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Original article

## Bariatric surgery in patients with previous COVID-19 infection

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### Abstract

**Background:** The process of reintroducing bariatric surgery to our communities in a COVID-19 environment was particular to each country. Furthermore, no clear recommendation was made for patients with a previous COVID-19 infection and a favorable outcome who were seeking bariatric surgery.

**Objectives:** To analyze the risks of specific complications for patients with previous COVID-19 infection who were admitted for bariatric surgery.

**Setting:** Eight high-volume private centers from 5 countries.

**Methods:** All patients with morbid obesity and previous COVID-19 infection admitted for bariatric surgery were included in the current study. Patients were enrolled from 8 centers and 5 countries, and their electronic health data were reviewed retrospectively. The primary outcome was to identify early (<30 d) specific complications related to COVID-19 infection following bariatric surgery, and the secondary outcome was to analyze additional factors from work-ups that could prevent complications.

**Results:** Thirty-five patients with a mean age of 40 years (range, 21–68 yr) and a mean body mass index of 44.3 kg/m<sup>2</sup> ( $\pm 7.4$  kg/m<sup>2</sup>) with previous COVID-19 infection underwent different bariatric procedures: 23 cases of sleeve (65.7%), 7 cases of bypass, and 5 other cases. The symptomatology of the previous COVID-19 infection varied: 15 patients had no symptoms, 12 had fever and respiratory signs, 5 had only fever, 2 had digestive symptoms, and 1 had isolated respiratory signs. Only 5

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patients (14.2 %) were hospitalized for COVID-19 infection, for a mean period of 8.8 days (range, 6–15 d). One patient was admitted to an intensive care unit and needed invasive mechanical ventilation. The mean interval time from COVID-19 infection to bariatric surgery was 11.3 weeks (3–34 wk). The mean hospital stay was 1.7 days ( $\pm 1$  d), and all patients were clinically evaluated 1 month following the bariatric procedure. There were 2 readmissions and 1 case of complication: that case was of a gastric leak treated with laparoscopic drainage and a repeated pigtail drain, with a favorable outcome. No cases of other specific complications or mortality were recorded.

**Conclusion:** Minor and moderate COVID-19 infections, especially the forms not complicated with invasive mechanical ventilation, should not preclude the indication for bariatric surgery. In our experience, a prior COVID-19 infection does not induce additional specific complications following bariatric surgery. (*Surg Obes Relat Dis* 2021;17:1244–1248.) © 2021 American Society for Bariatric Surgery. Published by Elsevier Inc. All rights reserved.

**Keywords:** COVID-19; Bariatric surgery; Complications; Sleeve; Bypass; SADI; Revisional surgery

Obesity and all its comorbidities are among the greatest public health threats of the 21<sup>st</sup> century, and the predictions for the future are not very encouraging [1]. Coronavirus disease 2019 (COVID-19) was declared a global pandemic by the World Health Organization on 11 March 2020 [2]. Worldwide, the most important factors associated with disease severity include increased age, diabetes, and obesity. In the United States, Lighter et al. [3] analyzed 3615 individuals who tested positive for COVID-19: 775 (21%) had a body mass index (BMI) of 30–34 kg/m<sup>2</sup> and 595 (16% of the total cohort) had a BMI > 35 kg/m<sup>2</sup>. They reported that in patients aged <60 years, BMIs of 30–34.9 kg/m<sup>2</sup> and >35 kg/m<sup>2</sup> were associated with 1.8- and 3.6-fold higher risks, respectively, of being admitted to critical care. Similarly, in France, a 7-fold increase in the risk of mechanical ventilation was reported in individuals admitted with COVID-19 who had a BMI > 35 kg/m<sup>2</sup> compared to those with a BMI < 25 kg/m<sup>2</sup> [4].

