OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Cosmetic

Impact of Body Mass Index on Outcomes of Patients Undergoing Liposculpture in Private Practice

Johanna Cruz Vargas, MD
Miguel Carbajal Barrios, MD
Gabriel De la Cruz Ku, MD

Background: The popularity of liposculpture has increased due to the high patient satisfaction rate and low number of complications. However, in Latin America, serious complications have been reported due to various factors. Therefore, our objective was to determine the association of a BMI of 30 kg/m² or more with the development of postoperative complications in patients undergoing liposculpture.
Methods: A retrospective cohort study was performed in patients undergoing liposculpture at the Clinica Nova Quirurgica in Arequipa between 2020 and 2021.
Results: A total of 231 patients were identified. The median age was 35 years, the majority of patients were women (97.4%), and 25.6% of patients had a BMI of 30 kg/m² or more. Postoperative complications developed in 13.4%, the majority being seromas (10.8%), followed by superficial site infections (2.6%), hematomas (1.7%), asymmetry (1.7%), and deep vein thrombosis (0.4%). No other complications were identified. In the multivariable analysis, risk factors for the development of complications were a BMI of 30 kg/m² or more [relative risk (RR) = 3.63; 95% confidence interval (CI), 1.27–10.32; $P = 0.016$], longer operative time (RR = 1.01; 95% CI, 1.00–1.02; $P = 0.001$), and greater volume of fat removed (RR = 1.01; 95% CI, 1.01–1.01; $P = 0.002$).
Conclusions: Patients with a BMI of 30 kg/m² or more undergoing liposculpture have a ~3.5-fold higher risk of developing postsurgical complications compared with patients without obesity. Other risk factors were longer operative time and greater volume of fat removed. Adequate patient selection is crucial to obtain optimal results.
(Plast Reconstr Surg Glob Open 2024; 12:e6291; doi: 10.1097/GOX.0000000000006291; Published online 20 November 2024.)

INTRODUCTION

Liposculpture is a modification of the liposuction procedure aimed at obtaining better results in aesthetic terms. It is based on eliminating fat deposits using a laser and includes transference of this fat to other areas that need volume. Liposuction is one of the most frequent aesthetic surgical interventions worldwide, with a record number of 1,704,786 and 1,677,510 interventions in 2018 and 2019, respectively,[1–3] closely after mammoplasty in the United States. However, liposculpture has increased in popularity due to the high patient satisfaction rates and fewer complications when performed in experienced centers.[4,5] In Latin America, the centers with the highest numbers of liposculpture procedures are in Brazil and Mexico, whereas in Peru, it is the most requested aesthetic procedure.[6] However, serious complications such as pulmonary thromboembolism, fat embolism, surgical site infections, and even death have been reported in young people with obesity, between 21 and 31 years of age, who underwent superwet infiltration and aspiration of more than 10 L of fat.[7,8]

Among other aesthetic procedures, surgical intervention is not recommended in subjects with a high body mass index (BMI), because of the greater risk of complications, specifically due to wound healing.[9] In abdominoplasties, it has been reported that patients with obesity have a 74% higher risk of complications, 66.7% higher risk of minor complications, and 51.9% higher risk of seromas compared with patients without obesity.[10,11] Moreover, 10%–20% of patients with a BMI more than 30 kg/m²

From the Universidad Cientifica del Sur, Lima, Peru.

Received for publication March 15, 2024; accepted September 16, 2024.

The data that support the findings of this study are available from the corresponding author upon reasonable request.

DOI: 10.1097/GOX.0000000000006291

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

may present local complications.[12] Thus, for body contouring surgery, the higher the BMI, the higher the rate of complications, with the subsequent need for surgical reinterventions and readmissions.[13] Other risk factors for the development of severe complications are insufficient hygiene standards, inadequate patient selection, and lack of surgical experience.[14–16]

The general perception of liposculpture as a minor surgery procedure underestimates the possible development of serious complications, and therefore, guidelines and health policies are required to maximize its safety. Moreover, due to the lack of restrictive legal regulations for body contouring interventions in several Latin American countries, these procedures are frequently performed by general surgeons or practitioners who are not trained in plastic or aesthetic surgery.[17] Indeed, previous studies have identified risk factors for postsurgical complications in patients undergoing liposuction that are related to the surgeon's experience, aseptic standards, excessive liposuction, high BMI, and multiple procedures performed during the same intervention.[18]

Therefore, our main objective was to determine the association of a BMI more than 30 kg/m^2 with the development of postoperative complications in patients undergoing liposculpture in a private clinic in Arequipa, Peru, between January 2020 and December 2021. The results of this study will provide scientific evidence as to whether a high BMI has an impact on the outcomes of patients with obesity undergoing liposculpture, similar to other surgical procedures, and provide recommendations for the development of future clinical practice guidelines.

Takeaways

Question: Is a body mass index (BMI) of 30 kg/m^2 or more associated with the development of postoperative complications in patients undergoing liposculpture?

Findings: A retrospective cohort of 231 patients showed that patients with BMI of 30 kg/m^2 or more have a 3.5 times higher risk of developing postsurgical complications, predominantly seromas. Other risk factors found were longer operative time and greater volume of fat removed.

Meaning: Patients with obesity should be cautiously selected when undergoing liposculpture to obtain optimal outcomes and prevent complications.

