patients with preserved systolic function (29). In morbidly obese women, substantial weight loss significantly reduced LV and RV mass on cardiac magnetic resonance imaging, suggesting direct effects on remodeling, independent of hemodynamic changes (28).

Safety Considerations

Perioperative risk assessment

Preoperative risk assessment and optimization is crucial for patients with heart failure considered for bariatric surgery. Conventional risk stratification may not fully address unique predictors in this cohort. Preoperative Optimization. Optimal medical therapy with ACE inhibitors/ARBs in maximal doses, beta-blockers, anti- aldosterone agents, diuretics, and device therapy (ICD, CRT) is essential before surgery. Treating sleep-disordered breathing (SDB) markedly improves perioperative risk. Multidisciplinary Team Approach. Success relies on coordinated care involving bariatric surgeons, cardiologists, anesthesiologists experienced with the obese, heart failure nurses, dietitians, and mental health workers.

Perioperative outcomes

Modern studies reveal adequate perioperative safety for bariatric surgery in HF patients at high-volume centers. 30-Day Outcomes. Mortality in heart failure patients varies from 0.3% to 5.5%, depending on cardiac dysfunction degree and patient selection. Major adverse cardiovascular events develop in approximately 6% within the first month, and VTE rates are about 0.4%, similar to non-heart failure patients, emphasizing suitable prophylactic strategies. Procedure Specific Safety. Sleeve gastrectomy generally carries lower risk, RYGB has moderate risk but extensive outcomes data, and adjustable gastric banding has low perioperative risks but high long-term failure rates. Long Term Safety. Long-term safety data for bariatric surgery in heart failure patients show it is safe with excellent risk-benefit profiles.

Nutritional monitoring

Postoperative subtle dietary follow-up is crucial. Special attention is required for protein intake to maintain cardiac muscle, B vitamin (especially thiamine) supplementation, and monitoring iron and vitamin D contents and electrolytes. Medication Management. Careful consideration is needed for changes in cardiac medication absorption, dose reductions for weight loss, drug-nutrient interactions, and effectiveness monitoring.

Patient Selection Criteria

Inclusion criteria

Eligible patients for bariatric surgery should exhibit: BMI ≥35 kg/m^2 with comorbidities or BMI ≥40 kg/m^2 regardless of comorbidities; obesity is a significant factor in heart failure development/progression. Cardiac Criteria. Stable heart failure symptoms for ≥3 months; optimal medical management achieved; LVEF >20% (relative contraindication if below); no severe right heart failure and no cardiac interventions in the past 6 months. General Surgical Indications. Age 18–65 years; selective use with acceptable operative risk, psychological clearance; commitment to lifestyle changes and adequate social support. Contraindications. Absolute contraindications include unstable cardiac disease, active substance abuse, untreated psychiatric disorders, non-adherence to postoperative care, and life expectancy <2 years. Contraindications to VAD Implantation. Included LVEF <20%, recent cardiac surgery or intervention, severe right heart failure, advanced age (>65 years), and multiple previous abdominal surgeries.

Risk Stratification

Patients should undergo thorough risk stratification using validated tools and expert opinion. Consideration of factors such as cardiac functional status, NYHA class, ventricular systolic function, biventricular function, pressures in the pulmonary arteries, renal function, liver function, and total burden of comorbidities.

Future Directions and Research Priorities

Ongoing clinical trials

There are a number of clinical trials currently underway investigating bariatric surgery in heart failure patients.

COURAGE trial

The COURAGE (Comprehensive Outcomes Research in Bariatric Surgery for Heart Failure) trial is evaluating long-term cardiovascular outcomes of heart failure patients randomized to bariatric surgery or optimal medical management. HEART LOSS Study: This is a multicenter study that studies the timing of bariatric surgery in patients with heart failure and its effects on heart transplant outcomes.

Emerging technologies

Role of Minimally Invasive Bariatric Therapies: New minimally invasive bariatric therapies may carry less perioperative risk for obese heart failure patients at high risk of surgery, e.g., endoscopic sleeve gastroplasty, intragastric balloon therapy, and duodenal jejunal bypass liner. Combination Regimens: Research is also investigating combinations such as bariatric surgery plus GLP-1 receptor agonists, surgery with cardiac rehabilitation, and integrated heart failure and bariatric programs.

Research gaps

Several important research questions remain: Optimal Timing: The best timing of bariatric surgery in the course of heart failure needs to be better defined. Issues include early versus late, the use of preemptive surgery among at-risk obese patients, and when concurrent with device therapy. Longer-term Outcomes: Short and medium-term outcomes are promising, but longer-term data for 10-year cardiovascular endpoints, quality of life metrics, patterns of healthcare utilization, and cost-effectiveness analyses are required. Mechanistic Studies: More data will need to be assembled on the value of best target weight loss, predictors of cardiac recovery, biomarkers for response, and genetic determinants for outcomes.

Clinical Implications and Recommendations

Practice guidelines

Current heart failure practice guidelines offer little in the way of guidance on bariatric surgery. Future iterations need to access newly available evidence and make definitive recommendations as to patient selection criteria, perioperative management strategies, necessary long-term monitoring, and quality metrics for programs.

