Research Article ISSN 2835-6276

American Journal of Medical and Clinical Research & Reviews

Factors associated with anaesthetic complications in bariatric surgery at the Delafontaine Saint-Dénis Hospital

Patient Keto[1,2], Wilfrid Mbombo[1,3], Barry Alpha Mamadou[2], Patricia Kiyombo[1], Mike Madika[1], Reagan Phanzu[4] , Médard Bula-Bula[1], Berthe Barhayiga[1]

1. Department of Anaesthesia and Intensive Care/Teaching Hospital of Kinshasa University/Kinshasa University,
2. Hôpital Delafontaine Saint-Dénis,
3. Centre hospitalier Monkole,
4. Department of Surgery/Teaching Hospital of Kinshasa/Kinshasa Universty

*Correspondence: Wilfrid Mbombo

Received: 16 Dec 2023; Accepted: 24 Dec 2023; Published: 30 Dec 2023

Citation: Wilfrid Mbombo. Factors associated with anaesthetic complications in bariatric surgery at the Delafontaine Saint-Dénis Hospital. AJMCRR 2023; 2(12): 1-14.

ABSTRACT

Background and objective. *Anaesthesia during bariatric surgery is a high-risk procedure. This study investigated factors associated with anaesthetic complications in patients undergoing this type of surgery at Delafontaine hospital.*

Methods. *This cross-sectional study was conducted at the Delafontaine Hospital from 01/01/2021 to 01/06/2022 in patients who underwent anaesthesia for bariatric surgery for all indications. Sociodemographic, clinical, anaesthetic and evolutionary data were collected and analysed with SPSS 25.0 using Student's t test, Pearson's Chi-square test or Fischer's exact test and logistic regression for $p<0.05$.*

Results. *One hundred and thirty-five patients were enrolled. Females predominated (sex ratio M/F: 0.35). The mean age was 39.41 (range: 20 to 57 years). The median BMI was 43.25kg/m². All patients underwent surgery under general anaesthesia with tracheal intubation. Complications were present in 44% of patients: arterial hypotension (28.8%), difficult orotracheal intubation (28.1%), desaturation (22.9%), postoperative nausea and vomiting (16.2%), bronchospasm (7.4%), arterial hypertension (6.6%) and anaphylactic shock (3.3%). No deaths were recorded. Older age, the presence of comorbidities and Mallampati, Cormack and ASA scores ≥ 3 were associated with the occurrence of complications.*

Conclusion. *The incidence of peri-anaesthetic complications in bariatric surgery is high in this series. Advanced age (> 40 years), the presence of comorbidities and Mallampati, Cormack and ASA scores ≥ 3 were associated with the occurrence of complications.*

Key words: bariatric surgery, anaesthetic complications, Delafontaine Hospital

Introduction

Bariatric surgery is considered a first-line treatment for people with morbid obesity because of the poor efficacy of non-surgical therapeutic measures (1, 2, 3). The indications for surgery are increasingly being extended to patients with a body mass index (BMI) of 30 to 34.9 kg/m^2 associated with complications such as type 2 diabetes, cardiovascular disease and respiratory disease (4,5). Regardless of the technique used, complications may arise during the anaesthetic management (6).

Obese patients are at risk of perioperative complications such as: difficult access to the airways (intubation, difficult or impossible ventilation), acute post-extubation respiratory failure due to atelectasis or airway obstruction, thromboembolic and cardiovascular complications (7). According to a survey by the French Society of Anaesthesia and Critical Care (FSACC) and the French National Academy of Medicine in 2004, difficult or impossible access to the airways accounted for 4% of anaesthetic deaths in France(8).

A Saudi meta-analysis of patients who had undergone bariatric surgery reported the occurrence of pulmonary atelectasis in 33.3% of patients, a consequence of perioperative reintubation (9). A Spanish observational study in 2002 reported that major complications of bariatric surgery occurred in 18.3% of patients and mortality was 5%. Physical condition (ASA>III) was a prognostic factor for morbidity and mortality(10). An analytical American study in 2015 reported that 38.9% of patients had respiratory complications, postoperative nausea-vomiting and arterial hypertension during the perioperative period of bariatric surgery (11). A 2019, South African review reported an overall morbidity of 14%, with no deaths in patients undergoing bariatric surgery (12).

