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Anesthesia in Obese Patients in Lubumbashi: Spirometric Specificities and Perioperative Complications

Mukalay Banza Yves[1], Situakibanza Nani-Tuma Hippolyte[2], Wasso Milinganyo Eddy[1], Teta Wa Mwanza Ildephonse[1], Tshibwaya Mutaka Nicole[1], Wani Avea Mireille[1], Tshikudi Mayunga Glody[1], Sagboze Zalambo Sandra[1], Mulewa Umba Déogracias[1], Nguz A Kutshid Nathan[1], Tshisuz Nawej Christian[1], Mabala Kipulu Foreman[1], Manika Muteya Michel[1], Mbuyi Musanzayi Sébastien[3], Muyumba Kiyana Emmanuel[4], Barhayiga Nsimire Berthe[5], Iteke Fefe Rivain[1]

[1]Department of Anesthesia and Intensive Care, University of Lubumbashi, Lubumbashi, Democratic Republic of the Congo
[2]Department of Internal and Tropical Medicine, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[3]Department of Surgery, University of Lubumbashi, Lubumbashi, Democratic Republic of the Congo
[4]Department of Internal Medicine, University of Lubumbashi, Lubumbashi, Democratic Republic of the Congo
[5]Department of Anesthesia and Intensive Care, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
Email: mukalay.Banza@Unilu.ac.cd

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Abstract

Introduction: Obesity is defined as an excessive increase in fat mass, leading to somatic, psychological, and social repercussions, as well as an impact on individuals' quality of life. In anesthesia, obese patients are at risk of complications, particularly respiratory issues, in resource-limited environments where respiratory function testing is scarce. **Aim:** This work aims to contribute to the understanding of spirometric abnormalities and perioperative complications in our environment. **Background:** Obesity is associated with numerous comorbidities and is notably a major risk factor for sleep apnea syndrome (SAS), with 30% to 70% of obese patients being apneic. Moreover, increased intra-abdominal pressure leads to changes in respiratory mechanics and a significant reduction in lung volumes, particularly functional residual capacity (FRC), which predisposes obese patients to atelectasis formation. As a result, obese patients are at increased risk of respiratory complications, including acute respiratory distress syndrome (ARDS). Any surgical procedure in the obese population carries a high risk, and perioperative respiratory complications remain common in these patients. Airway management is also particularly challenging. **Methods:** This is a cross-sectional analytical study conducted over 12 months in the anesthesia and intensive care department of the University Clinics of Lubumbashi and Medpark Clinic of Lubumbashi/DR Congo. **Results:** Forty-seven obese patients were included out

of 1394 operated subjects, representing a frequency of 3.37%. The mean age is 39.13 years ± 10.48 years (range 19 - 65 years), with women accounting for 78.7% of the study population. The mean BMI of obese patients was 37.06 kg/m^2 ± 6.16 kg/m^2. Most patients were classified as ASA 2 (51.1%) and operated under spinal anesthesia (56.6%), with obstetric surgery being the most frequent (31.9%). Five obese patients exhibited obstructive respiratory disorders (10.6%), 23 had restrictive disorders (48.9%), and three others (6.4%) presented mixed disorders. Desaturation was the respiratory complication observed in 2.1% of cases during surgery and 4.3% postoperatively. **Conclusion:** Obese patients present undiagnosed respiratory abnormalities due to a lack of respiratory function assessment in our environment. Standardizing their perioperative anesthetic management could help reduce morbidity and mortality.

Keywords

Anesthesia, Obesity, Spirometry, Perioperative, Lubumbashi/DR Congo

1. Introduction

More and more anesthesiologists will be confronted with the perioperative management of obese patients, whose prevalence is continuously increasing [1]. Obesity is defined as an excessive increase in body fat that has somatic, psychological, and social repercussions, affecting individuals' quality of life [2]. According to the World Health Organization, obesity is the excess of body fat, having undesirable consequences on health and well-being [3]. In clinical practice, the degree of obesity is determined by the body mass index, with obesity defined as a BMI ≥ 30 kg/m^2. Morbid obesity, defined by a BMI ≥ 40 kg/m^2, can also be classified into super obesity (BMI ≥ 50 kg/m^2) and super super obesity (BMI ≥ 60 kg/m^2). The prevalence of obesity is continuously increasing across all continents and is accompanied by the emergence of many specific medical and surgical problems [3] [4].