Currently, bariatric surgery represents the most effective treatment for severe obesity and its metabolic complications. In a nationwide study, Iannelli et al. [5] showed that bariatric surgery is independently associated with reduced risks of death and invasive mechanical ventilation in 8286 individuals with a previous diagnosis of obesity and infected with COVID-19. The need for invasive mechanical ventilation and the death rate decreased 2.1- and 4-fold, respectively, for the bariatric surgery group in contrast with the control group. In the initial phase of the COVID-19 pandemic, all reports considering scheduled surgery described an increased risk of admission to an intensive care unit [6] and increased fatalities [7]. Accordingly, all nonurgent surgical procedures were postponed to preserve equipment and minimize the exposure of patients and staff. The recommendations for bariatric surgery were extremely reserved, advising more diet and lifestyle modifications before surgical treatment [8], even if the importance of bariatric surgery has never been clearer.

The process of reintroducing bariatric surgery to our communities in a COVID-19 environment was particular to each

country. Every surgical society looked for a structured approach for safely reintroducing bariatric surgery, with caution due to the concerns of both undiagnosed asymptomatic or presymptomatic carriers of COVID-19 at the time of surgery carrying the inherent risk of suffering severe complications and of noninfected patients being exposed to the infection in the perioperative period. Furthermore, no clear recommendation was made for patients with favorable outcomes after previous COVID-19 infections who were seeking bariatric surgery. The purpose of the current manuscript is to analyze the risks of specific complications for patients with previous COVID-19 infections who were admitted for bariatric surgery in different countries.

## Methods

All patients admitted for bariatric surgery in 8 high-volume centers (5 countries) were analyzed. All patients with a previous COVID-19 infection were included in the current study. Their electronic health data were reviewed retrospectively. A retrospective analysis was performed for the patients' demographic characteristics, preoperative weight, COVID-19 infection history, interval to bariatric surgery, and early (<30 d) postoperative complications.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The database was anonymously created. Because of the retrospective analysis on an anonymous database, no informed consent was possible, and institutional review board approval was unnecessary according to French laws on biomedical research. The choice of the specific surgical procedure was based on the following variables: initial BMI, status of comorbidities, presence of the reflux symptoms, or patient decision.

The primary outcome was to identify early (<30 d) specific complications related to COVID-19 infection following bariatric surgery, and the secondary outcome

was to analyze additional factors from work-ups that could prevent complications. Complications were recorded using the Clavien-Dindo classification system [9], accepted as the method of reporting early surgical complications. The sequencing or reverse-transcriptase polymerase chain reaction (RT-PCR) test for COVID-19 nucleic acid using nasal and pharyngeal swab specimens was mandatory for every patient as part of the preoperative work-up. All patients underwent a standard evaluation with an upper endoscopy, nutritional and psychological counseling, and a multidisciplinary team evaluation for a minimum of 2 to 6 months prior to the bariatric surgery.

### Statistical analysis

For the statistical analysis, continuous demographic variables were expressed as means  $\pm$  standard deviations (SDs) and ranges; categorical variables, as well as complications, were reported as numbers and percentages. Continuous outcome variables were generally reported as means  $\pm$  SDs and ranges.

## Results

Our cohort consisted of a group of 35 patients with previous COVID-19 infection who underwent different bariatric procedures between June and October 2020. There were 23 cases of laparoscopic sleeve gastrectomy (LSG; 65.7%), 7 of Roux-en-Y gastric bypass (RYGB), 2 of single-anastomosis duodeno-ileal bypass, 2 of minigastric bypass, and 1 of gastric band removal, with 4 revisional cases. The demographic data are shown in Table 1. Patients had a mean age of 40 years (range, 21–68 yr) and a mean BMI of 44.3 kg/m<sup>2</sup> ( $\pm$ 7.4 kg/m<sup>2</sup>). The patients were included from 7 different bariatric centers in 4 countries, with the geographical distribution illustrated in Fig. 1.

