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Peri-Anaesthetic Complications in Obese versus Non-Obese Patients in a Country with Limited Resources: Retrospective Cohort Study

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Abstract

Background and Rationale: Anaesthesia in obese patients is characterised by the occurrence of complications due to comorbidities and physiological and pharmacological changes caused by obesity. This study investigated complications in anaesthesia of obese versus non-obese patients in the not-always-optimal conditions of limited resources. **Methods:** This was a retrospective cohort study conducted at Monkole Hospital from 01/01/2011 to 31/12/2023 in obese versus non-obese patients (one-to-one ratio) anaesthetised for all surgery, excluding cardiac surgery. Peri-anaesthetic data up to hospital discharge were collected ethically and analysed with SPSS 26.0 for $p < 5\%$. **Results:** The sample comprised 2718 patients (1359 obese and 1359 non-obese). The mean age was comparable in both groups. A history of cardiovascular disease ($p < 0.001$), respiratory disease ($p = 0.028$), diabetes ($p = 0.001$), difficult intubation ($p < 0.001$), and difficult vascular access ($p < 0.001$) predominated in the obese group. Premedication was more common in non-obese patients ($p < 0.001$), propofol was more common in obese patients ($p < 0.001$), obese patients were more frequently extubated on a table ($p = 0.012$), and postoperative morphine was more common in obese patients ($p < 0.001$). Intraoperative complications (28.1% vs

21.4%, p = 0.001), intraoperative transfusion (13.4% vs 6.4%, p < 0.001), and postoperative complications (10.9% vs 5.9%, p < 0.001) were more frequent in obese patients. Mortality (2.72 vs 0.8%, p < 0.04) was higher in obese patients. The factors associated with intraoperative complications were: obesity ORa 2.37 (1.47 - 3.84), female sex ORa 1.7 (1.27 - 3.0), hyperglycaemia ORa 1.66 (1.01 - 2.74), major surgery ORa 2.7 (1.01 - 3.15) and surgical duration of ≥ two hours ORa 1.6 (1.42 - 2.62). Those associated with postoperative complications were obesity ORa 1.9 (1.3 - 2.78), ASA class III ORa 1.57 (1.03 - 2.37), ASA class IV ORa 3.21 (2.63 - 5.67), low prothrombin rate ORa 1.63 (101 - 2.64) and emergency ORa 1.52 (1.04 - 2.24). Factors associated with mortality were: obesity ORa 5.1 (2.21 - 7.5), impaired consciousness ORa 2.26 (1.44 - 4.36), ASA classes 3 and 4 respectively ORa 2.16 (1.8 - 4.28) and ORa 5.19 (3.98 - 8.47), intraoperative transfusion ORa 2.89 (1.9 - 3.98), surgical duration ≥ two hours ORa 2.72 (1.56 - 4.68). **Conclusion:** This study suggests that obesity is a risk factor for complications and mortality in anaesthesia, and therefore, the management of this type of patient must comply with the relevant recommendations in order to reduce this morbidity and mortality.

Keywords

Complications, Anaesthetics, Obesity, Limited Resources

1. Introduction

Anaesthesia in obese patients is characterised by the occurrence of complications in the perioperative period due to cardiovascular, respiratory, gastrointestinal, metabolic, and thromboembolic disorders and pharmacological changes caused by obesity [1]-[4], but also due to the numerous comorbidities associated with obesity, in particular obstructive sleep apnoea syndrome (OSA), arterial hypertension, diabetes, etc. [5]

Obesity is defined by the World Health Organisation (WHO) as excess body fat with undesirable consequences for health and well-being [6]. In practice, it is defined by a body mass index (BMI) ≥ 30 kg/m^2 and classified into 4: overweight: BMI between 25 and 29.99; obesity class 1: BMI between 30 and 34.99; obesity class 2: BMI between 35 and 39.99 and obesity class 3: BMI ≥ 40 kg/m^2 [7]. In 2022, 2.5 billion adults aged 18 and over were overweight, and of these, more than 890 million were obese, representing 43% of overweight adults aged 18 and over (43% of men and 44% of women); this proportion had increased since 1990, when it was 25%. The global prevalence of obesity more than doubled between 1990 and 2022 and is rising steadily on every continent, with the emergence of numerous specific medical and surgical problems. More than half of all individuals could be affected by 2030 [8]. Long considered a health problem in high-income countries, obesity is now affecting middle and low-income countries [9]. As a result, anaesthetists in low-income countries are increasingly faced with the real challenge of perioperative management of obese patients.

Perioperative respiratory complications have a high incidence in this field: difficult mask ventilation, difficult intubation, increased insufflation pressures, desaturation, postoperative respiratory depression, and acute respiratory distress syndrome [4] [10]-[13]. Obesity leads to arterial hypertension and an increased incidence of coronary heart disease, rhythm disorders, and sudden death [14] [15]. The risk of myocardial infarction and stroke is high, and that of thromboembolic disease is ten times higher because of the prothrombotic state in the obese [16] [17]. The overall risk of postoperative complications after colonic surgery is increased by 37%, with increases of up to 60% for the risk of venous thrombosis and 130% for wall infections [10]. The risk of postoperative complication is said to be increased by 25% in obese patients after prosthetic hip surgery and by 22% after knee prosthesis, without any increase in mortality [11]. In the USA, Postlethwait [18] reported a higher incidence of atelectasis, wall infections, and thrombophlebitis in obese patients during the postoperative period. Overall mortality was 6.6% in the obese group compared with 2.7% in the non-obese group. In 2010, Frisch [19] and his team studied peri-operative hyperglycaemia in obese patients undergoing non-cardiac surgery. They showed that obese patients with high preoperative blood glucose levels are at risk of severe postoperative complications, in particular myocardial infarction and cardiac arrhythmias.

Bamgbade [20], in 2007, in a retrospective study covering a 4-year period on postoperative complications, found that obese patients had high rates of complications such as wound infections and myocardial infarction. In addition, morbidly obese patients had a postoperative mortality rate of 2.2% compared with 1.2% in non-obese patients.

In Africa, anaesthetists have had to deal with more and more obese patients in recent years. In the Kongo central region of the Democratic Republic of the Congo, for sample size of 1531, the prevalence of general obesity was 3,7% and abdominal obesity 32.1%, and these were not independent factors associated with diabetes [21]. In a study of anaesthesia in elderly subjects in Kinshasa city, Mbombo [22] found a prevalence of 11.9% of obese patients. In Kinshasa in 2023, Kasereka [23] found a prevalence of obesity of 34.6% in a sample of 555 adults in the Lemba and Limete health zones. The lack of high-performance technical facilities represents a major risk for this population. Unfortunately, studies on complications in anaesthesia for obese patients are rare. In the Democratic Republic of Congo (DRC), a single-centre study by Mukuna [24] found that obesity affected 19.8% of anaesthetised patients.

