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Ambulatory sleeve gastrectomy: a prospective feasibility and comparative study of early postoperative morbidity

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Abstract

Background Given its short procedure time and low morbidity, there is enthusiasm to perform sleeve gastrectomy (SG) in an outpatient setting. However, most relevant studies include an overnight stay at a medical facility (≤ 24-h). Hence, we investigated the feasibility and safety of a same-day discharge (SDD) protocol for laparoscopic SG.

Methods In a prospective pilot study (02/01/2021–02/28/2022), all patients planned for SG were screened for eligibility. Patients met the inclusion criteria if they were ≤ 65 years old, without major comorbidity, and lived close to the hospital. Postoperatively, patients who met discharge criteria were sent home directly from the recovery room. Patients were called the same night and the next morning. Feasibility was defined as discharge on the day of surgery without emergency department (ED) visit or readmission within 24-h. Secondary outcomes, including 90-day morbidity, were compared to patients who met inclusion criteria but chose a same-day admission (SDA) approach during the same study period. Descriptive statistics are displayed as count (percentage) and median (interquartile range).

Results A total of 320 patients were planned for SG during the study period, 229 of whom met eligibility criteria and underwent SG with 56 agreeing to SDD-SG while 173 opted for SDA-SG. Baseline characteristics were all similar between both groups except for obstructive sleep apnea being more prevalent in SDA-SG group (38.2% vs. 16.1%; $P < 0.001$). Operative characteristics including procedure time were similar between both groups. Successful SDD-SG was achieved in 54(96%) of patients with a median of 6.0(1.0) hours of stay in the recovery room. Ninety-day morbidity was similar between SDD-SG and SDA-SG groups (1.8% vs. 6.9%, respectively; $P = 0.196$).

Conclusion A SDD protocol for laparoscopic SG was feasible and safe in selected patients. Larger studies that evaluate patient reported outcomes and include bypass-type procedures may be needed to guide safe use of ambulatory bariatric surgery.

Keywords Ambulatory bariatric surgery · Same-day discharge · Day surgery · Sleeve gastrectomy · Bariatric surgery

Over the past two decades, the length of stay (LOS) after laparoscopic bariatric surgery has gone from 2–5 days down to 1–2 days while maintaining safety and reducing the cost of care [1, 2]. This is in part due to advancements in utilization of minimally invasive techniques and improvements in multi-disciplinary care of patients with severe obesity [3]. The implementation of enhanced recovery pathways (ERPs) after bariatric surgery has also been instrumental in further improvements in outcomes including shortening LOS [4].

Despite such strides in patient safety and utilization of resources, access to bariatric surgery remains poor [5]. The coronavirus (COVID-19) pandemic exacerbated surgical wait times and created a backlog of elective surgeries [6, 7]. Moreover, the pandemic has also elucidated the importance of minimizing the inpatient hospital stay. Same-day

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discharge (SDD) surgery has a potential to mitigate some of these concerns. Ambulatory laparoscopic surgery is already well established for several general surgery procedures including cholecystectomy and foregut surgery and is expanding to other surgeries like colectomy [8–10]. Hence, there is a growing interest to evaluate the feasibility and safety of bariatric procedures in an ambulatory setting.

Laparoscopic sleeve gastrectomy (SG) is the most commonly performed bariatric procedure worldwide [11, 12]. Its popularity is driven by the short procedure time, low morbidity and satisfactory long-term outcomes [13, 14]. Hence, SG is an ideal bariatric procedure to evaluate the SDD approach. However, most studies on SDD-SG either lack clearly defined selection and discharge criteria or include an overnight stay at a medical facility that cannot differentiate between those patients who truly underwent an outpatient surgery versus those who had a same-day admission (SDA) and were discharged within 24-h.[15, 16] Thus, the objective of our prospective pilot study was to assess the feasibility of a SDD protocol for SG, and estimate the effect on LOS, emergency department (ED) visits and 90-day morbidity.

Materials and methods

Setting

This pilot study was performed at two sites of a single academic institution [McGill University Health Center (MUHC)], which is a designated Center of Excellence for bariatric surgery with a high annual surgical volume (450–500 procedures per year). All bariatric procedures are performed by one of four bariatric surgeons. The program also has a dedicated multi-disciplinary team of bariatric nurses, dietitians and when required endocrinologists and a psychologist that provide extensive perioperative education to patients in both printed and digital formats, and in-person or virtually since the beginning of the COVID-19 pandemic. All patients receive a routine 2-week course of preoperative very low-calorie diet. In addition, a bariatric-specific ERP with a focus on early mobilization and oral intake as well as minimization of opioid use has already been established and utilized at the MUHC for over a decade.

