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Preoperative Change in 6-Minute Walk Distance Correlates With Early Weight Loss After Sleeve Gastrectomy

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ABSTRACT

Introduction: The 6-minute walk test (6MWT) is an objective preoperative measure of functional capacity and response to intervention in patients with heart or lung disease. In bariatric surgery, there has been no reliable preoperative measure predictive of postoperative success. Here we investigated the impact of bariatric surgery on changes in distance traveled in the 6MWT (the 6MWD) and whether preoperative changes in 6MWD correlated with weight change after surgery.

Methods: This is a retrospective study of consecutive patients in which the 6MWT was performed before and after laparoscopic sleeve gastrectomy for weight loss. 6MWD and total weight were measured. Pearson correlation was used to determine association between variables.

Results: Of 100 patients who underwent laparoscopic sleeve gastrectomy, 31 patients had a preoperative 6MWT. Thirty patients (97%) were available for follow-up after surgery. Percentage of excess weight loss was 45.7% over an average of 7 months after surgery. There was a weak correlation between the postoperative weight loss and the change in preoperative and postoperative 6MWD (r = 0.28; P = .13). In a subset of patients who demonstrated a change in distance traveled in 2 separate preoperative 6MWD measurements (average 18.5% increase in distance), there was a strong correlation with postoperative weight loss (r = 0.82; P = .02).

Conclusions: A demonstrated increase in 6MWD before surgery correlates strongly with early postoperative weight loss after laparoscopic sleeve gastrectomy. A multidisciplinary team that includes a physical therapist is useful in preparing bariatric patients for surgery.

Key Words: Bariatric surgery, 6-minute walk test, Sleeve gastrectomy, Weight loss.

INTRODUCTION

Obesity affects approximately one-third of adults in the United States, and weight loss surgery has proven to be an effective and durable treatment of morbid and severe obesity.[1,2] Whereas most individuals undergoing bariatric surgery have excellent weight loss and improvement of comorbidities, a subset of patients have disappointing weight loss outcomes or weight regain.[3] It is not clear which factors or characteristics separate those individuals who have postoperative results that are below those expected. Preoperative factors that predict postoperative weight loss success have been sought, with inconsistent results. It has been argued that preoperative weight loss is a proxy for patient motivation and that it predicts postoperative weight change. This rationale has been used by some centers to insist on a 10% total weight loss before surgery. However, the correlation between preoperative weight loss and postoperative success has been inconsistent and often contradictory.[4–7]

Both subjective and objective measures are in common use to evaluate specific functional ability, response to intervention, as well as more global functional capacity.[8,9] These measures are meant to provide further information to predict the safety of treatment intervention for a given individual and to predict perioperative morbidity. Several of these include the 2-minute, 6-minute, 12-minute walk tests, self-paced walk test, shuttle walk test, and the timed "up and go" test.[8–10] Of these, the 6-minute walk test (6MWT) was determined in a consensus statement to be an effective measure of functionality, and a measure of the response to medical intervention in patients with known heart or lung disease.[8] Considered to be reflective of "activities of daily living,"[10] we introduced the 6MWT as part of our preoperative workup for patients interested in bariatric surgery, as well as in the postoperative follow-up visit. In this study, we examined the change in 6MWD (the

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distance traveled in the 6MWT), and its correlation with postoperative morbidity and weight loss success.

METHODS

A prospective bariatric database was retrospectively reviewed after institutional review board approval was obtained. All patients evaluated for bariatric surgery were followed by a dedicated multidisciplinary bariatric team, which included a dedicated physical therapist. Patients were evaluated at least once at a variable time before surgery and at predetermined intervals after surgery. A complete history and physical examination were performed at each visit, including measurement of weight and body mass index. In addition, a 6MWT was performed, under the direct supervision of the physical therapist, at each outpatient visit, before and after surgery.

6-Minute Walk Test

The 6MWT was performed as described in the American Thoracic Society guidelines.[8] Briefly, the test was performed indoors, in the outpatient clinic building of the hospital. A 30-meter straight hallway was used, with a flat, hard floor. The floor was marked at 1-meter intervals along its length **(Figure 1).** The starting point and the turnaround point were marked with an orange cone. The patients were given clear generic instructions prior to starting the test, and they were given standard verbal encouragement at regular intervals throughout the test. Vital signs were monitored before and after the test, and total distance traveled was noted as the 6MWD (6-minute walk distance). Per protocol, those patients who did not feel well, or did not appear well, were instructed to stop. None of our patients needed to stop the test. A subset of patients had multiple evaluations prior to surgery. The 6MWD was determined at each of these visits, and the change in distance traveled was noted.

Surgical Procedure

Sleeve gastrectomy was performed by a single surgeon, as previously described.[11] Briefly, all operations were performed laparoscopically under general anesthesia. We used a 5-port technique, starting with division of the vascular supply to the greater curvature of the stomach. The gastrectomy was performed using an Echelon Flex stapler (Ethicon, Somerville, New Jersey) and started 6 cm proximal to the pylorus. The sleeve volume was calibrated over a 36-F endoscope. Patients were kept on a liquid diet for the first 2 postoperative weeks, after which they were advanced to a solid oral diet.

Figure 1. Hallway used for performance of 6-minute walk test. Hallway is 30-meters long, with 1-meter markings throughout its length (black arrows).

Statistical Analysis

The measure of linear correlation between variables was calculated using the Pearson correlation coefficient. A high correlation was determined for $r = 0.5$ to 1.0.