Obesity leads to multiple complications, particularly respiratory ones, which can worsen anesthetic risk. Spirometric abnormalities in obese patients, such as decreased vital capacity, ventilatory disorders (obstructive, restrictive, or mixed), or hypoxia, are common and affect anesthesia management [3].

In Lubumbashi, functional respiratory tests in the preoperative phase (spirometry) are limited. Hence, there is a need to objectively explore spirometric abnormalities and specific anesthetic complications associated with obesity in Lubumbashi.

The general objective of this study is to contribute to the understanding of spirometric abnormalities and their perioperative repercussions in our environment.

The specific objectives are to describe the sociodemographic and clinical characteristics of obese patients at the pre-anesthetic consultation, to study the spirometric ventilation disorders in the obese, and to describe the perioperative evolu-

tion of these patients.

2. Materials and Methods

We conducted this study in the Anesthesia and Intensive Care Service of the University Clinics of Lubumbashi and the Medpark Clinic in Lubumbashi (Democratic Republic of Congo). It was a cross-sectional analytical study focusing on obese patients undergoing surgery who received peri-anesthetic care over a period of one year. All obese patients during the pre-anesthetic consultation who underwent surgery during our study period were recruited. All adult patients with a BMI ≥ 30 kg/m^2, who received a pre-anesthetic consultation and spirometry, and in addition underwent surgery during our period of interest.

The variables were of a sociodemographic, clinical, spirometric, and anesthetic nature. Spirometric tests were performed using a portable turbine spirometer of the CONTEC brand, version 2.6, equipped with built-in functions (**Figure 1**).

Figure 1. Contec brand turbine spirometer.

2.1. Operating Method

Spirometric tests were performed using a CONTEC medical turbine spirometer version 2.6, and the recorded measurements concerned: FEV1 (in liters and percentage), FVC (in liters and percentage), and PEFR (in liters and percentage); these values allowed the calculation of the Tiffeneau index (FEV1/FVC*100). The measurement protocol strictly adhered to the recommendations of the scholarly societies [5]-[8].

Regarding the technical steps of spirometry:

Patient in a sitting or standing position (same position during the measurement and for each measurement).

Document the chosen position (reproducibility).

Forced vital capacity (FVC):

1) Maximum inspiration without having the mouthpiece in the mouth (to reduce the risk of cross-contamination).

2) Expiration into the spirometer: airtight mouth around the mouthpiece (avoid

leaks) without obstructing it with the tongue, maximum initial expiration, as hard and as long as possible.

3) Deep inspiration, with the mouthpiece always in the mouth [9].

Procedure in the operating room: After checking the equipment and anesthetic medications, the patient enters the operating room in regulation attire under the escort of healthcare personnel, followed by preparation (installation and appropriate monitoring, peripheral venous access).

- Installation: during the entire preparatory and induction period, the patient is in the proclive position (25˚ - 40˚) or preferably in the beach chair position (reclining chair position) [10].

- Suitable materials: for monitoring and preventing nerve damage often caused by stretching or pressure points.

- Anesthetic induction:

It depends on the anesthetic protocol chosen; in the case of general anesthesia, a crash induction was performed on the patient with a full stomach, and a classic induction was used in other cases. Due to their background (obese patient) and their pharmacological modifications, we adapted the dosages of the main anesthetic medications, taking into account the actual weight, theoretical ideal weight, and corrected weight.

In the case of regional analgesia, for spinal anesthesia, the patient was positioned sitting, the skin at the puncture site was disinfected, the space was located, and the anesthetic puncture was carried out after infiltrating the skin with 2% lidocaine without adrenaline and injecting 5% bupivacaine with an adjuvant (fentanyl or clonidine) into the subarachnoid space in a commented manner to instill more confidence in the patient.

The volume of local anesthetic and the choice of adjuvant depended on the type and duration of the intervention.

Figure 2 shows the course of a spirometry in a 29-year-old patient in preparation for surgery.

