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ORIGINAL CONTRIBUTIONS

Feasibility of Same-Day Discharge After Laparoscopic Roux-en-Y Gastric Bypass in Patients with Well-Regulated Obstructive Sleep Apnea

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Abstract

Introduction Same-day discharge after bariatric surgery is increasingly being performed. In current practice, patients with only minor comorbidities are considered eligible for same-day discharge after laparoscopic Roux-en-Y gastric bypass (RYGB). Obstructive sleep apnea (OSA) is a common comorbidity in patients with morbid obesity, with a prevalence of around 70–80% among patients undergoing bariatric surgery. Continuous positive airway pressure (CPAP) is the current gold standard treatment for OSA. We aimed to investigate whether same-day discharge after RYGB is feasible for patients with compliant use of CPAP.

Methods In this single-center prospective feasibility study, patients were selected who were scheduled for RYGB and were adequately treated for OSA. Compliance on the use of CPAP had to be proved (> 4 h per night for 14 consecutive nights). There were strict criteria on approval upon same-day discharge. The primary outcome was the rate of successful same-day discharge. Secondary outcomes included short-term complications, emergency department presentations, readmissions, and mortality.

Results Forty-nine patients underwent RYGB with intended same-day discharge, of whom 45 (92%) were successfully discharged. Three patients had an overnight stay because of divergent vital signs and one patient due to a delayed start of the surgery. Two patients (4%) were readmitted in the first 48 h postoperatively, both due to intraluminal bleeding which was managed conservatively (Clavien–Dindo 2). There were no severe complications in the first 48 h after surgery.

Conclusion Same-day discharge after RYGB can be considered feasible for selected patients with well-regulated OSA.

Keywords RYGB · Gastric bypass · Same-day discharge · OSA · Obstructive sleep apnea

Key Points
- RYGB with same-day discharge is feasible for patients with well-regulated OSA.
- OSA screening is crucial to perform bariatric surgery with same-day discharge.
- Same-day discharge after RYGB can result in a relatively high amount of ED visits.

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Introduction

In the Netherlands, over 12,000 bariatric surgeries are performed every year [1]. This number is expected to rise due to the increase of patients with morbid obesity. Bariatric procedures have proven to be safe with morbidity rates around 3% and mortality rates lower than 1% [1–3]. With the current COVID-19 pandemic and the increase in bariatric procedures as a consequence of the rising prevalence of obesity, novel bariatric care paths have to be developed. For instance, same-day discharge after Roux-en-Y gastric bypass (RYGB) is an effective way to lower the burden on clinical capacity. Feasibility for RYGB with same-day discharge was demonstrated in a large retrospective study by Leepalao et al. in 2020, who stated that further studies need to be done

to determine specific patient characteristics for adequate selection of bariatric surgery with same-day discharge [4]. Additionally, a prospective study by Nijland et al. in 2020 proved feasibility of a selected group of patients undergoing RYGB with a high success rate of 88% [5]. This group did not include patients with moderate or severe obstructive sleep apnea (OSA). Patient selection is considered very important for successful same-day discharge, since patients without severe comorbidities are fitter and recover faster [5]. Same-day discharge after RYGB is common practice in a selected group of bariatric patients with only minor comorbidities in increasingly more centers. Currently, these centers do not include patients with moderate or severe OSA.

Obstructive sleep apnea is a common comorbidity in patients with morbid obesity, with a prevalence of around 70–80% among patients undergoing bariatric surgery [6–9]. Continuous positive airway pressure (CPAP) is considered to be the gold standard treatment for OSA and works by pneumatically opening the upper airway. With the high prevalence in patients with morbid obesity, every patient could be considered as OSA patient. However, many hospitals routinely screen bariatric patients for OSA to minimize perioperative risk in undiagnosed patients [10]. In a systematic review by Raaff et al. in 2016, no clear association was found between OSA and overall complications, cardiopulmonary-related ICU admissions, length of hospital stay, and mortality. These results are influenced by optimized situations such as CPAP therapy [11]. Furthermore, multiple studies conclude that OSA is not associated with unplanned readmission after ambulatory surgery [12–15]. Therefore, we hypothesized that bariatric patients with OSA and the use of CPAP are eligible for same-day discharge. The aim of the present study was to investigate whether same-day discharge after RYGB is feasible for patients with well-regulated OSA on CPAP therapy. The number of potential patients that could be discharged on the same day of the operation would increase considerably, with the high prevalence of OSA among bariatric patients.

