

# Postoperative Complications in Obese and Nonobese Patients

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## Abstract

**Background:** Postoperative complications are undesirable and potentially common in the increasing obese population of surgical patients. There is a scarcity of recent and reliable studies comparing postoperative morbidity and mortality in obese and nonobese patients. The aim of this study was to evaluate the prevalence, pattern, and severity of postoperative complications in obese and nonobese surgical patients.

**Methods:** A retrospective review and analysis of adult postoperative complications recorded on an electronic database was conducted. The database covered a period of 4 years and consisted of 7,271 cases of postoperative complications that occurred within 30 days of noncardiac moderate or major surgery. Appropriate data and variables were compared between obese and nonobese patients using the SPSS program.

**Results:** The rate of postoperative complications was 7.7%. Obese patients had a higher prevalence of myocardial infarction ( $P = 0.001$ ), peripheral nerve injury ( $P = 0.039$ ), wound infection ( $P = 0.001$ ), and urinary tract infection ( $P = 0.004$ ). Morbidly obese patients had a higher mortality rate of 2.2% compared with 1.2% for all other patients ( $P = 0.034$ ) and a higher prevalence of tracheal reintubation ( $P = 0.009$ ) and cardiac arrest ( $P = 0.015$ ). Obese patients had higher American Society of Anesthesiologists (ASA) physical status scores than other patients ( $P = 0.001$ ).

**Conclusions:** Obese patients have a significantly higher risk of postoperative myocardial infarction, wound infection, nerve injury, and urinary infection. Obesity is an independent risk factor for perioperative morbidity, and morbid obesity is a risk factor for mortality.

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Postoperative complications occur in 4% of surgical patients and are potentially common in obese patients.<sup>1,2</sup> Obesity is an increasing major public health problem in the developed world. It is the second leading cause of death in the USA,<sup>3</sup> with approximately 300,000 deaths per year and an estimated total annual health cost of \$117 billion.<sup>4</sup> The latest data from the USA National Center for Health Statistics reveal that 30% of adults aged over 20 years are obese: approximately 60 million people.<sup>5</sup> Obese patients have an increased prevalence of

cardiovascular disease, respiratory dysfunction, type-2 diabetes pathology, gastroesophageal reflux, difficult airway, postoperative complications, and difficult regional anesthesia.<sup>2,6</sup> Thus, it is very important for anesthesiologists and surgeons to understand the perioperative implications of these serious problems in obese patients.

Obesity, defined as a body mass index (BMI)  $\geq 30$  kg  $m^{-2}$ , increases the risk of perioperative complications, and morbid obesity (BMI  $\geq 35$  kg  $m^{-2}$ ) is associated with potentially severe complications.<sup>6–9</sup> A study conducted 35 years ago showed a perioperative mortality rate of 6.6% in obese patients and 2.6% in nonobese patients

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following gastroduodenal surgery.<sup>10</sup> However, there is a dearth of recent and reliable studies comparing postoperative complications and/or mortality in obese and nonobese patients. The objective of this study was to evaluate the prevalence, pattern, and severity of postoperative complications in obese and nonobese surgical patients following moderate or major surgery.

## MATERIALS AND METHODS

This was a retrospective review of adult postoperative complications recorded on the University of Michigan Anesthesiology Department database. We merged perioperative data from our National Surgery Quality Improvement Program (NSQIP) database with data from our electronic patient records, including the Centricity anesthesia information system (Centricity, GE Technologies, Waukesha, WI, USA). Data covered a period of 4 years from July 2001 to July 2005. Postoperative complications that occurred within 30 days of surgery were recorded. Experienced nurses reviewed each patient complication record and documented additional information. Data collected and analyzed included age, gender, BMI, preexisting comorbidity, American Society of Anesthesiologists (ASA) physical status score, type of surgery, anesthetic management, complications, and mortality. Complications were recorded under broad terms, namely myocardial infarction, cardiac arrest, respiratory failure, unplanned postoperative intubation, pneumonia, acute renal failure, urinary tract infection, hemorrhage, stroke, coma, peripheral nerve injury, wound infection, septicemia, thromboembolism, and graft/wound breakdown. Patients underwent moderate or major surgery, but there were no cases of cardiac or bariatric surgery. Data analysis was performed using the SPSS program v.13 (SPSS Inc, Chicago, IL, USA). Bivariate analysis was performed using Student's *t*-test and the Levene's test. Differences between groups were compared using Pearson's chi-square test or Fisher's exact test, depending on the sample size of the groups. A *P* value <0.05 was considered statistically significant.