Figure 2. Spirometry in a 29-year-old cooperative patient.

The data encoding was done using Excel 2019. The file containing the data was exported to SPSS version 25 and EPI Info version 7.1.0.6 for analysis purposes.

2.2. Spirometric Criteria for the Classification of Ventilatory Disorders

To classify ventilator disorders, we used the Tiffenau index.

Tiffenau Index (TI) = FEV_1 (Forced Expiratory Volume in 1 second) × 100
FVC (Forced Vital Capacity)

Interpretation

1) TR =< 70%: Obstructive syndrome (obstructive ventilatory disorder).

2) A uniform decrease of the FEV1 and the FVC associated with a normal TI allowed us to conclude a restrictive syndrome.

Plethysmography, which is an accurate exam to conclude, was not performed due to a lack of equipment.

3) The association of the two conditions was considered a mixed syndrome.

2.3. Definition of Desaturation Criteria for the Study

Patients were considered to have desaturation if their SpO2 dropped below 92%. We considered a desaturation as severe when SpO2 dropped below 90%.

2.4. Ethical Considerations

We have complied with the current Helsinki standards in terms of confidentiality, non-harm, benefit, and distributive justice. Our patients were free to sign an informed consent beforehand.

Our work was authorized by the ethical commission of the University of Lubumbashi.

3. Results

3.1. Frequency

During the entire period of the study, 1324 surgical operations were conducted in our selected hospitals. Forty-seven of them had obesity, representing a frequency of 3.3%.

3.2. Gender

The Figure below (**Figure 3**) indicates that 79% of the patients were female. The sex ratio is 3.7 women for one man.

Figure 3. Distribution according to gender.

3.3. Distribution by Age

Table 1. Distribution according to age.

Age	Frequency	%	Mean ± Standard Deviation (Min-Max)
19 - 39	24	51.1	
40 - 59	20	42.6	39.13 ± 10.48 (19 - 65)
≥60	3	6.4	
Total	**47**	**100**	

More than half of the patients (51.1%) were aged between 19 and 39 years, as shown in Table 1.

The average age of the patients was 39.13 years ± 10.48 years, with extremes ranging from 19 years to 65 years.

3.4. Obesity Stages

We had 44.7% of patients with mild obesity and 2.1% with super-super obesity. The average BMI was 37.06 kg/m^2 ± 6.16 kg/m^2.

3.5. Personal Medical History

Table 2. Distribution according to personal medical history.

Personal Medical History	Frequency	%
Surgical	**10**	**21.3**
Medical:	**12**	**25.5**
• Hypertension (HTN)	8	17.0
• HTN + Diabetes	2	4.3
• Others	2	4.3
Toxic and Allergic History	**2**	**4.3**
No Important History	**23**	**48.9**
Total	**47**	**100**

Hypertension was the leading medical history at 17%. Approximately forty-nine percent did not have any important medical history, as shown in Table 2.

3.6. Type of Surgery

Table 3. Distribution according to the type of surgery.

Type of Surgery	Frequency	%
Digestive Surgery	4	8.5
General Surgery	9	19.1
Orthopedic Surgery	7	14.9
Gynecological Surgery	8	17.0

Continued

Obstetric Surgery	15	31.9
Neuro-Surgery	2	4.3
Urology	2	4.3
Total	**47**	**100.0**

Obstetric surgery was the most practiced, with a frequency of 31.9% (Table 3).

3.7. Anesthetic Procedure

Figure 4 shows that spinal anesthesia was the most commonly practiced in this study.

