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Anesthesia for non-cardiac surgery in obese patients in a secondary hospital located in an urban-rural area: A retrospective cohort study

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ABSTRACT

Background and Objectives: Anesthesia in obese patients is associated with increased morbidity and mortality but has never been studied in our setting. This study investigated the complications associated with different grades of obesity.

Methods: This paper was a retrospective cohort study conducted from January 2011 to December 2024 at Monkole Hospital. Perianesthetic data from all obese adult patients anesthetized for non-cardiac surgery were collected and analyzed with SPSS 26.0 using appropriate statistical tests for $p < 0.05$. Ethical guidelines were respected.

Results: Of 13,226 anesthetized patients, 1,668 were obese (12.6%), including 1,162 (69.7%) moderately obese, 384 (23%) severely obese, and 122 (7.3%) morbidly obese. Cardiovascular comorbidities, difficulties with intubation and venous access, and hyperglycemia predominated in the morbidly obese. The morbidly obese patients significantly more frequently underwent major surgery and general anesthesia, using intubation, propofol, and suxamethonium. Intraoperative complications were more frequent in morbidly obese ORa 2.98 (2.29–3.86) and influenced by Mallampati grades II to IV ORa 1.63 (1.06–2.66), ASA4 class ORa 2.55 (1.06–6.24), and major surgical procedure ORa 2.70 (2.06–3.55). Obesity grade was not associated with mortality or postoperative complications, which included the following factors: the presence of a history of hematological disease (ORa 2.79 (1.7–3.78), ASA class 4 (ORa 3.09 (1.32–9.28), severe anemia (ORa 3.12 (2.11–4.21), hyperglycemia (ORa 3.92 (1.27–5.07), and major surgery (ORa 2.88 (1.84–3.85).

Conclusion: This study indicates that obese patients of all grades benefit from anesthetic procedures in our setting, and we need to improve their management. Intraoperative complications are more frequent in cases of morbid obesity, requiring us to double our attention in this type of patient.

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Introduction

Obesity is a real public health problem, with 890 million adults over the age of 18 estimated to be obese in 2022. At least half of the world's population could be affected by obesity by 2030 [1], with the risk that they will increasingly benefit from anesthetic procedures. Anesthesia in this context is accompanied by an increase in perioperative complications [2]. The World Health Organization (WHO) defines

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obesity as excess body fat that can have harmful consequences on health [3]. In clinical practice, it is characterized by a body mass index (BMI) ≥ 30 kg/m2. It is grouped into 4: overweight BMI between 25 and 29.99, moderate obesity (BMI between 30 and 34.99, severe obesity BMI between 35 and 39.99 and morbid obesity BMI greater than or equal to 40 [4]. The respiratory, cardiovascular, metabolic, gastrointestinal, and thromboembolic disorders and pharmacological modifications caused by obesity are responsible for significant peri-anesthetic morbidity and mortality [5–7]. In addition, numerous comorbidities such as obstructive sleep apnea syndrome (OSA), diabetes, and high blood pressure are often associated with obesity and increase the risk of perioperative complications. The specific medical and surgical problems of obesity are now presenting themselves to anesthetists even in countries with limited resources and not only in high-income countries [8,9]. In Africa, the analysis shows that in the ten countries concerned, the prevalence of obesity will be between 5 and 16.5% in children and 13.6% and 31% in adults [10]. Thus, perianesthetic management of obese patients, particularly in the context of limited resources, becomes a major challenge. Cardiovascular complications are more frequent perioperatively in obese patients: a high incidence of coronary artery disease, arrhythmias, and sudden death; and a high risk of stroke and venous thromboembolic disease [11–14]. The frequency of respiratory complications is high: difficulty or even impossibility of tracheal intubation, difficult mask ventilation, rapid desaturation, very high insufflation pressures, and respiratory depression postoperatively [7,15–18]. In orthopedic prosthetic surgery, the risk of postoperative complications increases by 22 and 25%, respectively, for knee and hip prostheses [16]. After colonic surgery, there is a 37% increase in the risk of postoperative complications, including venous thrombosis and parietal infections [15]. In the USA, Postlethwait [19] reported a higher incidence of atelectasis, wall infections, and thrombophlebitis after gastric ulcer surgery in obese patients. Mortality was 6.6% in the obese group compared to 2.7% in the non-obese group. The Bamgbade study [20], conducted in 2007 over a 4-year period, found that myocardial infarction and postoperative infections were more frequent, with a higher mortality rate of 2.2% in the morbidly obese compared to 1.2% in the non-obese. Studies on anesthesia for obese patients in sub-Saharan Africa are rare. Reported frequencies of pre-anesthetic consultation in sub-Saharan African countries vary from 13.5% to 40%. [21,22].

