

# Diabetes and Hypertension: Is there Any Linkage to the Hemorrhage after Bariatric Surgery?

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## ABSTRACT

**Background:** Bleeding after bariatric surgery is one of the most common early postoperative complications that can cause morbidity or even mortality. Therefore, in this study, we investigated the relationship between demographic features and postoperative hemorrhage rate.

**Materials and methods:** We reviewed the patients' database who underwent laparoscopic bariatric surgery [sleeve gastrectomy (SG) and one anastomosis gastric bypass (OAGB)] from 2018 to 2020 in Loghman Hakim Hospital, Tehran, Iran. The patients' demographic features such as age, sex, weight, BMI, and history of diabetes mellitus and hypertension were accessed in all patients. Patients who required postoperative blood transfusion were then identified. Red blood cell transfusion or the need for reoperation to control bleeding was considered as significant acute bleeding after surgery. The Hb cut-off for red blood cell (RBC) transfusion was 7 gm/dL. The rate of bleeding was determined. By comparing the two groups (with and without the need for blood transfusion) by Chi-square test and independent *t*-test, the relationship between demographic features and postoperative bleeding was investigated.

**Results:** In total, 1481 morbidly obese patients (257 men and 1224 women) who underwent bariatric surgery SG and OAGB were studied. Twenty patients (0.13%) suffered a postoperative hemorrhage. In SG, 17 patients (1.3%), and in OAGB, 3 patients (4.3%) required blood transfusion. The difference in diabetes ( $p < 0.03$ ) and hypertension ( $p < 0.048$ ) in the two groups (with and without the need for blood transfusion) was statistically significant. Only two patients (10%) who underwent SG were taken to the operating room at the surgeon's discretion to control the bleeding (both had a blood transfusion before reoperation). Diabetes (35%) and hypertension (25.7%) were significantly more common in postoperative bled patients.

**Conclusion:** Despite all measures to reduce hemorrhage during and after bariatric surgery, bleeding is still one of the most common early postoperative complications after bariatric surgery. Therefore, recognizing the risk factors for bleeding is still important. In this study, an association was observed between hypertension and diabetes with postoperative bleeds.

**Keywords:** Bariatric surgery, Bleeding, Diabetes, Hemorrhage, Hypertension, Laparoscopy complications.

*World Journal of Laparoscopic Surgery* (2022); 10.5005/jp-journals-10033-1506

## INTRODUCTION

Bariatric surgery is one of the main and long-term durable treatments for patients with morbid obesity. Due to the increase in morbid obesity, these operations are increasing day by day.<sup>1</sup> Bariatric surgery can cause these people to lose weight by restricting or changing the course of food material through the alimentary tract and causing food to be expelled earlier. Sleeve gastrectomy and OAGB are the most common surgeries. Postoperative bleeding is one of the most common causes of morbidity in patients undergoing bariatric surgery.<sup>2</sup> The bleeding rate was reported at 3.1% after bypass and 2% after gastric sleeve,<sup>3,4</sup> and the problems caused by anemia can cause many related complications in the patients. Red blood cell transfusions can lead to many complications, such as sepsis, multiple organ failure, pulmonary embolism, and even death.<sup>5-7</sup> Some of these problems [including deep vein thrombosis (DVT)] occur due to the release of inflammatory mediators following blood transfusion.<sup>8,9</sup> Bleeding causes the surgeon to avoid starting anticoagulants for the bleeding patient. This issue and the need for blood transfusions can lead to DVT of the legs and pulmonary embolism, which is the second most common cause of death during the peri-bariatric surgery period and the first 30 days after that.<sup>2</sup> Another reason for the importance of bleeding after bariatric surgery is that the patients' surgery time with bleeding is longer; they are hospitalized for a more extended period. They are more likely to have reoperation and readmission.<sup>2</sup> Therefore, knowing more about the risk factors for bleeding after

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**How to cite this article:** Mirhashemi S, Mirzaian E, Gachkar L, *et al.* Diabetes and Hypertension: Is there Any Linkage to the Hemorrhage after Bariatric Surgery? *World J Lap Surg* 2022;15(2):163-166.

