

Resolution of Systemic Hypertension after Laparoscopic Gastric Bypass

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Received: 26 March 2008 / Accepted: 12 November 2008 / Published online: 3 December 2008
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Abstract

Background Hypertension is a well-recognized and treatable risk factor for coronary heart disease and is one of the most common comorbidities associated with obesity. The aim of this study was to characterize the clinical outcome of a cohort of patients with documented hypertension who underwent laparoscopic gastric bypass.

Methods Ninety-five obese patients with documented hypertension and being treated with antihypertensive medication(s) underwent laparoscopic gastric bypass. Main outcome measures included length of hypertensive condition, changes in systolic and diastolic blood pressures, and changes in antihypertensive medication(s) at follow-up.

Results There were 69 (72%) females with a mean preoperative body mass index of 47 kg/m². The mean duration of hypertension was 73±70 months. The mean excess body weight loss at 12 months was 66%. The mean systolic blood pressure significantly decreased from 140±17 mmHg preoperatively to 120±18 mmHg at 12 months ($p<0.01$). The mean diastolic blood pressure also significantly decreased from 80±11 mmHg preoperatively to 71±8 mmHg at 12 months ($p<0.01$). At 12 months follow-up, 44 (46%) patients had complete resolution of hypertension while 18 (19%) patients had improvement. Patients with complete resolution had a shorter duration of disease as compared to patients without resolution (53 vs. 95 months, respectively, $p=0.01$).

Conclusion Weight loss associated with laparoscopic gastric bypass substantially improves and/or resolves hypertension in the majority of patients. Improvement of hypertension occurs as early as 1 month postoperatively and is more frequently in patients with a shorter preoperative duration of disease.

Keywords Bariatric surgery · Morbid obesity · Systemic hypertension · Gastric bypass

Presented at the 3rd Annual Academic Clinical Congress of the Association of Academic Surgery, Huntington Beach, CA, February 13th 2008.

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Background

The prevalence of obesity in the USA is on the rise. It is estimated that one-third of the adult population in the USA is obese.^{1,2} Obesity has been associated with a number of comorbid conditions such as hypertension, hyperlipidemia, obstructive sleep apnea, type 2 diabetes, arthritis, and coronary artery disease.^{3,4} Of these conditions, hypertension is the most common comorbidity associated with obesity. The risk of developing hypertension has been found to increase with increasing weight class.⁵ Hypertension alone is a cardiovascular risk factor but when combined with obesity, there is a substantially higher cardiovascular risk.⁶ A number of studies have shown that weight reduction is associated with significant improvement or remission of many of the obesity-related comorbid conditions and can lead to a decrease in the predicted cardiovascular risk.^{7–13} Surgery is currently the most

successful method for sustained weight loss in the morbidly obese.^{3,14} There are a number of surgical approaches to weight loss which include both malabsorptive and/or restrictive mechanisms. Currently, in the USA, Roux-en-Y gastric bypass is the most commonly performed bariatric procedure. The aim of this study was to characterize the clinical outcomes, specifically with regard to improvement or resolution of hypertension, of a cohort of morbidly obese hypertensive patients who underwent laparoscopic Roux-en-Y gastric bypass.

Materials and Methods

Patient Identification and Selection

We performed a retrospective analysis of our prospectively collected bariatric database of 95 patients with documented hypertension who underwent laparoscopic gastric bypass with a minimum follow-up of 12 months. This group of patients represented 38% of the cohort of patients who underwent gastric bypass between 2003 and 2006. All patients met the 1991 National Institute of Health Consensus Conference guidelines for bariatric surgery. Our surgical technique consisted of constructing a 15- to 20-ml transected gastric pouch with a 150-cm Roux limb. The gastrojejunal anastomosis was performed in an end-to-side fashion using a circular stapler. Approval for this retrospective study was obtained from the University of California Medical Center Institutional Review Board.

