ORIGINAL ARTICLE

Predictors of Long-term Mortality After Bariatric Surgery Performed in Veterans Affairs Medical Centers

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Hypothesis: The purpose of this study was to examine patient factors associated with mortality among veterans who undergo bariatric surgery.

Design: Prospective study that uses data from the Veterans Affairs (VA) National Surgical Quality Improvement Program.

Setting: Group Health Center for Health Studies, the VA North Texas Health Care System, the Denver VA Medical Center, and the Durham VA Medical Center.

Patients: We identified 856 veterans who had undergone bariatric surgery in 1 of 12 VA bariatric centers from January 1, 2000, through December 31, 2006.

Main Outcome Measures: The risk of death was estimated via Cox proportional hazards.

Results: The 856 veterans had a mean body mass index (BMI) of 48.7, a mean age of 54 years, and a mean DCG score of 0.76; 73.0% were men, 83.9% were white, and 7.0% had an ASA class equal to 4. Fifty-four veterans (6.3%) had died by the end of 2006. In our Cox models, patients with a BMI greater than 50 (superobesity; hazard ratio [HR], 1.8; $P = .04$) or a DCG score greater than or equal to 2 (HR, 3.4; $P < .001$) had an increased risk of death.

Conclusion: Superobese veterans and those with a greater burden of chronic disease had a greater risk of death after bariatric surgery from 2000 through 2006.

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Currently, more than 10 million US adults, including 165 000 veterans who use Veterans Affairs (VA) medical facilities, have class III obesity (body mass index [BMI; calculated as weight in kilograms divided by height in meters squared] ≥40).[1,2] The impact of this epidemic is substantial; in 2000, class III obesity was associated with 82 066 deaths and more than $11 billion in direct US health care expenditures.[3,4] Furthermore, the expected life span of young adults with class III obesity may be reduced by 4 to 20 years.[5]

See Invited Critique at end of article

A series of systematic reviews of obesity treatment indicates that medical interventions, such as dietary changes, exercise, and pharmacotherapy, often cannot help morbidly obese individuals lose enough weight to improve their health and quality of life.[6,7] There is now evidence that bariatric surgery substantially improves body weight, obesity-associated chronic conditions, quality of life, and long-term survival.[8-10] Given this evidence, the number of bariatric procedures performed annually in the United States increased from 16 800 to more than 200 000 in the past decade despite infrequent insurance coverage.[11,12]

The risk of death related to bariatric surgery is generally thought to be low. A recent meta-analysis demonstrated that the 30-day mortality rate averaged 0.28%,[13] and the 1-year mortality rate has recently been estimated at less than 1% per year in the United States.[12,14] Prior studies[8,10,15-19] of bariatric surgery have primarily included younger female patients, so the mortality estimates from these studies might not apply to the older, predominantly male population that undergoes surgery at VA medical facilities.

Some of us have previously reported about modifiable preoperative risk factors associated with postoperative complications in veterans who undergo bariatric surgery; however, that study[20] was underpowered to examine predictors of perioperative death. Therefore, we have conducted a retrospective study of 856 bariatric surgical patients in 12 VA medical facilities from January 1, 2000, through December 31, 2006, to define the risk of death in this population and to identify patient-level factors associated with mortality.

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METHODS

This study was approved by the VA National Surgical Quality Improvement Program

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(NSQIP). It was also approved by the institutional review boards of the Group Health Center for Health Studies, the Veterans Administration North Texas Health Care System, the Denver Veterans Affairs Medical Center, and the Durham VA Medical Center.

DATA COLLECTION

Established in 1994, the NSQIP is an ongoing quality-management initiative that applies risk-adjustment methods to monitor, compare, and improve the quality of surgery in VA Medical Centers (VAMCs).[21,22] The NSQIP prospectively collects data on major surgical procedures performed in VAMCs, including bariatric procedures. To ensure consistent high-quality data in all participating sites, a dedicated surgical clinical nurse reviewer collects data on patient demographics, preoperative comorbidities and functional status, preoperative laboratory values, variables related to the operation, and variables related to 30-day postoperative morbidity and mortality from computerized and paper-based medical records that use explicit data definitions. These data are transmitted by the surgical clinical nurse reviewer to the NSQIP Denver VAMC Data Analysis Center, where the data are subject to checks for valid data entry.