**Source of support:** Nil

**Conflict of interest:** None

bariatric surgery will help reduce this common complication after these operations. In cases where it is not possible to change these risk factors, the surgeon, knowing more high-risk patients, can take more preventive measures to prevent postoperative bleeding in these patients.

Some patient factors reported as a risk factor for perioperative bleeding are a history of obstructive sleep apnea, bleeding disorders, high blood pressure, and diabetes.<sup>2,10</sup> Our center

(Loghman Hakim Hospital in Tehran) is a high-volume bariatric surgery center. Therefore, we aimed to investigate the prevalence of postop bleeding in our center. Demographic features (particularly diabetes and hypertension) were evaluated as postoperative hemorrhage's probable risk factors in this study.

## MATERIALS AND METHODS

We reviewed the patients' database who underwent laparoscopic bariatric surgery (including SG and OAGB) from 2018 to 2020 in Loghman Hakim Hospital, Tehran. The patients' demographic features such as age, sex, weight, BMI, and history of diabetes mellitus and hypertension were accessed in all patients. All data were gathered separately for laparoscopic sleeve gastrectomy (LSG) and laparoscopic OAGB groups. In all SG operations, the stapler line was reinforced by omentopexy.

In our center, OAGB surgery has been the option of choice for patients who are candidates for gastric bypass surgery and had no contraindications such as severe esophagitis or large hiatal hernia for this operation. If OAGB was contraindicated, the patient had undergone Roux-en-Y gastric bypass (LRYGB) and was not included in this study. At the surgeon's discretion, a Jackson-Pratt drain had been selectively placed for OAGB and LSG in patients.

Significant acute postoperative bleeding was evaluated in this study and defined as the need for blood transfusion after surgery or the need for reoperation to control bleeding.

All patients were monitored for blood pressure and vital signs for 12 hours postoperatively, every hour for up to 12 hours, and then every 3 hours until discharge.

The surgeon was suspected of bleeding if such conditions were present: dizziness, tachycardia, pallor, orthostatic hypotension, abnormal abdominal pain, and significant blood drainage into the drain (more than 200 mL). Other possibilities such as leakage and pulmonary embolism were also evaluated in such patients according to the clinical signs and symptoms. The selective evaluations in such patients included charting the drain discharge (if any), oral methylene blue leak test, lab tests (including CBC), upper GI series, sonography, and CT scan (if applicable).

If evaluations were in favor of bleeding after surgery, a CBC (Hb) check was done serially at 6-hour intervals, and continuous vital signs monitoring was also started for the patient. Also, if there was a drain, the amount of blood in the drain had been charted every hour. Along with vital signs control and serial hemoglobin check, if there was evidence of bleeding on postoperative ultrasound, serial ultrasonography had been performed to check the changes in the extent of intra-abdominal hemorrhage.

The RBC transfusion or the need for reoperation for bleeding control was considered acute significant postoperative bleeding (based on The Clavien-Dindo Classification of Surgical Complications class II and III).<sup>11</sup>

The Hb cut-off for RBC transfusion was 7 in non-cardiac and 8 in cardiac patients.

All patients' data, including the need for transfusion or reoperation for bleeding control, were collected. The rate of postop bleeding in all patients who underwent bariatric surgery was calculated. It was then examined whether demographic characteristics and history of diabetes and hypertension had been a potential risk factor for postoperative bleeding or not. For this purpose, all patients who underwent bariatric surgery were divided into two groups (with and without the need for postoperative blood transfusion). In addition to examining the rate of postoperative bleeding in patients

**Table 1:** Patients characteristics

Characteristics	n = 1427
Demographics	
Age (year) <sup>a</sup>	35.9 (9.5)
Sex <sup>b</sup>	
Male	250 (17.5)
Female	1117 (82.5)
Weight (kg) <sup>a</sup>	121.8 (20.4)
Height (cm) <sup>a</sup>	165.2 (28.1)
BMI (kg/m <sup>2</sup> ) <sup>a</sup>	44.8 (6.2)
Comorbidities	
DM <sup>b</sup>	229 (16)
HTN <sup>b</sup>	198 (13.9)
Surgery	
SG <sup>b</sup>	1357 (95.1)
OAGB	70 (4.9)
Transfusion	
RBC transfusion <sup>b</sup>	20 (1.4)

BMI, body mass index; DM, diabetes mellitus; HTN, hypertension; SG, sleeve gastrectomy; OAGB, one anastomosis gastric bypass

<sup>a</sup>Data reported as mean ± standard deviation

<sup>b</sup>Data reported as the number and percentage in parentheses

who had undergone bariatric surgery, the study will examine the role of demographic characteristics and history of diabetes and hypertension on the possibility of postoperative bleeding.