### COVID-19 data

All patients were diagnosed with COVID-19 infection before bariatric surgery by a sequencing or RT-PCR test for COVID-19 nucleic acid of nasal and pharyngeal swab specimens. In 14 cases (40%), a history of a computed tomography scan was found, but in 12 cases the imaging was performed preoperatively with the purpose of ruling out any sequelae following the COVID-19 infection. The symptomatology at the time of COVID-19 infection was the following:

- No symptoms in 15 patients who were diagnosed either as a contact case or routinely during the preoperative work-up.
- Fever and respiratory signs were reported in 12 patients.
- Only fever was reported for 5 patients.
- Digestive symptoms were present at the time of diagnosis in 2 patients, exclusively for 1 patient and associated with fever and respiratory signs for the other patient.
- Isolated respiratory signs were found for only 1 patient.

Only 5 patients (14.2%) were hospitalized for COVID-19 infection, for a mean period of 8.8 days (range, 6–15 d). One patient was admitted to an intensive care unit and needed invasive mechanical ventilation. A 37-year-old male patient with a preoperative BMI of 47.5 kg/m<sup>2</sup> underwent RYGB 28 weeks after his COVID-19 infection. The hospital stay was 1 day and the postoperative outcome was favorable 1 month after surgery.

The mean interval time from COVID-19 infection to bariatric surgery was 11.3 weeks (3–34 wk), and the time distribution is summarized in Fig. 2. All patients were free of any clinical signs at the time of bariatric surgery.

### Postoperative outcome

All cases were completed by laparoscopy with no intraoperative incidents. The mean hospital stay was 1.7 days ( $\pm$ 1

Table 1  
Demographic data

Parameter	Category	n	%
Sex	Male	6	17.1
	Female	29	82.8
Age, yr	Mean, SD	40	11.3
BMI	Mean, SD	44.3	7.5
History of bariatric surgery	No	31	88.6
	Yes (gastric band)	4	11.3
Type of bariatric procedure	23 cases of LSG (65.7%)	1	4.8
	7 cases of RYGB	1	4.8
	2 cases of SADI	3	14.3
	2 cases of MGB	7	33.3
	1 case of gastric band removal	9	42.9

SD = standard deviation; BMI = body mass index; LSG = laparoscopic sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass; SADI = single-anastomosis duodeno-ileal bypass; MGB = minigastric bypass.

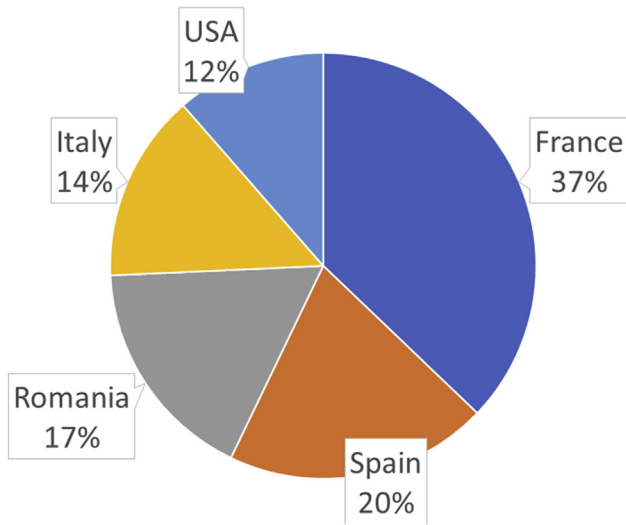


Fig. 1. Geographical distribution of included patients.

d), and all patients were clinically evaluated 1 month following the bariatric procedure. There were 2 readmissions and 1 case of complication: that case was of a gastric leak following LSG, which was treated with laparoscopic drainage and a repeated pigtail drain, with a favorable outcome. No cases of other specific complications or mortality were recorded.