Knowledge of the complications and associated factors for each hospital could help to reduce the perioperative morbidity of bariatric surgery patients. Bariatric surgery is constantly performed at Delafontaine hospital, but the frequency of complications is unknown.

The aim of this study was to determine the factors associated with anaesthetic complications during bariatric surgery at Delafontaine hospital.

Patients and Methods

Type, period and setting of the study

This was a cross-sectional study conducted at the Delafontaine Saint-Denis hospital centre during the period from 1 January 2021 to 1 June 2022. The Delafontaine Saint-Denis hospital is a French public hospital, a support facility for the Plaine de France regional hospital group, with a capacity of 740 beds and 10 divisions. It offers consultation services in medicine, surgery, obstetrics, geriatrics and child psychiatry, and regularly performs bariatric surgery.

Study population and selection of patients

Our study population consisted of all patients who underwent anaesthesia for bariatric surgery at Delafontaine hospital during the period of our study. Patients were recruited consecutively.

All patients over 18 years of age who had undergone anaesthesia for bariatric surgery were included and patients whose records were missing were excluded.

Data collection and study variables

Data collection was carried out prospectively by the investigator on the basis of a form containing all the variables of interest, which was drawn up and completed. Patients were followed up until they were discharged from the post-anaesthesia care unit. The variables collected were pre-anaesthetic: age, sex, weight, height, body mass index (BMI), comorbidities, Mallampati scores, ASA class according to the 2020 version, previous bariatric surgery. Per anaesthetic variables : premedication, anaesthetic technique and drogues, type of surgery (sleeve gastrectomy, by-pass, gastric band, resleeve), difficulty of intubation and means used for intubation, Cormack-Lehane score, ventilatory parameters (positive expiratory pressure, tidal volume ; alveolar recruitment manoeuvres), use of decurarisation, duration of surgery and anaesthesia, management of postoperative pain, prevention of postoperative nausea and vomiting (PONV). Intraoperative and postoperative complications were investigated.

Statistical analysis

Data were entered using Excel 2013, checked, encoded and exported to SPSS version 24.0 for analysis. Quantitative variables were expressed as mean ± standard deviation and compared using Student's t-test. Qualitative variables were expressed as frequency and percentage and compared using Pearson's Chi-square or Fischer's exact test. Logistic regression was used to identify factors associated with complications, and odds ratios and their 95% confidence intervals were calculated. For all tests, the p-value was set at <5%.

Ethical and regulatory aspects.

The local ethics committee had given its approval, and authorisation was obtained from the head of department. The principles of confidentiality and anonymity were respected in accordance with the Helsinki Convention. We have no conflict of interest in this work.

Results

Patient flow

During this period, 566 patients underwent digestive surgery, 431 for non-bariatric surgery and 135 for bariatric surgery. Of these 135, 133 were operated on and two were not operated on because they presented anaphylactic shock on induction, but they were nevertheless analysed.

Socio-demographic and clinical profile of patients

Table 1 shows the sociodemographic profile of the patients.

The mean age was 39.41±10.45 years, ranging from 20 to 57 years. There were 100 women and 35 men, giving an M/F sex ratio of 0.35. The 41 to 60 age group had 70 patients (51.8%), the 21 to 40 age group had 60 patients (44.4%) and the under 21 age group had 5 patients (3.7%). The comorbidities were: diabetes mellitus: 48 cases (35.5%), obstructive sleep apnoea syndrome (OSAS): 43 cases (31.8%), arterial hypertension: 38 cases (28.1%), gastro-oesophageal reflux disease (GERD): 32 cas-

es (23.7%), dyslipidaemia: 19 cases (14.1%), asthma: 5 cases (3.7%) and dysthyroidism: 3 cases (2.2%). The ASA class was: I: 32 patients (23.7%), II: 74 patients (54.8%) and III: 29 patients (21.5%). Obesity was distributed as follows: class II: 17 patients (12.6%) and class III: 118 patients (87.4%). The mean BMI was 43.25 ± 3.40. The Mallampati score was as follows: I: 15 patients (11.1%); II: 55 patients (40.7); III: 41 patients (30.4%) and IV: 24 patients (17.8%).