With the increase in obesity in the population of countries with limited resources and its likely growing frequency in anaesthesia, it seems useful to have data on the perianaesthetic complications of these obese patients anaesthetised in conditions that are not always optimal. This is why this comparative study looking at perianaesthetic complications in obese and non-obese patients was carried out using the example of a secondary-level hospital located in an urban-rural area of the city of Kinshasa, the Monkole hospital centre.

2. Methods

2.1. Type, Period, and Setting of the Study

This was a retrospective, single-centre cohort study conducted at the Monkole hospital from 01 January 2011 to 31 December 2023.

2.2. Study Population, Sampling, and Patient Selection Criteria

The study population consisted of all patients aged at least 18 years, obese and non-obese, who underwent anaesthesia for non-cardiac surgery at Monkole Hospital during the study period. Sampling was based on an exhaustive register. The sample size was calculated according to the formula:

$$n \geq \frac{2\left(Z_{\alpha} + Z_{1-\beta}\right)^{2} xP\left(1-P\right)}{\left(Po - P_{1}\right)^{2}}$$

$Z_{1-\alpha} = Z_{0.995} = 1.96$: Two-tailed test (confidence coefficient at significance level = 0.05).

$Z_{1-\beta} = Z_{1-0.80} = Z_{0.80} = 0.83$: The ability to detect a significant difference by test (u = 80%).

P_o: The expected proportion of obese patients in the operating theatre is 19.8%, according to the work of Mukuna [24].

OR: The odds ratio is = 2.0.

P_1: The expected proportion of obese people from not obese.

P: The proportion of people exposed to the risk factor in the two groups (case and control).

$$P_{1} = \frac{\left(P_{O} xOR\right)}{1 + Po\left(OR - 1\right)} = \frac{\left(0.198 * 2\right)}{1 + 0.198 * \left(2 - 1\right)} = 0.331$$

$$P = \frac{\left(PO + P1\right)}{2} = \frac{\left(0.198 + 0.331\right)}{2} = 0.2645$$

$$n \geq \frac{2\left(1.96 + 0.83\right)^{2} x0.2645\left(1 - 0.2645\right)}{\left(0.198 - 0.331\right)^{2}} \geq 206 \text{ subjects}$$

In order to better control for confounding factors, matching will be done in pairs (matching = one case will be matched to one control) so as to distribute potential confounding factors identically in the two groups to be compared.

To obtain the number of subjects to include in order to obtain a ratio of controls per case, we reduce the sample by the correction factor = (3 + 3)/1 × 1 = 6/1 = 6; n will thus be ≥ 206 × 6 = 1236 subjects (statistical units). After matching, our sample will be ≥ 2472 subjects (where the number of obese cases is ≥ 1236, and the number of controls is ≥ 1236 non-obese).

The percentage of obese patients receiving anaesthesia was taken from Noelly's study [24], which found 19.8% of obese patients. For each obese patient enrolled, a non-obese patient with the same characteristics in terms of age, ASA class, and severity of surgery was taken from the same database.

The study included all patients aged at least 18 years with a body mass index of at least 30 kg/mm^2 who had undergone anaesthesia for non-cardiac surgery. Each obese patient included was matched with a non-obese patient of the same characteristics. Any patient whose file was missing important study variables was excluded.

2.3. Data Collection

Data collection was carried out by the two principal investigators (author and corresponding author) using the anaesthesia database of the hospital concerned. Thus, the data of all obese patients anaesthetised during the study period were extracted, as well as those of non-obese patients of the same characteristics with a one-to-one ratio.

The variables investigated were sociodemographic (age, sex, residence in relation to the health zone), clinical (comorbidity, type of obesity, venous access, Mallampati grade, ASA class, and degree of urgency), biological data and available imaging or electrophysiology data; per-anaesthetic (premedication, type, products and duration of anaesthesia, severity, and duration of surgery) and evolutionary (intra- and post-operative complications, intra-operative transfusion and vital outcome). Patients were followed up until discharge from the hospital.

Intraoperatively, we looked for: difficulty in venous access, difficulty in tracheal intubation (evaluated by Cormack grade during laryngoscopy) or in performing locoregional anaesthesia, rhythm disorders including cardiac arrest, desaturation, arterial hypertension, hypotension, haemorrhage, anaemia/transfusion, inhalation, organ damage, etc., as well as any other complications that may have arisen during the operation.

Post-operatively, we looked for medical complications (hypotension, rhythm disorders including cardiac arrest, clinical myocardial infarction, stroke, desaturation, pulmonary embolism, sepsis/shock, anaemia/transfusion, renal failure, multi-visceral failure, etc.); anaesthetic complications (pruritus, post-anaesthetic headache, post-operative nausea and vomiting, nerve damage, urine retention, etc.) and surgical complications (haemorrhage, organ damage, revision, surgical site infection, etc.). Surgical procedures have been grouped into two categories: major and minor. A major procedure is any procedure that often involves opening one of the body's main cavities (abdomen, chest, and skull), performed under anaesthetic in the operating theatre by a team of doctors. Appendectomy and simple ovarian cystectomy were considered minor procedures. Fractures of the pelvis and femur treated by surgical osteosynthesis were considered major procedures. A minor procedure is any procedure that does not involve opening the body's main cavities.

2.4. Endpoints

The primary endpoint was mortality in obese patients compared with non-obese patients.

The secondary endpoint was the rate of intraoperative and postoperative complications in obese patients compared with non-obese patients.

2.5. Statistical Analysis

Data were entered using Excel 2016, double-checked, coded, and transferred to SPSS 26.0 for analysis. Quantitative variables were presented as mean with standard deviation and compared using Student's t-test or ANOVA. Categorical variables were presented as frequencies (proportions) and compared using Pearson's Chi-square or Fischer's exact test. Factors associated with complications were investigated using logistic regression, and the strength of the association between a factor and a complication was measured by calculating odds ratios with their 95% confidence intervals. For all tests, the p-value was set at less than 5%.

2.6. Ethical and Regulatory Aspects

Authorisations were obtained from the management of the hospital concerned. The study protocol was approved by the Ethics Committee of the School of Public Health under number ESP/CE/15/2025. The principles of anonymity and confidentiality were respected during the data collection and analysis processes. We have no conflict of interest in this work.

3. Results

3.1. Patient Flow Diagram

Figure 1 shows the patient flow diagram.