In the Democratic Republic of Congo, Kasereka [23] in 2023 reported a prevalence of obesity of 34.6% in 555 adults in two health zones (Lemba and Limete) of the city of Kinshasa. Musung [24] conducted a study in a school environment in Lubumbashi among 5341 adolescents aged 10 to 19 years, finding that the prevalence of overweight was 8% and obesity was 1%.

Overweight (10.7% girls versus 5% boys) and obesity (1.5% versus 0.4%) significantly affected girls more than boys. In the operating room, Mbombo [25], in a study on anesthesia in the elderly, found that obesity affected 11.9% of patients. Mukuna [26], in a cohort study of diabetic versus non-diabetic patients receiving anesthesia, found a frequency of 19.8%. There appears to be an increase in the prevalence of obesity and their attendance at the operating room, justifying that studies on the anesthesia of this type of patient should be conducted in our environment. This study was conducted to determine the morbidity and mortality associated with anesthesia for non-cardiac surgery in obese patients, categorized by their level of obesity.

Materials and Methods

We conducted a retrospective cohort study to evaluate perioperative complications in obese patients undergoing non-cardiac surgery. The study took place at the Monkole Hospital Center, a second-level facility serving as the general referral hospital for the Mont Ngafula I urban-rural health zone. The study covered the period from January 1, 2011, to December 31, 2024, including patient recruitment, exposure (surgery and anesthesia), and follow-up during hospitalization.

Study population

All patients aged 18 years or older with a body mass index (BMI) ≥ 30 kg/m^2 who received anesthesia for non-cardiac surgery during the study period qualified for eligibility. Patients were recruited consecutively and exhaustively from the hospital's anesthesia registry, and no patients meeting the inclusion criteria were excluded.

Patients were grouped according to the severity of obesity:

- Moderate obesity: BMI 30–34.99 kg/m^2
- Severe obesity: BMI 35–39.99 kg/m^2
- Morbid obesity: BMI ≥ 40 kg/m^2

Variables

We examined several categories of variables:

- Sociodemographic: age, sex, mother tongue according to the country's four national languages, and residence in relation to the health zone.
- Clinical: obesity grade, comorbidities, Mallampati and Cormack grades, ASA classification, thromboembolic risk, urgency of surgery.
- Paraclinical: hemoglobin, platelets, leukocytes, serum creatinine, prothrombin rate, activated partial thromboplastin time, blood glucose, and cardiac ultrasound if available.
- Anesthetic and surgical: difficulty with venous access, tracheal intubation, or regional anesthesia; premedication; anesthetic drugs and duration; surgical complexity and duration; use of antibiotics and postoperative morphine.
- Outcomes: perioperative complications and in-hospital vital status.

Complications were categorized as follows:

- Intraoperative: difficulties with venous access or intubation, desaturation, arrhythmias, allergic reactions, hypotension/hypertension, hemorrhage, transfusion, aspiration, organ injury.
- Postoperative: myocardial ischemia/infarction, arrhythmias, stroke, pulmonary embolism, sepsis/septic shock, anemia/transfusion, renal failure, multi-organ dysfunction, allergic reactions, cardiac arrest, respiratory distress, neurological deficits, urinary retention, nausea and vomiting, surgical site infections, hemorrhage, surgical revision.

Surgical procedures were classified as major or minor. Major procedures included laparotomies (including cesarean sections), hysterectomies, myomectomies, pelvic and limb osteosynthesis, thoracotomies, supra- and sub-gonadal amputations, and prolonged debridements, whereas all other procedures were considered minor.

Data sources and collection

Data were extracted from the hospital anesthesia database by the principal and secondary investigators. Clinical and laboratory measurements were standardized to ensure consistency and comparability across patients and minimize information bias.

Sample size calculation

The sample size will be calculated using Fisher's formula:

$n \geq \text{deff} \times \frac{z^2 \times (p)(1-p)}{d^2} \times \text{CPF} \times$ CPF where n = Sample size; z = 1.96 (confidence coefficient); p = assumption about the population proportion, equal to 0.5; d = the desired absolute precision of the estimate / half the width of the desired confidence interval, equal to 0.01; deff = the sampling effect in the case of public health sampling, equal to 2; CPF = the finite population correction, a correction applied to the sample size calculation when the size of the universe is known (or assumed to be less than a given value) and the sample represents more than 5% of the universe.

$$n \geq \frac{2 \times 1{,}96^2 \times (0{,}50)(1-0{,}50) \times 0{,}05}{(0{,}01)^2} = 960$$

The sample size after calculation was 960 by incorporating 20% of non-responders, the sample size is 1152 patients. Therefore, we need to include approximately 1152 obese patients.