MATERIALS AND METHODS

Study Design and Population

A retrospective cohort study was carried out on patients who underwent liposculpture at the Clinica Nova Quirurgica in Arequipa, Peru, between January 1, 2020, and December 31, 2021. The inclusion criteria included patients between 18 and 50 years of age who underwent liposculpture at the Clinica Nova Quirurgica; and individuals who underwent complete postoperative controls during the 2 months after surgery. The exclusion criteria included patients who previously had liposuction either in the same clinic or in another center; patients who underwent an additional procedure at the same time as the liposculpture procedure or within 60 days thereafter, patients with a clinical history such as diabetes mellitus or hypertension, cancer or rheumatological disease; patients with a history of abdominal or intra-abdominal cosmetic surgery; patients who had consumed tobacco 21 days before surgery; patients who did not comply with postoperative treatment based on drainage massage and use of an abdominal compression binder; patients with incomplete follow-up controls; incomplete medical records; patients with alcohol consumption less than 14 days before surgery; patients with illegal drug use such as marijuana, cocaine, heroin, among others; and pregnant patients. Data collection was carried out using a data collection form. The data were codified and transferred to a Microsoft Excel program and then transferred into the SPSS v.28 program for later analysis.

Variables

The variables analyzed included sociodemographic characteristics, such as age and sex; clinical and laboratory characteristics, such as BMI (classified according to the World Health Organization as nonobese: 18.5 to <25 kg/m^2, overweight: 25 to <30 kg/m^2, class 1: 30 to <35 kg/m^2, and class 2: 35 to 40 kg/m^2), preoperative hemoglobin level, and anesthesia risk classification according to the American Society of Anesthesiology (ASA); intraoperative characteristics, such as intraoperative bleeding and surgery time; follow-up characteristics, such as days of hospitalization; and postoperative complications, such as hematoma, bleeding requiring blood transfusion, deep vein thrombosis, pulmonary embolism, perforated viscus, surgical site infection, seroma, burn, hyperpigmentation, asymmetry, and fibrosis or retraction. In addition, the evaluation of hematoma, seroma, hyperpigmentation, asymmetry, retraction, or fibrosis was evaluated by 2 plastic surgeons different from those who performed the surgery.

Surgical Technique

Liposculpture included liposuction and lipotransfer, which included fat grafting and lipotransfer to certain areas of the body to create definition and tone. Before the procedure, a design of the areas of liposuction and lipotransfer was made. A previous photographic record was made. All patients underwent epidural anesthesia. The technique started with the infiltration of modified Klein solution, which combines sodium chloride 0.9% 1000 mL, 1.5 mL of 1:1000 epinephrine, 40 mL of 2% lidocaine, and 10 mL of 8.4% sodium bicarbonate. A total of 1.5–3L (wt/vol) of Klein solution was injected, it was distributed according to the area of the body with the following ranges: abdomen 500–1000 mL, each thigh 300–600 mL, and each upper hip 300–500 mL. The liposuction was performed in areas of fat accumulation, using a 1201-nm diode laser, with a cannula of 3.5 cm in diameter. The fatty tissue aspirated was washed with 0.9% sodium chloride to select only the adipose cells to be grafted, removing the connective tissue. The volume of sodium chloride was double that of the fat aspirated. Grafting of fatty tissue was

performed in areas where the volume was desired, such as buttocks, hips, breasts, and thighs, to achieve remodeling of the body contour. The volume of fat transferred per area did not exceed 100 mL. At the end of the procedure, a pressure garment was placed, which the patient was instructed to wear 24 hours/day for a total of 6 weeks, and this pressure garment should be reapplied after showering to cover incisions. Other postoperative instructions were as follows: it was possible to shower 48 hours after surgery, rest for at least 4 weeks, start walking as soon as possible, no sports or strenuous exercise for at least 4 weeks after surgery, increase in fluid intake, not resuming aspirin or anticoagulation for at least 5 days after surgery, no alcohol consumption for at least 3 weeks after surgery, no smoking for at least 6 weeks after surgery, avoid exposure of scars to sun for at least 12 months, and follow-up in the next 3–5 days after surgery.

Data Analysis

The sample calculation was made with the OpenEpi program using the Kelsey/Fleis formula. Of the total of 600 patients who underwent liposculpture during the study period, a sample of 205 patients was obtained with a 95% confidence interval (CI) and a power of 80%, based on a study by Neaman and Hansen,[18] which concluded that patients undergoing abdominoplasty with postoperative complications have a 2.4 greater probability of having a BMI more than 30 kg/m^2 [relative risk (RR) = 1.85]. The data from medical records were entered into a Microsoft Excel program, and simple, random, probabilistic sampling was carried out. Only patients who met the inclusion criteria were included. A descriptive analysis of all the patient characteristics was carried out using frequencies and percentages for variables with a nominal and ordinal measurement scale. The follow-up time was 2 months after the surgical procedure. The relationship between dichotomies and quantitative variables was determined using the χ^2 test and Fisher exact test. On the other hand, the Student *t* test and Mann-Whitney *U* test were used for continuous variables with normal and abnormal distribution, respectively. The univariate and multivariable binary logistic regression model was used to identify the association of the variables with complications, in addition to assessing risk factors. The Hosmer–Lemeshow test was used to evaluate the goodness of fit of the model. A 95% CI and a *P* value of less than 0.05 were used and considered statistically significant. We used the Statistical Package for Social Sciences software, version 28.0, for data analysis.