During this period, out of 6746 patients aged 18 and over who were anaesthetised, 1370 patients were obese, *i.e.*, 20.3%. Eleven obese patients had missing data and were excluded, so we retained a sample of 1359 obese patients. For each obese patient, a non-obese patient with the same characteristics in terms of ASA, age and severity of surgery was selected from the database, *i.e.*, 1359, so the total sample comprised 2718 patients.

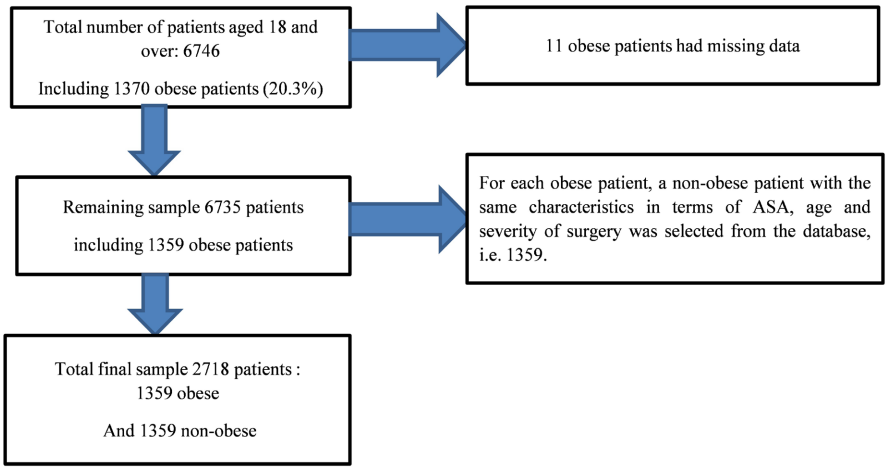

Figure 1. Patient flow chart.

3.2. Type of Obesity and Complications

Table 1 presents the type of obesity and complications.

The mean BMI values were (33.4 ± 3.5) kg/m² in obese patients and (23.7 ± 3.3) kg/m² in non-obese patients, with a statistically significant difference ($p < 0.001$). The characteristics of obesity were simple obesity (BMI: 30 - 34.99 kg/m²): 1039 cases or 76.5%, severe obesity (BMI: 35 - 39.99 kg/m²): 259 cases or 19.1%, and morbid obesity (BMI ≥ 40 kg/m²): 61 cases or 4.5%.

Intraoperative complications, postoperative complications, and blood transfusion were more frequent in morbidly obese patients, respectively $p < 0.004$, $p = 0.048$, and $p < 0.001$. On the other hand, the type of obesity had no influence on mortality $p = 0.424$.

Table 1. Type of obesity and complications.

Variable	Obese (n = 1039)	Severe Obesity (n = 259)	Morbid Obesity (n = 61)	p
Intraoperative Complications	242 (23.3)	114 (44.0)	26 (42.6)	**<0.001**
Post-Operative Complications	112 (10.8)	26 (10.0)	10 (16.4)	**0.048**
Transfusion	117 (11.3)	39 (15.1)	26 (42.6)	**<0.001**
Mortality	32 (3.1)	4 (1.5)	2 (3.3)	0.424

3.3. Socio-Demographic Characteristics of Patients

Table 2 presents the socio-demographic characteristics of the patients.

There was no difference between the two groups in mean age ($p = 0.09$) and surgical specialty ($p = 0.324$). However, the two groups differed in terms of sex ($p < 0.001$), with more women in the obese group, language (more obese Luba and Swahili-speaking patients, $p < 0.001$), and residence in relation to the health zone (more obese patients not living in the health zone, $p = 0.021$).

Table 2. Socio-demographic characteristics of patients and surgical specialty.

Variables	Obeses (n = 1359)	%	Non-Obeses (n = 1359)	%
Age (year)				**p = 0.090**
Average (SD)	39.8 ± 12.2		38.9 ± 15.5	
Sexe				**p < 0.001**
Male	153	11.3	332	24.4
Female	1206	88.7	1027	75.6
Residence				**p = 0.021**
Health Zone	315	23.2	368	27.1
Out of Health Zone	1044	76.8	991	72.9
Surgery Speciality				**p = 0,324**
Obstetric	713	52.5	718	52.8
Gynaecology	240	17.7	133	9.8

Continued

Orthopaedic	96	7.1	72	5.3
Digestive Surgery	239	17.6	344	25.3
Urology	44	3.2	72	5.3
Other	27	2	20	1.5

Legend: SD = Standard Deviation.

3.4. Comorbidity of the Patients

Table 3 shows the comorbidity of the patients.

There was no difference between the two groups in neurological history (p = 0.052), haematological history (p = 0.085), and chronic kidney disease (p = 0.165). On the other hand, a history of cardiovascular disease (p < 0.001), respiratory disease (p = 0.028), and diabetes mellitus (p = 0.001) were more common in obese patients. Alcohol and tobacco consumption were more frequent among the non-obese (p = 0.017).

Table 3. Comorbidity of the patients.

Medical History	Obeses	%	Non-Obeses	%
Cardiovascular disease				**p < 0.001**
Yes	442	32.5	356	26.2
No	917	67.5	1003	73.8
Respiratory disease				**p = 0.028**
Yes	109	8	79	5.8
No	1250	92	1280	94.2
Neurological disease				**p = 0.052**
Yes	40	12.9	60	4.49
No	1319	97.1	1299	95.6
Haematological history				**p = 0.085**
Yes	112	8.2	139	10.2
No	1247	91.8	1220	89.8
Diabetes mellitus				**p = 0.001**
Yes	166	12.2	116	8.5
No	1193	87.8	1243	91.5
CKD				**p = 0.165**
Yes	6	0.4	11	0.8
No	1353	99.6	1348	99.
Alcohol and tobacco consumption				**p = 0.017**
Ye	450	30.1	504	37.1
No	909	66.9	855	62,9

Legend: CKD = Chronic Kidney Disease.

3.5. Characteristics of Physical Examination and Degree of Urgency

Table 4 shows the characteristics of physical examination and degree of urgency.

Mallampati grades (estimating the risk of difficult intubation) II to IV and Cormack and Lehane grades (laryngoscopic view) II to III were more common in obese patients ($p < 0.001$). Venous access was more difficult in obese patients ($p < 0.001$). The risk of thromboembolism was higher in obese patients ($p = 0.001$). There was no difference in the ASA class ($p = 0.262$). However, there were more emergencies in the non-obese group: 45.6% compared with 31.2% in the obese group ($p < 0.001$).

Table 4. Characteristics of physical examination and degree of urgency.