Statistical analyses

Data were compiled in Excel 2010 and analyzed using IBM SPSS v25. Continuous variables were described as means ± SD or medians (IQR), while categorical variables were presented as percentages. Group comparisons were performed using one-way ANOVA with Bonferroni post hoc tests, Kruskal-Wallis tests, Pearson's chi-square, or Fisher's exact tests, as appropriate.

Factors associated with intraoperative and postoperative complications were first assessed using univariate logistic regression, and variables significantly associated in univariate analysis were included in multivariate logistic regression models to estimate adjusted odds ratios (ORs) with 95% confidence intervals. Statistical significance was defined as $p < 0.05$. Missing data were minimal, and no imputation was required.

Bias

To minimize selection bias**,** all eligible patients were included consecutively. Information bias was reduced through the use of standardized data extraction forms and definitions across all variables.

Ethical and regulatory aspects

The management of the hospital concerned had given its authorization. The study protocol was approved by the Scientific Committee of the

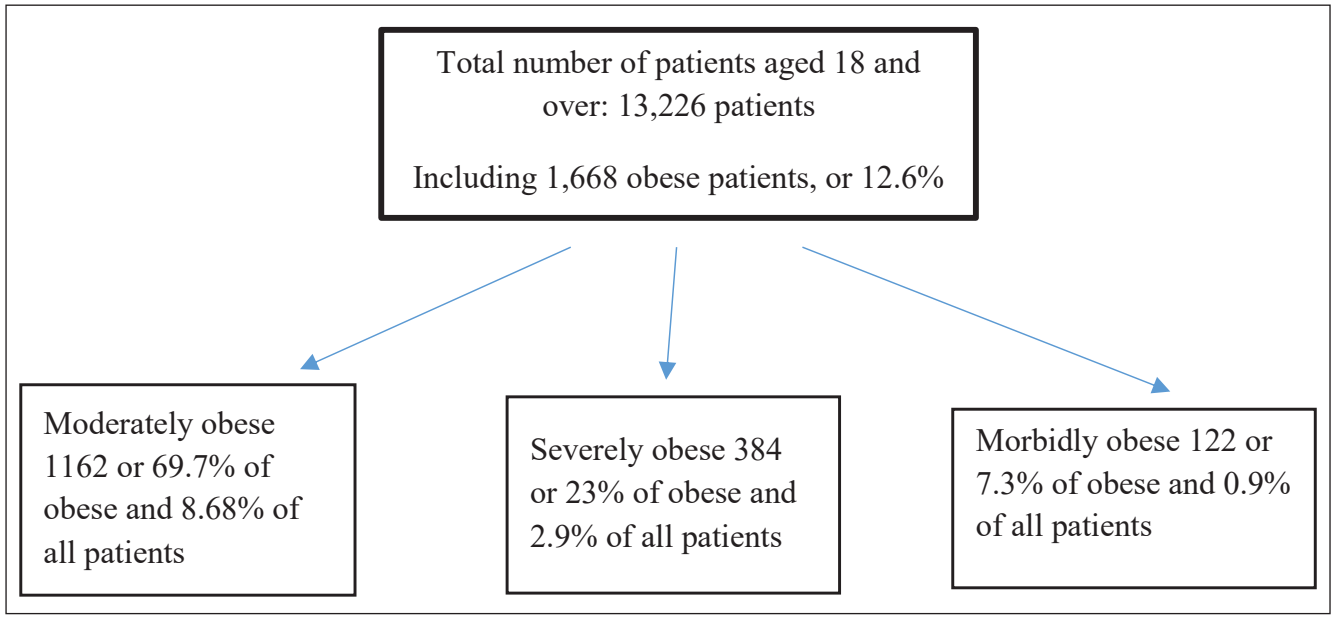

Figure 1 Patient flow diagram.

Table 1. General patient characteristics.

