Bariatric Surgery for Stable Cardiovascular Risk Reduction

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I have no disclosures.
Although diet, exercise, and behavior modification are mainstay therapy for overweight and obesity, they are disappointingly unsuccessful for long-term treatment of severe obesity.

Lifestyle modifications and drug therapy have been largely unsuccessful. ¹
Between 1986 and 2000, those with a BMI 30, 40, and 50 kg/m², are reported to have doubled, quadrupled, and quintupled, respectively. That trend continues to date.

The annual cost of treating disease attributable to obesity including stroke, heart disease and certain cancers -- is $190 billion annually in the United States.

With no decline in U.S. obesity rates, that surcharge is projected to reach $580 billion by 2030.
2014 Obesity Prevalence

[Map showing obesity prevalence by state in 2014]
The loss of years of life resulting from obesity is profound. A 25-year-old severely obese man has a 22% reduction in his expected remaining lifespan.

National Health and Nutrition Examination Survey III data that white women 20 to 30 years of age with a BMI 45 kg/m2 will lose 8 years of life and their male counterparts will lose 13 years.\textsuperscript{5}

The hazard ratios for mortality in severely obese subjects (BMI > 35 kg/m2) are typically increased 2.0–2.5 fold compared to normal weight individuals.\textsuperscript{1}
Prospective, nonrandomized, observational, or case-control population studies have shown bariatric surgery to prolong survival in the severely obese.\(^4\)

Once reserved only for the most severely afflicted, these operations now boast minimal mortality and rare morbidity, gaining widespread acceptance and appeal.
Operative (30-day) mortality for bariatric surgery ranges from 0.1% to 2%.\textsuperscript{10,24,25}

Gastric bypass and sleeve gastrectomy mortality is 0.5%, and more malabsorptive operations tend to carry a higher average mortality rate of 1%.

More recent data reported a 30-day mortality rate averaging 0.15% and not exceeding 0.3% at accredited centers.\textsuperscript{26}
In the Longitudinal Assessment of Bariatric Surgery Consortium study, none of the 1198 patients who had undergone LAGB died, whereas 0.2% of the 2975 patients who had undergone laparoscopic RYGB and 2.1% of the 437 patients who had undergone open RYGB died.  

Mortality rates improve secondary to prevalence of laparoscopic approaches, better anesthesia, and better monitoring and oversight, and also accessibility to surgery for healthier patients with lower BMI who have operations performed by an experienced surgeon at an experienced center.  

26-27
Surgery is indicated for patients with BMI 40 kg/m² or a BMI 35 kg/m² in the presence of high-risk comorbid conditions. These patients should have attempted prior conventional methods of diet and exercise, should be free of uncontrolled psychiatric disorders, and should be medically sound enough that the benefits of surgery outweigh the risks.
Patient Population
Degrees of Obesity

**NORMAL**
BMI 18.5 – 24.9

**OVERWEIGHT**
BMI 25 – 29.9

**OBESE**
BMI 30 – 34.9

**SEVERE OBESE**
BMI 35 – 39.9

**MORBIDLY OBESE**
BMI ≥ 40
Bariatric surgery has now become acceptably safe to offer in increasingly older and younger severely obese patient populations.

The consensus statement was revisited and updated in 2005 by the American Society for Bariatric Surgery, expanding the indications to adolescents and possibly to individuals with lower BMI (30 to 34.9 kg/m²) with associated poorly controlled comorbid conditions.²⁵
Surgical intervention leads to significant improvements through decreasing excess weight and comorbidities that can be maintained over time.

Reductions in conventional cardiac risk factors include:

- diabetes mellitus
- dyslipidemia
- systemic hypertension
- obstructive sleep apnea
- cardiovascular dysfunction
4 Most Common Weight Loss Surgery Procedures in the United States

Adjustable Gastric Band (Lap Band)
- Stomach pouch
- Adjustable band
- Port placed under skin

Roux-en-Y Gastric Bypass (RNY)
- Bypassed portion of stomach
- Gastric pouch
- Jejunum
- Bypassed duodenum

Duodenal Switch (DS)
- Gallbladder removed
- Duodenal switch
- Partially resected stomach
- Digestive loop
- Common loop