Variables	Obeses	%	Non-Obese	%
Mallampati grade				**p < 0.001**
I	607	44.7	969	71.3
II	584	43	306	22.5
III	148	10.9	81	6
IV	20	1.5	3	0.5
Cormack grade	**n = 286**		**n = 284**	**p = 0.003**
I	220	76.9	247	87
II	56	19.6	30	10.6
III	10	3.5	7	2.5
Venous access				**p < 0.001**
Easy	1241	91.3	1325	97.5
Difficult	118	8.7	34	2.5
Thromboemblism risk				**p = 0.001**
Absent	992	73	1063	78.2
Present	367	27	296	21.8
ASA class				**p = 0.815**
II	1101	81	1091	80.3
III	242	16	249	19
IV	16	1.2	19	1.4
Degree of urgency				**p < 0.001**
Scheduled	935	68.8	739	54.4
Urgency	424	31.2	620	45.6

Legend: ASA = American Society of Anesthesiologists.

3.6. Laboratory data, Electrocardiography and Cardiac Echocardiography Data

Table 5 shows the laboratory data, electrocardiography, and cardiac echography data.

There was no difference in mean haemoglobin (p = 0.094) but more anaemia in the non-obese group (p < 0.001). There was no difference in mean platelets between the two groups (p = 0.607) but more low platelets in the non-obese group (p < 0.001). There was no difference between the two groups in prothrombin levels and activated partial thromboplastin time (APTT). There were higher creatinine levels (p = 0.001) in the non-obese group. There was no difference in the results of cardiac echography and electrocardiography between the two groups (p = 0.379 and p = 0.878).

Table 5. Laboratory data, electrocardiography, and cardiac echocardiography data.

Variables	Obeses	%	Non-Obeses	%
Average (g/dl)	**11.4 ± 1.8**		**11.0 ± 2.2**	**p = 0.094**
Haemoglobin	**n = 1300**		**n = 1328**	**p < 0.001**
<7 g/dl	15	1.2	48	3.6
7 - 10.9 g/dl	471	36.2	600	45.2
11 g/dl and plus	814	62.6	680	51.2
Platelets × 10^3 (X)	**282 (230~484)**		**322 (229~446)**	**p = 0.607**
Platelets	**n = 1296**		**n = 1304**	**p < 0.001**
<150 × 10^3/mm^3	122	9.4	238	18.3
150 - 450 × 10^3/mm^3	1147	88.5	1016	77.9
>450 × 10^3/mm^3	27	2.1	50	3.8
Prothrombin levels (X)	**79.4 (52.4~89.0)**		**96.5 (82.7~118.7)**	**p = 0.061**
Prothrombin levels	**n = 985**		**n = 744**	**p = 0.95**
Pathological	103	10.5	63	8.5
Normal	882	89.5	681	91.5
APTT (X)	**37.0 (31.0~39.0)**		**33.5 (30.0~45.0)**	**p = 0.738**
APTT	**n = 751**		**n = 428**	**p = 0.357**
Pathological	87	11.6	58	13.6
Normal	664	88.4	370	86.4
Glycaemia (X)	103.5 (83~183)		113 (97~153)	**p = 0.75**
Creatininemia (X)	**0.95 (0.5~1.0)**		**1.2 (0.9~1.4)**	**p = 0.114**
Creatininemia	**n = 398**		**n = 355**	**p = 0.001**
Pathological	42	11.4%	120	33.8
Normal	326	88.6	235	66.2
ECG	**n = 62**		**n = 137**	**p = 0.878**
Normal	27	43.5%	58	42.3
Pathological	35	56.5%	79	57.7
Cardiac echography	**n = 49**		**n = 61**	**p = 0.379**
Pathological	39	79.6	43	70.5
Normal	10	20.4	18	29.5

Legend: X = Mean; PT = Prothrombin Rate; APTT = Activated Partial Thromboplastin Time; ECG = Electrocardiogram.

3.7. Intra-Anaesthetic Characteristics of Patients

Table 6 shows the intra-anaesthetic characteristics of the patients.

Pre-medication was more common in non-obese patients ($p < 0.001$), and there was no difference in anaesthetic technique ($p = 0.85$). Ketamine was used less for induction in the obese, whereas propofol was used more in the obese ($p < 0.001$), and there was no difference for curares ($p = 0.082$), maintenance hypnotics ($p = 0.005$), morphinics ($p = 0.09$), the surgical procedure or the severity of the surgical attack ($p = 0.56$) and the duration of the procedure ($p = 0.848$ and 1). Extubation was performed on a table more often in obese patients ($p = 0.012$), and postoperative morphine was used more often in obese patients (3.5% versus 1.1% $p < 0.001$). The anaesthetist and the surgeon were senior, often for obese patients, with a significant difference ($p < 0.001$).

Table 6. Intra-anaesthetic characteristics of patients.

Variables	Obeses	%	Non-Obeses	%
Pre-medication	**n = 1359**		**n = 1359**	**p < 0.001**
Yes	25	1.84	81	5.9
No	1334	98.16	1278	94.1
Anaesthestic technique	**n = 1359**		**n = 1359**	**p = 0.85**
LRA	873	64.2	882	64.9
GA without OTI	190	14	180	13.2
GA with OTI	296	21.8	297	21.9
Induction hypnotic	**n = 476**		**n = 474**	**p < 0.001**
Ketamine	24	0.5	77	16.2
Propofol	442	92.8	385	81.2
Propoket	10	2.1	12	2.5
Induction curare	**n = 281**		**n = 268**	**p = 0.082**
Suxamethonium	235	83.6	206	76.85
Pancuronium	32	11.3	51	19
Atracurium	14	4.9	11	4.1
Maintenance hypnotics	**n = 480**		**n = 481**	**p = 0.05**
Ketamine	7	1.4	45	9.3
Propofol	148	30.8	149	30.9
Isoflurane	193	40.2	267	55.5
Sevoflurane	132	27.5	20	4.1
Intraoperative morphinics	**n = 468**		**n = 463**	**p = 0.09**
Fentanyl	249	54.2	292	63
Sufentanil	219	46.8	171	37
Extubation	**n = 291**		**n = 289**	**p = 0.012**
On table	286	98.28	270	93.4
Late	5	1.72	19	6.6

Continued

Postoperative morphine using	**n = 1359**		**n = 1359**	**p < 0.001**
Yes	47	3.5	15	1.1
No	1312	96.5	1344	98.9
Surgical procedure	**n = 1359**		**n = 1359**	**0.56**
Major	910	67	910	67
Minor	449	33	449	33
Duration of anaesthesia				**p = 0.848**
< 2hours	1087	80	1082	79.6
≥2hours	272	20	277	20.4
Duration of surgery				**p = 1**
< 2hours	1160	85.4	1160	85.4
≥2hours	199	14.6	199	14.6
Surgeon's qualification	**n = 1359**		**n = 1359**	**p < 0.001**
Senior	860	63.3	579	42.6
Junior	499	36.7	780	57.4
Anesthetic's qualification				**p < 0.001**
Senior	1219	89.7	1140	83.9
Junior	140	10.3	219	16.1

Legend: GA = General Anaesthesia; LRA = Locoregional Anaesthesia; OTI = Orotracheal Intubation; Propoket = Propofol plus Ketamine.