Ethical Considerations

The research protocol was approved by the ethics and research committee of the Universidad Cientifica del Sur (1075-2021-PRE15), and by the research committee of the Clinica Nova Quirurgica with authorization from the clinic. The study was funded by the authors, and no financial support was received from another institution. The information of all the patients was handled confidentially and purely for the study purpose. The information was transcribed in a virtual medium with exclusive access for the main researchers. The final database does not contain information that allows the identification of any of the patients. In addition, coded patient data will not be disclosed.

RESULTS

A total of 231 patients, with a median age of 35 years [interquartile range (IQR): 29–40 y], were included in the study, and the majority were women (97.4%). Regarding BMI, 51.9% had a BMI less than 25 kg/m^2, 22.5% had a BMI between 25 and 30 kg/m^2, and 25.6% had a BMI of 30 kg/m^2 or more. The median ASA classification was 1 (IQR: 1–2). The median operative time was 150 minutes, whereas the median hospitalization time was 1 day (IQR: 1–2 days). The median preoperative hemoglobin value was 14.50 g/dL. Additionally, the median volume of fat removed was 3500 mL (IQR: 3000–4500 mL) and the median intraoperative bleeding was 105 mL (IQR: 90–135 mL) (Table 1).

A total of 40 (13.4%) patients developed postoperative complications, 25 (10.8%) had seromas, 4 (1.7%) had asymmetry, 6 (2.6%) had surgical wound infection, 4 (1.7%) presented hematomas, and 1 (0.4%) had deep vein thrombosis. No patient presented bleeding requiring transfusion, pulmonary embolism, burn, fibrosis, or retraction (Table 2).

Patients who developed complications were older (37.81 versus 34.02 y, $P = 0.001$). Sex was not related to complications ($P = 0.58$). Additionally, a BMI more than 30 kg/m^2 was associated with a greater number of complications (67.7% versus 19.0%, $P < 0.001$), and it was found that the higher the BMI, the greater the number of complications ($P < 0.001$). In addition, complications were related to a higher ASA classification (mean: 1.26 versus 1.06, $P < 0.001$), a longer operating time (median: 195.0 versus 150.0 min, $P < 0.001$), greater volume of fat removed (median: 5000.0 versus 3450.0 mL, $P < 0.001$),

Table 1. Sociodemographic and Surgical Characteristics of the Patients Undergoing Liposculpture from 2020 to 2021

Variables	N	%
Total	231	100
Age, y, median (IQR)	35 (29–40)	
Sex		
Female	225	97.4
Male	6	2.6
BMI, kg/m^2, median (IQR)	24.75 (22.77–27.26)	
Normal	120	51.9
Overweight	52	22.5
Obesity type 1	57	24.7
Obesity type 2	2	0.9
Classification according to BMI, kg/m^2		
<30	172	74.5
≥30	59	25.5
Operative time, min, median (IQR)	150.0 (120.0–190.0)	
Volume of fat removed, mL, median (IQR)	3500.0 (3000.0–4500.0)	
Intraoperative bleeding, mL, median (IQR)	105.0 (90.0–135.0)	

Table 2. Complications in Patients Undergoing Liposculpture from 2020 to 2021

Variables	N	%
Complications		
No	221	95.7
Yes	31	13.4
Hematoma		
No	227	98.3
Yes	4	1.7
Deep vein thrombosis		
No	230	99.6
Yes	1	0.4
Surgical site infection		
No	225	97.4
Yes	6	2.6
Seroma		
No	222	96.1
Yes	25	10.8
Hyperpigmentation		
No	231	100.0
Yes	0	0.0
Asymmetry		
No	227	95.7
Yes	4	1.7
Fibrosis/retraction		
No	231	100.0
Yes	0	0.0

and greater intraoperative bleeding (median: 150.0 versus 103.50 mL, $P < 0.001$), whereas sex (women 96.8% versus 97.5%, $P = 0.583$), preoperative hemoglobin (median: 14.30 versus 14.50 g/dL, $P = 0.678$), and length of hospitalization (mean: 1.05 versus 1.02 d, $P = 0.154$) were not related to the development of complications (Table 3).

When performing a stratified analysis, patients with obesity were older (median: 37.0 versus 34.5 y, $P < 0.001$). Furthermore, these patients had a higher ASA classification (mean: 1.24 versus 1.03, $P < 0.001$). Regarding operative characteristics, a BMI more than 30 kg/m^2 was related to a longer operative time (median: 160.0 versus 150.0 min, $P = 0.031$), greater volume of fat removed (median: 4500.0 versus 3000, $P < 0.001$), and greater operative bleeding (median: 135.0 versus 90.0 mL, $P < 0.001$). No differences were found in sex (women 98.3% versus 94.9%, $P = 0.16$), preoperative hemoglobin (median: 14.7 versus 14.3 g/dL, $P = 0.244$), or length of hospitalization (mean: 1.05 versus 1.01 d, $P = 0.165$) in relation to obesity. Regarding complications, patients with obesity had a higher frequency of seromas (25.4% versus 5.8%, $P < 0.001$), hematomas (6.8% versus 0.0%, $P = 0.001$), surgical wound infections (8.5% versus 0.6%, $P = 0.005$), and asymmetry (6.8% versus 0.0%, $P = 0.001$) (Table 4). Further stratified analysis according to BMI classification showed similar results. Obesity class 1 was related to older age ($P < 0.001$); longer operative time ($P = 0.004$); greater volumes of fat removed ($P < 0.001$); greater intraoperative bleeding ($P < 0.001$); and greater number of total complications ($P < 0.001$), seromas ($P < 0.001$), hematomas ($P = 0.003$), surgical site infections ($P = 0.005$), and asymmetry ($P = 0.001$). (**See table, Supplementary Digital Content 1,** which displays sociodemographic and surgical characteristics of patients undergoing liposculpture from 2020 to 2021 according to BMI classification, **http://links.lww.com/PRSGO/D625**.)