Table 1. Sociodemographic and clinical profile of patients.

Variables	Frequency (n= 135)	%
Age (mean±SD)	39.41±10.45	
≤ 20 years	5	3.7
21 to 40 years	60	44.4
41 to 60 years	70	51.8
Sex		
Male	35	25.9
Female	100	74.0
Comorbidities		
Diabetes mellitus	48	35.5
OSAS	43	31.8
Arterial hypertension	38	28.1
GERD	32	23.7
Dyslipidaemia	19	14.1
Asthm	5	3.7
Dysthyroidism	3	2.2
ASA class		
ASA 1	32	23.7
ASA 2	74	54.8
ASA 3	29	21.5
BMI (Kg/m^2) *mean±DS*	**43.25 ± 3.40**	
Obesity class		
Obesity Class II	17	12.6
Obesityclass III	118	87.4
Mallampati score		
Class 1	15	11.1
Class 2	55	40.7
Class 3	41	30.4
Class 4	24	17.8

Legend: OSAS = obstructive sleep apnoea syndrome, GERD = gastro-oesophageal reflux disease, BMI: body mass index, ASA: American Society of Anaesthesiologists, SD = standard deviation.

Intra-anaesthetic and surgical characteristics

Table 2 presents the intra-anaesthetic and surgical characteristics.

The surgical technique was: sleeve gastrectomy: 101 patients (74.8%), bypass: 13 patients (9.6%), resleeve: 12 patients (8.9%) and gastric band: 9 patients (6.7%). Premedication was with cimetidine in

75 patients (55.6%). All patients underwent surgery under general anaesthesia with tracheal intubation. Propofol was used for induction in all patients. Rocuronium was the most commonly used curare (89.6%), and desflurane (73.3%) was used for maintenance anaesthesia. Sugammadex was used for decurarisation (75.5%). Multimodal analgesia was used for 97.8% of pain management and morphine for 28.1% of patients with a VAS ≥ 4/10 in the post-interventional care room. The average duration of anaesthesia was 2 hours 55 minutes.

Table 2. Intra-anaesthetic and surgical characteristics

Variables	n=135	%
Surgical technique		
Sleeve gastrectomy	101	74.8
By pass	13	9.6
Resleev	12	8.9
Gastric band	9	6.7
Premedication with cimetidine	**75**	**55.6**
Induction with propofol	**135**	**100.0**
Morphinomimetics		
Sufentanil	128	94.8
Remifentanil	33	24.4
Curares and antagonisation		
Suxamethonium	14	10.4
Prostigmine + Atropine	12	8.9
Atracurium	13	9.6
Rocuronium	121	89.6
Sugamadex	102	75.5
Maintenance of anaethesia		
Desflurane	99	73.3
Sevoflurane	34	25.2
PONV prevention		
Dexamethasone-ondasetron	133	98.5
Pain managment		
Multimodal analgesia	132	97.8
Ketamine +Lidocaine	131	97.0
Local anaesthetic inflitration	128	94.8
Morphine	38	28.1
VAS (in PACU)		
1-3 : Ligth pain	39	28,9
3-5 : Moderate pain	67	49.6
5-7 :Severe pain	21	15.6
>7 : Verysevere pain	8	5.9
Duration of anaesthesia, mean ±SD	**2,55 (2,41-2,67)±0,81**	

Legend: PONV = postoperative nausea and vomiting, VAS = visual analogue scale, PACU = post-anaesthetic unit.