3.8. Evolutionary Characteristics of Patients

Table 7 shows the evolution of the patients.

Intraoperative complications were more frequent in obese patients (28.1%) than in non-obese patients (21.4%), with a significant difference (p = 0.001). They were dominated by arterial hypotension, discomfort, poor quality of the locoregional anaesthetic block, and haemorrhagic shock, which was often present from the outset. Obese patients benefited more from intraoperative transfusion than non-obese patients: 13.4% compared with 6.5%, with a significant difference (p < 0.001). Postoperative complications were more frequent in obese patients (10.9%) than in non-obese patients (5.9%), with a significant difference (p < 0.001).

Postoperative medical complications in obese patients were: anaemia requiring transfusion (30 cases), multi-organ failure (8 cases), pulmonary embolism (5 cases), septic shock (5 cases), eclampsia (3 cases), coagulopathy (2 cases), stroke (2 cases) and acute renal failure (one case) and in non-obese patients: anaemia requiring transfusion (20 cases), multi-organ failure (4 cases), eclampsia (3 cases), septic shock (3 cases), pulmonary embolism (2 cases), stroke (one case) asthma attack (one case) and complete arrhythmia due to atrial fibrillation (one case).

Postoperative surgical complications in obese patients were: haemorrhage requiring repeat surgery (15 cases), surgical site infection (14 cases), postoperative peritonitis (8 cases), progressive gangrene (2 cases), ureteral lesion (one case) and

in non-obese patients: haemorrhage (13 cases), surgical site infection (6 cases), postoperative peritonitis (5 cases), progressive gangrene (one case), ureteral lesion (one case) and vesico-vaginal fistula (one case).

Postoperative anaesthetic complications in obese patients were: pruritus due to the use of morphine during spinal anaesthesia (10 cases), urine retention (2 cases), myalgia associated with suxamethonium (one case) and post-spinal anaesthesia headache (2 cases), and non-obese patients: pruritus (2 cases) and urine retention (one case). Overall mortality was 1.8% (49 patients), 2.72% (37 patients) in obese patients and 0.8% (11 patients) in non-obese patients.

Table 7. Evolutionary data.

Variables	Obeses (n=1359)	%	Non-Obeses (n=1359)	%
Intraoperative complications				**p < 0.001**
No	977	71.8	1068	78.6
Yes	382	28.1	291	21.4
Type of intraoperative complications	**n = 382**		**n = 291**	
Arterial hypotension*	270	70.7	217	74.6
Discomfort*	107	28	42	14.4
Haemorrhagic shock	47	12.3	13	4.5
Spinal anaesthesia failure*	21	5.5	7	2.4
High blood pressure*	19	5	6	2.1
Vomiting	12	3.1	6	2.1
Insufficient block*	10	2.6	18	6.2
Desaturation*	5	1.3	8	2.7
Cardiac arrest	1	0.3	2	0.7
Anaphylactic shock	1	0.3	5	1.7
Intraoperative transfusion	**n = 1359**		**n = 1359**	**p < 0.001**
No	1177	86.6	1271	93.5
Yes	182	13.4	88	6.5
Postoperative complications	**n = 1359**		**n = 1359**	**p < 0.001**
No	1211	89.1	1278	94.1
Yes	148	10.9	80	5.9
Type of postoperative complications	**n =148**		**n = 80**	
Medical	56	37.8	36	45
Surgical	40	26.9	30	37.6
Anaesthetics	15	10.1	3	3.8
Anaesthetic complications	**n =15**		**n = 3**	
Pruritus	10	66.66	2	66.66
Urine retention	2	13.3	1	33.3

Continued

Post-spinal anaesthetic headaches	2	13.3	0	0
Myalgia (suxamethonium)	1	6.66	0	0
Death	**37**	**2.72**	**11**	**0.8**

* = intraoperative anaesthetic complications.

3.9. Judging Criteria

3.9.1. Primary Endpoint: Mortality

Figure 2 shows mortality according to obesity status and the presence of complications.

Mortality was higher in obese patients: 37 patients (2.72%) compared with 11 patients (0.8%) in non-obese patients with 25.2% and 13.6%, respectively of obese and non-obese patients who developed complications, with a significant difference ($p < 0.05$).

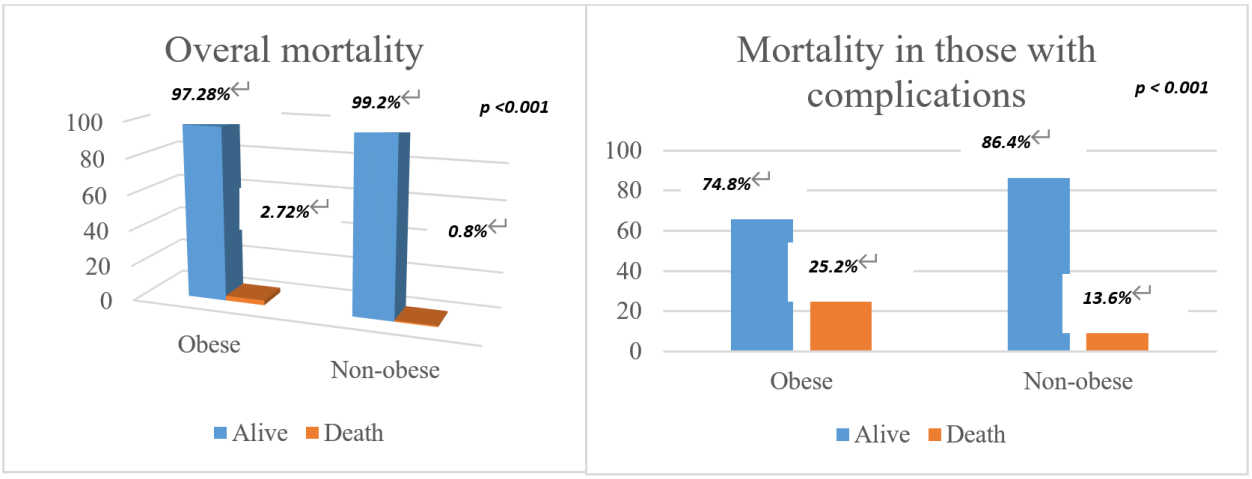

Figure 2. Mortality is determined according to obesity status and the presence or absence of complications.