## RESULTS

A total of 7,271 cases of postoperative complications were recorded, constituting 7.7% of all the 94,853 adult surgical procedures performed over the 4-year period. After excluding 498 complication records because of

**Table 1.**  
Type and frequency of complications

Complications	Nonobese (%)	Obese (%)	<i>P</i> value
Myocardial infarction	0.1	0.5	0.001
Wound infection	3.5	6.0	0.001
Peripheral nerve injury	0.1	0.4	0.039
Urinary tract infection	2.6	3.9	0.004
Acute renal failure	0.7	0.9	0.376
Hemorrhage	0.4	0.2	0.176
Cardiac arrest	0.4	0.5	0.545
Coma	0.2	0.2	1.000
Thromboembolism	1.0	0.9	0.588
Graft/wound breakdown	1.1	1.2	0.714
Postoperative 48-hour ventilation	1.7	1.8	0.690
Pneumonia	1.5	1.5	0.831
Stroke	0.1	0.2	0.312
Septicemia	1.2	1.6	0.261
Unplanned intubation	1.1	1.2	0.714
Death	1.3	1.3	1.000

incomplete data, the remaining 6,773 complications were examined and analyzed. There were 2,217 obese patients (32.7%) and 4,556 nonobese patients (67.3%). In the obese group, 993 patients were morbidly obese, constituting 44.8% of all obese cases and 14.7% of all complications. The pattern of complications is shown in Table 1. Obese patients had a higher prevalence of myocardial infarction (*P* = 0.001), peripheral nerve injury (*P* = 0.039), wound infection (*P* = 0.001), and urinary tract infection (*P* = 0.004). The mortality rate was 1.3% in both the obese and nonobese groups. However, morbidly obese patients had a higher mortality rate of 2.2% compared with 1.2% for all other patients (*P* = 0.034). The morbidly obese patients also had a higher prevalence of tracheal reintubation (*P* = 0.009) and cardiac arrest (*P* = 0.015).

The frequency of complications by surgical specialty is shown in Table 2. There was no difference in the prevalence of complications between obese and nonobese patients in terms of surgical specialty. There were no cardiac surgical cases. Patient characteristics are shown in Table 3. A significant majority of patients were ASA 2. Obese and elderly patients had significantly higher ASA physical status scores than other patients (*P* = 0.001). About 83.1% of complications occurred in patients who had general anesthesia versus 16.9% patients who had regional anesthesia. About 86% of obese patients and 82% of the nonobese patients had general anesthesia. There was no significant difference in anesthesia technique between the different ASA physical scores.

**Table 2.**  
Frequency of complications by surgical specialty

Surgical specialty	Nonobese (%)	Obese (%)	Percent of total
Plastics	20.8	23.3	21.6
ENT	19.5	17.3	18.8
Gynecology	18.0	16.4	17.5
Urology	10.7	9.1	10.1
Oncology	8.4	9.1	8.6
Gastrointestinal	3.8	4.2	3.9
Transplant	3.8	4.0	3.9
Endocrine	3.4	4.4	3.7
Thoracic	3.1	2.9	3.1
Trauma/burns	3.1	2.6	2.9
Maxillofacial	1.8	2.5	2.0
Neurosurgery	2.0	2.1	2.0
Vascular	1.3	1.6	1.4
Others	0.3	0.5	0.5

ENT: ear, nose and throat.

**Table 3.**  
Patient characteristics

	Nonobese	Obese	Percent of total
Age			
Adults ≤64 years	n=3318	n=1755	n=5073 (74.9%)
Elderly ≥65 years	n=1223	n=477	n=1700 (25.1%)
Gender			
Female	n=2264	n=1267	n=3531 (52.1%)
Male	n=2277	n=965	n=3242 (47.9%)
ASA class			
1	18.2%	7.2%	14.7%
2	53.6%	59.2%	55.4%
3	24.8%	29.7%	26.4%
4	3.1%	3.7%	3.3%
5	0.3%	0.2%	0.2%

ASA: American Society of Anesthesiologists' physical status class.