Furthermore, patients who had more than 5000 mL fat removed were older (median: 37.5 versus 34.0 y, $P < 0.002$), had a higher ASA classification (mean: 1.21 versus 1.05, $P < 0.001$), longer operative time (median: 180 versus 150 min, $P < 0.001$), greater intraoperative bleeding (median: 165 versus 90 mL, $P < 0.001$), and longer length of hospitalization (mean: 1.07 versus 1.01, $P = 0.041$). In terms of complications, these patients had a higher frequency of total complications (50.0% versus 5.3%, $P < 0.001$), seromas (38.1% versus 4.8%, $P < 0.001$), hematomas (9.5% versus 0%, $P = 0.001$), surgical site infections (7.1% versus 1.6%, $P = 0.041$), and asymmetry (6.8% versus

Table 3. Sociodemographic and Surgical Characteristics of Patients Undergoing Liposculpture from 2020 to 2021 According to the Presence of Complications

	Complications		
Variables	No (N = 200)	Yes (N = 31)	*P*
Age, y, median (IQR)	34.0 (29.0–39.0)	38.0 (33.0–44.0)	0.001*
BMI, kg/m^2, median (IQR)	24.2 (22.5–26.6)	30.4 (26.5–32.5)	<0.001*
BMI, according to the WHO classification			
Normal	115 (57.5)	5 (16.1)	<0.001†
Overweight	47 (23.5)	5 (16.1)	
Obesity type 1	38 (19.0)	19 (61.3)	
Obesity type 2	0 (0.0)	2 (6.5)	
Classification according to BMI			
<30 kg/m^2	162 (81.0)	10 (32.3)	<0.001‡
≥30 kg/m^2	38 (19.0)	21 (67.7)	
Operative time, min, median (IQR)	150.00 (120.00–180.00)	195.0 (150.0–255.0)	<0.001*
Volume of fat removed, mL, median (IQR)	3450.00 (3000.00–4000.00)	5000.0 (4000.0–6000.0)	<0.001*
Intraoperative bleeding, mL, median (IQR)	103.50 (90.00–120.00)	150.0 (120.0–180.0)	<0.001*

WHO, World Health Organization.
*Mann-Whitney *U* test.
†Fisher exact test.
‡χ^2 Test.

Table 4. Sociodemographic and Surgical Characteristics of Patients Undergoing Liposculpture from 2020 to 2021 According to BMI

Variables	BMI		*P*
	<30 kg/m² (N = 172)	≥30 kg/m² (N = 59)	
Age, y, median (IQR)	34.5 (29.0–39.0)	37.0 (32.0–43.0)	<0.001*
Operative time, min, median (IQR)	150.0 (120.0–180.0)	160.0 (130.0–210.0)	0.031*
Volume of fat removed, mL, median (IQR)	3000.0 (3000.0–4000.0)	4500.0 (4000.0–5000.0)	<0.001*
Intraoperative bleeding, mL, median (IQR)	90.0 (90.0–120.0)	135.0 (120.0–150.0)	<0.001*
Complications			
No	162 (94.2)	38 (64.4)	<0.001†
Yes	10 (5.8)	21 (35.6)	
Seroma			
No	162 (94.2)	44 (74.6)	<0.001†
Yes	10 (5.8)	15 (25.4)	
Hematoma			
No	172 (100.0)	55 (93.2)	0.004‡
Yes	0 (0.0)	4 (6.8)	
Surgical site infection			
No	171 (99.4)	54 (91.4)	0.005†
Yes	1 (0.6)	5 (8.5)	
Asymmetry			
No	172 (100.0)	55 (93.2)	0.001‡
Yes	0 (0.0)	4 (6.8)	

*Mann-Whitney *U* test.
†χ^2 Test.
‡Fisher exact test.

0.0%, *P* = 0.001). No differences were found in sex (women 95.2% versus 97.9%, *P* = 0.330), preoperative hemoglobin (median: 14.7 versus 14.4 g/dL, *P* = 0.123), or length of hospitalization (Table 5).