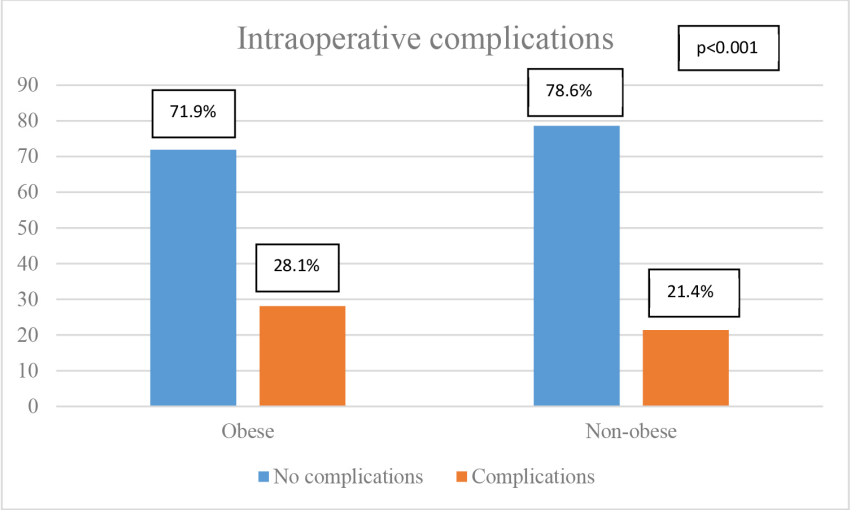

Figure 3. Intraoperative complications according to obesity status.

3.9.2. Secondary Endpoints: Complications

1. Intraoperative complications

Figure 3 shows the intraoperative complications according to the obese status.

Intraoperative complications were more frequent in obese patients (28.1%) than in non-obese patients (21.4%), with a significant difference ($p < 0.001$).

2. Post-operative complications

Figure 4 shows post-operative complications according to obesity status.

Postoperative complications were more frequent in obese patients (10.9%) than in non-obese patients (5.9%), with a significant difference ($p < 0.001$).

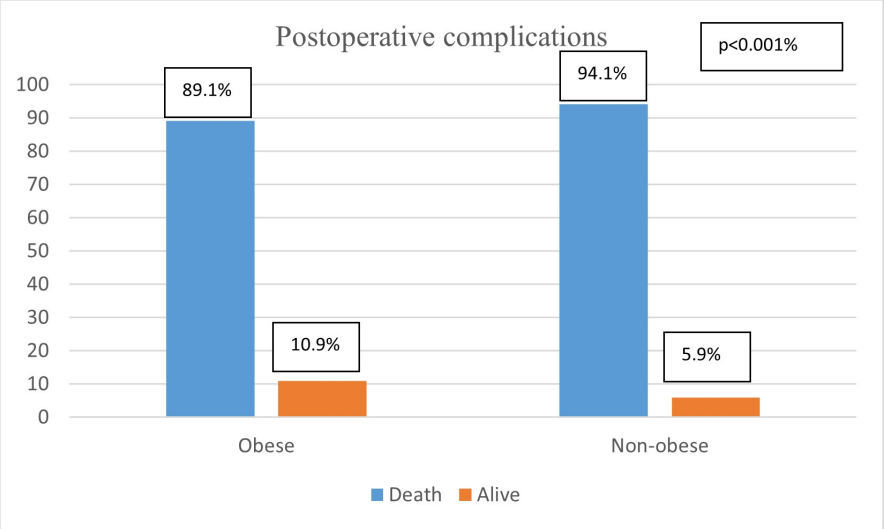

Figure 4. Postoperative complications according to obesity status or not.

3.10. Factors Associated with the Occurrence of Complications in All Patients

3.10.1. Factors Associated with the Occurrence of Intraoperative Complications

Table 8 presents the factors associated with the occurrence of intraoperative complications.

In multivariate analysis, obesity increased the risk of complications by a factor of 2.37, female gender increased the risk of complications by a factor of 1.74, hyperglycaemia increased the risk of complications by a factor of 1.66, major surgery increased the risk of complications by a factor of 2.78, and surgery lasting two hours or more increased the risk of complications by a factor of 1.6, and these factors were associated with the occurrence of intraoperative complications.

Table 8. Factors associated with the occurrence of intraoperative complications.

Variable	Univariate analysis		Multivariate analysis	
	P	OR (CI 95%)	P	ORa (CI 95%)
Status				
Non-obese		1		1

Continued

Obese	<0.001	1.44 (1.20~1.71)	**<0.001**	2.37 (1.47~3.84)
Sex				
Male		1		1
Female	<0.001	1.74 (1.35~2.24)	**0.031**	1.74 (1.27~3.04)
Respiratory history				
No		1		1
Yes	0.029	1.53 (0.05~2.24)	0.951	1.02 (0.49~2.14)
Mallmpati score				
I~II		1		1
III~IV	0.005	1.29 (1.08~1.53)	0.891	1.03 (0.67~1.58)
Thromboembolic risk				
No		1		1
Yes	<0.001	2.81 (2.19~3.61)	0.127	1.63 (0.87~3.05)
Glycaemia				
Normal		1		1
Hyperglycaemia	0.010	1.83 (1.16~2.88)	**0.046**	16 (11~2.74)
Surgical procedure				
Minor		1		1
Major	<0.001	3.05 (2.45~3.80)	**0.005**	28 (11~35)
Duration of anaesthesia				
<2 hours		1		1
≥2 hours	0.002	1.39 (1.13~1.71)	0.446	139 (9~36)
Duration of surgery				
<2 hours		1		1
≥2 hours	0.002	1.44 (1.14~1.82)	**0.024**	10 (12~22)

3.10.2. Factors Associated with the Occurrence of Postoperative Complications

Table 9 presents the factors associated with the occurrence of postoperative complications.

In multivariate analysis, obesity increased the risk of complications by a factor of 1.9, the presence of a haematological history increased the risk of complications by a factor of 1.64, ASA class III and IV increased the risk of complications by a factor of 1.57 and 3.21 respectively, a low prothrombin level increased the risk of complications by a factor of 1.63, and urgency increased the risk of complications by a factor of 1.52. These factors were associated with postoperative complications.

3.10.3 Factors Associated with Mortality in All Patients

Table 10 presents the factors associated with mortality in all patients.

In multivariate analysis, the factors associated with mortality remained: obesity

Table 9. Factors associated with the occurrence of postoperative complications.