Variables	Moderate obesity (*n* = 1162) *n* (%)	Severe obesity (*n* = 384) *n* (%)	Morbid obesity (*n* = 122) *n* (%)	All patients (*n*=1668) *n* (%)	*p*-value
Age (years), mean ± SD	39.7 ± 12.5	40.7 ± 11.8	40.0 ± 11.3	39.9 ± 12.2	0.981
Age group					
18–59 years	1044 (89.8)	347 (90.4)	110 (90.2)	1501 (90.0)	
≥60 years	118 (10.2)	37 (9.6)	12 (9.8)	167 (10.0)	
Sex					<0.001
Male	150 (12.9)	26 (6.8)	4 (3.3)	180 (10.8)	
Female	1012 (87.1)	358 (93.2)	118 (96.7)	1488 (89.2)	
Native language					0.542
Luba	347 (29.9)	109 (28.4)	38 (31.1)	494 (29.6)	
Kongo	493 (42.4)	142 (37.0)	46 (37.7)	681 (40.8)	
Swahili	209 (18.0)	92 (24.0)	32 (26.2)	333 (20.0)	
Ngala	106 (9.1)	41 (10.7)	6 (4.9)	153 (9.2)	
Stranger	7 (0.6)	0 (0.0)	0 (0.0)	7 (0.4)	
Payment for care					0.013
Company	644 (55.4)	181 (47.1)	70 (57.4)	895 (53.7)	
Patient himself	518 (44.6)	203 (52.9)	52 (42.6)	773 (46.3)	
Residence					0.229
Health Zone	271 (23.3)	98 (25.5)	22 (18.0)	391 (23.4)	
Outside Health Zone	891 (76.7)	286 (74.5)	100 (82.0)	1277 (76.6)	
Surgical specialty					0.223
Obstetrics	644 (55.4)	173 (45.1)	46 (37.7)	863 (51.7)	
Gynecology	188 (16.2)	78 (20.3)	34 (27.9)	300 (18.0)	
General and visceral surgery	178 (15.3)	90 (23.4)	30 (24.6)	298 (17.9)	
Orthopedics	83 (7.1)	29 (7.6)	10 (8.2)	122 (7.3)	
Urology	48 (4.1)	8 (2.1)	0 (0.0)	56 (3.4)	
Others	21 (1.8)	6 (1.6)	2 (1.6)	29 (1.7)	

Table 2. Clinical characteristics.

Variable	Moderate obesity *N* = 1162(%)	Severe obesity *N* = 384(%)	Morbid obesity *N* = 122(%)	All patients *N* = 1668(%)	*p*
BMI (Kg/m²)	31.9 ± 1.7	37.5 ± 2.3	43.3 ± 3.5	34.0 ± 4.0	0.000
Cardiovascular comorbidity	375 (32.3)	150 (39.1)	46 (37.7)	571 (34.2)	0.037
Respiratory comorbidity	72 (6.2)	12 (3.1)	6 (4.9)	90 (5.4)	0.059
Neurological comorbidity	35 (3.0)	9 (2.3)	4 (3.3)	48 (2.9)	0.805
Hepato-digestive comorbidity	111 (9.6)	38 (9.9)	8 (6.6)	157 (9.4)	0.540
Hematological history	110 (9.5)	22 (5.7)	8 (6.6)	140 (8.4)	0.057
Diabetes mellitus	84 (7.2)	114 (29.7)	40 (32.8)	238 (14.3)	<0.001
Alcohol consumption	377 (32.4)	150 (39.1)	44 (36.1)	571 (34.2)	0.055
Mallampati grade					<0.001
I	539 (46.4)	139 (36.2)	42 (34.4)	720 (43.2)	
II	525 (45.8)	190 (49.5)	40 (32.8)	755 (45.3)	
III	96 (8.2)	51 (13.2)	25 (20.5)	172 (10.3)	
IV	2 (0.1)	4 (1.0)	15 (12.3)	21 (1.2)	
Cormack grade					0.001
I	185 (79.4)	72 (76.6)	18 (50.0)	275 (75.8)	
II	39 (16.7)	19 (20.2)	18 (50.0)	76 (20.9)	
III	9 (3.9)	3 (3.2)	0 (0.0)	12 (3.3)	
Difficult venous access	72 (6.2)	52 (13.5)	44 (36.1)	168 (10.1)	<0.001
Thromboembolic risk	290 (25.0)	120 (31.3)	36 (29.5)	446 (26.7)	0.042
ASA class					<0.001
ASA 2	997 (85.8)	248 (64.6)	36 (29.5)	1281 (76.8)	
ASA 3	141 (12.1)	133 (34.6)	86 (70.5)	360 (21.6)	
ASA 4	24 (2.1)	3 (0.8)	0 (0.0)	27 (1.6)	

Legend: BMI: Body Mass Index, ASA = American Society of Anesthesiologists.

Department of Anesthesia and Intensive Care and the Ethics Committee of the School of Public Health, under the number ESP/CE/15/2025. The principles of anonymity and confidentiality were respected in accordance with the Helsinki Convention. The study did not receive any external funding, and we have no conflicts of interest.

Results

Patient flow diagram

Figure 1 presents the patient flow diagram. During the study period, 13,226 patients were anesthetized, of which 11,558 were non-obese, and 1,668 were obese, or 12.6%. All 1,668 patients were selected and grouped into three groups: moderately obese (1,162, or 69.7% of obese patients and 8.68% of all patients), severely obese (384, or 23% of obese patients and 2.9% of all patients), and morbidly obese (122, or 7.3% of obese patients and 0.9% of all patients).