When performing the logistic regression, univariate analysis showed that a BMI more than 30 kg/m² (RR = 8.95; 95% CI, 3.89–19.56; *P* < 0.001), a higher ASA classification (RR = 5.97; 95% CI, 2.18–16.38; *P* = 0.001), longer operating time (RR = 1.02; 95% CI, 1.01–1.02; *P* < 0.001), greater volume of fat aspirated (RR = 1.01; 95% CI, 1.01–1.01; *P* < 0.001), and greater intraoperative bleeding (RR = 1.03; 95% CI, 1.02–1.04; *P* < 0.001) were factors associated with complications. Multivariable analysis showed that the independent risk factors for postoperative complications were a BMI more than 30 kg/m² (RR = 3.63; 95% CI, 1.27–10.32; *P* = 0.016), a longer operative time (RR = 1.01; 95% CI, 1.00–1.02; *P* = 0.001), and a greater volume of fat removed (RR = 1.01; 95% CI, 1.01–1.01; *P* = 0.002) (Table 6). The Hosmer–Lemeshow test was nonsignificant (χ^2 = 5.34, *P* = 0.721), which indicated a good model fit.

DISCUSSION

Liposculpture is a technique that can be adjusted for any patient with any amount of body fat. However, an elevated risk of complications has been reported in obese patients undergoing different plastic surgery procedures. In the present study, patients with a BMI more than 30 kg/m² who underwent liposculpture had a 3.5 higher risk of overall complications. Furthermore, a longer operative time and a higher volume of fat removed were independent risk factors for developing complications. These results are consistent with other body contouring procedures and highlight the need to optimally select the patients undergoing these procedures to achieve ideal results with a lower complication rate.

Our study reported a complication rate of 13.4%. Previous studies on this type of procedure have reported a complication rate between 8% and 16%.[19,20] Although over time liposculpture has evolved with fewer complications compared with standard liposuction,[21] the most frequent complication continues to be the development of seromas that varies between 2% and 30%, followed by hematomas at 0%–1%, surgical wound infection at 0%–2%, hyperpigmentation at 0%–6%, fibrosis at 0%–1%, and asymmetry at 0%–2%.[19–21] Our complication rate was similar to that of previous studies, with the most frequent complication being seromas with ~10%, whereas others such as burns, hyperpigmentation, and fibrosis were not reported in any of the patients. It is important to highlight that 25% of our population was obese (BMI >30 kg/m²), although in previous studies the maximum BMI was less than 28 kg/m².[19,21] Therefore, the complication rate was in an upper acceptable range compared with previous literature, most likely due to the greater number of patients with obesity included.

Age has been reported to be an independent risk factor for wound and systemic complications in aesthetic procedures, especially patients older than 65 years of age, due to disorganization, fragmentation, and reduction in the number of collagen fibers with an increase in metalloproteinases, a decrease in neocollagenesis and local and systemic immune function.[22–24] Although older age was related to complications, this was not a risk factor in our study. Similarly, a higher ASA classification is associated with a higher risk of infection, bleeding, and failure to be weaned off mechanical ventilation.[25,26] Therefore,

Table 5. Sociodemographic and Surgical Characteristics of Patients Undergoing Liposculpture from 2020 to 2021 According to the Volume of Fat Removed

Variables	Volume of Fat Removed		*P*
	<5000 mL (N = 189)	≥5000 mL (N = 42)	
Age, y, median (IQR)	34.0 (29.0–39.0)	37.5 (32.0–46.0)	0.002*
Operative time, min, median (IQR)	150.0 (120.0–180.0)	180.0 (150.0–228.8)	<0.001*
Intraoperative bleeding, mL, median (IQR)	90.0 (90.0–120.0)	165.0 (150.0–180.0)	<0.001*
Complications			
No	179 (94.7)	21 (50.0)	<0.001†
Yes	10 (5.3)	21 (50.0)	
Seroma			
No	180 (95.2)	26 (61.9)	<0.001†
Yes	9 (4.8)	16 (38.1)	
Hematoma			
No	189 (100.0)	38 (90.5)	0.001‡
Yes	0 (0.0)	4 (9.5)	
Surgical site infection			
No	186 (98.4)	39 (92.9)	0.041‡
Yes	3 (1.6)	3 (7.1)	
Asymmetry			
No	172 (100.0)	55 (93.2)	0.001‡
Yes	0 (0.0)	4 (6.8)	

*Mann-Whitney *U* test.
†χ^2 Test.
‡Fisher exact test.

Table 6. Logistic Regression of Patients Undergoing Liposculpture from 2020 to 2021 According to the Presence of Complications

Variables	Complications					
	Univariate Analysis			Multivariable Analysis		
	RR	95% CI	*P*	RR	95% CI	*P*
Age, y	1.09	1.04–1.16	0.001	1.04	0.98–1.11	0.220
Classification according to BMI, kg/m²						
<30	1.00			1.00		
≥30	8.95	3.89–19.56	<0.001	3.63	1.27–10.32	0.016
Sex						
Female	1.00			1.00		
Male	0.77	0.09–6.81	0.814	0.79	0.07–8.64	0.850
ASA classification	5.97	2.18–16.38	0.001	2.58	0.68–9.75	0.161
Preoperative hemoglobin, g/dL	1.08	0.77–1.51	0.68	0.76	0.47–1.23	0.265
Operative time, min	1.02	1.01–1.02	<0.001	1.01	1.01–1.02	0.001
Volume of fat removed, mL	1.01	1.01–1.01	<0.001	1.01	1.01–1.01	0.002
Intraoperative bleeding, mL	1.03	1.02–1.04	<0.001	1.03	0.99–1.02	0.153

adequate selection of patients for aesthetic procedures, such as liposculpture, is crucial to avoid morbidity in these patients. Indeed, to obtain optimal results in terms of the complication profile after liposculpture, usually only patients with ASA I are included,[26] whereas patients with a BMI more than 30 kg/m² are considered to be ASA II. Furthermore, greater intraoperative bleeding has been associated with a greater number of seromas, hematomas, and longer days of hospitalization, among others.[27,28] Currently, tranexamic acid is used in aesthetic procedures to reduce postsurgical bleeding and hematomas, showing optimal results in plastic surgery and other surgical specialties.[29–31]