Variables	Univariate analysis		Multivariate analysis	
	P	OR (CI 95%)	P	ORa (CI 95%)
Status				
Non-obese		1		1
Obese	<0.001	1.95 (1.47~2.59)	**0.001**	1.90 (1.30~2.78)
Cardiovascular disease				
No		1		1
Yes	0.015	1.42 (1.07~1.89)	0.390	1.18 (0.81~1.71)
Haematological history				
No		1		1
Yes	0.019	1.62 (1.08~1.43)	**0.022**	1.64 (1.30~2.69)
Consciousness				
Lucid		1		1
Altered	0.005	2.74 (1.35~5.54)	0.774	1.21 (0.33~4.45)
Thromboembolic risk				
No		1		1
Yes	0.019	1.52 (1.07~2.16)	0.284	0.76 (0.47~1.25)
ASA class				
II		1		1
III	<0.001	2005 (1.51~2.80)	**0.035**	1.57 (1.03~2.37)
IV	<0.001	10.28 (5.16~20.49)	**<0.001**	3.21 (2.63~5.67)
Prothrombin level				
Normal		1		1
Low	0.003	2.01 (1.28~3.17)	**0.047**	1.63 (1.01~2.64)
Duration of anaesthesia				
<2 hours		1		1
≥2 hours	<0.001	2.23 (1.67~2.98)	0.172	1.58 (0.82~3.05)
Duration of surgery				
<2 hours		1		1
≥2 hours	<0.001	2.46 (1.80~3.36)	0.647	1.18 (0.58~2.38)
Degree of urgency				
Scheduled		1		1
Urgency	0.002	1.55 (1.18~2.04)	**0.033**	1.52 (1.04~2.24)

Legend: ASA = American Society of Anesthesiologists.

increased the incidence of death by a factor of 5, altered consciousness increased the incidence of death by a factor of 2.26, ASA classes 3 and 4 increased the incidence of death by a factor of 2.16 and 5.19, respectively, intraoperative transfusion

increased the risk of death by a factor of 2.89 and surgical procedures lasting two hours or more increased the risk of death by a factor of 2.72.

Table 10. Factors associated with mortality in all patients.

Variable	Univariate analysis		Multivariate analysis	
	P	OR (CI 95%)	P	ORa (CI 95%)
Status				
No-obese		1		1
Obese	0.007	3. (1.37~7.05)	**<0.001**	5.10 (2.21~7.50)
Surgeon				
Junior		1		1
Senior	0.048	2.04 (1.01~4.12)	0.09	1.39 (0.69~2.79)
Consciousness				
Lucid		1		1
Altered	0.002	3.32 (1.83~5.44)	**0.032**	2.26 (1.44~4.36)
ASA class				
II		1		1
III	0.002	2.73 (1.49~5.22)	**0.029**	2.16 (1.08~4.28)
IV	<0.001	7.93 (6.84~9.99)	**0.004**	5.19 (3.98~8.47)
Anaesthetic technique				
Locoregional		1		1
General without OTI	0.879	1.08 (0.41~2.87)	0.974	0.98 (0.36~2.68)
General with OTI	0.002	2.61 (1.40~4.85)	0.707	1.17 (0.53~2.59)
Intraoperative transfusion				
No				
Yes	<0.001	4.13 (2.18~7.84)	**0.019**	2.89 (1.90~3.98)
Duration of anaesthesia				
<2 hours		1		1
≥2 hours	0.015	2.14 (1.16~3.96)	0.417	1.24 (0.32~2.30)
Duration of surgery				
<2 hours		1		1
≥2 hours	0.001	2.89 (1.55~5.41)	**0.016**	2.72 (1.56~4.68)

Legend: ASA = American Society of Anesthesiologists; OTI= Orotracheal Intubation.

4. Discussion

The general aim of this study was to determine the perianesthetic morbidity and mortality of obese and non-obese patients who had undergone anaesthesia for non-cardiac surgery over a period of thirteen years in a secondary-level hospital located in an urban-rural environment. Obesity affected 20.3% of patients in this

study. Patient characteristics were comparable in terms of age, ASA class, and severity of surgery, except for gender, where obesity was more common in women. Mortality was higher in obese patients at 2.72% compared with 0.8% in non-obese patients, with a significant difference ($p < 0.005$). Postoperative complications were more frequent in obese patients: 10.9% compared with 5.9% in non-obese patients, with a significant difference ($p < 0.001$). Intraoperative complications were more frequent in obese patients (28.1%) than in non-obese patients (21.4%), with a significant difference ($p < 0.001$). About the type of obesity (obesity, severe obesity, and morbid obesity), intraoperative complications, postoperative complications, and blood transfusion were more frequent in morbidly obese patients, respectively $p < 0.004$, $p = 0.048$, and $p < 0.001$. On the other hand, the type of obesity had no influence on mortality $p = 0.424$.

Mean BMI values were logically significantly higher in obese patients. Morbid obesity concerns 4.5% of patients, unlike the US population, which has a higher rate [25]. Soualem [26] in Yugoslavia in the Albanian population, Bita Fouda [27] in Douala, although they were not patients coming for anaesthesia had found a predominance of obesity in women as in this study. This high frequency of obesity in women is linked to hormonal problems, pregnancy, and slow metabolism. Estrogen inhibits a woman's ability to burn calories after each meal. On the other hand, cardiovascular ($p < 0.001$), respiratory ($p = 0.028$), and diabetes mellitus ($p = 0.001$) histories were more frequent in obese patients, corroborating the data in the literature. Indeed, obesity is a known factor associated with the occurrence of cardiovascular diseases, diabetes, and respiratory diseases [28] [29]. After 5323190 person-years of follow-up, myocardial infarction, ischemic stroke, and cardiovascular mortality increased in increasing BMI categories without diabetes ($p < 0.005$) [30]. Hypertension is the most frequent complication found in obese patients; it was present in nearly 34.7% of subjects in the Obépi-Roche study [31]. For example, Basdevant [28] in 2006 in France reported that the impact of obesity on the risk of type 2 diabetes is major: 75% of type 2 diabetic patients are obese. For a BMI value greater than or equal to 30 compared to a BMI less than 30, the risk of type 2 diabetes is multiplied by 10 in women and 8 in men. Alcohol and tobacco consumption was more common among non-obese patients, probably due to the occurrence of cardiovascular diseases in obesity with the restriction on alcohol and tobacco consumption that it imposes. Venous access was more difficult in obese patients in accordance with literature data [32] [33]. Thromboembolic risk was more common in obese patients because obesity itself is a risk factor for venous thromboembolism [16] [17]. The risk of difficult intubation predicted by the high Mallampati grade and difficult intubation confirmed by the Cormack grade at laryngoscopy are data consistent with the literature [10]. Ronit Lavi [34] made the same observations with a correlation between the Mallampati III and IV scores and difficult intubation. The average platelet count was not different in the two groups, but more hypoplateletosis in the non-obese group ($p < 0.001$). However, Dorit Samocha-Bonet [35] reported that platelet counts increased with BMI in