STUDY POPULATION

Bariatric patients were identified in the NSQIP database by the use of an algorithm of *Current Procedural Terminology 4* (*CPT-4*)[23] codes (43842, 43843, 43846, 43847, and 43848) and *International Classification of Diseases, Ninth Revision (ICD-9)*[24] codes (278.01 associated with *CPT-4* codes 43659, 43621, and 43633). To ensure the reliability of this patient-finding strategy, the medical centers with the largest volumes were asked to verify that the patients identified were indeed bariatric patients and whether any bariatric patients were missed. We found that the algorithm identified bariatric patients with a sensitivity of 99.2% and specificity of 99.9%. Finally, each medical center provided preoperative body weight and height for patients who had undergone bariatric surgery before October 1, 2004, because NSQIP had not captured these values before that date.

DATA ELEMENTS

The main outcome of interest for our analysis was survival until December 31, 2006, by veterans who had undergone bariatric surgery during the period January 1, 2000, through December 31, 2006. Briefly, mortality is entered into the NSQIP database in two ways. First, the surgical clinical nurse reviewer tracks each patient for postoperative mortality and morbidity for 30 days after the operation. Second, veterans whose surviving spouse or children receive death benefits from the VA have a date of death recorded in the Beneficiary Identification Records Locator Subsystem. The NSQIP database is merged with the Beneficiary Identification Records Locator Subsystem semiannually, allowing capture of long-term mortality. Surgical complications as defined by NSQIP have been described elsewhere.[21,22]

The main independent variables for our analyses included age, sex, ethnicity, body mass index (BMI) (calculated as the weight in kilograms divided by height in meters squared), American Society of Anesthesiology (ASA) physical status classification, smoking status at the time of surgery, diabetes mellitus medication treatment status, and the diagnostic cost group (DCG) risk adjustment measure. Patient age, sex, and ethnicity are extracted from the VA electronic medical record. The ASA class of each patient is extracted from the anesthesia record based on the following scale: 1, healthy patient; 2, patient with mild systemic disease; 3, patient with moderate systemic disease; 4, patient with severe systemic disease that is a constant threat to life; and 5, moribund patient who is not expected to survive the next 24 hours with or without surgery. In the NSQIP, tobacco smoking status is classified by whether a veteran had smoked within the past year. Diabetes medication treatment status is coded based on evidence of long-term treatment with insulin or an oral hypoglycemic agent in the medical record.

We adjusted for comorbidities by use of the DCG score because it accounts for a broad range of diagnoses, it can be represented in a single score, and prior studies[25-27] have shown that DCG scores predict expenditures and 1-year mortality rates of veterans, as well as other comorbidity scores. The DCG assigns 15 000 *International Classification of Diseases, Ninth Revision, Clinical Modification*[24] diagnosis codes generated during inpatient and outpatient encounters to 804 diagnostic groups, which are further aggregated into 189 condition categories.[25] A single beneficiary may be coded for none, 1, or more than 1 diagnostic group, and the DCG model assigns a specific weight to clusters of health conditions with the same cost, with that weight representing the average cost of that cluster.[25] A patient whose predicted expenditures are equal to the Medicare national average has a DCG score of 1.0. A patient with a DCG score greater than 1.0 has above-average expected expenditures, whereas a patient with a DCG score below 1.00 has lower-than-average expected expenditures. The DCG score of each bariatric patient was based on diagnoses from health care utilization in the year before surgery.

STATISTICAL ANALYSES

Statistical comparisons between decedents and survivors were evaluated with *t* tests for continuous data and with χ^2 analysis and the Fisher exact test for categorical data. Survival until 2006 of surgical patients was estimated via a Cox proportional hazards regression model. Because of the limited number of deaths, we restricted our final model specification to 8 covariates (age, sex, race, BMI ≥50, ASA class, smoking status, diabetes medication treatment status, and DCG score) that were associated with mortality ($P < .20$) in bivariate analyses. Kaplan-Meier survival curves were compared using the log-rank test. These analyses were conducted using a commercially available software package (SAS; SAS Institute Inc, Cary, North Carolina).

