

# Concerns during initiation of sleeve gastrectomy in a laparoscopic bariatric program: a single surgeon's initial experience and review of latest literature

## Abstract

**Introduction:** Among the existing weight-loss procedures, laparoscopic sleeve gastrectomy has gained increasing popularity in the past decade, due to its remarkable results concerning EWL and resolution of comorbidities. However, most of major concerns for a team initiating with sleeve gastrectomy, still remain as subjects of major controversy among authors.

**Aim:** to present a single surgeon's technique and initial results with laparoscopic sleeve gastrectomy and review the latest literature for main concerns of a novice team.

**Material:** Six patients aged 24-49years, underwent full preoperative workup, including history, physical examination, evaluation from cardiologist, anesthesiologist, as well as clinical dietician and pneumologist. A laparoscopic sleeve gastrectomy was offered as the most suitable bariatric procedure for 5 of the patients. One of the patients underwent a robotic-assisted technique.

**Results:** All 6 patients followed an uncomplicated course. All patients were assessed for leaks on postoperative day 2 by gastrographin swallow. One patient presented with high fever on postoperative day 4 and was readmitted. No leaks were noted in any of the patients.

**Conclusion:** Reinforcing the staple line during sleeve gastrectomy by suturing and glue is the routine followed by the authors. Robotics seem to facilitate sleeve gastrectomy, especially during challenging mobilization of the fundus near the spleen as well as during intracorporeal suturing.

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Savvas Hirides, Petros Hirides

Athens Medical Center, Greece

**Correspondence:** Savvas Hirides, Athens Medical Center, Greece, Email savashirides@gmail.com

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## Introduction

Among the existing weight-loss procedures, laparoscopic sleeve gastrectomy has gained increasing popularity in the past decade, due to its remarkable results concerning EWL and resolution of comorbidities. Also because it seems fast and easy and doesn't have the burden of often visits and adjustments as it used to be with the cases of gastric banding. However, most of major concerns for a team initiating with sleeve gastrectomy, still remain subjects of major controversy among authors. Our aim in this paper is to present a single surgeon's technique and initial results with laparoscopic sleeve gastrectomy and review the latest literature for main concerns of a novice team.

## Material

In 2007 the authors joined a fellowship program at an IFSO-accredited private clinic in Athens Medical Center, Greece with large experience in gastric banding, sleeve gastrectomy and robotic bariatric redo cases. In 2009 they became part of this clinical team and gained experience from 114 laparoscopic and robotic bariatric cases in the period 2009-2017. Based on this experience, the authors initiated their own bariatric program in the same institution, at first with adjustable gastric banding placement and band removals and then with sleeve gastrectomies.

Six patients aged 24-49years, underwent full preoperative workup, including history, physical examination, evaluation from bariatric surgeon, cardiologist, anesthesiologist, as well as clinical dietician

and pneumologist. A laparoscopic sleeve gastrectomy was offered as the most suitable bariatric procedure. One of the patients underwent a robotic-assisted laparoscopic sleeve combined with cholecystectomy. All patients signed an informed consent for the procedure. Two patients denied blood transfusion in the remote case of intraoperative bleeding due to religious reasons. Perioperative thromboprophylaxis is performed as a routine by our team using LMW heparin according to body weight.

## Surgical technique

Patient is positioned supine in steep anti-Trendelenburgh with pressure garments on the lower extremities. Entrance to the peritoneal cavity is achieved by means of an optiview trocar but in case of difficulty we usually use an open Hasson technique. A 5-port approach (5mm to 15mm) is routinely used. After exploration of the abdomen and reassessment of liver size, a constant distance of 6cm from the gastric pylorus is measured along the greater curvature. At this point, division of the gastrocolic ligament with laparoscopic ultrasonic scissors (articulated vessel sealer in robotic technique) takes place and entrance in the omental bursa is achieved. Following that, division of the short gastric vessels is initiated. This is usually more challenging as we move proximally towards the spleen and the angle of HIS. Most of the times the fundus is firmly attached to the upper pole of the spleen and procedure is most challenging at this point in the narrow, fatty operative field often anticipated in these patients. After mobilisation of the angle of HIS, recognition of the left crus and preservation of the blood supply of this area, we