## DISCUSSION

The average annual incidence of postoperative complications in the USA is 4%, or 1.25 million surgical patients, with an average annual cost of \$25 billion.<sup>1</sup> The incidence rate of postoperative complications appears to be increasing and may be partly due to the increasing surgical load and the growing elderly and obese populations. These factors are projected to lead to a 25% increase in the number of surgeries, a 50% increase in surgery-related cost, and a 100% increase in postoperative complications.<sup>1,5</sup> The postoperative complication rate of 7.7% in our study probably reflects the complexity of surgery and patients in our tertiary institution.

Obesity is a growing problem in the developed world, especially in the USA. Thirty percent of the adult

population in the USA is obese.<sup>3,5</sup> This study was conducted in a large teaching hospital in the state of Michigan, which is one of the 10 states in the USA with a very high obesity prevalence of more than 25% of the population.<sup>5</sup> Thus, the results of this study may be representative of an obese population in the developed world. Our study showed that 32.7% of complications occurred in obese patients, and this may reflect the proportion of obese patients in the patient population. On the other hand, this percentage of postoperative complications made up of obese patients is much higher than the obesity prevalence rate of 25% in our state or region and may indicate that obese patients constitute a higher proportion of postoperative complications. However, the limitation of data in this retrospective study did not allow conclusive statistical analysis of the possibility of an overall higher prevalence or frequency of postoperative complications in obese patients.

The few previous studies evaluating the impact of obesity on perioperative outcome have produced questionable results, suggesting that obesity is not a risk factor for postoperative complications.<sup>11,12</sup> The studies are questionable, and their methodology limited the possible impact of complications because they excluded many types of surgery and failed to include or analyze all types of postoperative complications. In our study, we analyzed a large database of postoperative complications in adult patients who underwent a large variety of elective and emergency noncardiac surgical procedures performed in a large teaching hospital or tertiary referral center in North America. Our results showed a significantly higher prevalence of postoperative myocardial infarction, peripheral nerve injury, wound infections, and urinary tract infection in obese patients.

Obesity is associated with a higher frequency of cardiovascular disease, such as ischemic heart disease, hypertension, peripheral vascular disease, cardiomyopathy, and heart failure. Our study confirmed a significantly higher risk of myocardial infarction in obese patients compared with nonobese patients, and this outcome from a large cohort of patients undergoing noncardiac surgery is very significant. This finding further proves that it is imperative that obese patients undergo adequate cardiovascular monitoring during the intraoperative and postoperative periods, including patients undergoing minor surgery and patients undergoing procedures under local or regional anesthesia. It also implies that most obese patients may need to undergo mandatory preoperative cardiovascular evaluation, including electrocardiography, especially in the presence of a positive history or symptoms of cardiovascular disease.

The higher prevalence of peripheral nerve injury that was observed in the obese patients may be related to prolonged surgery and associated prolonged immobilization, with significant pressure on vulnerable peripheral nerves by the obese body. Peripheral nerves that are prone to pressure injury, such as the ulnar nerve at the elbow or the peroneal nerves at the knee, should be adequately protected by pressure relief devices. In addition, upper- or lower-limb abduction should be minimized and performed carefully to avoid traction injury of the brachial plexus or lumbosacral plexus nerves. Extra care should be taken to prevent nerve injury in obese patients with diabetes who may have peripheral neuropathy and/or peripheral vascular disease.

Our study confirmed that wound infections are commoner in the obese, and this has been shown to be associated with reduced subcutaneous tissue perfusion and oxygenation in these patients.<sup>7</sup> Hyperglycemia is common in obese patients and may predispose to surgical wound infections. However, all our patients invariably received strict perioperative glycemic control according to hospital protocol. Insulin infusion was administered appropriately based on routine blood glucose levels measured in the immediate preoperative or perioperative period. Glycemic control is a key critical marker that is closely monitored in our anesthesia quality control. In addition, all our patients received standard perioperative antibiotic prophylaxis. This high standard of care minimizes the effects of confounding factors and suggests that the occurrence of wound infections in our study is valid and associated with obesity.