Methods

A prospective single-center study has been performed in a high-volume bariatric center in the Netherlands. The Medical Ethical Review Committee approved the present study. A local Data Safety Monitoring Board was established to warrant the safety of patients treated with the study protocol.

Study Population

The study population consisted of patients with morbid obesity, aged between 18 and 65 years. Patients had to be eligible for primary laparoscopic RYGB according to IFSO criteria [16] and had to meet the inclusion and exclusion criteria as presented in Table 1. Patients were informed about the study during their preoperative consultation with the bariatric surgeon. Furthermore, patients received a written document containing information on the study. Written informed consent was obtained according to the Guidelines of Clinical Research in Humans. The required sample size was dependent on the probability of non-successful discharge, which we estimated around 7% based on our experience with same-day discharge in patients undergoing RYGB. Using a confidence interval of 95% with a probability of 0.07, the required sample size for our primary outcome was 42 participants [17]. To compensate for potential loss of follow-up, the sample size was extended to a maximum of 50 participants. Seventy-one patients were eligible for this study. Fourteen patients were not interested in participation. Seven patients were excluded due to CPAP failure or an AHI of > 10 per hour, with the use of CPAP.

Preoperative Screening

All patients attended a preoperative multidisciplinary program to assess medical history and nutritional, endocrine, and psychological status. Different diagnostic tests were performed on all patients before surgery, including screening of blood anomalies and a stool test for identification of *Helicobacter pylori* infection. A respiratory polygraphy for screening of OSA was performed in patients who were not already treated for OSA. Treatment for OSA was indicated, if there was an apnea–hypopnea index (AHI) of > 15 per hour, oxygen saturation of < 90% for at least 10 min, or oxygen saturation of 80% or less. Treatment consisted of usage of continuous positive air pressure therapy (CPAP), initiated by the pulmonologist. After 2 weeks, compliance in the use of CPAP was checked (> 4 h use of CPAP for 14 consecutive nights). If patients were not compliant, they were not approved for surgery and were instructed on the use of CPAP again. After 2 weeks, compliance was checked a second time to assess whether they were eligible for study participation. The anesthesiologist performed a preoperative screening before giving final approval for the surgery.

Perioperative Protocol

In the morning on the day of surgery, patients were admitted to the hospital. Vital signs were checked, and a blood sample was taken to determine the hemoglobin level. The operation had to start before noon and was the first, second, or third procedure on the bariatric program of the day, to warrant at least 6 h of postoperative observation. Experienced and certified bariatric surgeons performed all operations, according to the international guidelines of bariatric surgery. The protocol for anesthesia was specifically developed for use in

Table 1 Inclusion and exclusion criteria

Inclusion criteria
- Patients with morbid obesity (IFSO criteria) with a BMI < 50 kg/m^2
- Age between 18 and 65 years
- Primary laparoscopic Roux-en-Y gastric bypass
- OSA with the use of CPAP, with compliancy (use > 4 h/night for 14 consecutive nights) and AHI with CPAP of ≤ 10/h
- Proficient in Dutch language
- Able to understand and use the remote medical devices
- Residing within a maximum of 45-min travel time to the hospital
- An informal caregiver is available to for the first 24 h following hospital discharge
Exclusion criteria
- Uncontrolled diabetes mellitus or use of insulin, cardiac disease (i.e., history of myocardial infarction, heart rhythm disorder) and coagulation abnormalities or use of anticoagulants
- Large abdominal surgeries in the past including abdominal laparotomy
- Unapproved for same-day discharge by anesthesiologist for any possible reason
- Unable to fully understand the requirements to participate in the study, as assessed by surgeon

bariatric surgery following the ERAS concept [18]. The anesthetic protocol was standardized with multimodal analgesia, combining local infiltration of the abdominal trocar sites with bupivacaine, intravenous propofol (dose using adjusted bodyweight), intravenous remifentanil (dose using ideal body weight), 30 mg rocuronium, acetaminophen, metamizol, and morphine [19–21]. Postoperative medication for pain was standardized oral medication, acetaminophen 1000 mg four times daily, naproxen 500 mg two times daily (for three days), and if necessary rescue medication Oxynorm 5 mg with a maximum of four times daily (for 3 days). To prevent postoperative nausea and vomiting, all patients received antiemetics (dexamethasone and granisetron) during and after surgery.