both sexes. But only in women, platelet counts were significantly elevated in the overweight ($p = 0.015$), obese ($p < 0.001$), and morbidly obese ($p < 0.001$) subgroup compared to non-obese. There was no difference in the results of cardiac ultrasound and electrocardiography between the two groups, with certainly a bias linked to the low percentage of performance of these examinations. Because, normally, heart failure, arrhythmias, in particular, atrial fibrillation, and cardiomyopathy are more common in obese people [30] [36] [37]. Premedication was more practiced in the non-obese ($p < 0.001$), probably due to the fear of airway obstruction before intubation in the obese. Indeed, OSA is more common in obese people and is a contraindication to sedative premedication [5] [10] [13]. There was no difference regarding the anaesthetic technique used, although the literature recommends that regional anaesthesia has benefits by avoiding difficult intubation and inhalation and by facilitating rapid mobilization and a reduction in the length of hospitalization. It should be noted, however, that performing this locoregional anaesthesia can be difficult for this type of patient and sometimes requires specific equipment [38] [39]. However, for all intubations, crash induction was the rule in accordance with the recommendations in this area [40]. Although opioids such as alfentanyl, which are less lipid soluble than fentanyl, are preferable in obese patients. Fentanyl has been used the most because of its availability in this environment [41]. Ketamine was used less during induction in obese patients, while propofol was used more. Thus Bazin [42] reports that for the induction of general anaesthesia in obese patients, the use of easily reversible rapid-acting drugs should be favoured in this type of patient. Postoperative morphine was paradoxically more used in obese patients (3.5% versus 1.1% $p < 0.001$) without a plausible explanation, probably the variability of expression of dolour in patients and morphine effect. Because the anaesthetist and the surgeon were senior, often for obese patients, with a significant difference. Indeed, the risk of respiratory depression is higher in obese patients when using opioids [43]. However, opioids, particularly morphine, can be used for the treatment of postoperative pain in obese patients [44] [45]. More frequent use of morphine was noted in obese patients undergoing open surgery for gynaecological cancer at 57.25 mg compared to 50 mg in non-obese patients ($p = 0.003$). Both intraoperative and postoperative complications were more frequent in obese than in non-obese patients, with a significant difference. Bamgbade (20), in a population of 7271 patients, found that the obese presented more complications than the non-obese and that mortality was higher in cases of morbid obesity. The nature of postoperative complications was different from ours apart from surgical site infection. However, the myocardial infarction that he had encountered was not in our series because no patient had presented the suggestive symptoms, which does not exclude silent infarctions. Likewise, peripheral nerve lesions were not encountered in our series because we do not use a lot of peripheral locoregional anaesthesia, which is known to cause this type of lesion. Note that the high frequency of intraoperative hypotension is linked to the use of spinal anaesthesia, and the morphine systematically administered intrathe-

cally administered for postoperative analgesia explains the occurrence of pruritus. We did not find an explanation for the fact that the obese had a significantly higher risk of intraoperative transfusion than the non-obese, especially since the average haemoglobin was the same in the two groups and severe anaemia was significantly more frequent in the non-obese patients. Perhaps the habit of the practitioner who transfuses obese patients more easily because of cardiovascular comorbidity. We encountered 5 cases of pulmonary embolism in obese people compared to 2 cases in non-obese people because obesity is a risk factor for pulmonary embolism [46] [47]. Mortality was higher in obese patients, *i.e.*, 25.2% compared to 13.6% in non-obese patients, with a significant difference ($p < 0.001$) in patients who had complications and 2.72% in all obese patients compared to 0.8% in non-obese patients. A similarity was found in a study by Mullen [48], who had a mortality rate of 21% in obese subjects compared to 12% in non-obese people, but a big difference with Bamgbade [20], who had a mortality of 2.2% in obese subjects compared to 1.2% in subjects of normal weight. In this same work by Bamgbde [20], postoperative complications represented 7.7%, including myocardial infarction, surgical site infection, and urinary infection. Surgical site infection was also common in our study, corroborating literature data [10] [49]. However, some studies found high mortality only in class III obese and lean patients [50]. This is the famous obesity paradox. However, in our study, morbid obesity, compared with simple obesity and extreme obesity, was associated with the occurrence of intraoperative and postoperative complications and not with mortality. On the other hand, Dindo [51], in a cohort study carried out in 2003, found that there was no difference in terms of morbidity between obese people of different classes and non-obese people. In logistic regression, obesity was not a risk factor for the development of postoperative complications, contrary to the results of our study. Thus, in our study, obesity increased the risk of intraoperative complications by 2.37, the risk of postoperative complications by 1.9, and the risk of mortality by 5. High ASA classes (III and IV) and respiratory comorbidities were also independent factors of mortality, as reported by other authors [10] [11] [52].

Intraoperative complications were present in 28.1% of obese patients compared to 21.4% of non-obese patients with a significant difference ($p < 0.001$), as well as postoperative complications which were present in 10.9% of obese patients compared to 5.9% of non-obese patients with a significant difference ($p < 0.001$). Dindo [51] only reported an increased frequency of surgical site infections in obese patients. Other authors have also reported that obesity is a factor in the complications [2] [3] [20]. This occurrence of complications in the perioperative period due to cardiovascular, respiratory, gastrointestinal, metabolic, and thromboembolic disorders and pharmacological changes caused by obesity [1]-[4], but also due to the numerous comorbidities associated with obesity, in particular obstructive sleep apnoea syndrome (OSA), arterial hypertension, diabetes, etc. [5]

Strengths and Weaknesses of the Study

The strengths of this study are that apart from being the first to address this subject in our country, it has two groups, allowing a comparison between the obese and the non-obese. In addition, the sample size is large enough to give strength to the results. On the other hand, it presents the weaknesses of all retrospective studies with missing data, particularly those from the laboratory, electrocardiography, cardiac echography, etc.

5. Conclusion

This study shows that obesity is increasingly found among patients receiving anaesthesia, even in low-income countries. Obese patients not only have higher rates of perioperative complications but also higher mortality, especially in patients with comorbidities and high ASA scores, reflecting a poorer overall state of health. These results highlight the importance of adapting care protocols for obese patients, and integrating specific risk management strategies before, during, and after surgery in line with the recommendations of learned societies.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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