RESULTS

POPULATION CHARACTERISTICS

We identified 911 patients who had undergone bariatric surgery in 1 of 12 approved VA bariatric centers from 2000 through 2006 and excluded 29 patients (3.2%) with missing baseline data that pertained to BMI and 26 patients (2.9%) with missing DCG scores. All analyses were conducted with the remaining 856 surgical patients. From January 1, 2000, through December 31, 2006, the number of bariatric procedures performed in the VA increased from 52 to 170 per year. The 856 surgical patients had a mean preoperative BMI of 48.7, a mean age of 54 years, and a mean DCG score of 0.76. Of these patients, 73.0% were men and 83.9% were white. Most patients (93.0%) had an ASA class of 2 or 3, and the remaining 7.0% had an ASA class of 4. Roux-en-Y gastric bypass was performed on 96.9% of patients, with 1.9% undergoing gastric banding and 1.1% undergoing gastroplasty. Laparoscopic procedures were performed on 25.0% of patients, and 75.0% underwent open proce-

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Table 1. Demographic and Preoperative Characteristics of 856 Bariatric Patients by Survival Status, 2000-2006

Demographic and Preoperative Characteristics	Survivors, Mean (SD) or Frequency (%) (n=802)	Decedents, Mean (SD) or Frequency (%) (n=54)	*P* Value
Age (SD), y	54.2 ± 8.4	56.6 ± 7.8	.04
Age ≥65 y	54 (6.7)	7 (13.0)	.10
Male	582 (72.6)	46 (85.2)	.04
Ethnicity			
Unknown[a]	345 (43.0)	25 (46.3)	.64
White	382 (83.2)	25 (86.2)	.87
Other than white	75 (16.4)	4 (13.8)	NA
BMI	48.5 ± 8.2	51.8 ± 8.1	.004
Superobese (BMI ≥50)	278 (34.7)	30 (55.6)	.005
DCG	0.72±0.96	1.33 ±1.78	.02
DCG ≥2	55 (6.9)	14 (25.9)	<.001
ASA physical status classification			.01
2	94 (11.7)	2 (3.7)	
3	655 (81.7)	42 (77.8)	
4	53 (6.6)	10 (18.5)	
Smoker within year before surgery	104 (13.0)	10 (18.5)	.25
Functional status			
Independent	788 (98.3)	50 (92.6)	.01
Partially dependent	13 (1.6)	4 (7.4)	
Dependent	1 (0.1)	0	
Cardiac: history of CHF	72 (9.0)	11 (20.4)	.006
Central nervous system			
Impaired sensorium	0	1 (1.9)	.001
Hemiplegia	5 (0.6)	1 (1.9)	.30
History of TIA	10 (1.3)	0	.41
CVA with neurologic deficit	14 (1.8)	0	.33
CVA without neurologic deficit	9 (1.1)	0	.43
Pulmonary			
Dyspnea: none	640 (79.8)	32 (59.6)	.001
Dyspnea: moderate exertion	152 (18.9)	19 (34.6)	
Dyspnea: at rest	10 (1.3)	3 (5.6)	
History of COPD	78 (9.7)	8 (14.8)	.23
Renal: on dialysis	0	1 (1.9)	.001
Nutritional, immune, or other			
Diabetes mellitus: none or diet alone	477 (59.5)	29 (53.7)	.01
Diabetes: oral agents	217 (27.1)	10 (18.5)	
Diabetes: insulin	108 (13.5)	15 (27.8)	
Open wound or infection	6 (0.8)	1 (1.9)	.38
Corticosteroid use	5 (0.6)	3 (5.6)	.001
Bleeding disorder	6 (0.8)	3 (5.6)	.001

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; DCG, diagnostic cost group; NA, not applicable; TIA, transient ischemic attack.

[a] The proportion of bariatric patients for whom data on ethnicity was not recorded in Veterans Affairs databases. Percentages do not total 100 because of rounding.

dures. The median follow-up duration for bariatric patients was 984 days.

UNADJUSTED OUTCOMES

Overall 30-day, 90-day, and 1-year mortality rates were 1.3%, 2.1%, and 3.4%, respectively. **Table 1** compares the baseline demographic and preoperative characteristics of the 54 bariatric patients (6.3%) who died during follow-up with the 802 bariatric patients who were alive at the end of 2006. Patients who died were older (*P*=.04); more likely to be male (*P*=.04); had a higher BMI (*P*=.003), DCG score (*P*=.001), and ASA classification (*P*=.001); were more impaired functionally (*P*=.01); and had more comorbidities, including congestive heart failure (*P*=.006), impaired sensorium (*P*=.001), dyspnea (*P*=.001), dialysis (*P*=.001), diabetes (*P*=.01), corticosteroid use (*P*=.001), and bleeding disorders (*P*=.001). Decedents were less likely to have undergone laparoscopic bariatric procedures (2% vs 26.4%; *P*<.001) than survivors.