Study cohort and protocol

Between February 01 2021 and February 28 2022, all patients planned for laparoscopic SG at the MUHC were screened for eligibility for a SDD approach. The inclusion and exclusion criteria for SDD-SG are detailed in Table 1. After the launch of our pilot study and with continuous monitoring of the logistics and patient outcomes coupled with increased patient enthusiasm due to positive feedback from other patients, we revised our protocol during the study period and expanded the eligibility criteria. For the first 20 patients in the SDD-SG group, the study protocol excluded any patient with age ≥ 55 years and BMI ≥ 55 kg/m^2. After an interim analysis of our results and as the multidisciplinary team became more accustomed to the protocol, we expanded our inclusion criteria to include patients with age ≤ 60 years and BMI ≤ 60 kg/m^2. The strict cut-off for

Table 1 Inclusion and exclusion criteria for SDD-SG protocol

Inclusion criteria
Age ≤ 65 years
BMI ≤ 60 kg/m^2
No mobility restriction (i.e., no need for wheelchair or walker/cane)
Lives within proximity of MUHC for the first 48 h after surgery (50 km or 30 min drive)
Adequate support at home (e.g., live in support within first 48 h)
Exclusion criteria
ASA class ≥ IV
Presence of cognitive impairment
Uncontrolled HTN
Untreated or poorly controlled OSA
Poorly controlled DM
Need for therapeutic anti-coagulation
Evidence of end-stage organ failure, organ transplant, or significant cardiac or pulmonary impairment (congestive heart failure, end-stage renal disease, severe liver disease, etc.)
Chronic opioid use
Inability to communicate in French or English
Revisional bariatric surgery e.g., adjustable gastric band removal to SG

BMI Body mass index, *MUHC* McGill University Health Center, *ASA* American Society of Anesthesiologists, *HTN* Hypertension, *OSA* Obstructive sleep apnea, *DM* Diabetes mellitus, *SG* Sleeve gastrectomy

glycated hemoglobin A1C of 7% was also removed for the diabetics. This did not result in any increase in the adverse outcomes among the SDD-SG group (results not tabulated).

Eligible patients were offered SDD-SG and if agreed were planned accordingly and scheduled as the first or second case of the day. Patients who met inclusion criteria but chose same-day admission (SDA) were also prospectively followed during the same study period. The study follows Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines for reporting observational studies. As a Quality Improvement pilot project, the study was approved by the Director of Professional Services of MUHC after receiving an exemption from the institutional Research Ethics Board (study number: 2021-7358).

A standard laparoscopic SG procedure was performed using a 40-60Fr bougie catheter without routine drainage or staple line reinforcement. All patients received a surgeon-administered laparoscopic guided transversus abdominis plane (TAP) block using 0.25% Bupivacaine with epinephrine, which is shown to minimize postoperative nausea, vomiting and opioid requirements [17, 18]. Intraoperative guidelines in the ERP include totally intravenous anesthesia (TIVA), antiemetic therapy with 4–8 mg Dexamethasone at induction and 4 mg of Ondansetron administered intravenously at the end of the case, and hydration with at least 1 L of crystalloids.

In the SDD protocol, patients received ≥ 1 L of crystalloids in the post-anesthesia care unit (PACU) prior to discharge. A complete blood count was done 4 h after surgery to ensure a stable hemoglobin level compared to baseline (defined as no drop > 20 g/L). Subsequently, patients were evaluated by the surgical team 4–6 h after arrival in PACU and were discharged if they were able to ambulate, tolerate clear liquids, had a stable hemoglobin level, were afebrile, had a normal heart rate (< 100 bpm), and had met other standard PACU discharge criteria [19]. If any of these conditions was not met, the patient was admitted overnight for monitoring and would follow the default SDA approach. Routine postoperative discharge instructions along with a standard exit prescription was provided at discharge. Of note, our standard exit prescription for SG includes antiemetics and multi-modal analgesia involving acetaminophen, a 3-day course of celecoxib (100 mg twice daily), and hydromorphone (16 tabs of 1 mg) among other routine postoperative medications including Beneprotein®, laxative (polyethylene glycol) as needed, 3-month course of lansoprazole fastab (30 mg daily), 6-month course of ursodiol (250 mg twice daily), Centrum Select Adults 50 + (1 tablet daily), and vitamin D (1000 IU daily).