Postoperative Treatment

Patients were admitted to the recovery room after surgery, for assessment of vital signs, postoperative nausea, and pain. If patients were not fully awake, their CPAP machine was put on by the nurse or anesthesiologist. Respiratory events were monitored and noted. If patients had multiple episodes of bradypnea, apnea, or desaturation [22], they were not declared fit for same-day discharge. After patients had returned to the surgical ward, a specialized bariatric nurse closely monitored them. Patients had to start to mobilize as soon as possible and start with a liquid diet. In the absence of clinical abnormalities after 6 h of observation and no respiratory events in the recovery room or on the ward, patients were deemed suitable for discharge by the surgeon, who performed the operation. Patients with abnormal vital signs, more than 1 mmol/L loss in hemoglobin level, or disapproval of the surgeon were classified as failure for same-day discharge. Upon discharge, patients were given a one-time-only injection with low-molecular-weight heparin, according to our national guideline [23]. The criteria for approval of same-day discharge are summarized in Table 2.

Before discharge, all patients were provided with an information sheet describing symptoms that require emergency consultation and the hospital's 24-h emergency telephone numbers. Furthermore, the importance of CPAP usage was emphasized, especially for the first postoperative nights. Patients were provided with a pulse oximeter (Nonin Onyx Vantage 9590) and a tympanic thermometer (Covidien Genius 2). Three times a day for 48 h postoperatively, patients were asked to report on pain, heart rate, oxygen saturation, and body temperature, in order to detect early complications. Patients were contacted by telephone by the surgeon on postoperative day (POD) 1, for assessment of potential complications and to answer any questions. On POD 2 or 3, patients had an appointment at the outpatient clinic for a thorough medical check-up by a specialized bariatric nurse.

Outcomes

The primary outcome of this study was the number of patients that achieved successful same-day discharge without readmission within 48 h. Secondary outcomes included short-term complications (< 30 days), using the Clavien–Dindo classification [25], emergency department (ED) presentations, readmissions within 30 days postoperative, and mortality.

Statistical Analysis

All data were analyzed using SPSS 22.0 for Windows (SPSS Inc. Chicago, IL, USA). Patient characteristics were described as mean ± SD, median (interquartile range), and categorical data as counts and percentages. The normality of the variables has been judged by visual inspection of histograms and Q–Q plots.

Results

A total of fifty patients were included in this study and operated between November 2021 and April 2022. One patient withdrew from informed consent after surgery. Of forty-nine patients, the mean (SD) age was 43 ± 12, the mean (SD) preoperative BMI was 42 ± 3 kg/m^2, and the majority of the participants were female (74%). Median (IQR) AHI without and with CPAP therapy was 22 (18–31)/h and 1 (1–2)/h, respectively. Baseline characteristics are summarized in Table 3.

Forty-five (92%) patient could be successfully discharged on the same day after surgery. Three patients had an overnight stay because of divergent vital signs. One patient had to stay overnight due to a delayed start of the surgery, so 6 h of postoperative observation was not achievable with same-day discharge. All four patients were discharged in good clinical condition on the following day after surgery.

Out of the patients who were successfully operated with same-day discharge, two (4%) were readmitted in the first 48 h after surgery. One patient had hematemesis with stable vital signs and was observed for two nights. The other patient had rectal blood loss with stable vital signs and was observed for one night. Both patients were treated conservatively and were in no need of an intervention (Clavien–Dindo 2). A third patient presented at the ED in the first 48 h because of tachycardia, due to a missed dose of her beta-blocker. She did not need to be readmitted, and it was not registered as a complication.