General patient characteristics

Table 1 presents the general patient characteristics.

The mean age of the patients was 39.9 years, with no significant difference between the three groups. The three types of obesity predominated among women, and there were more morbidly obese patients whose costs were covered by their company.

Clinical characteristics

The clinical characteristics of the patients are presented in Table 2.

Body mass index was significantly higher in the morbidly obese group. Cardiovascular comorbidities and thromboembolic risk predominated in severe obesity; diabetes mellitus, Mallampati grade III and IV, difficult venous access, and ASA class 3 were significantly more frequent in morbidly obese patients.

Table 3. Paraclinical characteristics of the patients.

Variable	Moderate obesity (*n* = 1162)	Sevre obesity (*n* = 384)	Morbid obesity (*n* = 122)	All patients (*n* = 1668)	*p*
Hemoglobin (g/dl) (Mean ±SD)	11.3±1.8	11.4±1.8	11.2±1.6	11.3±1.8	
Anemia					0.410
Severe	16 (1.4)	4 (1.1)	0 (0.0)	20 (1.3)	
Moderate	415 (37.5)	124 (33.6)	40 (33.3)	579 (36.3)	
Normal	676 (61.1)	241 (65.3)	80 (66.7)	997 (62.5)	
Platelet counts/mm^3 (Median)	229.0 (186.0-279.0)	252.0 (192.0-299.0)	258.5 (232.5-306.0)	236.0 (189.0-286.0)	0.003
Low platelet	120 (10.8)	27 (7.5)	6 (5.4)	153 (9.6)	0.036
Normal	975 (87.5)	321 (88.9)	104 (92.9)	1400 (88.2)	
High Platelet	19 (1.7)	13 (3.6)	2 (1.8)	34 (2.1)	
PR in % (mean)	90.6±32.0	88.7±20.8	92.8±25.4	90.3±29.5	0.467
PR abnormal	92 (10.8)	33 (12.8)	4 (4.3)	129 (10.7)	0.056
aPTT in sec. (X)	33.1±7.8	32.4±5.3	39.0±5.1	33.1±7.3	0.472
aPTT in abnormal	77 (11.9)	22 (11.3)	8 (10.8)	107 (11.7)	0.985
Mean creatinine	0.80 (0.66-1.02)	0.70 (0.60-0.92)	0.70 (0.60-1.00)	0.80 (0.60-1.00)	0.265
Creatinine abnormal	42 (13.7)	13 (10.3)	0 (0.0)	55 (11.8)	0.046
Mean serum glucose (mg/dl)	103.0 (84.3-154.3)	117.0 (84.0-154.0)	111.0 (81.0-133.0)	106.0 (84.0-154.0)	0.607
Hyperglycemia	47 (22.5)	30 (34.5)	14 (38.9)	91 (27.4)	0.028
Leukocytes (mean)	6.96 (5.64-8.63)	6.96 (54.49-8.89)	7.01 (5.89-9.09)	6.97 (5.64-8.73)	0.213
Abnormalities on cardiac ultrasound	28 (71.8)	20 (87.0)	2 (100.0)	50 (78.1)	0.295

Hb = hemoglobin, X = mean, SD = standard deviation, aPTT = activated partial thromboplastin time, PR = prothrombin rate.

Paraclinical characteristics

Table 3 presents the paraclinical characteristics of the patients.

Low platelet was more frequent in moderate obesity, and hyperglycemia was more common in morbid obesity.

Intraoperative characteristics

Table 4 presents the intraoperative characteristics.

General anesthesia with tracheal intubation was more commonly used in morbidly obese patients, and locoregional anesthesia in moderately obese patients. Ketamine was less commonly used in all three groups, while propofol, suxamethonium, and postoperative morphine were more commonly used, especially in morbidly obese patients. Surgery was often major in moderately obese patients. Specialists performed the surgical procedure more often in morbidly obese patients. The procedure was often scheduled in morbidly obese patients, with a significant difference.

Intra- and postoperative complications

Intra- and postoperative complications are presented in Table 5.

Statistical tests were not performed due to zero patients for some variables. Intraoperative complications occurred in 16.1% of cases. Anesthetic complications were relatively more frequent in morbidly obese patients. Postoperative complications were present in 4.3% and were slightly more frequent in severely obese patients. Overall mortality was 0.6%, 0.68% in moderately obese patients, 0.52% in severely obese patients, and zero in morbidly obese patients.

Factors associated with complications

Factors associated with intraoperative complications

Table 6 presents the factors associated with intraoperative complications.

