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Cardiovascular benefits of bariatric surgery



Glenn K. Lee, MD^a, and Yong-Mei Cha, MD^{b,*}

^aDepartment of Medicine, National University Health System, Singapore

^bDivision of Cardiovascular Diseases, Mayo Clinic, Rochester, MN

ABSTRACT

The prevalence of obesity is increasing in the United States and worldwide, bringing with it an excess of morbidity and premature death. Obesity is strongly associated with both traditional cardiovascular risk factors as well as direct effects on hemodynamics and cardiovascular structure and function. In fact, cardiovascular disease is one of the major causes of morbidity and mortality in obese patients. Often, lifestyle and pharmacological weight-loss interventions are of limited efficacy in severely obese patients. Bariatric surgery has been shown to be a feasible option to achieve substantial and sustained weight loss in this group of patients. It is a safe procedure with low in-hospital and 30-day mortality rates even in groups that are considered higher risk for surgery (e.g., the elderly), especially if performed in high-volume centers. There is observational evidence that bariatric surgery in severely obese patients is associated with both a reduction of traditional cardiovascular risk factors as well as improvement in cardiac structure and function. Marked decreases in the levels of inflammatory and prothrombotic markers, as well as markers of subclinical atherosclerosis and endothelial dysfunction, are seen after bariatric surgery. This article summarizes the existing evidence regarding the cardiovascular benefits in patients following bariatric surgery.

Key words: Bariatric surgery, Obesity, Cardiovascular risk factors, Arrhythmia, Cardiac structure and function.

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Introduction

Obesity refers to the accumulation of excess body fat such that it has an adverse effect on health. While generally described as a disease of the developed world, it is now the sixth most important risk factor contributing to the overall burden of disease worldwide [1]. It is one of the main preventable causes of morbidity and premature death, relating to over 400,000 deaths per year [2]. The main adverse consequences of obesity include cardiovascular morbidity and mortality such as hypertension, coronary artery disease, sleep disordered breathing, dyslipidemia, type 2 diabetes and several cancers, precisely the conditions that affect a large proportion of the North American population [3]. Worryingly, the prevalence of obesity in the United States has further increased by one-third over the last decade, and is becoming

a burgeoning epidemic world-wide [4]. Data from the Centers for Disease Control and Prevention (CDC) Behavior Risk Factor Surveillance System (BRFSS) showed an increase in the prevalence of obesity nationwide between 1985 and 2000.

It has been shown that changes in lifestyle that relate to weight loss are associated with the prevention of or improvements in insulin resistance, diabetes, hypertension, and dyslipidemia [5]. However, some epidemiologic studies have paradoxically shown that weight loss is associated with an increased incidence of cardiovascular events [6], even in subjects who were overweight or obese at baseline [7]. There is conflicting evidence whether self-reported intentional weight loss is associated with decreased cardiovascular events [8]. It appears that lifestyle interventions in combination with pharmacological weight loss therapy have either had no effect on primary cardiovascular end points or has shown an

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*Corresponding author. Tel.: +1 507 255 2502; fax: +1 507 255 2550.

E-mail address: ycha@mayo.edu (Y.-M. Cha).

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Table 1 – Beneficial cardiovascular effects of bariatric surgery.

Comorbidity	Effect of bariatric surgery
Hypertension	Lowering of systolic and diastolic blood pressure Resolution of hypertension
Type 2 diabetes mellitus	Reduction in blood glucose and HbA1c levels Reduction in insulin resistance Prevention of progression of impaired glucose tolerance to type 2 diabetes mellitus Resolution of type 2 diabetes mellitus Reduction in mortality because of type 2 diabetes mellitus
Dyslipidemia	Lowering of serum low density cholesterol and triglyceride levels Increase of serum high-density lipoprotein cholesterol levels Resolution of dyslipidemia
Hyperuricemia	Resolution of hyperuricemia
Metabolic syndrome	Resolution of metabolic syndrome
Left ventricular hypertrophy	Reduction in left ventricular mass index
Obstructive sleep apnea	Resolution of obstructive sleep apnea
Coronary heart disease	Reduction in mortality because of coronary heart disease