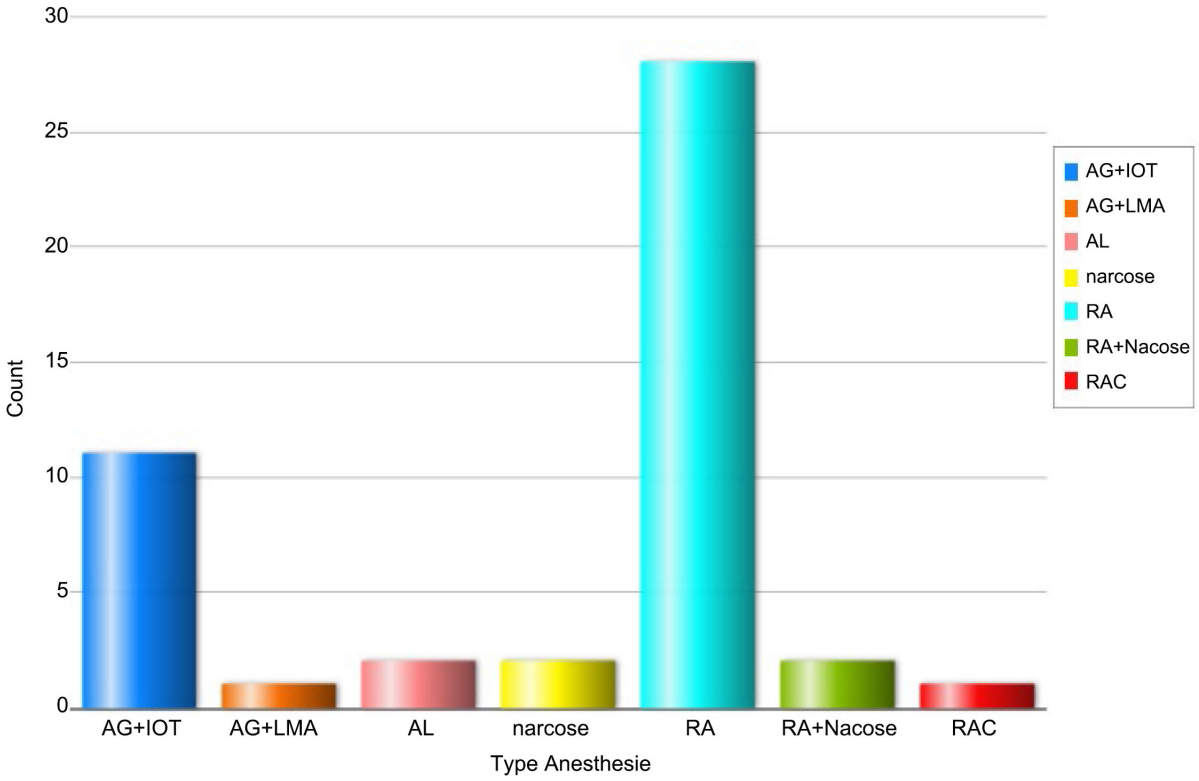

Figure 4. Distribution according to the type of anesthesia.

3.8. Spirometric Caractors

Out of a total of 47 patients, the combined Table 4 states:

- Five obese individuals had a low Tiffeneau ratio (obstructive syndrome), representing 10.6%.

- And 23 showed a harmonious decrease in FVC and FEV1 (restrictive syndrome in 48.9% of cases.

- Three others had a mixed syndrome due to a combined decrease of FEV1 + FVC + Tiffeneau ratio (6.4%), and a low DEP was found in 83.0% of cases.

Table 4. Distribution according to spirometric parameters and associated diagnosis.

Spirometric Characteristics	Frequency	%	Spirometric Diagnostic	Frequency	%
Tiffeneau Index			**Obstructive Syndrome**		
Low	5	10.6	No	42	89.4
Normal	42	89.4	Yes	5	10.6
Total	**47**	**100**	**Total**	**47**	**100**
FEV_1	**Frequency**	**%**	**Restrictive Syndrome**		
Low	30	63.8	No	24	51.1
Normal	17	36.2	Yes	23	48.9
Total	**47**	**100**	**Total**	**47**	**100**
FVC	**Frequency**	%	**Mixed Syndrome**		
Decreased	23	48.9	No	44	93.6
Normal	24	51.1	Yes	3	6.4
Total	47	100	Total	47	100
PEF (Peak Expiratory Flow)	**Frequency**	**%**			
Low	39	83			
Normal	8	17			
Total	**47**	**100**			

3.9. Association between BMI, Age, and Spirometric Abnormalities

Table 5. Association between BMI, age, and spirometric abnormalities.