After discharge, the SDD patients had two early phone follow-ups by the surgical team including the surgeon or the bariatric nurse. The follow-up calls were made 4–6 h after discharge on the same night of surgery and the following morning on postoperative day (POD) 1 to screen for any alarming symptoms (including fever, shortness of breath, severe pain, inability to hydrate, and nausea/vomiting) that would necessitate the patient to present to the ED. The remainder of the postoperative follow-up visits were carried out as per routine intervals at the MUHC including visits with bariatric nurse at 2 weeks after surgery followed by bariatric surgeon and dietitian at 1 month after surgery and routine multi-disciplinary visits at 3, 6, 9, 12 months, and yearly thereafter. Of note, at MUHC there is no dedicated bariatric outpatient hydration clinic, and no such visits were planned for any of the patients as part of this study.

Outcome measures

The primary outcome to evaluate was the feasibility of the SDD protocol defined as the proportion of patients that were successfully discharged from PACU on the day of surgery and did not require an ED visit or readmission within the first 24-h after surgery. The timeframe of 24-h was chosen because at our center, the ERP target discharge day is POD 1 after SG.

Secondary outcomes included LOS, and 90-day complications, ED visits, readmissions, and reinterventions. These outcomes after SDD-SG were compared to patients who met inclusion criteria but chose SDA-SG during the study period or those medically eligible patients who refused or were unable to commit in advance to arrange for adequate support and temporary residence within proximity of the hospital.

Statistical analysis

Descriptive statistics are presented as count (percentage) and median (interquartile range). Baseline, operative, and 90-day postoperative parameters between both SDD-SG and SDA-SG groups were compared using the Chi-squared test for categorical variables and Mann–Whitney U test for continuous variables. Statistical analyses were carried out using STATA version 12 (StataCorp LP). Inference is based on a two-sided 5% level.

Results

Out of 320 patients who were planned to undergo SG during the study period, 229 were eligible for a SDD approach (Fig. 1). Of these patients, 56 (24%) agreed to SDD-SG while 173 declined and were planned for SDA-SG. The flowchart of the entire study cohort is provided in Fig. 1.

Baseline characteristics of the SDD-SG and SDA-SG groups were similar except for obstructive sleep apnea (38% vs. 16%; $P < 0.001$) being more prevalent in SDA-SG group (Table 2). While not statistically significant, there were more