Vertical Sleeve Gastrectomy (Gastric Sleeve)
- Gastric sleeve (new stomach)
- Removed portion of stomach
Weight loss after malabsorptive bariatric surgery reaches a nadir at 12 to 18 months with an average of 70% excess body weight loss and 35% decrease in BMI with an approximate 10% weight regain over the next decade.\textsuperscript{55, 7}

An average percent excess body weight loss of 61% was accompanied by improvements in type 2 diabetes mellitus, systemic hypertension, obstructive sleep apnea, and dyslipidemia.\textsuperscript{24}
In a large, long-term, controlled study comparing bariatric surgery and conventional therapy for obesity, established diabetes mellitus was reversed in 21% of the control group and 72% of the surgical group at 2 years of follow-up. 55

An interesting aspect of the reversal of diabetes mellitus observed after bariatric surgery is the rapidity of its remission, sometimes occurring within days after operation. 68

Rapid resolution of insulin resistance and hyperglycemia that appear before observable weight loss may be related to alterations in gut regulatory peptides. 70
Although bariatric surgery appears to be an effective means for preventing or reversing type 2 diabetes mellitus, surgery is by some not considered a practical response,

In the United States alone, over 24 million people are currently estimated to have type 2 diabetes.

There are approximately 2400 surgeon members in the ASMBS, each capable of performing several hundred bariatric operations per year. In the US currently only 220,000 operations are performed annually. ¹
If every bariatric surgeon in the US did 500 cases per year at a cost of roughly $25,000 per operation, we could do 1.2M operations annually, giving 5% of diabetics the best current curative treatment at a cost of $30B or 16% of our current domestic annual expenditure on obesity related illness.

Cardiovascular benefits of bariatric surgery and resulting savings may not be realized for at least 10 years.

Eventually there could be direct and indirect cost savings to employers and insurers through reduced: costs of care, absenteeism and disability claims.
ASMBS database shows highly significant reduction in mortality rates.
Cancer mortality reduced by 60 percent for bariatric surgery patients.
Death in association with diabetes reduced by more than 90 percent
From heart disease by more than 50 percent.
Also, improvement or resolution of other life-threatening obesity-related diseases.
Triglyceride levels are consistently reduced both immediately and after long-term follow-up. Greater impacts are seen after RYGB, with reductions of up to 50% to 60%.

Several studies have also shown a significant increase in HDL cholesterol (13% to 47%) after weight loss surgery. 24,55,76–78,80,81,83,85

Notably, these improvements persist despite weight regain. 76,77
It is well documented that “at-risk” obesity is associated with an elevated inflammatory state as a result of adipose tissue secretion of a number of proinflammatory cytokines or “adipokines.”

These include tumor necrosis factor-α, interleukin (IL)-6, and IL-18 and elevated markers of inflammation such as C-reactive protein.

A proposed mechanism of accelerated atherosclerosis in this population, these markers decrease with weight loss. ⁸⁶,⁸⁷
Measurements of carotid intima-medial thickness done at baseline and 3–4 years later showed that obese subjects undergoing bariatric surgery had a rate of IMT progression similar to a lean control group whereas patients with continued obesity had a rate of progression ~ 3 times higher.

Patients having surgery had less progression of coronary atherosclerosis over 10 years compared to a control group as assessed by serial invasive coronary angiography. bb
In obese patients, both body mass and heightened sympathetic activation contribute to the blood pressure elevation.\textsuperscript{128}

Insulin activates angiotensinogen secretion from adipose tissue, which leads to a higher plasma renin activity and exerts important cardiovascular effects through the sympathetic nervous system.

It has been shown that plasma renin activity is significantly increased in obese individuals.\textsuperscript{130,131,132}
Highly satisfactory results have been obtained after gastric bypass, with long-term resolution of systemic hypertension in nearly three quarters of the subjects with preoperative systemic hypertension who had an operation.\textsuperscript{139}

Systemic hypertension recovery throughout a 10-year follow-up period was related to the amount of weight lost, whereas the relationships with age and with initial body weight were not significant.

Indeed, only 20\% of the preoperatively hypertensive subjects still had blood pressure values above normal limits in longterm follow-up.\textsuperscript{140}
Obesity is a potent risk factor for the development and progression of obstructive sleep apnea.