Another four patients presented at the ED during the follow-up period but more than 48 h after surgery. Two patients had abdominal pain without any signs of complications (POD 3 and POD 21) and were discharged from the ED. One patient was readmitted on POD 18 with abdominal pain and vomiting and was discharged after one night of observation (Clavien–Dindo 1). One patient, a former smoker, was presented in the ED on POD 4 with abdominal pain due to anastomotic leakage and was re-operated. There appeared to be staple line dehiscence, which was sutured and drained. Postoperatively, the patient was admitted to the ICU with respiratory insufficiency (Clavien–Dindo 4a). Her recovery was further complicated by a COVID infection. She was discharged after a long admission of 89 days and has recovered fully. There was no mortality in this study. The outcomes are summarized in Table 4.

Discussion

The aim of this prospective study was to investigate the feasibility of same-day discharge for patients with well-regulated OSA undergoing RYGB. We observed a high success rate of 88% (43/49) of same-day discharge without readmission within 48 h. Four patients had to stay overnight, due to both clinical and logistic reasons, and they were all discharged on POD 1

Table 3 Baseline characteristics

Age at surgery, years (mean, SD)	43 ± 12
Female (*n*, %)	36 (74)
Weight, kg (mean, SD)	121 ± 18
BMI, kg/m^2 (mean, SD)	42 ± 3
ASA (n, %)	
2	12 (24)
3	37 (76)
AHI without CPAP (median, IQR)	22 (18–31)
AHI with CPAP (median, IQR)	1 (1–2)
Comorbidities (*n*, %)	
Hypertension	6 (12)
NIDDM	5 (10)
Dyslipidemia	4 (8)
Osteoarthritis	22 (45)
History (*n*, %)	
Laparoscopic cholecystectomy	7 (14)
Psychiatric	8 (16)
Smoking (*n*, %)	
No	32 (65)
Former	13 (27)
Current	4 (8)
Operation time, minutes (mean, SD)	46 ± 10
Duration of hospital admission, hh:mm (mean, SD)	10:14 ± 00:47
Perioperative complications (*n*, %)	0
Postoperative decrease in hemoglobin, mmol/L (mean, SD)	0.34 ± 0.38

Table 2 Postoperative criteria for approval of same-day discharge

Postoperative criteria for approval of same-day discharge

- No abnormalities or complications during the surgical procedure
- No anesthetic abnormalities or complications. This includes respiratory events in the recovery room[a]
- Normal vital signs after 6 h of observation[b]
- Maximum decrease in hemoglobin-level postoperative of 1.0 mmol/L
- Approval of bariatric surgeon and patient for discharge

[a]Respiratory events defined as bradypnea < 8 breaths per minute, apnea lasting more than 10 s, oxygen saturation less than 90% on nasal cannula [22]

[b]Divergent vital signs defined as tachycardia > 100 bpm, temperature > 38 °C, > 10 mmHg decrease in diastolic blood pressure from the preoperative diastolic situation, oxygen saturation < 95% [24]

without any complications. Only two patients had a mild complication within the first 2 postoperative days and were readmitted to the hospital. Both patients had intraluminal bleeding which required conservative treatment (Clavien–Dindo 2). One patient with an anastomotic leakage presented at the ED on POD 4. We presume that same-day discharge did not influence her complication. She did not have any complaints on the first postoperative day, so she probably would have been discharged on POD 1, if she were planned for surgery with an overnight stay. There were no pulmonary complications or any other complications associated with OSA in the study population. The high success rate of the study suggests that within bariatric surgery with same-day discharge, patients with well-regulated OSA are comparable to patients without OSA. This statement is supported by multiple studies that conclude that OSA is not associated with unplanned readmission after ambulatory surgery [12–15]. Moreover, among patients that are at high risk for OSA, presenting for ambulatory laparoscopic adjustable gastric banding (LAGB), the incidence of clinically significant morbidity and mortality appeared to be very low [26].