Baseline clinical data including patient characteristics, length of hypertensive condition, weight, antihypertensive medication(s) requirement, and blood pressure readings were obtained at the initial clinic visit. Each patient underwent three blood pressure measurements and the average reading was recorded by one of two medical assistants. All patients with a preexisting diagnosis of hypertension and currently being treated with antihypertensive medication(s) were included in this review. All patients were followed postoperatively in an outpatient clinic at 1 week, 1 month, and then at 3 months interval. Medication adjustments in the postoperative period were made at the discretion of each patient's primary care physician. There was no established protocol for the reduction or discontinuation of antihypertensive medication(s). Improvement of hypertension was defined as a decrease in medication requirement and a normal blood pressure (systolic pressure <140 mmHg and diastolic pressure <80 mmHg). Resolution of hypertension was defined as a normal blood pressure and discontinuation of all antihypertensive medications. The Assessment of Obesity-Related Comorbidity (AORC) scale was used to objectively quantify preoperative and postoperative degrees of hypertension.¹⁵ The scale of 0 was

defined as *not present*; a scale of 1 was defined as *borderline/intermittent diagnosis not confirmed*; a scale of 2 was defined as *controlled by diet and exercise*; a scale of 3 was defined as *treatment with a single medication*; and a scale of 4 was defined as *treatment with multiple medications*.

Statistical Analysis

Continuous variables were expressed as mean±standard deviation and were analyzed using two-sample *t* tests. Categorical variables were analyzed using Fisher's exact tests or the Chi-square tests with Yates' correction when appropriate. Statistical analysis was performed using SPSS statistical software, version 12.0 (SPSS Inc., Chicago, IL, USA). A *p* value of less than 0.05 was considered significant.

Results

There were 95 morbidly obese patients with documented hypertension who underwent laparoscopic gastric bypass with complete data at 1-year follow-up (Table 1). There were 26 (28%) males and 69 (72%) females with a mean age of 47±9 years (range 26–64 years). The mean body mass index was 47±8 kg/m². The mean excess body weight loss was 23% at 1 month, 38% at 3 months, 55% at 6 months, 62% at 9 months, and 66% at 1 year. There were no in-hospital or 30-day mortalities. The mean duration of hypertension prior to gastric bypass was 73±70 months. Preoperatively, all patients were on at least a single antihypertensive medication; 57 patients (60%) have a hypertension AORC scale of 3 and 38 patients (40%) have a hypertension AORC Scale of 4.

Table 1 Characteristics and Outcomes of Hypertensive Morbidly Obese Patients who Underwent Laparoscopic Gastric Bypass

No. of hypertension patients (<i>N</i>)	95
No. of females (%)	69 (72)
Mean age (years)	47±9
Baseline body mass index (kg/m ²)	47±8
Mean duration of disease (months)	73±70
No. of patients with preoperative hypertension AORC scale=3 ^a (%)	57 (60)
No. of patients with preoperative hypertension AORC scale=4 ^b (%)	38 (40)
30-day or in-hospital mortality (%)	0 (0)
Mean excess body weight loss at 1 month (%)	23±9
Mean excess body weight loss at 12 months (%)	66±16

AORC scale Assessment of Obesity-Related Comorbidity scale

^a Treatment of hypertension with a single medication

^b Treatment of hypertension with multiple medications

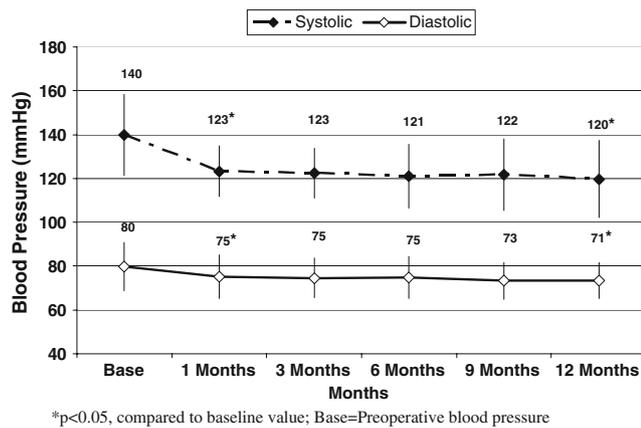


Figure 1 Mean change in systolic and diastolic blood pressure in morbidly obese patients with documented hypertension who underwent laparoscopic gastric bypass. * $p < 0.05$, compared to baseline value. Base preoperative blood pressure.