move on with mobilisation of the pancreatic fold. After that, the anesthesiologist introduces a 36Fr bougie and we facilitate its course down to the pyloric opening. Through the right 12mm trocar we introduce the linear endoGIA stapler and initiate the firings guided by the bougie. This maneuver ensures that the sleeve will become narrow enough, without risk for stenosis; it is of great value when cutting near the angle of the stomach. We routinely use a battery-powered linear stapler (one green, one gold and three or four blue cartridges) which offers a stable and perfectly linear cut of the tissue. Gastric resection takes place carefully in order to avoid twisting of the staple line. The most proximal firing is performed along the angle of HIS while trying to protect the blood supply of the area. Following that, suture line reinforcement takes place starting proximally and moving distally along the cut margin of the stomach. Suturing is performed intracorporeally using a 3-0 continuous barbed suture and laparoscopic needle holders (articulated robotic needle holders in the robotic technique). In addition, fibrin sealant is spread over the reinforced line with a laparoscopic applicator. After that we check for leaks using two methods: first, we put the patient in Trendelenburgh position and fill the upper abdomen with normal saline. Then, we introduce air through the nasogastric tube while closing the distal stomach. After this test, we remove the air from the stomach and put methylene blue solution through the nasogastric tube while closing the distal stomach as a second test for possible leaks. The specimen is removed through the left 15mm incision with a 1.5cm extension of it. A negative-pressure Jackson-Pratt drain is routinely used for 7 days postoperatively. Typical cholecystectomy with ligation of cystic duct and cystic artery, and detachment of the gallbladder from the liver bed, was performed at the same setting in one of our patients (Figures 1-3).

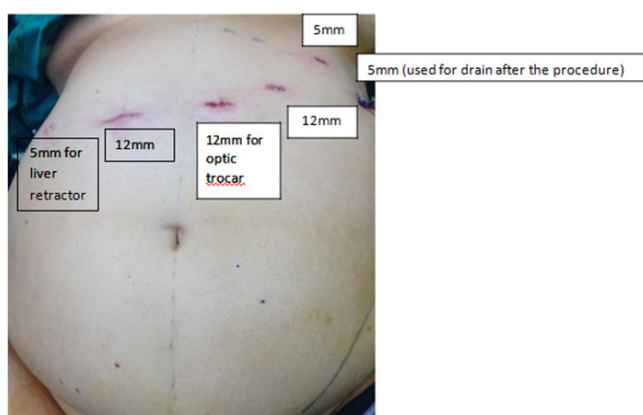


Figure 1 Positioning of trocars.

## Results

There were no intraoperative episodes of bleeding, any need for transfusion or any other intraoperative complication. In our first patient the firings near the gastroesophageal junction left a rather large proximal gastric pouch. This was managed by invaginating the excess tissue in the suturing line during oversewing. All 6 patients followed an uncomplicated postoperative course. They all underwent a gastrographin swallow on the 2<sup>nd</sup> postoperative day which confirmed the correct shape of the sleeve and excluded leaks and stenoses. No leaks were noted in any of the patients. Nasogastric tube was removed on day 2 and drain removed on postoperative day 7. Patients were discharged on postoperative days 3-5. One of our patients had a minor infection in the subumbilical incision. Another patient presented with fever on postoperative day 4. This led us to immediate readmission and CT scan with per os contrast medium. Although alarming, her fever was most probably related to transient upper splenic pole

ischemia, which was identified in CT. Fever subsided spontaneously within 24hours and the patient was discharged (Table 1). On follow up, all patients declared satisfied by the rate of weight loss, although one patient (a sweet eater) remained stable with her weight one year after surgery (Figure 4).

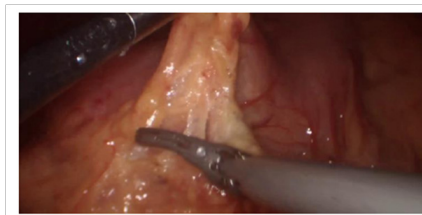


Figure 2a Opening gastrocolic ligament into omental bursa.



Figure 2b Division of short gastric vessels with ultracision.

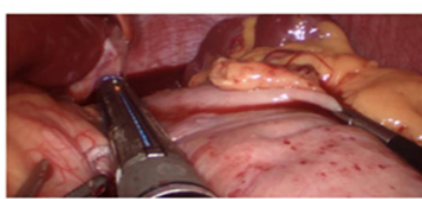


Figure 2c & 2d Division of stomach with the endoGIA linear stapler.

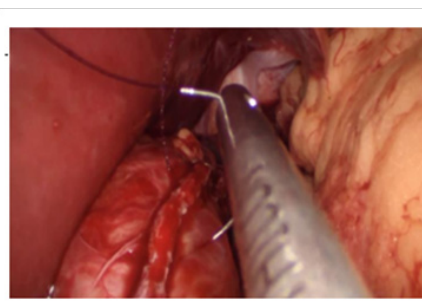


Figure 2e Oversewing the staple line.