After surgical weight loss, success is often measured only by subjective symptom alleviation.

End points that measure improvements in the apnea-hypopnea index and in oxygen saturation cannot be found in the literature.

It was reported in a meta-analysis of bariatric surgery outcomes that obstructive sleep apnea improved in 80% of patients.²⁴
In a low powered study, average apnea-hypopnea index improved by a reduction of 38.2 events per hour or a combined reduction in the apnea-hypopnea index of 71%. ¹⁴⁵

Both age and follow-up weight loss independently predicted sleep apnea cure.

Because only 44% of the patients attained an apnea-hypopnea index of 10 per hour, it is important to emphasize continued compliance with obstructive sleep apnea therapy with repeated polysomnography 6 to 18 months postoperatively. ¹⁴⁵
Physical examination and electrocardiography of obese patients often underestimate the presence and extent of cardiac dysfunction in the obese.

Progressive dyspnea with exertion and lower-extremity edema are often ubiquitously prevalent and nonspecific.

Obesity causes an increase in total blood volume and cardiac output as a result of increased metabolic demand. 148,149
Longer durations of obesity are associated with increased circulatory volume, progressive cardiac demand, poorer left ventricular systolic function and greater impairment of left ventricular diastolic function.\textsuperscript{152}

Ventricular chamber dilatation occurs, increasing wall stress and promoting compensatory increased myocardial mass. This results left ventricular remodeling or hypertrophy, characteristically from the concentric to the eccentric type.\textsuperscript{150,151}

This obesity cardiomyopathy occurs most commonly with a relative weight of 175\% of ideal or a BMI 40 kg/m$^2$ and is often sub-clinical.\textsuperscript{153}
Obesity has been shown to be an independent risk factor for atrial fibrillation with an adjusted 50% risk increase for developing atrial fibrillation with a commensurate increase in stroke.

Left atrial dimensions and volume are increased in obese patients explaining this predilection.

All of the metabolic syndrome components except elevated triglycerides have been reported to be associated with the development of atrial fibrillation as well.¹
Weight loss has beneficial impacts on functional and structural cardiac status.

Improvements in left ventricular systolic function occur mainly in severely obese individuals whose systolic function was significantly depressed preoperatively.

Bariatric surgery also has been associated with clinically significant improvement in left ventricular systolic function in patients with severe cardiomyopathy such as patients awaiting heart transplantation.\textsuperscript{166,167}
A prolonged QT is observed in a relatively high percentage of obese subjects, and the association between abnormal corrected QT and BMI is most evident in the severely obese.\textsuperscript{168,169}

Caution must therefore be taken because weight loss after obesity surgery has been associated with prolongation of the corrected QT interval, which could be deleterious in some individuals by inducing fatal arrhythmias.\textsuperscript{170}
There is increasing, although not definitive, evidence that bariatric surgery provides a significant survival benefit 6 that is due specifically to decreases in:

- myocardial infarction,
- diabetes mellitus, and
- cancer-related deaths.

6
Owenimo et al found an 81% reduction in mortality for bariatric surgery patients versus those who did not have surgery when compared at 4 years.

Christou et al also noted an 89% reduction in mortality in patients in the province of Que´bec who underwent surgery for obesity compared with a matched cohort of severely obese patients at 5 years. 172, 173

The Swedish Obese Subjects study reported a 25% mortality decrease in bariatric surgery patients at 10 years compared with a well-matched control population. 67
Studies have demonstrated reductions in 10-year total and cardiovascular mortality of approximately 50% in patients who had bariatric surgery.
Surgery alone is insufficient to reach desired endpoints. Patients should be seen early and often after bariatric surgery to monitor progress, to guide diet advancement, and to educate about healthful eating and activity.

Diet progression to a full solid food diet may take from 6 to 18 months. During this time, patients will go through various stages of food intolerances, changes in food preferences, and changes in hunger and satiety.

When weight is stabilized, patients may need a full re-education about healthful eating.¹
There is compelling evidence that prevention of weight regain in formerly obese individuals requires 60 to 90 minutes of daily moderate intensity activity or lesser amounts of vigorous activity.”

Surgically induced weight loss can also increase peak heart rate, respiratory exchange ratio, and relative oxygen consumption (mL kg1 min1 ), augmenting the exercise capacity.
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