There was a significant reduction in mean systolic blood pressure from 140 ± 17 mmHg preoperatively to 123 ± 18 mmHg at 1 month and ultimately to 120 ± 18 mmHg at 12 months postoperatively, $p < 0.01$ (Fig. 1). There was also a significant reduction in the mean diastolic blood pressure from 80 ± 11 mmHg preoperatively to 75 ± 10 mmHg at 1 month and 71 ± 8 mmHg at 12 months postoperatively, $p < 0.01$. At 1 month postoperatively, 24 (25%) patients had complete resolution of hypertension while 34 (36%) had improvement (Fig. 2). At 12 months postoperatively, 44 (46%) patients had complete resolution while 18 (19%) patients had improvement of hypertension. Patients with complete resolution of hypertension at 1 month postoperatively had a shorter duration of disease as compared to those without resolution (38 ± 45 months vs. 87 ± 74 months, $p < 0.01$). At 12 months postoperatively, the mean duration of preexisting hypertension was also lower for patients with resolution of hypertension compared to patients who did not have resolution, 53 ± 52 months vs. 95 ± 81 months, respectively, $p = 0.03$ (Table 2). The median percent excess

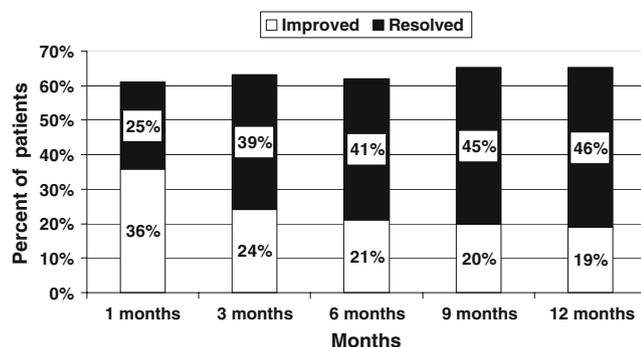


Figure 2 Improvement or resolution of hypertension in morbidly obese patients with documented hypertension who underwent laparoscopic gastric bypass.

Table 2 Comparisons of Patient with Complete Resolution of Hypertension vs. Patients without Resolution at 12 Months Postoperatively

	Resolution (N=44)	No resolution (N=51)
Mean age (years)	46±9	49±8
No of females (%)	33 (75)	34 (67)
No. of Hispanics (%)	8 (18)	6 (12)
No. of African Americans (%)	3 (7)	5 (10)
Mean preoperative no. of antihypertensive medications	2±1	2±1
Mean duration of hypertensive disease (months)	55±52*	93±81
Preoperative systolic blood pressure (mmHg)	136±16	142±17
Systolic blood pressure at 12 months (mmHg)	114±17*	128±12
Preoperative diastolic blood pressure (mmHg)	78±10	81±12
Diastolic blood pressure at 12 months (mmHg)	70±10*	80±11

* $p < 0.05$, compared to patients without resolution of hypertension

body weight loss was 57% at 12 months. Of the patients who achieved excess body weight loss above the median value, 72% had resolution of hypertension as compared to 19% had resolution for patients who did not achieve the median weight loss ($p < 0.01$). The 12 months, mean systolic blood pressure was lower in patients who had resolution of hypertension when compared to those without resolution, 114 ± 17 mmHg vs. 128 ± 12 mmHg ($p = 0.02$) and the diastolic blood pressure was also lower in patients who had resolution of condition, 70 ± 10 mmHg vs. 80 ± 11 mmHg, respectively, $p < 0.01$. At 12 months, 46% of patients have a hypertension AORC scale of 0 while 7% and 46% have an AORC scale of 3 and 4, respectively. Age, gender, race, preoperative BMI, preoperative blood pressure, preoperative AORC scale, and preoperative medication requirements were similar between those with resolution of hypertension and those without.

Discussion

The main finding of this study is that morbidly obese patients with hypertension who underwent laparoscopic gastric bypass had a significant improvement in both systolic and diastolic blood pressure at 12 months after surgery and reduction in the need for anti-hypertensive medications. Improvement in blood pressure was seen as early as 1 month postoperatively. At 1 month after gastric bypass, there was 25% complete resolution of hypertension and at 12 months postoperatively, 44% of individuals had

complete resolution. Individuals with complete resolution of hypertension had shorter duration of disease compared to those without resolution.