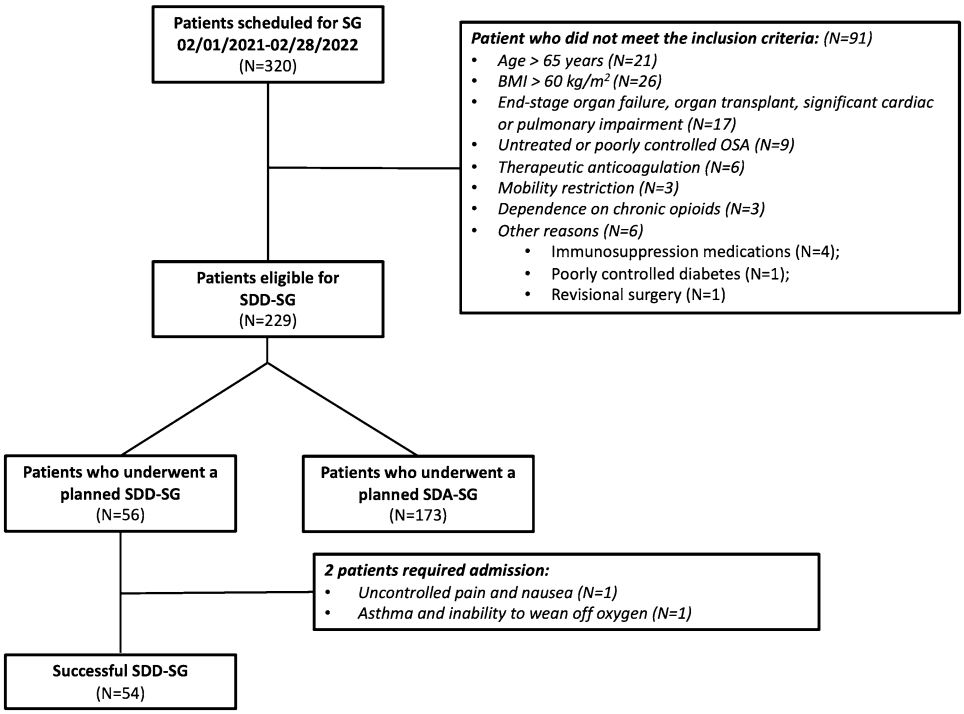

Fig. 1 Study flowchart

Table 2 Baseline characteristics of the study cohort

Patient characteristic	Entire cohort ($N=229$)	SDD-SG ($N=56$)	SDA-SG ($N=173$)	P value
Age (y)—Median (IQR)	46.5 (16.0)	43 (17.5)	46 (16.0)	0.254
Sex (female)—*N* (%)	174 (76.0)	46 (82.1)	128 (74.0)	0.214
Weight (kg)—Median (IQR)	126.4 (34.9)	119 (35.9)	127 (35.1)	0.465
BMI (kg/m^2)—Median (IQR)	49.1 (8.4)	44.0 (7.5)	45.0 (8.4)	0.672
Comorbidities—*N* (%)				
DM	46 (20.1)	8 (14.3)	38 (22.0)	0.052
Insulin-dependent	5 (2.2)	1 (1.8)	4 (2.3)	0.147
HTN	71 (31.0)	15 (26.8)	56 (32.4)	0.085
DLP	50 (21.8)	13 (23.2)	37 (21.4)	0.154
OSA	75 (32.8)	9 (16.1)	66 (38.2)	< 0.001
Using CPAP	59 (25.8)	7 (12.5)	52 (30.1)	0.002
GERD	62 (27.1)	15 (26.8)	47 (27.2)	0.146
ASA class—*N* (%)				0.075
II	196 (85.6)	52 (93.0)	144 (83.2)	
III	33 (14.4)	4 (7.0)	29 (16.8)	

SDD Same-day discharge, *SG* Sleeve gastrectomy, *SDA* Same-day admission, *IQR* Interquartile range, *BMI* Body mass index, *DM* Diabetes mellitus, *HTN* Hypertension, *DLP* Dyslipidemia, *OSA* Obstructive sleep apnea, *GERD* Gastroesophageal reflux disease, *ASA* American Society of Anesthesiologists

patients with diabetes in the SDA-SG group (22% vs. 14%; $P=0.052$; Table 2). Intraoperative characteristics were also similar with no intraoperative complications and no conversions to laparotomy in either group (Table 3). Median hospital LOS was shorter in the patients enrolled in SDD-SG, (6.0 [1.0] hours vs. 24 [0] hours, $P=0.007$; Table 3). In the SDD-SG group, one patient required an in-and-out foley catheterization for urinary retention prior to discharge.

Among the 56 patients who enrolled in SDD-SG, 54 were discharged from the PACU as planned, and did not return to the ED or require admission within the first 24-h. Therefore, the planned SDD approach was successful in 96% of patients (95% Confidence Interval: 87.7%-99.6%). Of the 2 SDD-SG patients admitted from PACU, one had uncontrolled pain and nausea requiring analgesia, intravenous antiemetics and hydration. The other patient had a history of asthma and was

Table 3 Operative characteristics and outcomes after SDD-SG compared to SDA-SG

	Entire cohort ($N=229$)	SDD-SG ($N=56$)	SDA-SG ($N=173$)	*P* value
Operative time (min)—Median (IQR)	78 (31.5)	72 (29.8)	80 (32.5)	0.066
Conversion—*N* (%)	0 (0.0)	0 (0.0)	0 (0.0)	N/A
Intraoperative complication—*N* (%)	0 (0.0)	0 (0.0)	0 (0.0)	N/A
LOS (h)—Median (IQR)	24 (0.0)	6 (1.0)	24 (0.0)	0.007

SDD Same-day discharge, *SG* Sleeve gastrectomy, *SDA* Same-day admission, *IQR* Interquartile range, *LOS* Length of stay

not able to be weaned off supplemental oxygen and required bronchodilators overnight. Both patients had an uneventful hospital admission and were successfully discharged on POD 1. The two subsequent planned phone follow-ups after discharge did not reveal any alarming symptoms prompting a change in management. There were 2 ED visits in the SDD-SG group beyond 24 h. One patient presented on POD 13 for abdominal pain and was discharged home after a full negative workup. Another patient presented on POD 35 with symptoms of dehydration and was found to have an acute kidney injury requiring readmission for intravenous hydration. There were no other ED visits or readmissions in the SDD-SG group.