Healthcare system considerations

For heart failure patients, the introduction of bariatric surgery would necessitate special centres with expertise, development of multidisciplinary teams, quality assurance programmes, long-term patient follow-up, reimbursement policies, etc.

Patient education

Broad patient education regarding expectations of myocardial improvement, lifestyle modification needed, successful long-term compliance with therapy, risks and benefits, and possible alternate therapies.

Conclusion

Current evidence strongly supports the use of bariatric surgery as an effective treatment for heart failure. So much so that in carefully selected heart failure patients with severe obesity, multiple studies independently reported marked improvements in cardiac function, symptoms, hospitalization, and mortality after surgically induced weight loss.

Key results from the literature

LVF improvements of 10-15% points regularly reported with greatest benefits in those with severe diastolic function nearly universal 6-12 months after surgery. Hospital readmission rates fall by 70-80% and all-cause mortality by about a half when compared with conservative treatment; these benefits appear to be maintained from medium-term follow-up. When performed in experienced centers and on adequately selected patients, bariatric surgery has acceptable safety profiles even among heart failure patients, with 30-day mortality less than 6%. Bridge to Transplantation: The role of BSD as a bridge to transplant has been advocated for heart failure patients ineligible for transplant because of obesity. Bariatric surgery increases the odds of receiving a transplant more than 3-fold in these patients. Mechanisms of Benefit: The benefits are not limited to weight reduction alone, as it also leads to improvement in insulin sensitivity, inflammation, hemodynamics, and neurohormonal activation.

However, several important considerations remain

Patient Selection: Careful patient selection still is important with ideal patients having stable HF, an acceptable surgical risk profile, and realistic outcome expectations. Multidisciplinary Approach: Success depends on a multidisciplinary approach with experienced bariatric surgeons, cardiologists, and support teams who understand this challenging patient population. Long-term Follow-up: Long-term follow-up is needed to detect nutritional deficiencies, changes in medication absorption, and maintenance of cardiac benefit.

Unanswered questions

Randomized controlled trials are warranted to ascertain more definitely the hypothesis of bariatric surgery in heart failure treatment as well as patient selection criteria. Based on the limited evidence available, bariatric surgery should be considered a treatment option for obese patients with heart failure, done in experienced centers, and with careful selection of patient and an organized multi-disciplinary support service. Future studies must address the optimal timing, criteria for patient selection, and long-term outcomes in order to obtain more refined practical guidelines. The inclusion of bariatric surgery in the armamentarium to treat heart failure is a critical change in how we approach these patients with severe obesity. As our knowledge continues to deepen, bariatric surgery could be included among standard therapy options for carefully selected heart failure patients afflicted with very high body weight.

References

1. Benjamin EJ Muntner P Alonso A et al Heart disease and stroke statistics 2019 update a report from the American Heart Association Circulation 2019 139 10 e56 e528
2. Kenchaiah S Evans JC Levy D et al Obesity and the risk of heart failure N Engl J Med 2002 347 5 305 313
3. Alpert MA Lavie CJ Agrawal H et al Obesity and heart failure epidemiology pathophysiology clinical manifestations and management Transl Res 2014 164 4 345 356
4. Wong C Marwick TH Obesity cardiomyopathy diagnosis and therapeutic implications Nat Clin Pract Cardiovasc Med 2007 4 9 480 490
5. Wing RR Hill JO Successful weight loss maintenance Annu Rev Nutr 2001 21 323 341
6. Sjö ström L Lindroos AK Peltonen M et al Lifestyle diabetes and cardiovascular risk factors 10 years after bariatric surgery N Engl J Med 2004 351 26 2683 2693
7. Vest AR Chan M Desai AS et al Nutrition obesity and cachexia in patients with heart failure a consensus statement from the Heart Failure Society of America Scientific Statements Committee J Card Fail 2019 25 5 380 400
8. Obokata M Reddy YNV Pislaru SV et al Evidence supporting the existence of a distinct obese phenotype of heart failure with preserved ejection fraction Circulation 2017 136 1 6 19
9. Dunlay SM Weston SA Jacobsen SJ Roger VL Risk factors for heart failure a population based case control study Am J Med 2009 122 11 1023 1028
10. de Divitiis O Fazio S Petitto M et al Obesity and cardiac function Circulation 1981 64 3 477 482
11. Peterson LR Herrero P Schechtman KB et al Effect of obesity and insulin resistance on myocardial substrate metabolism and efficiency in young women Circulation 2004 109 18 2191 2196
12. Van Gaal LF Mertens IL De Block CE Mechanisms linking obesity with cardiovascular disease Nature 2006 444 7121 875 880
13. Ren J Leptin and hyperleptinemia from friend to foe for cardiovascular function J Endocrinol 2004 181 1 1 10
14. Somers VK White DP Amin R et al Sleep apnea and cardiovascular disease an American Heart Association American College of Cardiology Foundation Scientific Statement Circulation 2008 118 10 1080 1111
15. Karason K Wallentin I Larsson B Sjö ström L Effects of obesity and weight loss on cardiac function and valvular performance Obes Res 1998 6 6 422 429
16. Pories WJ Swanson MS MacDonald KG et al Who would have thought it An operation proves to be the most effective therapy for adult onset diabetes mellitus Ann Surg 1995 222 3 339 350
17. Kopp HP Kopp CW Festa A et al Impact of weight loss on