Figure 2f Placement of Jackson-Pratt drain.

Figure 2 Basic steps of procedure.



Figure 3 Specimen.

Table 1 Initial personal LSG series. Preoperative and postoperative weights and BMIs and follow up summaries.

Patient	Age at OP	Initial BW	Initial Height	Initial BMI	Follow up	Current BW	Current BMI	Comorbidity Resolution	Complications	Dietary Modifications	Exercise	Other	Patient Satisfaction
#1	49	122	165	44.82	2 years	83	30.49	Joint pains and Sjogren symptoms improved	No vomiting.	Only amount. Quality of food remained the same. Sweet-eater. No changes during alcohol consumption	For short period after the operation. Stopped due to trigeminal neuralgia.	History of esophagitis. Developed gallstones postoperatively. Cannot tolerate junk food postop.	Very satisfied
#2	22	110	168	38.9	1,5 year	62	21.97	Less pain during menstruation.	Postop fever on DAY#4 – upper pole spleen ischemia		Requested avoidance of blood transfusion	No excess skin	Very satisfied
#3	23	147	190	40.7	1 year	89	24.6	Resolution of knee pains during first month. Resolution of high TG and Cholesterol levels.		Intolerance to alcohol.	Requested avoidance of blood transfusion	Fastest Weight Loss - 23 kg in first month. No excess skin	Very satisfied
#4	34	115	168	40.75	5 months	88	31.18	Borderline glucose and cholesterol levels corrected. Gastric ulcers prior to surgery.	Mild wound infection. 3 months of gastric pains and frequent vomiting after eating meat. Excess skin not remarkable.	Reduced carbs although she lives abroad and works really hard so diet is not always appropriate. Still eats a lot of snacks at work. No binge Eating anymore	Increased. Pilates reformer helped her Significantly.	She was enthusiastic about her clothes size: from 20-22UK to 12-14 (ie from XXL to MEDIUM)	Says she doesn't regret doing the operation. Wishes to have undergone it even earlier.

Table Continued....

Patient	Age at OP	Initial BW	Initial Height	Initial BMI	Follow up	Current BW	Current BMI	Comorbidity Resolution	Complications	Dietary Modifications	Exercise	Other	Patient Satisfaction
#5	35	150	172	50.84	14 months	122	41.35	Resolution of joint pains	Painful wounds for ten days postoperative.	Reduced junk food.	Increased		Very satisfied
#6	59	135	169	47.2	6 months	105	36.7	Resolution of glucose intolerance. Normalization of blood pressure	Vomiting during first 3 weeks	Reduced carbonated beverages	Increased	Robotic case (plus cholecystectomy)	Very satisfied



**Figure 4** Postoperative result 6 months after Sleeve (patient #3).

## Discussion and literature review

Sleeve gastrectomy was born out of the first phase of Marceau's BPD/DS operation, and from 1993 it was evolved by Michelle Gagner to an effective stand-alone bariatric procedure.

There are numerous studies comparing surgery for obesity to conservative measures. A new retrospective cohort study with a total of 33,540 patients, showed that bariatric procedures (including bands, sleeves and bypasses) were superior to conservative measures. Bariatric surgery was associated with significantly lower mortality rates from all causes, in a medium follow-up of 4.5 years.<sup>1</sup> All of the patients in our series had a history of failed attempts with conservative treatments prior to surgery.

### Effects of sleeve gastrectomy

Many recent publications reassess the miscellaneous effects of sleeve gastrectomy. A recent study from Tovar and Bozhychko shows the changes in frequency intake of food in patients undergoing sleeve gastrectomy under a strict dietary control. The authors concluded that problems with food which had been difficult to digest were solved 1 year after sleeve. Such foods were meat, bread, vegetables and

legumes. Patients in this study gradually decreased dairy products, pasta and rice developing intolerance to them. The decreased intake of unhealthy foods was attributed to strict counseling.<sup>2</sup> In our experience all of our patients felt 'obliged' to follow a healthy diet after the operation. Four of our patients decreased consumption of unhealthy foods. Two of our patients became very anxious not to regain weight and limited volume of meals as well.