Postoperative adverse outcomes were higher in decedents than survivors (**Table 2**). These outcomes included longer operative times (*P*=.005), higher rates of return to the operating room (*P*=.02), total length of hospital stay (*P*<.001), and higher rates of postoperative surgical complications, including cardiac arrest (*P*=.001), systemic sepsis (*P*=.001), pneumonia (*P*=.001), unplanned intubation (*P*=.005), failure to wean from ventilator after 48 hours postoperatively (*P*=.001), progressive renal insufficiency (*P*=.002), acute renal failure (*P*=.001), urinary tract infection (*P*=.001), and wound dehiscence (*P*=.001).

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Table 2. Unadjusted Postoperative Outcomes of 856 Bariatric Patients by Survival Status, 2000-2006[a]

Outcome	Survivors (n=802)	Decedents (n=54)	P Value
Operative time in hours, mean (SD)	3.3 (1.2)	3.8 (1.5)	.005
Return to operating room	52 (6.5)	8 (14.8)	.02
Total length of hospital stay, mean (SD)	6.5 (7.8)	11.0 (13.9)	<.001
DVT/thrombophlebitis	4 (0.5)	1 (1.9)	.21
Pulmonary embolism	4 (0.5)	1 (1.9)	.21
Cardiac arrest	4 (0.5)	3 (5.6)	<.001
Myocardial infarction	3 (0.4)	0	.65
Systemic sepsis	11 (1.4)	4 (7.4)	.001
Stroke	0	0	NA
Pneumonia	11 (1.4)	4 (7.4)	.001
Unplanned intubation	14 (1.8)	4 (7.4)	.005
Failure to wean from ventilator >48 h	13 (1.6)	6 (11.1)	<.001
Progressive renal insufficiency	7 (0.9)	3 (5.6)	.002
Acute renal failure	4 (0.5)	3 (5.6)	<.001
Urinary tract infection	18 (2.2)	6 (11.1)	<.001
Superficial wound infection	59 (7.4)	4 (7.4)	.99
Deep wound infection	9 (1.1)	0	.43
Wound dehiscence	10 (1.3)	4 (7.4)	<.001

Abbreviations: DVT, deep vein thrombosis; NA, not applicable.
[a]Data are presented as number (percentage) of patients unless otherwise indicated.

Table 3. Multivariable Cox Proportional Hazards Model Results

Variable	Hazard Ratio (95% Confidence Interval)	P Value
Age, continuous	1.02 (0.98-1.05)	.41
Male	1.26 (0.58-2.75)	.57
Ethnicity		
Other than white[a]	0.71 (0.28-2.36)	.71
Unknown[a]	1.51 (0.85-2.66)	.16
BMI ≥50	1.77 (1.01-3.09)	.04
ASA class 3[b]	2.13 (0.50-9.12)	.31
ASA class 4[b]	4.65 (0.95-22.84)	.06
DCG score ≥2[c]	3.40 (1.79-6.48)	<.001
Smoker	1.24 (0.61-2.53)	.56
Diabetes mellitus (oral/insulin)	1.08 (0.62-1.90)	.78
Laparoscopic procedure	0.10 (0.01-0.74)	.02

Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; DCG, diagnostic cost group.
[a]Compared with white patients.
[b]Compared with ASA class 2.
[c]Compared with DCG score less than 2.

MULTIVARIABLE COX MODELS

In our multivariable-adjusted Cox model (**Table 3**), we found that veterans with a BMI of 50 or higher (hazard ratio [HR], 1.77; *P*=.04) or a DCG score of 2 or higher (HR, 3.4; *P*<.001) had a significantly increased risk of death compared with those with a BMI less than 50 or a DCG score less than 2. We also found a trend toward a greater risk of death in patients with a preoperative ASA classification of 4 (HR, 4.65; *P*=.06) compared with an ASA classification of 2. Patients who underwent a laparoscopic procedure had a significantly decreased risk of death compared with those who underwent an open procedure (HR, 0.10; *P*=.02). The risk of death was not significantly related to age, sex, ethnicity, active tobacco smoking, or diabetes treatment status. Kaplan-Meier survival curves of the 856 surgical patients in the **Figure** show that the probability of death at any time point is significantly different (*P*<.001) according to whether they had a BMI of 50 or higher and/or a DCG score of 2 or higher at baseline. Approximately one-quarter of patients who had both a BMI of 50 or higher and a DCG score of 2 or higher died within the first 3.5 years of follow-up, whereas patients who had both a BMI less than 50 and a DCG score less than 2 had the highest overall survival.