In multivariate analysis, severe obesity (ORa 2.65 (1.70-4.12), morbid obesity (ORa 2.98 (2.29-3.86), Mallampati grades II to IV (ORa 1.63 (1.06-2.66), ASA4 class (ORa 2.55 (1.06-6.24), and major

Table 4. Intraoperative characteristics.

Variable	Moderate obesity *N* = 1162(%)	Sevre obesity *N* = 384(%)	Morbid obesity *N* = 122(%)	All patients *N* = 1668(%)	*p*
Premedication	22 (2.0)	4 (1.1)	0 (0.0)	26 (1.6)	0.264
Anesthesia technique					<0.001
LRA	780 (67.1)	215 (56.0)	60 (49.2)	1055 (63.2)	
GA without intubation	143 (12.3)	72 (18.8)	22 (18.0)	237 (14.2)	
GA with intubation	239 (20.6)	97 (25.3)	40 (32.8)	376 (22.5)	
Hypnotics					<0.001
Ketamine	34 [3]	6 (1.6)	2 (1.6)	42 (2.6)	
Propofol	341 (29.3)	156 (40.6)	60 (49.2)	557 (33.4)	
Isoflurane	166 (14.3)	50 (13.0)	22 (18.0)	238 (14.3)	
Sevoflurane	89 (7.7)	59 (15.4)	30 (24.6)	178 (10.7)	
Curares					<0.001
Suxamethonium	181 (15.6)	86 (22.4)	40 (32.8)	307 (18.4)	
Non-depolarizing	45 (3.9)	5 (1.3)	0 (0.0)	50 (3.0)	
Morphine for POP	29 (2.5)	20 (5.2)	10 (8.2)	59 (3.5)	0.001
Main Procedure					0.003
Major	805 (69.3)	236 (61.5)	72 (59.0)	1113 (66.7)	
Minor	357 (30.7)	148 (38.5)	50 (41.0)	555 (33.3)	
Surgeon					0.016
Specialist	726 (62.5)	245 (63.8)	92 (75.4)	1063 (63.7)	
Non-specialist	436 (37.5)	139 (36.2)	30 (24.6)	605 (36.3)	
Anesthesiologist					0.035
Specialist	963 (82.9)	333 (86.7)	110 (90.2)	1406 (84.3)	
Non-specialist	199 (17.1)	51 (13.3)	12 (9.8)	262 (15.7)	
Anesthetic duration	75.0 (55.0-105.0)	75.0 (50.0-115.0)	80.0 (60.0-110.0)	75.0 (55.0-105.0)	0.185
<2 hours	934 (80.4)	293 (76.3)	94 (77.0)	1321 (79.2)	
≥2 hours	228 (19.6)	91 (23.7)	28 (23.0)	347 (20.8)	
Degree of Emergency					0.013
Scheduled	777 (66.9)	272 (70.8)	96 (78.7)	1145 (68.6)	
Emergency	385 (33.1)	112 (29.2)	26 (21.3)	523 (31.4)	

Legend: LRA = locoregional anesthesia, GA = general anesthesia, POP = postoperative pain.

surgery (ORa 2.70 (2.06-3.55)) were factors associated with intraoperative complications.

Factors associated with postoperative complications

Table 7 presents the factors associated with postoperative complications.

In multivariate analysis, the presence of a history of hematological disease (ORa 2.79 (1.7-3.78), ASA class 4 (ORa 3.09 (1.32-9.28), severe anemia (ORa 3.12 (2.11-4.21), hyperglycemia (ORa 3.92 (1.27-5.07), and major surgery [ORa 2.88 (1.84-3.85)] were factors associated with postoperative complications.

Discussion

This study was carried out to determine morbidity and mortality in anesthesia for non-cardiac surgery in obese patients of different grades. It found that obesity affected 12.6% of patients, of whom 8.68% were moderately obese, 2.9% severely obese, and 0.9% morbidly obese. Patients with any grade of obesity were predominantly female. ASA III, diabetes mellitus, Mallampati grades II and IV, and difficult venous access were significantly more frequent in morbidly obese patients. Intraoperative complications occurred in one in six patients, and anesthetic complications were more frequent in the morbidly obese. Postoperative complications

Table 5. Intra- and postoperative complications.