Overweight and obesity have been considered independent risk factors for postoperative infections and systemic complications in plastic surgery.[32–34] Our study found that a BMI 30 kg/m² or more is a risk factor for complications, being 5.8% in patients without obesity versus 35.5% in patients with obesity, with seromas being the most common. Although plastic surgery societies state that obesity is not an absolute contraindication for aesthetic abdominal procedures, these patients should be carefully selected.[35,36] The pathogenesis of the above-mentioned complications is based on the decreased vascularity and angiogenesis in the adipose tissue in these patients, in addition to the chronic state of inflammation that is generated by cytokines, such as hypoxia-inducible factor 1-alpha, due to hypoxia in the setting of abundant adipose tissue.[37] Another important factor is the venous insufficiency of adipose tissue, which leads to a healing barrier, which is a consequence of high

hydrostatic pressure and less delivery of nutrients, leading to extravasation of proteinaceous material.[37,38] Because liposculpture is a safe procedure, the complication profile observed was not high; however, this profile may be even better if patients with obesity are recommended to lose weight before surgery.

A longer operative time is an independent risk factor for operative site complications.[39,40] The operating time in patients with obesity is usually longer, generally due to induction or intubation factors, and the surgical procedure is more complicated due to excess adipose tissue.[41,42] In recent decades, the cost per minute in the operating room has increased from 20 dollars to 46 dollars per minute.[43–45] With an increase of 1% per minute, longer operative times can significantly increase the risk of complications, especially when procedures increase by 1 or 2 hours. Although operative time has independent factors that may be related, such as the experience and efficiency of the surgeon, patients with obesity can be referred to more experienced surgeons to avoid longer operative time and thereby reduce the risk of complications without affecting the results of the surgery.

The American Society of Plastic Surgeons has described that a volume of fat removed greater than 5000 mL may be associated with a greater number of complications.[46] Our study showed that the higher the volume of fat removed, the greater the risk of complications, with an increase of 1% for each milliliter, having a crucial impact when large volumes of fat are removed. Although in select patients undergoing liposuction, it has been reported that it is feasible to remove a volume greater than 5 L, the metabolic risks do not improve and the risk of complications increases.[47,48] In a study including 4500 patients, Chow et al[49] concluded that a volume more than 100 mL per unit of BMI is a predictor of complications. Therefore, it is crucial to obtain a balance between the volume of fat to be removed and the desired physical result, to avoid repercussions on postsurgical complications, emphasizing the need for adequate patient selection.

Our study is not without limitations. The retrospective design of the study limits our results for a very high level of evidence; however, it provides important results and conclusions for patients undergoing liposculpture. Although the volume of lipotransfer was small or less than 100 mL per site, the total volume of fat transferred was not included in our results. Neither was the specific location of fat transference per patient reported. These could be additional risk factors for complications and should be taken into account in future studies. In addition, a longer study period could have increased the power of the study. However, this sample is representative of the population in the study period, and thus, including all patients may not affect the final results.

Probabilistic sampling identified the association of patient characteristics with their complications and risk factors for postsurgical complications. These results may be representative of the private clinic where the study was carried out and should be interpreted with caution, especially if they are extrapolated to other populations. Hence, it is recommended to carry out a national and international multicenter study to obtain results that can be generalized. Furthermore, the development of prospective studies is encouraged to provide results with a higher level of evidence.

CONCLUSIONS

In conclusion, patients undergoing liposculpture with a BMI 30 kg/m^2 or more have approximately a 3.5-fold greater risk of postsurgical complications compared with patients without obesity. Other risk factors identified for complications were longer operative time and greater volume of fat removed. Based on these findings, our patient selection criteria have changed. Indeed, adequate patient selection is crucial and may be considered as a separate risk factor for surgical complications, and thus, patients with an ASA classification more than 1, which includes BMI 30 kg/m^2 or more and other multiple comorbidities, should be excluded from this elective procedure. It is imperative that patients with obesity be instructed and advised to lose weight before undergoing liposculpture. Moreover, to obtain the best aesthetic results, patients with overweight are encouraged to be at or close to their goal weight, despite their profile of complications is similar to patients with normal weight. Furthermore, the development of national and international clinical practice guidelines with absolute and relative contraindications for liposculpture is recommended.

Gabriel De la Cruz Ku, MD
Universidad Cientifica del Sur
Tacna St. 1471 Apt E, Magdalena del Mar
Lima, Peru
E-mail: gabrieldelacruzku@gmail.com

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

ACKNOWLEDGMENT

The authors thank the Universidad Científica del Sur for their support in the publication of this research/project.