Characteristics related to intubation and ventilatory parameters

Table 3 presents the characteristics related to intubation and ventilatory parameters.

The Cormack and Lehanne score was: I: 38 patients (28.1%), II: 59 patients (43.7%), III: 23 patients (17%) and IV: 15 patients (11.1%). Orotracheal intubation was difficult in 42 patients (31.2%) and easy in 93 patients (68.8%). The majority of patients (89.6%) had a positive expiratory pressure (PEP) of between 6 and 7cmH_2O. The alveolar recruitment manoeuvre was performed in a quarter of patients (25.8%). The mean tidal volume was 6.76ml/kg.

Table 3. Intubation-related characteristics and ventilatory parameters

Variables	n=135	%
Cormack andLehane score		
Grade 1	38	28.1
Grade 2	59	43.7
Grade 3	23	17.0
Grade 4	15	111
Difficult of intubation		
Difficult OTI(+devices for difficult OTI)	42	31.2
Easy OTI(simple laryngoscopy)	93	68.8
Ventilatoryparameters		
PEP (cm H_2O), mean±SD	6.76 (6.56-6.98)±1.23	
PEP ≤ 5	11	8.1
PEP 6-7	121	89.6
PEP≥10	3	2.2
Tidal volume (ml/kg), mea±SD	6.76 (6.62-6.88) ±0.69	
Recruitment manœuvre	33	25.8

Legend: PEP = positive expiratory pressure, OTI = orotracheal intubation, Thedevices for OTI difficultwere: videolaryngoscopy (Mac grath, airtraq), Eschmann chuck, SD = standard deviation.

Anaesthetic complications.

Table 4 shows the anaesthetic complications.

Complications were present in 60 patients, i.e. 44%. They were: hypotension: 39 patients or 28.8%, difficult intubation: 38 patients or 28.1%, desaturation: 31 patients or 22.9%, postoperative nausea and vomiting: 22 patients or 16.2%, bronchospasm: 10 patients or 7.4%, hypertension: 9 patients or 6.6% and anaphylactic shock: 2 patients or 1.4%.

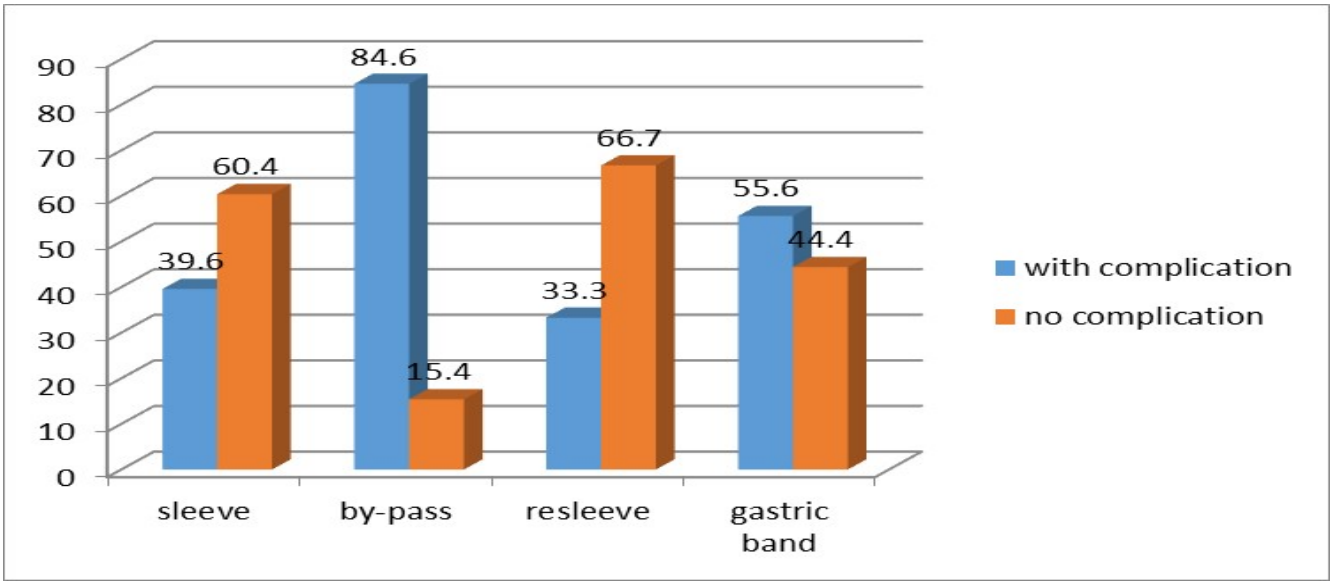
Table 4. Anaesthetic complications.