An interesting paper from Acevedo and Eagon illustrated changes in alcohol consumption i.e. an increased blood alcohol concentration after roux-en-y gastric bypass and sleeve gastrectomy. The authors advocate that previous results based on breathalyzer are not considered valid.<sup>3</sup> Our patients did not notice any changes after alcohol consumption; but they also avoided it anyway. Works of Schiavo et al. tried to assess body composition and resting energy expenditure after sleeve gastrectomy. This subject is very important because loss of fat free mass after sleeve could change the weight maintenance and trigger sarcopenia, with all its related complications in the long term. The authors came to the conclusion that sleeve gastrectomy does not provoke excessive fat free mass depletion.<sup>4</sup> However a letter from Cecile et al. identified at least three methodological errors in the previous study rendering its conclusions incorrect.<sup>5</sup> As a result, it seems that the important topic of body composition alterations after sleeve gastrectomy needs further clarification with more studies. A study from St.Louis USA failed to show any difference in the taste perception and eating behavior induced from gastric bypass in comparison to sleeve gastrectomy. In contrast, both operations produced the same beneficial effects on the factors involved in regulation of eating behavior and hedonic part of taste perception.<sup>6</sup> Our patients did not describe any changes in taste perception.

Sleeve gastrectomy was compared to bypass in the SMBOSS randomized clinical trial. This trial, coming from multiple Swiss centers, with 107 gastrectomies and 110 bypasses showed no significant difference in excess weight loss between the two groups at five years of follow-up.<sup>7</sup> The Sleeve Pass randomized clinical trial showed that gastric bypass was associated with greater percentage of excess weight loss at 5 years, although the difference was not statistically significant.<sup>8</sup>

Effects of sleeve on comorbidities are also remarkable. Recently, Erol and coworkers demonstrated improvement of serum lipid levels including decreases in total cholesterol, LDL, triglyceride levels and an increase in HDL cholesterol levels.<sup>9</sup> Meanwhile, Huang and coworkers published that predicted coronary heart disease risk decreased after sleeve gastrectomy in 870 sleeve patients. Thus early

bariatric intervention for the high-risk groups is strongly recommended by the authors.<sup>10</sup> Our patients did not have increased risk of coronary heart disease but three of our patients had a significant improvement in serum cholesterol and triglyceride levels 6months postoperatively. As far as glycemic control and diabetes are concerned, data for benefits after sleeve gastrectomy are still conflicting, suggesting the need for further studies. Sista and associates studied the resolution of type 2 diabetes after sleeve gastrectomy as a two-step hypothesis. Ninety-one sleeve patients were assessed for insulin secretion, insulin resistance, plasma glucose levels and percentage of glycated hemoglobin. Sleeve was found to affect glucose homeostasis via two different time-related modes: first with hormonal changes and secondly with the percentage of excess weight loss as a determining factor for the end metabolic result.<sup>11</sup>

Compared to gastric bypass, sleeve exhibited similar effects on glycemic control despite lower GLP-1 levels and inferior BMI decrease.<sup>12</sup> Insulin resistance was improved while GLP-1 and Ghrelin was changed significantly in type 2 diabetes prior to weight loss in both groups. HOMA IR decreased to less than the cut-off value after 3months and it was close to complete remission. The main mechanism of action was remission of insulin resistance but dietary factors played also a significant role.<sup>13</sup>

## Technique

Technical aspects of sleeve gastrectomy procedure are often a matter of controversy among authors. Assessment of learning curves in a big study with 500 patients showed that the institutional learning process stabilisation point in a newly established bariatric center is between the 100 and 200 operation. Prior to this, morbidity rates were high, a fact that should raise concerns to surgeons willing to start performing their first sleeve gastrectomy cases without experienced guidance.<sup>14</sup>

Concerning the bougie size, a systematic review and meta-analysis from Wang and co-workers supports that bougie size should not exceed 36Fr. Some researchers support that bougie size below 32 Fr may increase the possibility of strictures.<sup>15</sup> Concerning the shape of sleeve, a study from Saleh showed a tendency for decreased reflux and improved weight loss in the lower pouch shape group, regardless of the calibration device.<sup>16</sup> Preliminary results from a randomized trial reported a global tendency for accelerated gastric emptying after sleeve, although there were no differences in weight loss in either antrum preservation or antrum resection groups.<sup>17</sup> Overswinging of the staple line is still a matter of great controversy, while in a recent study with 200 patients the staple line bleeding rate was significantly lower in the oversewing group of patients and the authors support the method as a non expensive and easy way to protect for bleeding, although it should be performed by an experienced surgeon to avoid the complications related to the seroserosotomy suturing.<sup>18</sup> In our experience, overswinging is greatly facilitated by the robotic system, if this is available in the institution. anagement of hiatal hernias during sleeve gastrectomy is still a matter of great debate among authors. Recent studies show that patients with hiatal hernia and reflux experience significant symptom improvement after cruroplasty with buttressing of the crurae during sleeve gastrectomy.<sup>19</sup>