Further analysis of wound infection complications in our study revealed that both superficial and deep wound infection types were significantly commoner in obese patients. Most surgeries were plastics and otorhinolaryngology, and these are mostly clean surgical wounds, with expected perioperative infection occurrence rates of less than 1.5%. Although a small proportion of these types of surgeries are clean-contaminated wounds, nonetheless, the significant incidence of wound infections in our study population may be associated with obesity as a major predisposing factor. This probable high risk of wound infections in obese patients indicates that extra care and monitoring of surgical wounds should be ensured in these patients.

Postoperative urinary tract infection is a common complication of urinary tract instrumentation, surgery, or manipulation, particularly in gynecologic and urologic surgery. The higher prevalence of this complication that was observed in obese patients may be related to the higher female population of obese patients, which implies

a higher frequency of gynecologic surgery in obese patients with the associated higher risk of postoperative urinary tract infection. Moreover, our results showed a higher frequency of complications from gynecology and urology relative to other surgical specialties, and this may be related to a high frequency of urinary tract infections and hemorrhage. The higher frequency of complications from plastic surgery and ear-nose-throat surgery may be associated with wound infections, graft/wound breakdown, or hemorrhage. The lower frequency of postoperative complications in patients who underwent relatively complex surgery (such as transplant, thoracic, trauma, maxillofacial, vascular, neurosurgery) may be due to the higher level of attention provided during their perioperative care and/or the postoperative intensive care usually provided. It may also indicate that a lower number of these surgeries are performed relative to plastic, gynecologic, or urologic surgery.

The Persian physician Avicenna (980–1037 AD), wrote that “severe obesity restricts the movements and maneuvers of the body...these people are at risk of sudden death.”<sup>13</sup> The limited power of this retrospective study does not allow determination of mortality risk in obese patients, but the significantly higher mortality and cardiac arrest rate in the morbidly obese may indicate this possibility. In addition, our results showed that obese patients are classified as higher ASA scores based on their obesity and comorbidities. These findings suggest that obesity is a comorbid risk factor that elevates a patient’s ASA score. Although ASA score is not a measure of surgical risks, it is a reliable measure of comorbidity, and our results, therefore, imply that obesity is associated with increased degree and risk of perioperative morbidity or complications. It is arguable that the surgical complications associated with obesity may not be due to the obesity itself but to its comorbidities, such as sleep apnea. However, it is difficult to separate the complications of obesity from those of its comorbidities. Many authorities, including the Centers for Disease Control, USA, describe and label obesity as the actual cause of death in all patients who die from obesity-related comorbidities.<sup>3</sup> Our retrospective study has data limitations that prevent further analysis, and it is unlikely that a prospective study would provide clearer information or precise delineations.

Most complications occurred in patients who had general anesthesia, but this appears to be unrelated to anesthesia. Anesthesia technique was mainly influenced by type of surgery more than ASA score. Further studies are required to examine the influence of regional and general anesthesia on perioperative complications in obesity. We recommend that the best anesthetic

technique should be provided to individual obese patients to ensure optimal perioperative outcome. It is very important to ensure close perioperative monitoring of the cardiorespiratory system and glycemic control, even in low-risk surgery. Postoperative monitoring should be continued in obese patients with suboptimal clinical parameters. Although ambulatory surgery is expanding and increasingly being provided to morbidly obese patients, we recommend that ambulatory surgical patients who are morbidly obese should undergo a 23-hour hospital stay for postoperative monitoring because of the higher risk of complications. Preoperative identification of risk factors in obese patients can be ensured by paying attention to morbidly obese patients and obese patients with comorbidities. Surgeons and family physicians must play an important role in identifying these potentially difficult patients and referring them to the anesthesia clinic for further evaluation and anesthesia plan. Detailed information should be obtained from, and appropriate risk information provided to, patients.

In conclusion, obese patients have a significantly higher risk of myocardial infarction, wound infection, nerve injury, and urinary tract infection. Obesity may be an independent factor that increases the risk of perioperative morbidity and, to a lesser extent, mortality. Every effort was made to minimize errors and data limitations in this retrospective study.

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