REFERENCES

1. International Society of Aesthetic Plastic Surgery. ISAPS international survey on aesthetic/cosmetic procedures performed in 2019. Published 2020. Available at https://www.isaps.org/wp-content/uploads/2020/12/Global-Survey-2019.pdf. Accessed February 21, 2024.
2. American Society of Plastic Surgeons. 2018 Plastic surgery statistics report. Published 2018. Available at https://www.plasticsurgery.org/documents/News/Statistics/2018/plastic-surgery-statistics-fullreport-2018.pdf. Accessed February 22, 2024.
3. American Society of Plastic Surgeons. 2020 National plastic surgery statistics report. Published 2020. Available at https://www.plasticsurgery.org/documents/News/Statistics/2020/plastic-surgery-statistics-report-2020.pdf. Accessed February 22, 2024.
4. Cárdenas-Camarena L, Andrés Gerardo LP, Durán H, et al. Strategies for reducing fatal complications in liposuction. *Plast Reconstr Surg Glob Open*. 2017;5:e1539.

5. Hoyos A, Prendergast P. High definition body sculpting. In: *Art and Advanced Lipoplasty Techniques*. 1st ed. Verlag Berlin Heidelberg: Springer; 2014.
6. Zhang YX, Lazzeri D, Grassetti L, et al. Three-dimensional superficial liposculpture of the hips, flank, and thighs. *Plast Reconstr Surg Glob Open*. 2015;3:e291.
7. Vizcarra N. Factores asociados a mortalidad por lipoaspiración en necropsias de ley—Morgue Central de Lima, 2000–2005. Lima, Peru: Universidad Nacional Mayor de San Marcos, 2009. Available at https://cybertesis.unmsm.edu.pe/handle/20.500.12672/14628?show=full. Accessed February 22, 2024.
8. Ruiz D. Experiencia en riesgo de muerte asociada a liposucción entre los médicos legistas de Lima y Callao. Enero 2000–Diciembre 2006. Lima, Peru: Universidad Nacional Mayor de San Marcos, 2007. Available at https://cybertesis.unmsm.edu.pe/bitstream/handle/20.500.12672/14056/Ruiz_vd.pdf?sequence=1&isAllowed=y. Accessed February 15, 2024.
9. Brito M, Meireles R, Baltazar J, et al. Abdominoplasty and patient safety: the impact of body mass index and bariatric surgery on complications profile. *Aesthetic Plast Surg*. 2020;44:1615–1624.
10. Winocour J, Gupta V, Ramirez JR, et al. Abdominoplasty: risk factors, complication rates, and safety of combined procedures. *Plast Reconstr Surg*. 2015;136:597e–606e.
11. Greco JA, III, Castaldo ET, Nanney LB, et al. The effect of weight loss surgery and body mass index on wound complications after abdominal contouring operations. *Ann Plast Surg*. 2008;61:235–242.
12. Vidal P, Berner JE, Will PA. Managing complications in abdominoplasty: a literature review. *Arch Plast Surg*. 2017;44:457–468.
13. AlQattan HT, Mundra LS, Rubio GA, et al. Abdominal contouring outcomes in class III obesity: analysis of the ACS-NSQIP database. *Aesthetic Plast Surg*. 2018;42:13–20.
14. Hammond DC, Chandler AR, Baca ME, et al. Abdominoplasty in the overweight and obese population: outcomes and patient satisfaction. *Plast Reconstr Surg*. 2019;144:847–853.
15. Kim J, Stevenson TR. Abdominoplasty, liposuction of the flanks, and obesity: analyzing risk factors for seroma formation. *Plast Reconstr Surg*. 2006;117:773–779; discussion 780.
16. Lehnhardt M, Homann HH, Daigeler A, et al. Major and lethal complications of liposuction: a review of 72 cases in Germany between 1998 and 2002. *Plast Reconstr Surg*. 2008;121:396e–403e.
17. Samas J, Mir T, Deane LM. Toxic shock syndrome associated with the use of silicone gel dressing. *Dermatol Surg*. 2020;46:1350–1353.
18. Neaman KC, Hansen JE. Analysis of complications from abdominoplasty: a review of 206 cases at a university hospital. *Ann Plast Surg*. 2007;58:292–298.
19. Danilla S, Babaitis RA, Jara RP, et al. High-definition liposculpture: what are the complications and how to manage them? *Aesthetic Plast Surg*. 2020;44:411–418.
20. Aljerian A, Abi-Rafeh J, Hemmerling T, et al. Complications of aesthetic liposuction performed in isolation: a systematic literature review and meta-analysis. *Plast Surg*. 2022;32:19–32.
21. Hoyos AE, Cala LC, Perez ME, et al. High-definition liposculpture 18-year evolution: patient safety and aesthetic outcomes. *Plast Reconstr Surg*. 2023;151:737–747.
22. Roh DS, Panayi AC, Bhasin S, et al. Implications of aging in plastic surgery. *Plast Reconstr Surg Glob Open*. 2019;7:e2085.
23. Kaoutzanis C, Gupta V, Winocour J, et al. Cosmetic liposuction: preoperative risk factors, major complication rates, and safety of combined procedures. *Aesthet Surg J*. 2017;37:680–694.
24. Cammarata MJ, Kantar RS, Rifkin WJ, et al. Advanced age is a risk factor for complications following abdominal panniculectomy. *Obes Surg*. 2019;29:426–433.