Variables	Moderate obesity *n*=1162(%)	Severe obesity *n*=384(%)	Morbid obesity *n*=122(%)	All patients *n*=1668(%)
Intraoperative Complications	203 (17.46)	46 (11.97)	20 (16.39)	269 (16.1)
Surgical	12 (1.03)	5 (1.29)	0 (0)	17 (1)
Medical	2 (0.17)	0 (0)	0 (0)	2 (0.1)
Anesthetic	189 (16.26)	41 (10.6)	20 (16.39)	250 (14.9)
Hypotension	150 (12.9)	31 (0.8)	16 (13.1)	197 (11.8)
Poor Block	17 (1.4)	1 (0.2)	2 (1.6)	20 (1.2)
Anxiety	13 (1.1)	4 (1)	1 (0.8)	17 [1]
Postoperative Complications	55 (4.73)	20 (5.2)	3 (2.45)	73 (4.3)
Surgical	13 (1.11)	6 (1.56)	2 (1.6)	21(1.2)
SSI	7 (0.6)	5 (1.3)	1 (0.8)	13 (0.7)
Medical	24 (2.06)	6 (1.56)	1 (0.8)	31 (1.8)
PE	2 (0.1)	1 (0.2)	0 (0)	3 (0.18)
Anesthetic	10 (0.86)	6 (1.56)	0 (0)	16 (0.9)
Pruritus	6 (0.5)	5	0 (0)	11 (0.6)
Death	8 (0.68)	2 (0.52)	0 (0)	10 (0.6)

Legend: SSI = surgical site infection, PE = pulmonary embolism.

Table 6. Factors associated with intraoperative complications.

Variables	n	Intraoperative complication	Univariate analysis		Mulitvariate analysis	
			p	OR (CI 95%)	*p*	ORa (CI 95%)
Sex						
Male	180	20.6%		1		1
Female	1488	31.4%	0.003	1.77 (1.21-2.57)	0.769	1.06 (0.70-1.61)
Obesity Class						
Moderately Obese	1162	17.46%		1		1
Severely Obese	384	11.97%	<0.001	2.37 (1.62-3.48)	<0.001	2.65 (1.70-4.12)
Morbidly Obese	122	16.9%	<0.001	2.68 (2.20-3.41)	<0.001	2.98 (2.29-3.86)
Mallampati grade						
I	720	24.9%		1		1
II-IV	948	34.3%	<0.001	1.58 (1.27-1.96)	0.015	1.63 (1.06-2.66)
ASA Class						
ASA 2	1281	27.5%		1		1
ASA 3	360	38.1%	0.002	1.62 (1.27-2.07)	0.891	1.02 (0.77-1.35)
ASA 4	27	55.6%	<0.001	3.30 (1.53-7.12)	0.037	2.55 (1.06-6.24)
Surgical Procedure						
Minor	555	18.7%		1		1
Major	1113	35.9%	<0.001	2.43 (1.90-3.11)	<0.001	2.70 (2.06-3.55)

Legend: ASA = American Society of Anesthesiologists.

were present in 4.3% and were slightly more frequent in severely obese patients. Overall mortality was 0.6% or 0.68% in moderately obese patients, 0.52% in severely obese patients, and zero in morbidly obese patients. High Mallampati and ASA scores, severe or morbid obesity, and major surgery were associated with intraoperative complications. Hematological history (previous transfusion), ASA class 4, severe anemia, hyperglycemia, and major surgery were factors associated with postoperative complications.

Table 7. Factors associated with postoperative complications.

Variables	n	Postoperative complication	Univariate analysis		Mulitvariate analysis	
			p	OR(CI 95%)	*p*	ORa (CI 95%)
Obesity Class						
Moderate Obese	1162	4.73%		1		
Severe Obesity	384	5.2%	0.441	0.80 (0.46-1.40)	-	-
Morbid Obesity	122	2.45%	0.433	1.22 (0.74-2.01)	-	-
Cardiovascular Comorbidities						
No	1097	15.3%		1		1
Yes	571	22.4%	<0.001	1.60 (1.24-2.07)	0.310	1.60(0.64-3.99)
History of Hematology						
No	1528	16.9%		1		1
Yes	140	27.1%	0.003	1.83 (1.23-2.72)	0.005	2.79(1.70-3.78)
ASA Class						
ASA 2	1281	15.6%		1		1
ASA 3	360	20.6%	0.027	1.40 (1.04-1.88)	0.122	1.87 (0.52-2.72)
ASA 4	27	81.5%	<0.001	3.78 (1.90-6.54)	0.004	3.09 (1.32-9.28)
Anemia						
Normal	997	15.4%		1		1
Moderate	579	20.4%	0.013	1.40 (1.08-1.83)	0.473	1.40 (0.55-3.51)
Severe	20	40.0%	0.005	3.65 (1.47-9.08)	<0.001	3.12 (2.11-4.21)
Prothrombin rate						
Normal	1078	17.3%		1		1
Abnomal	129	26.4%	0.012	1.72 (1.13-2.62)	0.258	2.37 (0.53-10.60)
Glycemia						
Normal	241	14.1%		1		1
Hyperglycemia	91	26.4%	0.010	2.18 (1.21-3.94)	0.017	3.92 (1.27-5.07)
Creatinine						
Normal	411	36.4%		1		1
Pathological	55	19.0%	0.004	2.44 (1.34-4.46)	0.691	1.38 (0.28-2.85)
Surgical Procedure						
Minor	555	15.1%		1		1
Major	1113	19.0%	0.049	1.32 (1.01-1.74)	0.020	2.88 (1.84-3.85)
Degree of emergency						
Scheduled	1145	15.5%		1		1
Emergency	523	22.6%	0.001	1.58 (1.22-2.05)	0.817	1.16 (0.32-4.17)
Transfusion						
No	1416	16.5%		1		1
Yes	252	24.6%	0.002	1.65 (1.20-2.27)	0.151	2.57 (0.71-9.34)