Of the forty-nine patients with intended same-day discharge in the present study, four stayed overnight at the hospital. None of them turned out to have a complication. This suggests that there are strict criteria set for approval upon same-day discharge in this study. These criteria might be scaled down, but larger studies are required to determine patient safety. The present study had a relatively high amount of ED visits. Seven patients (14%) presented at the ED during the 30-day follow-up, of which three patients (6%) presented within the first 48 h postoperatively. This could be due to the comprehensive and strict instructions that are provided to the patient before discharge. To prevent any delay in the detection of complications, patients were encouraged to contact the hospital in case of any complaints or alarming signs (e.g., severe pain, hematemesis, rectal blood loss, divergent vital signs). This probably resulted in a relatively high amount of patients who presented at the ED, of whom only four out of seven (57%) had a complication. These strict instructions therefore may cause overtreatment. However, an increase in ED visits does not outweigh the benefits of early detection of those patients that do have a complication and need medical attention.

There is no consensus on preoperative OSA screening for bariatric patients. In the present study, every patient had a respiratory polygraphy, except for patients that were already diagnosed with OSA. CPAP compliance had to be proven. The results from this study suggest that selected patients with well-regulated OSA are suitable for same-day discharge after RYGB. However, as known from previous studies, patients with severe unregulated OSA have an increased risk of complications [27–29]. Therefore, these patients need to be clinically observed and are not suitable candidates for same-day discharge. Hence, OSA screening is crucial in patients who are eligible for bariatric surgery with same-day discharge [10].

Table 4 Outcomes

Primary outcome	
Same-day discharge (*n*, %)	45 (92)
Same-day discharge without readmission within 48 h (*n*, %)	43 (88)
Secondary outcomes	
Overall complications	
ED visits	7 (14)
Readmissions	4 (8)
Complications	1 (2)
Clavien–Dindo I	2 (4)
Clavien–Dindo II	1 (2)
Clavien–Dindo IVa	0
Mortality	
Postoperative day 1 and 2	
ED visits	3 (6)
Readmissions	2 (4)
Complications	2 (4)
Clavien–Dindo II	0
Mortality	
Postoperative day 3–30	
ED visits	4 (8)
Readmissions	2 (4)
Complications	1 (2)
Clavien–Dindo I	1 (2)
Clavien–Dindo IVa	0
Mortality	

The present study has several limitations. First and foremost is the small sample size of this study. This makes it difficult to draw hard conclusions on the secondary outcomes, particularly the safety of same-day discharge of patients with well-regulated OSA. Larger studies are necessary to assess safety, given the overall low incidence of complications in bariatric surgery. Furthermore, due to the small sample size, it is not possible to perform subgroup analysis, for example, patients who were already treated for OSA versus patients who were diagnosed with OSA during preoperative screening. In the present study, patients had to prove compliancy preoperatively by using their CPAP machine for at least 4 h per night for 14 consecutive nights. This was deemed sufficient, to assume that patients would use their CPAP postoperatively as well. However, the actual CPAP usage on the days after surgery was not verified. Finally, patient satisfaction on same-day discharge was not an outcome measure in this study. It is very important to consider the patient perspective on this subject, as patients have to detect early complications themselves. In the feasibility study on same-day discharge after RYGB by Nijland et al., patients were very satisfied with their treatment [5]. Since the present study was only a feasibility study with forty-nine participants, further research on patient satisfaction in this population is needed.

There is an increasing demand on hospital capacity worldwide, due to the COVID-19 pandemic, local staff shortages, and the increased prevalence of patients with morbid obesity. Same-day

discharge is an effective care pathway to lower the burden on hospital capacity. Based on our results, we conclude that SDD after RYGB is feasible for patients with well-regulated OSA. Larger studies are required to evaluate the safety of same-day discharge of this population. Moreover, further studies are needed to determine if other criteria can be safely extended in selecting suitable patients for bariatric surgery with same-day discharge.

Data Availability Data is available upon request.

Declarations

Ethical Approval The institutional research ethics committee has approved this study, and all procedures have been performed in accordance with the Declaration of Helsinki originally adopted in 1964 and its later amendments or comparable ethical standards.

Consent to Participate All patients voluntarily participated. Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare no competing interests.

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