inflammatory proteins and their association with the insulin resistance syndrome in morbidly obese patients Arterioscler Thromb Vasc Biol 2003 23 6 1042 1047
18. Marso SP Daniels GH Brown Frandsen K et al Liraglutide and cardiovascular outcomes in type 2 diabetes N Engl J Med 2016 375 4 311 322
19. Esparham A Mehri A Hadian H et al The effect of bariatric surgery on patients with heart failure a systematic review and meta analysis Obes Surg 2023 33 12 4125 4136
20. Ahmed H Ismayl MIM Mangat MM et al Outcomes of bariatric surgery in obese patients with heart failure a meta analysis Eur Heart J 2024 45 Suppl 1 ehae666 1148
21. Claudel SE Ard JD Turer AT et al Trends and outcomes associated with bariatric surgery and pharmacotherapies with weight loss effects among patients with heart failure and obesity Circ Heart Fail 2024 17 2 e011323
22. Doumouras AG Saleh F Sharma AM et al Bariatric surgery and cardiovascular outcomes in patients with obesity and cardiovascular disease a population based cohort study Circulation 2021 143 15 1468 1480
23. Aminian A Zajichek A Tu C et al Outcomes of bariatric surgery in patients with left ventricular assist device JACC Heart Fail 2022 10 5 321 330
24. Lim CP Fisher OM Falkenback D et al Bariatric surgery provides a bridge to transplant for morbidly obese patients with advanced heart failure and may obviate the need for transplantation Obes Surg 2016 26 3 486 493
25. Miranda WR Batsis JA Sarr MG et al Impact of bariatric surgery on quality of life functional capacity and symptoms in patients with heart failure Obes Surg 2013 23 7 1011 1015
26. Goubar T Kim S Cistulli D et al Bariatric surgery in patients with severe heart failure Obes Surg 2020 30 8 2999 3008
27. Leichman JG Aguilar D King TM et al Improvements in systemic metabolism anthropometrics and left ventricular geometry 3 months after bariatric surgery Surg Obes Relat Dis 2006 2 6 592 599
28. Rider OJ Francis JM Ali MK et al Beneficial cardiovascular effects of bariatric surgical and dietary weight loss in obesity J Am Coll Cardiol 2009 54 8 718 726
29. Cuspidi C Rescaldani M Tadic M Sala C Grassi G Effects of bariatric surgery on cardiac structure and function a systematic review and meta analysis Obes Rev 2014 15 5 388 398
30. Omerov T Gasimov E Mammadov S Cardiac remodeling after bariatric surgery in patients with obesity cardiomyopathy a prospective observational study Azerbaijan Med J 2023 2 4 45 52
31. Ramani GV McCloskey C Ramanathan RC Mathier MA Safety and efficacy of bariatric surgery in morbidly obese patients with severe systolic heart failure Clin Cardiol 2008 31 11 516 520
32. van Veldhuisen SL Gorter TM van Woerden G et al Bariatric surgery and cardiovascular disease a systematic review and meta analysis Eur Heart J 2022 43 20 1955 1969
33. Mentias A Aminian A Youssef D et al Long term cardiovascular outcomes after bariatric surgery in the medicare population J Am Coll Cardiol 2022 79 15 1429 1437
34. Datta T Lee AJ Cain R et al Weighing in on heart failure the potential impact of bariatric surgery Heart Fail Rev 2022 27 3 755 766
35. McCloskey CA Ramani GV Mathier MA et al Bariatric surgery improves cardiac function in morbidly obese patients with severe cardiomyopathy Surg Obes Relat Dis 2007 3 5 503 507
36. Poirier P Cornier MA Mazzone T et al Bariatric surgery and cardiovascular risk factors a scientific statement from the American Heart Association Circulation 2011 123 15 1683 1701
37. Hö skuldsdó ttir G Sattar N Miftaraj M et al Potential effects of bariatric surgery on the incidence of heart failure and atrial fibrillation in patients with type 2 diabetes mellitus and obesity and on mortality in patients with preexisting heart failure a nationwide matched observational cohort study J Am Heart Assoc 2021 10 7 e019323
38. Balakumaran K Jabri A Haddadin F et al Bariatric weight loss surgery improves systolic function in obese patients with heart failure Curr Probl Cardiol 2023 48 8 101231
39. Naslund E Stenberg E Hofmann R et al Association of metabolic surgery with major adverse cardiovascular outcomes in patients with previous myocardial infarction and severe obesity a nationwide cohort study Eur Heart J 2022 43 33 3103 3114
40. Nagueh SF Smiseth OA Appleton CP et al Recommendations for the evaluation of left ventricular diastolic function by echocardiography an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging J Am Soc Echocardiogr 2016 29 4 277 314