This study has been registered and approved in Shahid Beheshti University of Medical Sciences' research department with the reference code: 24631. Also, the medical ethics committee of this university has approved this study with a tracking code:

IR.SBMU.RETECH.REC.1399.623.

## RESULTS

In this study, 1481 morbidly obese patients (257 men and 1224 women) who underwent bariatric surgery (SG and OAGB) were studied. These patients' mean age was 35.9 (9.6%) (13–76-years-old). Patients with missing data (n = 54) were excluded from the study.

Patients data are presented in Table 1.

As mentioned before, acute significant postoperative bleeding is defined as the need for blood transfusion or reoperation to control bleeding in this study.

None of the patients had cardiovascular problems based on the database study. So, the threshold for RBC was seven or fewer in the current study.

Twenty patients (0.13%) out of these 1481 patients suffered a postoperative hemorrhage.

In patients who underwent GS surgery, 17 patients (1.3%) and patients who underwent gastric bypass (OAGB) surgery, three patients (4.3%) required blood transfusion.

In this study, two patients underwent reoperation to control bleeding; both had undergone gastric sleeve surgery and received blood transfusions before reoperation.

The two groups (with and without the need for blood transfusion), based on mean demographic features (particularly history of diabetes and hypertension), are shown in Table 2.



**Table 2:** Demographic features, diabetes and hypertension, association with RBC transfusion

	With transfusion (n = 20)	Without transfusion (n = 1407)	p value
Demographics			
Age (year) <sup>a</sup>	39 (10.7)	35.8 (9.5)	0.17
Sex			
Male	10 (14.3)	240 (17.7)	0.07
Female	13 (85.7)	1164 (82.7)	
Weight (kg) <sup>a</sup>	124.5 (28.1)	121.8 (20.3)	0.7
Height (cm) <sup>a</sup>	163.8 (10)	165.3 (28.3)	0.38
BMI (kg/m <sup>2</sup> ) <sup>a</sup>	44 (5.5)	44.9 (6.3)	0.001
Comorbidities			
DM	7 (35)	222 (15.8)	0.001
HTN	6 (30)	192 (13.6)	0.007

BMI, body mass index; DM, diabetes mellitus; HTN, hypertension

<sup>a</sup>Data reported as mean ± standard deviation

<sup>b</sup>Data reported as the number and percentage in parentheses

By Chi-square test (or Fisher exact test) and independent t-test, the difference between the two groups (with and without the need for blood transfusion) was statistically significant only in terms of diabetes ( $p < 0.03$ ) and hypertension ( $p < 0.048$ ).

Patients who needed blood transfusion were 2.9 times more likely to have diabetes OR = 2.9 (95% CI: 1.1–7.3). These patients also suffered from hypertension 2.7 times more often than other patients who did not need blood transfusions OR = 2.7 (95% CI: 1.03–7.3).

## DISCUSSION

Bariatric surgery is one of the most effective and long-term durable treatments for patients suffering from morbid obesity. In most bariatric operations, the stomach is manipulated. Excessive gastric perfusion makes these operations prone to bleeding during and after surgery. Moreover, bleeding is still one of the most common early complications after bariatric surgeries. Therefore, knowing more about bleeding risk factors will help take more preventive measures in patients.

In a study by Zafar et al., performed on 168,093 patients from 742 centers, the rate of postoperative bleeding was 1.2%. The rate of postoperative bleeding in the current study was 1.4%.<sup>12</sup>

In a study by Carabajo et al., on 209 patients who underwent OAGB surgery, two patients (0.9) needed reoperation to control bleeding. The study did not mention patients who needed a blood transfusion following bleeding.<sup>13</sup> None of the patients who underwent OAGB required reoperation to control bleeding in the present study, but blood transfusions were given to three patients (4.3%) following hemorrhage.