Factor	Spirometric Abnormalities	N	Min	Q1	Median	Mean	Standard Deviation	Q3	MAX	Statistic Test	p-value
BMI	**No**	18	30.4	31.68	34.94	36.26	7.15	36.82	62	Mann-Whitney Test	0.203
	Yes	24	30	32.97	37.72	37.7	5.24	41.3	49.7		
AGE	**No**	18	28	32	41	40.19	8.53	45	63	T-Student	0.538
	Yes	24	19	30.25	37	38.27	11.93	43.75	65		

The distributions of BMI and age were identical across the categories of obese patients with and without spirometric abnormalities, and the test was not statistically significant according to the test results ($p > 0.05$) (Table 5).

3.10. Association between BMI, Age, and Perioperative Complications

The distributions of BMI and age were the same in the obese patients who did not present any respiratory perioperative complications. It was the same for patients who presented respiratory perioperative complications. The statistical test appears not significant (Table 6).

Table 6. Association between BMI, age, and perioperative complications.

Factors	Perioperative Complications	n	Min	Q1	Median	Mean	Standard Deviation	Q3	Max	Statistic Test	p-value
BMI	**No**	46	30	32.8	35.69	36.84	6.04	40.08	62	Mann-Whitney Test	0.17
	Yes	1									
AGE	**No**	46	19	30.75	38.5	39.09	10.6	45	65	T-Student	0.859
	Yes	1									

3.11. Association between BMI, Age, and Postoperative Complications

Table 7. Association between BMI, age, and postoperative complications.

Factors	Postoperative Respiratory Complications	n	Min	Q1	Median	Mean	Standard Deviation	Q3	Max	Statistic Test	p-value
BMI	**No**	45	30	31.68	35.75	37.06	6.22	36.82	62	Mann-Whitney Test	0.936
	Yes	2	32.6	32.97	37.05	37.05	6.29	41.3	41.5		
AGE	**No**	45	19	31.5	39	39.27	10.49	45	65	T-Student	0.671
	Yes	2	26	26	36	36	14.14		46		

We had identical statistical distributions for BMI and age in obese stage patients who presented postoperative respiratory complications and those who did not present any complications. The statistics support a non-significant result (Table 7).

4. Discussion

We recruited 47 obese patients out of the 1394 operated during the period of this study, which corresponds to a frequency of 3.37%. We note the predominance in our series of the female sex at 78.7%, with a sex ratio of 3.7 women to one man. This aligns with data from the literature, as compared to the study by Khallati [2] in Morocco, by Musikas *et al.* [11] in France, by Dindo *et al.* [12] in Switzerland, and by Tjeertes *et al.* [13] in the Netherlands, which recorded 59%, 82%, 61%, and 58.5%, respectively.

The age group of 19 - 39 years was the most represented at 51.1% in our series, with an average age of 39.13 years; the study conducted in Meknès by Khallati [2] had an average age of 39.15 years over a series of 34 operated obese patients at the military hospital Moulay Ismail. We note a discrepancy with European series [11]-[13]; the predominantly young African population with a reduced life expectancy compared to that of Europe would be the main reason for this discrepancy [14].

In this study, the average BMI of our patients is 37.05 kg/m^2. We find that the average BMI of our series aligns with the data in the literature; multiple factors, such as a sedentary lifestyle, lack of physical activity due to urbanization, and a calorie-rich diet from industrial products (fast food and sweets), would perpetuate

this severe obesity, as unanimously reported by authors.

Hypertension was the predominant comorbidity at 17% and was associated with diabetes at 4.3%. These data differ from the work of Moata *et al.* [15], which evaluated cardio-metabolic comorbidities in obese individuals who had high hypertension at 62%, which could be correlated with the morbid obesity in their series that had an average BMI of 47.48 kg/m^2.

From this diversity of interventions, we have a high rate of obstetric surgery at 31.9%, and this superiority follows the predominance of the female sex in this study, which is not the case in the Moroccan series by Khallati *et al.* [2], who reported a significant rate of visceral surgery (33%).