In terms of 90-day morbidity, the follow-up was complete for the entire study cohort. Overall, the incidence of any complication was similar between the SDD-SG and SDA-SG groups (1.8% vs. 6.9%, respectively; $P=0.196$) (Table 4). There were no deaths, staple-line leaks, wound infections, or venous thromboembolic events in either group. Only 3 patients, all part of the SDA-SG group, experienced postoperative bleeding requiring either an expectant management with holding off on the prophylactic anti-coagulation with serial monitoring of hemoglobin after a significant drop of more than 20 g/L ($N=1$) or the need for blood transfusion ($N=2$). ED visits and readmissions at 90-days occurred in a similar proportion of patients in the SDD-SG and SDA-SG groups (4% vs. 9% and 2% vs. 4%, respectively; Table 4).

Discussion

This prospective pilot study demonstrated the feasibility of a SDD protocol for SG, with 72% of patients eligible for SDD, 24% agreeing to it, and 96% successfully discharged from PACU. This high success rate was achieved with a median postoperative hospital stay of only 6 h and without any ED visits or need for readmission in the first 24-h after surgery. Moreover, after a successful discharge from the PACU, no alarming symptoms were identified in any patients on the two follow-up phone calls (same night of the surgery and the following morning) that would have prompted an ED visit. Our findings support that SDD-SG is feasible in selected patients undergoing laparoscopic SG.

Table 4 Stratified 90-day postoperative complications of the study cohort

	Entire cohort ($N=229$)	SDD-SG ($N=56$)	SDA-SG ($N=173$)	*P* value
Mortality—*N* (%)	0	0	0	N/A
Staple-line leak—*N* (%)	0	0	0	N/A
VTE—*N* (%)	0	0	0	N/A
SSI—*N* (%)	0	0	0	N/A
Bleeding*—*N* (%)	3 (1.3)	0	3 (1.7)	1.000
ED visit—*N* (%)	17 (7.4)	2 (3.6)	15 (8.7)	0.206
Unplanned Readmission—*N* (%)	8 (3.5)	1 (1.8)	7 (4.0)	0.423
Unplanned Reintervention†—N (%)	2 (0.9)	0 (0.0)	2 (1.2)	1.000

SDD Same-day discharge, *SG* Sleeve gastrectomy, *SDA* Same-day admission, *VTE* Venous thromboembolic event, *SSI* Surgical site infection, *ED* Emergency department

*Bleeding was defined as one that required either an expectant management with holding off on the prophylactic anti-coagulation and serial monitoring of hemoglobin given a significant drop (> 20 g/L) and/or need for blood transfusion

†Both reinterventions were unrelated to the SG. One patient required a laparoscopic appendectomy for acute appendicitis (POD 6); the other patient underwent a laparoscopic cholecystectomy for acute cholecystitis (POD 12)

Currently, SG is carried out as an SDA procedure in majority of centers worldwide. The common reservations against SDD-SG are that it could lead to missing some life-threatening postoperative complications like staple-line bleeding or result in higher rates of readmissions. However, in carefully selected patients, cared for in a high-volume center using an established ERP, and with explicit PACU discharge criteria, these concerns can potentially be mitigated. Beyond the first 24-h, our overall incidence of postoperative complications after SDD-SG was low and comparable to patients monitored overnight [20, 21]. Moreover, our postoperative morbidity (2%) and readmission rates (2%) were similar to other single-institution series of ambulatory SG that report 30-day morbidity and readmission rates ranging between 2.3–5% and 0.6–8.5%, respectively [11, 12, 22–26]. A large retrospective case-series of 328 patients undergoing SDD-SG based on clear inclusion and discharge criteria reported a similar success rate of SDD to our study (98%) but with a higher 30-day readmission rate (8.5%), with the most common causes being nausea/vomiting and dehydration [24]. We did not have any patients readmitted within 30 days, with the single readmission presenting on POD 35 due to vomiting and dehydration. In other studies, the most common cause for 30-day readmission is staple-line leak, which is unlikely to be detected during the overnight admission as it usually becomes evident beyond POD 1 [11, 12, 23, 26]. We did not observe any staple-line leak, other surgical site infection or bleeding/hematoma in the SDD-SG group.