**Discussion**

Currently, obesity is considered a chronic disease that has become an epidemic with important economical implications. The majority of patients have struggled for many years with noninvasive measures like diet, exercise, and pharmacotherapy before surgery. The current COVID-19 pandemic, with its high morbidity and mortality, has led to the cancellation of millions of surgeries, including all bariatric surgery procedures [10,11]. Many centers were afraid to resume activity due to the risk of contamination for patients with morbid obesity or additional deterioration of

their pulmonary function. In the initial phase, Aminian et al. [7] reported that COVID-19 can complicate the post-operative course of patients after bariatric surgery. At the same time, many patients with morbid obesity have had severe forms of COVID-19 infection with long hospital stays [3–5]. Different mechanisms were advanced to explain the relationship between obesity and adverse outcomes in individuals with COVID-19. Patients with morbid obesity have an overall decreased respiratory capacity, with a reduced expiratory reserve volume and lower total respiratory system compliance, especially in the supine position [12]. COVID-19 is associated with impairments of immune responses [13], which are also exacerbated by the secretion of cytokines in excess adipose tissue, increasing the virus’ impact on both lung parenchyma and bronchi [14,15].

Previous bariatric surgery and its associated weight loss have beneficial effects in cases of COVID-19 infection. This was very well demonstrated by Iannelli et al. [5]. They analyzed a population of 4,248,253 patients with obesity, with 8286 cases admitted for COVID-19 infection. Bariatric surgery had been previously performed for 541 patients, while 7745 patients did not have a history of bariatric surgery. The need for invasive mechanical ventilation and the death rate caused by COVID-19 were significantly different for the 2 groups of patients. Invasive mechanical ventilation was required for 7% of patients with a previous bariatric procedure, compared to 15% of nonoperated patients. Death occurred in 3.5% of patients in the surgical group versus 14.2% of those with no bariatric history.

Considering the increased risks for severe forms of COVID-19 infection that obesity engenders and the protective role of bariatric surgery in avoiding invasive mechanical ventilation and death, the pressure to return to normal activity for bariatric surgery was important. The resumption of bariatric surgery following the first peak of COVID-19 infections was controlled by several guidelines [8,16–18]. All these recommendations focused on the preoperative work-up for bariatric surgery and COVID-19 and on perioperative measures to avoid contamination. Information regarding patients with morbid obesity and a previous COVID-19 infection is scarce or absent. Is it safe to perform a bariatric procedure for a patient with a previous COVID-19 infection? Our current manuscript partially answers this question, finding no specific complications (respiratory) in 35 patients who underwent different bariatric procedures. Even though several studies have identified male sex as a risk factor for severe COVID-19 and death [19–21], in our study’s population the majority of patients were female (29 out of 35 patients). This is explained by the fact that female patients are always more common in these surgical groups [5].

Our study has several limitations to consider. First, our data represent 35 patients with previous COVID-19 infections who underwent bariatric surgery, but only 1 patient with a severe infection. Only 5 patients were hospitalized for their COVID-19 infection, and 1 was admitted to the

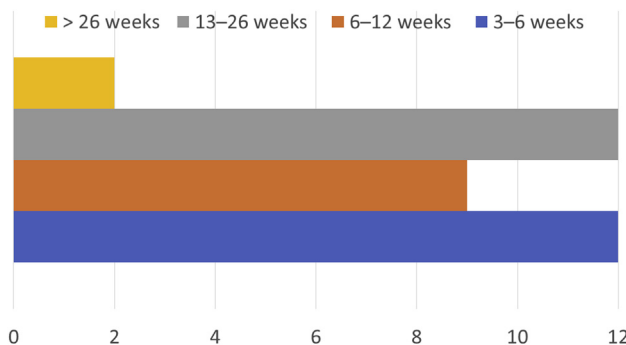


Fig. 2. The mean interval time from COVID-19 infection to bariatric surgery.



intensive care unit and needed invasive mechanical ventilation. Furthermore, our sample size is relatively small and may reduce our ability to uncover differences that may exist. However, we were able to abstract a robust conclusion: that bariatric surgery in patients with minor or moderate previous COVID-19 infections has no additional specific complications.