Complications	Frequency (n =135)	%
No	75	56
Yes	60	44
Type of complications		
Hypotension	39	28.8
Difficult of intubation	38	28.1
Desaturation	31	22.9
PONV	22	16.2
Bronchospasm	10	7.4
Hypertension	9	6.6
Anaphylactic shock	2	1.4

Legend: PONV=Postoperative Nausea and Vomiting

Evolution of patients according to surgical technique

Figure 1 shows the outcome according to surgical technique.



Complications (60 = 100%) were in decreasing order of frequency: bypass (84.6%), gastric band (55.6%), sleeve gastrectomy (39.6%) and resleeve gastrectomy (33.3%).

Complications by socio-demographic and clinical characteristics.

Table 5 shows the complications according to socio-demographic and clinical characteristics.

The mean age of patients with complications was older than that of patients without complications (p =0.001). Complications were more frequent in men (p =0.001) and in patients with comorbidities: smoking, alcoholism, arterial hypertension, diabetes and obstructive sleep apnoea syndrome (p <0.05).

Table 5: Complications by sociodemographic and clinical characteristics

Variables	Presence of complications (n=60 or 44%)	No complications (n=75 or56%)	p
Age (years) mean ±SD	44.42 ± 9.26	35.40 ± 9.63	0.001
Sex			
Female	31 (31.0)	69 (69.0)	0.001
Male	29 (82.9)	6 (17.1)	
BMI mean±SD	59.28 ± 2.39	59.27 ± 2.39	0.923
Number of comorbidities mean ±SD	2.38 ± 1.76	0.88 ± 1.11	0.001
Alcoholism	21 (75.0)	7 (25.0)	0.001
Smoking	31 (60.8)	2 (29.2)	0.011
Hypertension	33 (86.8)	5 (13.2)	0.001
Diabetes mellitus	32 (66.7)	16 (33.3)	0.001
OSAS	28 (65,1)	15 (34.9)	0.002

Legend: OSAS = obstructive sleep apnoea syndrome, SD = standar deviation, BMI: body mass index.

Complications according to anaesthetic characteristics

Table 6 presents complications according to anaesthetic characteristics.

Mallampati, Cormack and Lehane scores greater than or equal to 3 were associated with the occurrence of anaesthetic complications (p=0.001). Patients with complications had higher mean PEEP and mean tidal volume (p=0.001). The use of sevoflurane, morphine, local infiltration of the anaesthetic and the ketamine-lidocaine combination were associated with the occurrence of complications (p<0.05).