CHARACTERISTICS AND OUTCOMES OF HIGH-RISK PATIENTS

In our study, 36% of patients were superobese (BMI ≥50). At baseline, these patients were significantly more likely to have hypertension (*P*=.002), congestive heart failure (*P*=.001), chronic obstructive pulmonary disease (*P*=.03), an open wound or infection (*P*=.04), and a higher ASA class (*P*=.001). The superobese patients had 30-day, 90-day, and 1-year mortality rates of 2.0%, 3.6%, and 5.2%, respectively. These patients were significantly less likely to undergo a laparoscopic procedure (14.9% vs 30.5%; *P*<.001). They also had longer hospital stays (8.4 vs 5.9 days; *P*=.0001) and were significantly more likely to have had 1 or more NSQIP-defined complications within 30 days postoperatively, including deep vein thrombosis (*P*=.04), postoperative pneumonia (*P*=.01), unplanned and prolonged intubations (*P*=.001), acute (*P*=.001), and progressive renal insufficiency (*P*=.02), wound infection or dehiscence (*P*=.002), systemic sepsis, and cardiac arrest (*P*=.04).

In our cohort, 8% of patients had a DCG score of 2 or higher. At baseline, these patients were significantly more likely to have smoked within the year before surgery (*P*=.03) and to have had congestive heart failure (*P*=.001), a history of stroke with neurologic deficits (*P*=.005), diabetes with complications (*P*=.001), chronic obstructive pulmonary disease (*P*=.001), an open wound or infection (*P*=.001), a serum creatinine level of 1.2 mg/dL or higher (to convert creatinine to micromoles per liter, multiply by 88.4; *P*=.04), and a white blood cell count of 11 000/μL or higher (to convert white blood cell count to $\times 10^9$/L, multiply by 0.001; *P*=.001) (data not shown). Comparing patients with a DCG score of 2 or higher with those with scores less than 2, no significant difference was found in the proportions of patients who required oral hypoglycemic agents or insulin (*P*>.05). Patients with a DCG score of 2 or higher had 30-day, 90-day, and 1-year mortality rates of 1.5%, 5.8%, and 10.1%, respectively. These patients had longer hospital stays (10.8 vs 6.4 days) and were significantly more likely to have 1 or more NSQIP-defined complications within 30 days postoperatively, including unplanned (*P*=.001) and prolonged intubations (*P*=.001), acute (*P*=.001) and progressive renal insufficiency (*P*=.01), and cardiac arrest (*P*=.04).

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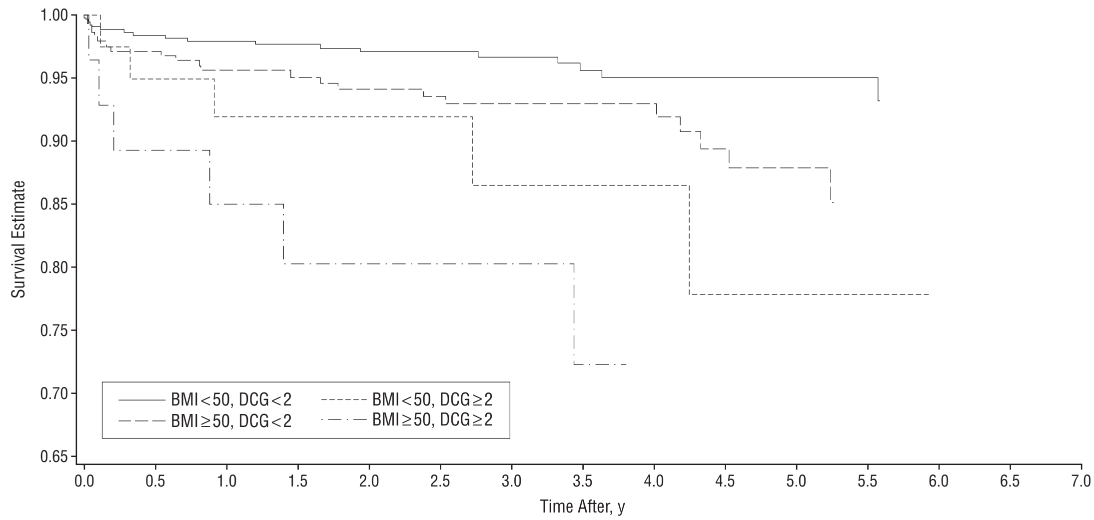