4.1. Anesthetic Characteristics

The ASA class 2 is predominant with 51.1%; we found a similarity with the study by Bamgbad *et al.* [16] conducted on postoperative complications of obese and non-obese patients (59.2%). Our data agree that the average BMI of patients in both series (severe obesity) influenced the ASA score according to the standards prescribed by the American Society of Anesthesiologists on ASA classification [17].

Most interventions were performed under spinal anesthesia at 59.6%, which is justified by the significant rate of obstetric surgery mentioned above. This differs from literature data, where general anesthesia was more commonly practiced at 86% in obese patients in the series by Tahouna *et al.* [18] and at 58% in the Moroccan experience with Khallati *et al.* [2]. This choice of anesthetic protocol is significantly linked to the high rate of visceral surgery in their work.

4.2. Spirometric and Evolutionary Characteristics

We found, on one hand, a decrease in the Tiffeneau index (indicative of an obstructive ventilatory disorder) in 10.6% of cases, a combined uniform reduction of FVC and FEV1 (suggesting a restrictive ventilatory disorder) in 48.9% of cases, and a reduction in three parameters (Tiffeneau ratio, FVC, and FEV1) indicating a mixed ventilatory disorder in 6.4% of subjects in our series; and, on the other hand, perioperative complications were marked by respiratory desaturation during surgery in 2.1% of patients and postoperatively in 4.3% of patients.

Obesity presents a high surgical risk due to increased rates of postoperative atelectasis, which can lead to desaturation.

Furthermore, statistical analyses associating perioperative and postoperative complications with other categorical factors (age, BMI, ASA) did not show statistically significant differences (p> 0.05). This result is similar to the study by Mohammed [19] conducted on the effect of obesity on spirometry tests in healthy non-smoking adults, where no significant difference was found in FEV_1 ($p = 0.686$), FVC ($p = 0.733$), the FEV_1/FVC ratio ($p = 0.197$), and between obese and non-obese subjects.

A discordance exists between our data found in the literature and the results of

Wang *et al.* [20], who studied the effects of BMI on spirometry tests in adults in China and reported a significant decrease in the percentage of FVC ($p = 0.037$) in obese subjects compared to non-obese subjects; and also Abdul-lah *et al.* [21], who studied the spirometric profile of overweight and obese patients and noted that all spirometry parameters [FVC, FEV_1, FEF (mean forced expiratory flow between 25% - 75%), and PEF (peak expiratory flow)] were significantly lower in obese individuals experiencing dyspnea than in normal weight subjects.

In light of the rising prevalence of non-communicable diseases such as obesity, which our study suggests may be associated with spirometric impairments, there is a compelling need to advocate for or systematically incorporate pulmonary function testing in the management of obese patients, particularly in resource-limited settings.

In perspective, other multicentric studies with a higher sample size would be necessary for more accurate analysis.

5. Conclusions

The prevalence of obesity is constantly increasing across all continents and is accompanied by the emergence of numerous medical and surgical problems.

This study focused on spirometric abnormalities in obese patients and their perioperative repercussions during anesthesia in Lubumbashi.

It should be noted that the pathophysiological characteristics of obese patients mean that their perioperative management differs completely from that of normal-weight individuals, and as practitioners, we will increasingly face their management requiring adaptation and, especially, perfect collaboration between surgeons and anesthetists, who must take these modifications and associated comorbidities into account.

Aligning with the variables of this work, the female sex is more affected in the sociodemographic aspect; moderate obesity and hypertension, as the main comorbidities, are observed clinically. To this, we associate the predominance of obstetric surgery and spinal anesthesia.

From a spirometric point of view, this study highlighted the presence at the pre-anesthetic consultation of various underdiagnosed ventilatory disorders (obstructive, restrictive, and mixed) in obese patients who are to be operated on.

Particular emphasis is also placed on their repercussions or perioperative complications, mainly respiratory desaturation and hypertension in general.

In our context, in low-resource countries, respiratory functional explorations (such as spirometry) are scarce or almost non-existent during pre-anesthetic consultations, and this encroaches on the proper perioperative preparation of patients.

It is therefore appropriate for us, in the era of evidence-based medicine, to systematize the assessments of respiratory function in obese individuals, mainly spirometry, in order to improve their perioperative management, as reflected in the results of our study.

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Conflicts of Interest

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

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