## Conclusion

Minor and moderate COVID-19 infections, especially when not complicated with invasive mechanical ventilation, should not preclude the indication for bariatric surgery. In our experience, a previous COVID-19 infection does not induce additional specific complications following bariatric surgery. The interval needed between the complete resolution of COVID-19 infection and bariatric surgery should be appropriate to the severity of the disease, but in minor forms a period of 4 weeks is sufficient. Further studies should prospectively evaluate the outcomes of bariatric surgery in patients with more severe forms of COVID-19 infection.

## Disclosures

*The authors have no commercial associations that might be a conflict of interest in relation to this article.*

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.soard.2021.03.029>.

## References

- Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87:4–14.
- World Health Organization. WHO characterizes COVID-19 as a pandemic [Mar 11, 2020]. WHO. Available from: <https://www.who.int/emergencies/diseases/novelcoronavirus-2019/events-as-they-happen>.
- Lighter J, Phillips M, Hochman S, et al. Obesity in patients younger than 60 years is a risk factor for COVID-19 hospital admission. *Clin Infect Dis* 2020;71(15):896–7.
- Simonnet A, Chetboun M, Poissy J, et al. High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARSCoV-2) requiring invasive mechanical ventilation. *Obesity (Silver Spring)* 2020;28(7):1195–9.
- Iannelli A, Bouam S, Schneck AS, et al. The impact of previous history of bariatric surgery on outcome of COVID-19. A nationwide medico-administrative French study. *Obes Surg* 2021;31:1455–63.
- Aminian A, Safari S, Razeghian-Jahromi A, Ghorbani M, Delaney CP. COVID-19 outbreak and surgical practice: unexpected fatality in perioperative period. *Ann Surg* 2020;272(1):e27–9.
- Aminian A, Kermansaravi M, Azizi S, et al. Bariatric surgical practice during the initial phase of COVID-19 outbreak. *Obes Surg* 2020;30(9):3624–7.
- Yang W, Wang C, Shikora S, Kow L. Recommendations for metabolic and bariatric surgery during the COVID19 pandemic from IFSO. *Obes Surg* 2020;30(6):2071–3.
- Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;240(2):205–13.
- Lazaridis II, Kraljević M, Schneider R, et al. The impact of the COVID-19 pandemic on bariatric surgery: results from a worldwide survey. *Obes Surg* 2020;30(11):4428–36.
- Beisani M, Vilallonga R, Petrova C, et al. Effects of COVID-19 lockdown on a bariatric surgery waiting list cohort and its influence in surgical risk perception. *Langenbecks Arch Surg* 2021;406:393–400.
- Dixon AE, Peters U. The effect of obesity on lung function. *Expert Rev Respir Med* 2018;12(9):755–67.
- Huttunen R, Syrjänen J. Obesity and the risk and outcome of infection. *Int J Obes* 2013;37(3):333–40.
- Zhang X, Zheng J, Zhang L, et al. Systemic inflammation mediates the detrimental effects of obesity on asthma control. *Allergy Asthma Proc* 2018;39(1):43–50.
- Jose RJ, Manuel A. Does coronavirus disease 2019 disprove the obesity paradox in acute respiratory distress syndrome? *Obesity (Silver Spring)* 2020;28(6):1007.
- Behrens E, Poggi L, Aparicio S, et al. COVID-19: IFSO LAC recommendations for the resumption of elective bariatric surgery. *Obes Surg* 2020;30(11):4519–28.
- Kassir R, Rebibo L, Genser L, et al. SOFFCO-MM guidelines for the resumption of bariatric and metabolic surgery during and after the COVID-19 pandemic. *J Visc Surg* 2020;157(4):323–34.
- Stier C, Lopez-Nava G, Neto MG, et al. IFSO Endoscopy Committee position statement on the practice of bariatric endoscopy during the COVID-19 pandemic. *Obes Surg* 2020;30(11):4179–86.
- Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395(10223):497–506.
- Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020;395(10229):1054–62.
- Shi Y, Yu X, Zhao H, et al. Host susceptibility to severe COVID-19 and establishment of a host risk score: findings of 487 cases outside Wuhan. *Crit Care* 2020;24(1):108.