Table 6. Complications according to anaesthetic characteristics

Variables	Presence of complications (n=60 or 44%)	No complications (n=75 or 56%)	p
Anaesthetic agents			
Rocuronium	54 (44.6)	67 (55.4)	0.900
Sufentanil	56 (46.1)	69 (53.9)	0.208
Suxamethonium	3 (21.4)	11 (78.6)	0.067
Remifentanil	12 (36.4)	21 (63.9)	0.282
Sevoflurane	9 (26.5)	25 (73.5)	0.015
Desflurane	49 (49.5)	50 (50.5)	0.050
Sugammadex	48 (47.1)	54 (52.9)	0.282
Prostigmine+Atropine	5 (41.7)	7 (58.3)	0.694
Atracurium	6 (46.2)	7 (53.2)	0.896
Analgesia			
Ketamine+Lidocaïne	56 (42.7)	75 (57.3)	0.037
Multimodal analgesia	57 (43.2)	75 (56.8)	0.084
Local anesthetic infiltration	57 (44.5)	71 (55.5)	0.008
Morphine	28 (73.7)	10 (26.3)	0.001
Mallampati class			
≥3	42 (64.6)	23 (35.4)	0.001
<3	18 (25.7)	52 (74.3)	
Cormack and Lehane class			
≥3	26 (68.4)	12 (31.6)	0.001
<3	34 (35.1)	63 (64.9)	
Ventilatory parameters			
PEP	7.20 ± 1.54	6.41 ± 0.77	0.001
Tidal volume	7.00 ± 0.79	6.57 ± 0.54	0.001

Legend: PEP = positive expiratory pressure.

Discussion

This study was carried out to determine the complications of anaesthesia in bariatric surgery. It was found that these complications are very frequent (44%, represented by arterial hypotension, difficult intubation, desaturation, bronchospasm, postoperative nausea and vomiting). Older age, male sex, the presence of comorbidities and the use of certain products such as sevoflurane, morphine, lidocaine/ ketamine and bypass surgery technique were associated with the occurrence of these complications.

Bariatric surgery has mainly affected younger women, with an average age of around forty. This cor-

roborates the data in the literature (13, 14, 15). Aesthetic motivation and improved appearance would explain the predominance of women undergoing bariatric surgery (16).

The mean BMI in our study was 43.25±3.40 kg/m², as some authors (13, 17) had found mean BMIs around 40 to 49 kg/m^2. In the hospital where the study was conducted, bariatric surgery is reserved for patients with morbid obesity (BMI ≥ 40 kg/m²) and those with a BMI ≥ 35 associated with comorbidities. ASA classes 2 and 3 were predominant as described in the literature (10, 18=19) due to obesity-related comorbidities. Comorbidities, in particular hypertension, OSAS, diabetes and dyslipidaemia, were frequent in our series and sometimes constitute the indication for surgery. This has been noted by other authors (6,10,18,19,20).

In this series, patients with Mallampati grade 3 represented 30.4% compared with 17.8% for grade 4, while Cormack and Lehane grade 3 was present in 17% and grade 4 in 11.1%, and these factors were associated with the occurrence of complications. Several studies have shown that Mallampati grades 3 and 4 are predictive of difficult intubation (1,11,21). However, Mohamed (22) reported that the association between Mallampati grade and difficult intubation was not statistically significant (p=0.176), probably because they had not encountered any patients with Mallampati grade 4. Mean PEEP was 6.7 cmH20 in 89.6% of patients. We used alveolar recruitment in 25.8% of patients. To date, there is no consensus regarding the optimal invasive mechanical ventilation strategy for obese surgical patients. Protective ventilation with small tidal volume, motor pressure and optimal positive end-expiratory pressure (PEEP) and alveolar recruitment manoeuvres minimise lung injury (23).Tiffany (24) in the USA in 2019 reported that morbidly obese patients were more likely to have 95% difficult mask ventilation and 4.2% of patients had difficult intubation. Other factors predictive of both difficult mask ventilation and difficult intubation included age > 46 years, male sex, Mallampati score 3-4 and the presence of OSAS. Propofol was the induction hypnotic for all patients because of its good kinetics as reported in other studies (6, 25, 26, 27, 28). However, Kirby suggests that the dose should be calculated on the basis of lean body mass and not actual weight, given the haemodynamic consequences of high doses (29). Desflurane was used in 73.3% of cases, followed by sevoflurane in 25.2% of cases because of their favourable kinetics. Earl M. Strum (30) in the USA compared the speed of awakening between desflurane and sevoflurane, noting a significantly earlier recovery of response to command and tracheal extubation in patients on desflurane than in patients on sevoflurane. This finding was also made by PreetMohinder (31) in India in 2017. On the other hand, Manuel Vallajo (32) in the USA found no difference in the time between stopping the inhalation agent, opening the eyes and extubation, or the average length of stay in the recovery room depending on whether desflurane or sevoflurane was used. Desflurane and sevoflurane are the volatile agents of choice for obese patients because of their low solubility in fat and therefore their lack of storage (3). Badaoui (6) in France in 2012 found that remifentanyl (63.4%) was used more than sufentanil (36.6%) in bariatric surgery. These results are contrary to those of our study, in which sufentanil was used in 94.8% of cases. The FSACC recommends using remifentanil in obese patients for short-term surgery because of its short half-life and provides better recovery than sufentanil with less respiratory depression. However, it did not