In our study, patients undergoing SDD-SG had a similar incidence of 90-day complications compared to other eligible patients who underwent SDA-SG (2% vs. 7%). This is in contrast to findings from other large multicenter studies using data from the 2015–2017 Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) database that reported significantly higher 30-day morbidity including readmission and reintervention after SDD-SG compared to patients discharged on POD 1 [16, 27]. Our observation on similar 90-day morbidity between both groups is explained in part by the fact that in our prospective study, we compared outcomes after SDD-SG to a similarly selected group of patients who opted for SDA-SG, with only 72% of patients meeting the eligibility criteria for SDD. Furthermore, our SDD protocol was built upon our longstanding bariatric surgery ERP, which has been implemented at our institution for more than a decade and has undergone multiple iterative improvements since introduction. This is not surprising since ERPs are associated with shorter LOS, less postoperative nausea and vomiting, and similar postoperative morbidity compared to traditional care [4, 28]. Finally, the extensive counseling and patient education by our bariatric multi-disciplinary team with regards to the expected postoperative course including anticipated level of pain, need for early ambulation and adequate hydration undoubtedly played an integral role in the success, efficiency and safety of the SDD approach after SG.

Cleary, SDD-SG is not suitable for all patients especially the elderly or high-risk patients with complex medical comorbidities such as end-stage organ dysfunction including compensated cirrhosis or advanced kidney disease requiring dialysis, or complex abdominal wall hernia, who are all more likely to undergo SG yet are consistently shown to suffer from higher morbidity after surgery [29–32]. However, our study contributes evidence supporting that ambulatory SG can to be safely performed in a carefully selected group of patients, granted we utilize lessons learned from predictors of failure of an SDD approach from available literature to establish a realistically strict and safe eligibility criteria [21, 33]. While we did not measure cost, a previous prospective single-center study of 250 consecutive patients that underwent an ambulatory SG over a 6-year time period, reported a significant reduction in cost per patient (up to 43%) compared to the traditional overnight admission [26]. In a health care system where access to beds is limited, an effective SDD-SG, with a short 6-h PACU stay, can increase access to bariatric surgery by reducing the need for in-patient bed utilization. Hence, this better allocation of resources/beds creates a positive cycle that can increase access to definitive care for higher-risk patients including those suffering from severe obesity who need an overnight admission. The importance of such effective SDD protocol is particularly relevant in the COVID-19 pandemic era with the negative impact on surgical waitlists and backlog with a disproportionate effect on elective surgeries.

This study has several strengths, including its prospective design with feasibility criteria defined a priori. We used defined inclusion and exclusion eligibility criteria and a discharge protocol that may help with reproducibility of the study and to plan larger studies/trials that may also include bypass-type bariatric procedures. Unlike other studies, we did not change our postoperative routines to add additional visits within the first week after surgery for intravenous hydration or assessment by the surgeon or multi-disciplinary team [12, 26].

However, several limitations should be considered. We did not formally evaluate patient satisfaction or other patient-centered outcomes. However, in follow-up visits patients were overwhelmingly satisfied with their choice and the possibility of an ambulatory approach for their SG procedure especially in the context of the COVID-19 pandemic, where visitors may not have been allowed. Anecdotally, in phone and in-person follow-up visits, some recurrent themes emerged which included “glad to have slept in one’s own bed”, “happy to have used one’s own bathroom”, and “glad not to have worn a mandated mask and be surrounded by family”. We also observed a steady increase in the number of

new patients requesting an SDD-SG during the study period which may have been related to positive feedback from other fellow patients and in support groups. Other limitations must also be considered when interpreting our results. This is a single center pilot study with a small sample size both of which impact the generalizability of our findings. Despite the prospective nature and while the important baseline characteristics of the SDD and the SDA groups were similar, the non-randomized design of our study may impede our ability to account for some unknown confounders as well as introduce a selection bias during the recruitment process that may have led to enrollment of lower-risk patients being offered and planned for SDD-SG. We also did not measure some patient factors that may have affected participation in this study like health literacy or patient engagement.

Conclusions

This prospective pilot study provides preliminary data supporting the feasibility and safety of an SDD approach in select group of patients undergoing laparoscopic SG. Larger studies that evaluate patient reported outcomes and include anastomotic procedures like gastric bypass are needed to guide the safe use of ambulatory bariatric surgery.

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