RESULTS

Of 100 patients who underwent laparoscopic sleeve gastrectomy, 31 patients also had a preoperative 6MWT. In this cohort, 30 patients (97%) were available for follow-up and a 6MWT after surgery. Of these, 80% were male with an average age of 52 years, and mean BMI of 46.9 kg/m^2 **(Table 1).** All patients had >1 obesity-related comorbid conditions: 37% were diabetic; 77% had hypertension; and 77% had a diagnosis of obstructive sleep apnea before bariatric surgery. Major complications were identified in 3 patients: 1 was converted to an open procedure for control of splenic bleeding during surgery; 1 patient had a

Table 1.
Demographic Data

n	30
Male/female, %	80/20
Age, yrs, mean	52
BMI, kg/m^2, mean	46.9
DM, %	37
HTN, %	77
OSA, %	77

Abbreviations: BMI, body mass index; DM, diabetes mellitus type 2; HTN, hypertension; OSA, obstructive sleep apnea.

postoperative leak; and 1 patient was readmitted due to nausea and vomiting.

The average postoperative follow-up period was 7 months (range 4–12 months) after sleeve gastrectomy, with an average percentage of excess weight loss (%EWL) of 45.7%. During the same follow-up period, the average 6MWD increased by 113.2 meters, from 390.3 meters before surgery to 503.5 meters after surgery (29% increase) **(Table 2).** There was a weak correlation between early postoperative weight loss and change in postoperative 6MWD ($r = 0.28$; $P = .13$). However, a subset of 7 patients demonstrated an increase of 18.5% (+72.1 meters) in 2 separate 6MWD evaluations prior to surgery (each evaluation separated by an average of 8.5 months). In these patients there was a strong correlation between preoperative change in 6MWD and postoperative weight change ($r = 0.82$; $P = .02$). Interestingly, this subset of patients had a %EWL of 38.7%, whereas the larger subset of patients (who did not show a preoperative improvement in 6MWD) had an average %EWL of 47.8%, although this difference was not found to be significant.

DISCUSSION

Morbidly obese patients being evaluated for bariatric surgery frequently have multiple comorbid conditions, limited mobility, and decreased exercise capacity. Obesity in and of itself disrupts the mechanics of mobility, favoring a more sedentary lifestyle and likely leading to a cycle of increased obesity and decreased mobility.[12] Bariatric surgery has proven to be an excellent modality for treatment of obesity and its related comorbid conditions, partly by disrupting this vicious cycle, as patients are able to incorporate exercise into their regular routine and significantly increase their functional capacity.[13,14]

We have used the 6MWT as a measure of functional capacity before and after surgery. This test has been used extensively in the medical literature to evaluate patients with known cardiopulmonary disease. Walking ability is an inexpensive, yet informative clinical test, providing data related to functional performance and quality of life. The 6MWT has been shown to be affected by obstructive lung disease, heart failure, arthritis, and neuromuscular disease, and it can suggest impaired activities of daily living in the elderly.[15] More recently, the 6MWT has been performed and followed in obese patients undergoing bariatric surgery. Vargas et al[16] demonstrated a 20% increase in distance of a 6MWT, in 67 patients, 3 months after Roux-en-Y gastric bypass, in a mostly young, female population. Meanwhile, Maniscalco et al[17] showed a weak correlation between 6MWD and BMI change in 15 patients, 1 year after laparoscopic adjustable gastric banding; this study was also performed in a young, female population.

In our study, we also noted an increase in 6MWD after bariatric surgery (sleeve gastrectomy in our study), but we failed to show a direct correlation between the change in 6MWD and change in BMI. This may be a reflection of our population being mostly male, older, and with multiple comorbid conditions. The vast majority of our patients also had obstructive sleep apnea, reflecting their overall cardiopulmonary status. However, to our knowledge, this present study is the first description of improvement in preoperative 6MWD—measured at different times as part of the bariatric evaluation before surgery—correlating with postoperative decrease in BMI. This may suggest that

Table 2.
High Correlation Between Improvement in 6MWD (Measured at 2 Separate Time-Points Before Surgery) and Postoperative Weight Change, After Laparoscopic Sleeve Gastrectomy

	Meters	Percentage of Change in 6MWD	%EWL (mean)	*r*	*P* Value
Δ 6MWD (after surgery vs. before surgery)	+113.2	+29	45.7	+0.28	0.13
Δ 6MWD (2 separate time-points before surgery)	+72.1	+18.5	41.3	+0.82	0.02

Abbreviations: 6MWD, 6-minute walk distance; %EWL, percentage of excess weight loss.

the distance traveled in the 6MWT (6MWD)—an easy to perform, inexpensive, and safe preoperative test—can predict postoperative weight loss success.

Improvement in 6MWD at different times throughout the preoperative period is a reflection of the intensive multidisciplinary support that also includes the participation of a physical therapist. This intensive support may result in a more physically fit patient presenting to bariatric surgery, but it also serves to teach prospective patients about effective physical activity and mobility that can then be incorporated in the postoperative period. The test being used as a measure of functional status before surgery is especially attractive in our patient population that is a mostly male, older cohort, with a high prevalence of obstructive sleep apnea and hypertension. As we have shown, it may also have predictive value for postoperative weight loss outcome and is useful for following patient progress postoperatively. We found, however, no correlation with postoperative morbidity.

Limitations of this study include a small population size and short duration of follow-up. However, our results do suggest that the 6MWD—a cheap and simple test to perform—may be a valuable tool in the multidisciplinary preoperative evaluation, and postoperative care, of the bariatric surgery patient. Further studies with larger numbers of patients and for longer terms follow-up are needed to elucidate the efficacy of this test in the bariatric patient.

CONCLUSIONS

A dedicated multidisciplinary team, including a physical therapist, is integral in preparing patients for bariatric surgery. A demonstrated improvement in 6MWD before surgery correlates with weight loss after bariatric surgery, in a mostly male population with multiple comorbid conditions.

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