Hypertension is the most common comorbidity associated with obesity. Numerous mechanisms have been proposed as to how obesity contributes to the development of hypertension. Some of the proposed mechanisms include alteration in the renin–angiotensin–aldosterone system, increased sympathetic nervous system activity, development of insulin resistance, hyperleptinemia and leptin resistance, altered coagulation factors, inflammation, and endothelial dysfunction.¹⁶ Most likely, the mechanism for hypertension in the obese is multifactorial. The incidence of hypertension in patients who undergo bariatric surgery ranges from 40% and up to 70% depending on the definition for hypertension.^{10,12,16–19} For example, Fernstrom et al., in their evaluation of 285 gastric bypass patients, included patients with stage 1 hypertension (systolic blood pressure >140 mmHg and diastolic >90 mmHg) without anti-hypertensive medications and thus found a 57% incidence of hypertension within their study group.²⁰

The combination of obesity and hypertension places patients at a higher cardiovascular risk than those patients without hypertension. This risk can be markedly reduced after resolution of hypertension following weight loss.¹⁹ In a large population-based study of 197 patients, Batsis et al. found a significant improvement in hypertension, diabetes, and dyslipidemia, leading to a decrease in the estimated 10-year risk of cardiovascular events in morbidly obese patients after gastric bypass.¹³ In our study, the weight loss following laparoscopic gastric bypass led to significant decrease in both systolic and diastolic blood pressure. At 12 months postoperatively, our cohort had a 14% reduction (by 20 mmHg) in the systolic blood pressure and an 11% reduction (by 9 mmHg) in the diastolic blood pressure. Fernstrom et al., in a retrospective review of 347 patients who underwent either gastric bypass or vertical band gastroplasty, reported only a modest reduction in systolic (3 mmHg) and diastolic (4 mmHg) blood pressure.²⁰ Outcome data from the Swedish Obese Subjects (SOS) study, which compared 1,157 obese patients who underwent bariatric surgery to 1,031 obese-matched medically treated patients, revealed marked reductions in both weight and blood pressure in the surgical group when compared to the medically treated group.²¹ The surgically treated group had an improvement of 11 mmHg for systolic blood pressure and 7 mmHg for diastolic blood pressure. However, by year 8, there was no difference between the blood pressures of the surgical group vs. the medically treated group.²¹ However, in a small subset of patients who underwent gastric bypass in the SOS study, weight loss and improvement of hypertension persisted. Other studies have also reported similar results with continual improvement/resolution of hypertension after 1 year.²⁰

Multiple studies have shown that weight loss after gastric bypass will lead to the resolution of multiple comorbidities. In our study, 46% of patients had complete resolution of hypertension with 65% of patients showed improvement or resolution at 12 months. Sugeran et al. reported a 69% resolution of hypertension in their analysis of 1,025 gastric bypass patients, which was maintained out to 5 to 7 years.¹⁸ Similarly, Fernstrom et al. found 50% resolution of hypertension after surgery with no relapse at 12 to 18 months follow-up. In a large meta-analysis that included 136 studies and 2,115 gastric bypass patients, Buchwald et al. found that 75% of patients had resolution and 87% had resolution or improvement of hypertension.³ In a retrospective analysis of 55 veterans who underwent gastric bypass, Huerta et al. found 89% resolution of hypertension following the gastric bypass.²² Maggard and colleagues reviewed 19 studies that reported changes in hypertension after bariatric surgery and found that resolution or improvement of hypertension occurred in 25% to 75% of patients while improvement was seen in 95% to 100% of patients following bariatric surgery.¹⁴

Our study also showed a relationship between the length of preexisting hypertension and the likelihood for resolution of the disease. The mean length of condition was significantly lower in patients who had complete resolution of hypertension when compared to those without resolution. At 1 month after gastric bypass, patients who experienced resolution of hypertension had a shorter mean length of hypertension at 38 months compared to 87 months in patients without resolution. The same was true at 12 months; patients with resolution of hypertension had a significantly shorter length of hypertension when compared to those without resolution. These findings suggest that a length of preexisting hypertension of less than 4 years may be predictive for those patients who will not only have resolution of hypertension following gastric bypass but those who will resolve sooner. These findings also suggest that the longer hypertension persists, the more functional and structural changes accompany the disease and the more difficult for the disease to resolve.^{23,24} This was previously proposed by Sugeran et al.¹⁸ Given this finding, perhaps bariatric surgery should be offered much sooner to morbidly obese patients with hypertension, as length of preexisting condition is an important factor predicting its resolution.

Conclusion

In conclusion, weight loss associated with laparoscopic gastric bypass significantly improves systolic and diastolic blood pressure and is effective in leading to discontinuation or a marked reduction of hypertensive medication

requirements in a large proportion of morbidly obese hypertensive patients. These findings occur as early as 1 month postoperatively and seem to be associated with the duration of preexisting disease. Moreover, patients with a length of preexisting hypertension of less than 4 years are more likely to have resolution of hypertension. This suggests that perhaps patients with morbid obesity and hypertension should be offered surgical weight loss earlier in their disease process.

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