In the study of Spivak et al., bleeding's relationship after GS surgery and a history of diabetes was investigated. Examining the databases of 394 patients, they found a link between a history of diabetes and postoperative bleeding (OR = 2.6). As in the current study, the criterion for acute postoperative bleeding in that study was the need for postoperative RBC transfusion. Acute bleeding after LSG was reported to be 2.8%, and it was stated that the operation technique was not related to it.<sup>10</sup> The rate of bleeding after LSG was 1.3% in the current study. We also found a link between diabetes and postoperative bleeding (OR = 2.9).

In De Angelis et al.'s study on 870 patients who underwent sleeve gastrectomy, the postoperative bleeding rate was 1.9%. In their study, Buttress material was used to prevent bleeding during the operation. They did not do omentopexy and stapler line routine overswing in gastric sleeve surgery.<sup>14</sup> In the present study, the bleeding rate was 1.3%. We still believe that omentopexy might reduce intra and postoperative bleeding rates.

In a study by Saber et al., omentopexy reduced surgery-related bleeding. He compared 100 patients with and 100 without omentopexy done. They found that omentopexy effectively reduced postoperative bleeding (0.8 vs 2.3%).<sup>15</sup> We also performed omentopexy for all SG patients, and the prevalence of bleeding after this operation was 1.3% in the current study.

In Lim et al., which examined a database of 633 patients, the rate of bleeding after gastric sleeve surgery was 7.4%. Low BMI was reported as a risk factor for postoperative bleeding in this study. They used sealants to strengthen the stapler line, which did not reduce postoperative bleeding.<sup>16</sup> In the current study, BMI did not affect the bleeding rate after bariatric surgery.

In our experience, the best way to reduce bleeding during and after surgery is to prevent it. Accordingly, one way to prevent intraoperative bleeding is complete intraoperative homeostasis. Furthermore, we propose omentopexy in SG to prevent intraoperative and postoperative bleeding.

We still believe that intraoperative drain placement will not be necessary to diagnose postoperative bleeding. We also believe that controlling the patient's vital signs and laboratory tests after surgery would be the best surveillance method for bleeding.

In this study, a clear relationship was seen between the history of diabetes and hypertension with postoperative bleeding. Previous studies have shown an association between intraoperative blood pressure changes and postoperative bleeding,<sup>17</sup> but no association was found between a history of hypertension and postoperative bleeding. Therefore, we assume that proper control of the patient's blood sugar and blood pressure before, during, and after surgery may prevent surgery-related bleeding. However, more postoperative bleeding in diabetic and hypertensive patients may be due to these diseases' long-term effects on the patient's vessels. So, short-term control of blood sugar and blood pressure factors might not be useful for omitting these risk factors. We recommend that in the future, more extensive studies be performed on the exact role of blood sugar, patient's blood pressure, and their fluctuations on bleeding in the perioperative period to develop more accurate protocols for diabetic and hypertensive patients undergoing bariatric surgery.

According to the current study, a history of diabetes and hypertension might be a risk factor for postbariatric surgery hemorrhage. Therefore, it is recommended that bariatric surgeons pay more attention to hemostasis during surgery and postoperative care for such patients to prevent bleeding after surgery.

However, multicentric studies are recommended to investigate the hemorrhage after bariatric surgery associated with diabetes and hypertension.

One of the limitations of this study was the small number of patients who underwent OAGB surgery, so we suggest that these variables be examined more in this operation in the future.

Patients with a lower drop in hemoglobin levels who did not require blood transfusions were not evaluated in this study. Further studies could investigate the risk factors for minor and sub-acute bleeding after bariatric surgery.

Another limitation of this study is that it is descriptive. Therefore, cohort studies are recommended to investigate the relationship between diabetes, hypertension, and other demographic features with hemorrhage after bariatric surgery in the future.

## CONCLUSION

Despite all measures to reduce hemorrhage during and after bariatric surgery, bleeding is still one of the most common early postoperative complications after bariatric surgery. Therefore, recognizing the risk factors for bleeding is still important. In this study, an association was observed between hypertension and diabetes with postoperative bleeds.

## ACKNOWLEDGMENTS

This study was conducted with Shahid Beheshti University of Medical Sciences' research budget, and the follow-up code is 24631.

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