No. at Risk

	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0
BMI<50, DCG<2	507	452	397	340	283	259	216	182	136	106	80	54	32	16	1
BMI≥50, DCG<2	280	254	232	201	185	166	142	110	86	60	40	26	17	8	2
BMI<50, DCG≥2	41	36	30	27	20	19	14	11	10	8	5	4	2	2	0
BMI≥50, DCG≥2	25	23	19	17	17	17	11	8	3	3	0	0	0	0	0

Figure. Kaplan-Meier survival curves by superobese status and diagnostic cost group (DCG) score. The probability of death at any time point is significantly different across the 4 groups; $P<.001$ by log-rank test. BMI indicates body mass index (calculated as weight in kilograms divided by height in meters squared).

COMMENT

Between 2000 and 2006, the number of bariatric procedures performed in approved VA medical facilities increased more than 3-fold. Despite this increase, bariatric surgery is only being performed on approximately 0.1% of all veterans who meet BMI eligibility criteria. Whether the volume of the VA bariatric surgery program should be expanded in the coming years largely depends on the impact such operations have on long-term health outcomes.

In this study, we found that overall 30-day, 90-day, and 1-year mortality rates were 1.3%, 2.1%, and 3.4%, respectively. These rates are consistent with our prior report[20] regarding NSQIP data from 1998 to 2004. The mortality rates in our population of veterans are more than 3 times higher than the rates reported in a recent meta-analysis of 361 studies of bariatric surgery by Buchwald and colleagues.[28] Our rates are slightly lower than those reported by Flum et al[19] for the older and more disabled US Medicare population, for whom 30-day, 90-day, and 1-year mortality rates were 2.0%, 2.8%, and 4.6%, respectively. The observed differences in mortality rates between these cohorts likely relate to patient selection, especially age, sex, and burden of comorbid disease. For example, our cohort was on average 14 years older than the study populations included in the review by Buchwald et al. After standardization for age, our 30-day mortality rates are slightly lower than those reported in a recent population-based analysis of 16 683 bariatric patients performed in Pennsylvania from 1995 through 2004 (standardized mortality ratio for our sample, 0.91),[14] and our mortality rates are substantially lower than those found in the US Medicare population from 1997 through 2002 (standardized mortality ratio for our sample, 0.60).[19]

The current analysis expands our prior work by examining patient-level factors associated with excess long-term mortality risk. In these analyses, we found that superobese patients (those with a BMI ≥50) had a significantly increased risk of death, especially at 90 days and 1 year after bariatric surgery. Exclusion of superobese patients from our cohort would have reduced the overall 30-day, 90-day, and 1-year mortality rates by approximately one-third to 0.9%, 1.3%, and 2.4%, respectively. Although superobese patients have a higher risk of death after bariatric surgery, they also have a high risk of death without surgical treatment because of their multiple obesity-related medical comorbidities.[5,29] Thus, a patient's decision to undergo bariatric surgery is clearly preference sensitive[30]; that is, the decision should be based on the patient's own evaluation of accurate information regarding the potential risks and benefits of surgical treatment.

Several possible explanations for worse survival rates among superobese patients exist. Bariatric procedures are generally considered to be more technically difficult in this population because of visceral adiposity and hepatomegaly, which increases intra-abdominal pressure and reduces visualization.[31] Superobese patients may also be at greater risk for wound complications, especially with open procedures. Our population of superobese patients had significantly higher rates of wound infections or dehiscence (13.3% vs 7.2%; $P=.002$). Given the technical challenges of bariatric procedures in superobese patients, it has been suggested that they should either lose weight preoperatively, undergo a 2-stage bariatric procedure, or undergo laparoscopic Roux-en-Y gastric bypass or gastric banding to minimize operative complications.[32] Notably, in our population, only 15% of patients with a BMI of 50 or higher underwent a laparoscopic procedure compared with 31% of patients with a BMI less than 50. Superobese patients are also known to have