Legend: ASA = American Society of Anesthesiologists.

As other authors have reported [21,22], these results indicate that obesity of all grades affects patients undergoing anesthesia and is becoming a real problem even in developing countries [27]. However, the proportion of morbidly obese patients remains lower than in developed countries [28]. Obesity affects women more than men, in line with data from other authors [29–31]. Hormones, particularly estrogen, slower metabolism, and pregnancy explain the predominance of obesity in women.

Diabetes mellitus, difficulty of intubation predicted by a high Mallampati grade, cardiovascular comorbidities, and difficulty with venous access, present in all obese patients, predominated in

morbidly obese patients, corroborating data from the literature. Obesity is a known factor associated with the onset of cardiovascular disease, diabetes, and respiratory illness [32]. There is a proportional increase in the risk of mortality from cardiovascular disease and BMI [33]. Propofol was preferentially used, especially in morbidly obese patients, because of its effective elimination kinetics as recommended in this type of patient [34]. Rapid elimination drugs prevent delayed recovery and postoperative respiratory depression and may explain the low incidence of postoperative complications and mortality in morbidly obese patients.

Intraoperative complications, particularly those related to anesthetics, were relatively more frequent in morbidly obese patients, corroborating the data in the literature [32]. Indeed, difficulties in airway management and vascular access, as well as cardiovascular comorbidities, are more frequent in morbidly obese patients, which explains this finding [32]. Arterial hypotension was the most frequent intraoperative complication in the three obesity groups. This finding may be explained using spinal anesthesia and propofol, all of which are associated with arterial hypotension [35,36]. Mortality among the morbidly obese patients was nil, probably due to their very low representation. Nevertheless, postoperative complications were similar in cases of morbid obesity, which did not emerge as a factor associated with their occurrence, a fact reported in the literature, notably by Dindo [37]. This author [37] found no difference in morbidity between obese people of different grades and non-obese people. For Didier Quilliot [38], after surgery, overweight and moderate and severe obesity (grades 1 and 2) are not associated with an increased risk of postoperative mortality in general and cardiovascular surgery. On the other hand, morbid obesity is associated with an increased risk of complications, contrary to our results, probably due to their low proportion in this sample. So, unlike the literature, obesity severity didn't affect postoperative complications. These results must be qualified because the grade of obesity influences the ASA class, and the high ASA class, particularly 4, was a factor associated with postoperative complications [39]. Moreover, hyperglycemia, which increased the risk of complications by a factor of 4, is very common in the morbidly obese [32]. Severe anemia and the severity of surgical aggression, which were also associated with postoperative complications, are morbidity factors described in the literature [40,41]. Intraoperative complications were associated with severe obesity, high Mallampati grade, ASA class 4, and major surgery. Thus, the relatively more frequent poor quality of spinal block in morbidly obese patients may be linked to the difficulties of performing spinal anesthesia in this population [32].

Strengths and limitations of the study

This study is one of the first to address the topic of anesthesia for obese patients in our setting and could serve as a basis for future studies. It also offers the advantage of having three comparative groups based on obesity levels.

However, it shares the weakness of all retrospective studies, with data dependent on patient records. Being a single-center study, the results cannot be generalized to the entire country or the entire city of Kinshasa.

Conclusion

This study indicates that obese patients of all degrees benefit from anesthetic procedures in our setting, and we need to know how to better manage them. Intraoperative complications are more frequent in cases of morbid obesity, requiring us to double our attention in this type of patient.

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Author contributions

EMo and WM: Study conception and design, data collection, manuscript drafting. AMo and FM: Data collection. ANK: Statistical analysis and data interpretation. AMB, RK, PK, TM, KA, PB, JBK, EN, DN, JN, MBB, and BB: Critical revision of the manuscript. All authors read and approved the final version and agree to be accountable for all aspects of the work.

Conflicts of interest

The authors declare no conflicts of interest.

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