provide better postoperative analgesia for long-term surgery, which is why sufentanil was preferred in this study. Rocuronium was the most widely used curare because of its ease of decurarisation with sugammadex, as other authors have found (33,34). Cisatracurium was widely used in Badaoui's study (6), in contrast to this study. Several studies have shown that there is no difference in muscle relaxation between rocuronium and cisatracurium (35). It should be noted that curarisation is essential in bariatric surgery, which is often performed laparoscopically. Multimodal analgesia was used in 97% of patients in this study, as observed by Badoui (6). Morphine was required in 28.1% of patients with a VAS ≥4, similar to the study by Badaoui (6) with 35.6%. The combination of ketamine and lidocaine in an electric syringe pump was widely used (97%) in this study. Assouline (36) in a meta-analysis associating ketamine with PCA morphine found a significant 32% reduction in pain intensity at rest at 24 h, a 28% reduction in morphine consumption at 24 h, and a 44% reduction in nausea-vomiting with no increase in the incidence of hallucinations. Kranke (37) observed a reduction in pain scores for up to 48 hours postoperatively. In 2015, an FSACC survey showed that intravenous ketamine was used in 92% of perioperative patients as an anti-hyperalgesic, and that it offered the best benefit/tolerance balance(38).

The prevalence of complications was 44%. Arterial hypotension was the most frequent complication (28.8%), followed by difficult orotracheal intubation, desaturation and postoperative nausea and vomiting. The high frequency of arterial hypotension in our study may be explained by the arterial and venous vasodilatory effects of propofol, the main hypnotic used, which are potentiated by halogenated agents. Ziemann (25) reported that 57.3% of patients had PONV. Heinrich (39) found an overall PONV rate of 32%. Numerous studies have found a prevalence of complications quite similar to that of this study and the type of complication most commonly encountered was respiratory. Shireen (40) Ahmad found that morbidly obese subjects, with or without OSAS, experienced frequent episodes of postoperative desaturation despite additional oxygen therapy.

In this study, the factors associated with the occurrence of complications were: age (≥40 years), male sex, presence of comorbidities (OSAS, diabetes and hypertension) and Mallampati, Cormack and ASA scores ≥ 3. Vieito Amor (10) reported ASA score > 3, male sex, high BMI and underlying disease as factors associated with complications, results similar to ours. Liu (41) found that males were 1.69 times more likely to present complications, and the presence of comorbidities increased the risk of complications by a factor of 1.60.

This study has the weakness of being monocentric, but confirms the high frequency of complications in bariatric surgery.

Conclusion

Bariatric surgery seems to be the prerogative of young women who resort to it for aesthetic reasons or to improve their appearance, or for medical reasons, and is accompanied by complications which are very frequent in this series, fortunately without any deaths. The factors associated with complications (age, sex, comorbidity, Mallampati and Cormack grades) seem to be more related to the patients, factors that are difficult to modify.

Authors' contributions

Patient Keto: Study design, data collection and drafting of the manuscript.

Wilfrid Mbombo: Study design and drafting of the manuscript.

All other authors: reading and correction of the manuscript.

Acknowledgements

We would like to thank the staff of the operating theatre and the intensive care unit of the Delafontaine Saint Dénis hospital for their collaboration.

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