## Innovations

Stapleless technique as a means of a more affordable alternative has been recently introduced by Mateo Catanzano.<sup>20</sup> Single port bariatric surgery needs further evaluation, although reproducible techniques have been already described.<sup>21</sup> Robotic surgery may offer

a future advantage in the setting of single port approaches, with its new intuitive single port platform coming up in the end of 2018. However use of robotics in bariatric surgery needs further evaluation in order to find its proper role. A recent systematic literature search included 16 studies with 29,787 cases. Use of the robot was associated with increased operative times and length of stay, while leakage, bleeding, infections and excess weight loss were comparable between the two groups. Costs have been found to be higher with the robotic approach.<sup>22</sup> Our experience shows that in centers with active robotic surgery program from other teams, the robot is very useful in bariatric cases because it facilitates work in narrow spaces, it overcomes the large liver and heavy abdominal wall lifting issues, and offers an ideal suturing platform for procedures involving intracorporeal suturing.

## Clinical considerations

Early discharge after sleeve is related to several factors both clinical and operative. Early operating room start times and treated obstructive sleep apnea positively influenced early discharge. In contrast preoperative opioid use, psychiatric illness, chronic kidney disease and revision cases were associated with delayed discharge.<sup>23</sup> Another study showed that BMI over 50 in sleeve gastrectomy patients compared to bypass was associated with increased risk of failure to discharge on day 1. In the same study early discharge on post-operative day 1 was safe and not associated with greater risk for readmission.<sup>24</sup> Our patients were all discharged between postoperative day 3 and 5.

## Complications

Concerning early complications, one of our patient had a minor infection in the subumbilical incision. Another patient presented with fever (38.3°) on postoperative day 4 and was readmitted. Fortunately, her fever was due to splenic arterial demarcation of the upper pole of spleen. Splenic arterial demarcation has been observed often during sleeve gastrectomy. In a study by Stamou et al.,<sup>25</sup> it was found to happen in 4.1% of patients. One of the 12 patients in this study raised temperature to 38.5 at the 7th postoperative day, was also readmitted and discharged on the 10th postoperative day. Splenic discoloration following sleeve is a very uncommon complication with minimal clinical significance which could be related to hematoma, venous congestion or ischemia. Splenic abscess cannot be ruled out. If splenic abscesses do occur, they should be treated with broad-spectrum antibiotics because they tend to be polymicrobial. Treatment for solitary abscesses tends to be percutaneous or laparoscopic (drainage) in order to preserve the spleen. Splenectomy is required only if these minimally-invasive options failed.<sup>26</sup> Delayed intrasplenic abscesses are very rare but bariatric surgeon should be aware of them as a potential complication. Exact causes are still unclear.<sup>27</sup> Portal mesenteric venous thrombosis is a very rare but fatal complication. It is very difficult to diagnose while presenting symptoms are usually non specific. Patients without previous risk factors can be anticoagulated for 3 to 6months.<sup>28</sup> Major complications such as bleeding, leakage and gastric stenosis occur in 5% of cases in large series. Risk of leakage is 2.1%, usually found in the upper part of the staple line. It is the second most common cause of death from sleeve, with mortality rates up to 0.4%.<sup>29</sup> No major complications in our series. Endoscopic internal drainage either by septotomy or pigtailed are discussed nowadays in the management of post sleeve fistulae. It is advised that septotomy should be performed at least one month after surgery. Although drainage is considered the first line of therapy, septotomy is a good option for treatment of organized collections or chronic fistulae.<sup>30</sup> Use of self expandable metal stents is the most popular endoscopic

management of post sleeve leaks. Double pigtail plastic stents have also been used with good results. The over-the-scope-clip-system is also a promising endoscopic approach for management of leaks with reported rates of success up to 86%. Stent migration and related ulcers are common after stent placement.<sup>31</sup>

## Conclusion

Numerous parameters have to be taken into account for every young surgeon introducing sleeve gastrectomy in his bariatric surgical program. For many reasons it is the most attractive bariatric procedure today. However, long learning curves have been described in the literature and one should always bear in mind that it may be associated with serious complications such as hemorrhage or leaks, even death of the patient. Reinforcing the staple line by suturing and glue as well as use of negative pressure drain is the routine followed by the authors. Robotics may facilitate sleeve gastrectomy, especially during challenging mobilization of the fundus near the spleen and during reinforcement of the staple line.

## Acknowledgements

None.

## Conflict of interest

The author declares no conflict of interest.

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