25. Thepmankorn P, Choi CB, Haimowitz SZ, et al. ASA physical status classification and complications following facial fracture repair. *Ann Otol Rhinol Laryngol*. 2022;131:1252–1260.
26. Miller TJ, Jeong HS, Davis K, et al. Evaluation of the American Society of Anesthesiologists Physical Status classification system in risk assessment for plastic and reconstructive surgery patients. *Aesthet Surg J*. 2014;34:448–456.
27. Thorarinsson A, Fröjd V, Kölby L, et al. Blood loss and duration of surgery are independent risk factors for complications after breast reconstruction. *J Plast Surg Hand Surg*. 2017;51:352–357.
28. Saldanha O, Salles AG, Llaverias F, et al. Predictive factors for complications in plastic surgery procedures—suggested safety scores. *Rev Bras Cir Plást*. 2014;29:105–113.
29. Hoyos AE, Duran H, Cardenas-Camarena L, et al. Use of tranexamic acid in liposculpture: a double-blind, multicenter, randomized clinical trial. *Plast Reconstr Surg*. 2022;150:569–577.
30. Cansanção ALPC, Cansanção AJC, Cansanção BPC, et al. Effect of tranexamic acid in bleeding control in liposuction. *Plast Reconstr Surg*. 2015;136(4S):80.
31. Weissler JM, Banuelos J, Molinar VE, et al. Local infiltration of tranexamic acid (TXA) in liposuction: a single-surgeon outcomes analysis and considerations for minimizing postoperative donor site ecchymosis. *Aesthet Surg J*. 2021;41:NP820–NP828.
32. Gupta V, Winocour J, Rodriguez-Feo C, et al. Safety of aesthetic surgery in the overweight patient: analysis of 127,961 patients. *Aesthet Surg J*. 2016;36:718–729.
33. Bigarella LG, Ballardin AC, Couto LS, et al. The impact of obesity on plastic surgery outcomes: a systematic review and meta-analysis. *Aesthet Surg J*. 2022;42:795–807.
34. Niu EF, Honig SE, Wang KE, et al. 33. Obesity as a risk factor in cosmetic abdominoplasty: a systematic review and meta-analysis. *Plast Reconstr Surg Glob Open*. 2023;11(4S):16–17.
35. American Society of Plastic Surgeons. No increase in complications with "Tummy Tuck" in obese patients. Published March 28, 2019. Available at https://www.plasticsurgery.org/news/press-releases/no-increase-in-complications-with-tummy-tuck-in-obese-patients. Accessed February 15, 2024.
36. Fernandes JW, Miró A, Rocha AAS, et al. Practical criteria for a safer liposuction: a multidisciplinary approach. *Rev Bras Cir Plást*. 2017;32:454–466.
37. Pierpont YN, Dinh TP, Salas RE, et al. Obesity and surgical wound healing: a current review. *ISRN Obes*. 2014;2014:638936.
38. Vastine VL, Morgan RF, Williams GS, et al. Wound complications of abdominoplasty in obese patients. *Ann Plast Surg*. 1999;42:34–39.
39. Wan M, Zhang JX, Ding Y, et al. High-risk plastic surgery: an analysis of 108,303 cases from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP). *Plast Surg (Oakville, Ont)*. 2020;28:57–66.
40. Hardy KL, Davis KE, Constantine RS, et al. The impact of operative time on complications after plastic surgery: a multivariate regression analysis of 1753 cases. *Aesthet Surg J*. 2014;34:614–622.
41. Chinn J, Tellez R, Huy B, et al. Comparison of BMI on operative time and complications of robotic inguinal hernia repair at a VA medical center. *Surg Endosc*. 2022;36:9398–9402.
42. Hatch JL, Boersma IM, Weir FW, et al. The influence of obesity on operating room time and perioperative complications in cochlear implantation. *World J Otorhinolaryngol Head Neck Surg*. 2017;3:231–234.
43. Shippert RD. A study of time-dependent operating room fees and how to save $100 000 by using time-saving products. *Am J Cosmet Surg*. 2005;22:25–34.
44. Patel S, Lindenberg M, Rovers MM, et al. Understanding the costs of surgery: a bottom-up cost analysis of both a hybrid operating room and conventional operating room. *Int J Health Policy Manag*. 2022;11:299–307.
45. Smith T, Evans J, Moriel K, et al. Cost of OR time is $46.04 per minute. *J Orthop Bus*. 2022;2:10–13.

46. American Society of Plastic Surgeons. How much liposuction is "safe?" The answer varies by body weight. Published August 28, 2015. Available at https://www.plasticsurgery.org/news/press-releases/how-much-liposuction-is-safe-the-answer-varies-by-body-weight. Accessed February 25, 2024.
47. Mohammed BS, Cohen S, Reeds D, et al. Long-term effects of large-volume liposuction on metabolic risk factors for coronary heart disease. *Obesity (Silver Spring, Md).* 2008;16:2648–2651.
48. Khanna A, Filobbos G. Avoiding unfavourable outcomes in liposuction. *Indian J Plast Surg.* 2013;46:393–400.
49. Chow I, Alghoul MS, Khavanin N, et al. Is there a safe lipoaspirate volume? A risk assessment model of liposuction volume as a function of body mass index. *Plast Reconstr Surg.* 2015;136:474–483.