Adapted from Athyros et al. [38].

increase in cardiovascular events [9]. Taken together, non-surgical weight loss trials in obese patients did not show any benefit in terms of cardiovascular event rates [9]. Conversely, there is evidence that weight loss with bariatric surgery is associated with a reduction in cardiovascular events [10], diabetes [5], cancer [11], and overall mortality (Table 1) [12]. However, much of this evidence has not been assessed with sufficiently robust methods, and in many cases, lack the rigor of randomized controlled trials comparing bariatric surgery with non-surgical interventions [13]. This review summarizes the existing evidence regarding the cardiovascular benefits in patients following bariatric surgery.

Pathophysiology of the cardiac effects of obesity

Obesity is strongly associated with both traditional cardiovascular risk factors as well as direct effects on hemodynamics and cardiovascular structure and function (Figs. 1 and 2) [14]. The pathophysiologic association of obesity with insulin resistance and cardiovascular disease is mediated by hyperleptinemia and inflammation. Leptin is an adipocyte-derived hormone and cytokine that regulates energy balance through a wide range of functions, including several that are important to cardiovascular health. Hyperleptinemia is a marker of leptin resistance, and is common in obese subjects. Increased levels of CRP are also seen in obese subjects, and may play a role in the development of leptin resistance. Indeed, increased serum concentrations of CRP and leptin are independently associated with insulin resistance and cardiovascular disease [15]. Additionally, insulin resistance and diabetes are associated with intracellular lipid accumulation in the myocardium, and may contribute to cell death through both oxidative and non-oxidative mechanisms. There has been evidence to suggest that myocardial lipid levels increase with obesity and contribute to heart failure [16]. Obese patients have increased total blood volume and cardiac output resulting in greater cardiac workload. The increase in cardiac output is primarily driven

by increased stroke volume but heart rate is often mildly increased as well compared to normal subjects given the increased sympathetic activation in obese patients [17]. Increases in filling pressures and volumes shift the Frank-Starling curve left, increasing cardiac workload. With time, left ventricular structural abnormalities such as chamber dilation and left-ventricular hypertrophy ensue [17,18]. Obesity also leads to left atrial dilatation, due to increased total blood volume and left ventricular diastolic dysfunction. This increases the risk for heart failure, systolic and diastolic dysfunction [18], ventricular arrhythmias [17], and atrial fibrillation [19].

Safety and efficacy of bariatric surgery

At the moment, bariatric surgery is recommended for severely obese patients [body mass index (BMI) > 40 kg m⁻² or BMI > 35 kg m⁻² in the presence of significant comorbidities]

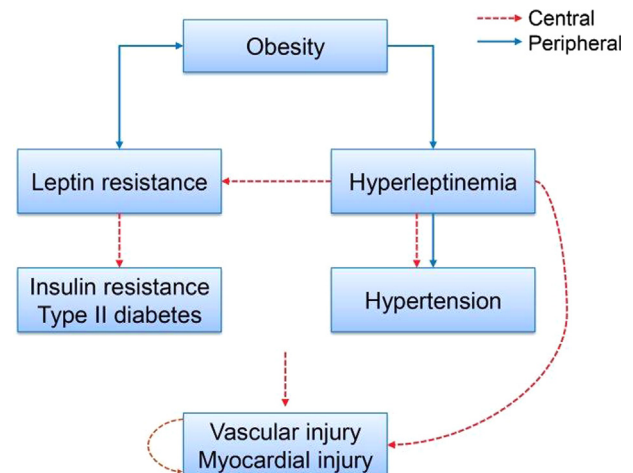


Fig. 1 – Overview of leptin resistance and hyperleptinemia in obesity-related cardiovascular disease. (Adapted from Lavie et al. [14].)

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