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a significantly increased risk for venous thromboembolism, which is a leading cause of death after bariatric surgery. Indeed, superobese patients in our study had slightly higher rates of deep vein thrombosis (1.3% vs 0.2%; $P = .03$); however, they did not have higher rates of pulmonary embolism. Finally, superobese patients are likely to have multiple and severe obesity-related medical comorbidities, which, as seen in our cohort, put them at increased risk for medical adverse events.[33] Clearly, more research is needed to inform the perioperative care and optimal selection of superobese patients for bariatric procedures.[34]

We also found that patients with a DCG score of 2 or higher had a significantly increased risk of death after bariatric surgery. A patient with a DCG score of 2 or higher has health expenditures in the year before surgery that are more than twice the national Medicare average (which was equal to $5598 in 2005). Our analyses indicate that these patients had significantly higher rates of several severe chronic health conditions, including congestive heart failure and stroke. Excluding patients with a DCG score of 2 or higher from our cohort would not significantly reduce our overall 30-day mortality rate; however, our 90-day and 1-year mortality rates would be reduced by approximately one-fifth to 1.8% and 2.8%, respectively. The practical utility of DCG for clinical care is limited because scores are calculated from administrative data. Further research is needed to develop practical bariatric risk assessment measures.

Our analyses also indicate that patients who underwent a laparoscopic procedure had a significantly lower risk of death than those who underwent an open procedure; however, there may be substantial unmeasured confounding that might account for this result. The overwhelming majority of laparoscopic procedures (93.9.%) were performed at 4 of the 12 approved VA bariatric centers. Thus, it is impossible to separate laparoscopic effects from site-level effects, such as differences in patient selection, surgical skill, and perioperative care. Further data collection on site characteristics and larger sample sizes would be needed to validate this finding.

Our study has several other limitations. Unlike earlier studies,[10,18,19] we did not find advanced age and male sex to be significant risk factors for mortality after bariatric surgery because our population was older, most patients were men, and there were a limited number of deaths. We did not have access to data on the cause of death in this population, so we were unable to estimate cause-specific hazard ratios. We also did not have access to data on changes in body weight after surgery, so we are unable to analyze the risk of death according to the amount of weight lost.

Our findings indicate that superobese veterans and those with a high burden of chronic disease (reflected in DCG scores ≥ 2) are significantly more likely to die within 1 year of bariatric surgery than their healthier peers. The results of this study should inform discussions with patients with regard to the potential risks and benefits of bariatric surgery. These findings also suggest that the risks of bariatric surgery in patients with significant comorbidities, such as congestive heart failure, complicated diabetes, and chronic obstructive pulmonary disease, should be carefully weighed against potential benefits in older male patients and those with superobesity. Future studies should address the comparative survival of these high-risk patients against superobese control populations that do not undergo bariatric surgery. Finally, further research is needed to identify ways to optimize the preoperative selection and treatment of superobese patients to further reduce their risk of complications and death.

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INVITED CRITIQUE

Possible Lack of Survival Advantage for One Group

In their article, "Predictors of Long-term Mortality After Bariatric Surgery Performed in Veterans Affairs Medical Centers," Arterburn et al make several salient conclusions. The first and most important point is that the postoperative mortality rate between 30 days and 1 year is higher than the 30-day postoperative mortality rate. The second point is that patients with a BMI greater than 50 and a diagnostic cost group score of greater than 2 were at increased risk for mortality at any point up to the year in which they were studied and that 25% of these patients died within the first 3.5 years of follow-up. In their unadjusted data, the authors found that male sex, older age, and higher American Society of Anesthesiologists classification also correlated with a higher risk of death in the first year after gastric bypass. These data are important because they correlate with data of other series that concern risk of death during the first year after gastric bypass.[1-3] The mortality rate in this series, which is slightly higher than the national average, reflects many of the factors that contribute to increased mortality (ie, male, older, increased comorbidities).

Despite seeing increased mortality up to 1 year, others have demonstrated a clear survival benefit of bariatric surgery during 5 to 10 years, with survival advantage (operated on vs not operated on) beginning at 6 months after surgery.[4-6] Therefore, despite the fact that the mortality rate increases during the postoperative period up to 1 year, it is small and does not negate the several advantages for patients who undergo bariatric surgery. However, there seems to be a group of patients (male, older, high morbidity scores) in whom bariatric surgery may not offer a survival advantage.

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