

Bipolar Coagulation versus Ultrasonic Dissection Devices in Laparoscopic Sleeve Gastrectomy

Ahmed A Sabry, Saleh MY

Department of Surgery, Faculty of Medicine, Alexandria University, Egypt

Laparoscopic sleeve gastrectomy (LSG) comprises the first choice for treating morbid obesity in many bariatric centers. In the era of modern laparoscopic techniques and minimally invasive surgery, tying and knots have a limited role. New devices as ultrasonic and electrothermal bipolar have evolved in order to achieve adequate haemostasis, tissue dissection and coagulation with reduced operating times. The aim of this study was to compare the usage of Ligasure as one of the electrothermal bipolar devices and Harmonic scalpel as one of the ultrasonic devices in devascularization of the greater curvature of the stomach during LSG as regard the operative time and intra-operative and postoperative complications. There were no statistically significant difference in the operative time and complications between both groups. The mean operative time in Ligasure group was 100.50 ± 15.95 minutes and in Harmonic group mean 97.71 ± 8.21 minutes. Both Ligasure and Harmonic provide the surgeon comfort, time saving, safety and efficacy in such a demanding operation. Choice between these two devices lies within the surgeon's preference.

Key words: Sleeve gastrectomy, bariatric surgery, Harmonic, Ligasure.

Introduction

Laparoscopic sleeve gastrectomy (LSG) was introduced by Gagner and colleagues¹ in 2000 as a first-step procedure to minimize surgical risk for super-obese or high-risk patients.^{1,2} Today, laparoscopic sleeve gastrectomy is gaining popularity because of its relative simplicity, the great results over the years, the less technical demands and the small learning curve. Sleeve gastrectomy comprises the first choice for treating morbid obesity in many bariatric centers.³

The operation begins with devascularization of the greater curvature of the stomach, with division of the short gastric vessels using one of vascular sealing devices. The most popular sealing devices are bipolar electrothermal and Ultrasonic dissection devices.

The electrothermal bipolar vessel sealing (EBVS) systems are a modification of the bipolar electrothermal technology developed in the 1940s. In 1984 a team of neurosurgeons from Sweden introduced a modification to reduce the inadvertent burning and charring produced by these systems.⁴ This was accomplished by incorporating a computer algorithm monitoring the impedance between the jaws of the instruments in real time. In 1998, a computer algorithm used to monitor the impedance in an instrument designed as clamp, this first EBVS system allowed for blood vessel of up to 7mm to be sealed.⁵ The instrument is usually designed as a clamp e.g.: Ligasure Atlas.

The basic working principle of ultrasonic surgical instruments, such as ultrasonically activated scalpel (UAS) is to use the low-frequency mechanical vibrations produced by the piezoelectric transducers embedded in the tools that convert the applied electrical energy to mechanical vibrations, which are then transferred to the active blades which induce protein denaturation by breaking down the hydrogen bonds in tissues due to the internal cellular friction caused by the vibrations for cutting or coagulation. The Harmonic scalpel is one of these devices which operates at a frequency of 55.5 kHz.⁶

Patients and methods

This study was carried out on 37 morbidly obese patients that were randomly divided in to two groups according to the type of the sealing device used. The Ligasure group contained 20 patients, while the Harmonic group contained 17 patients. All operations were performed under general anesthesia. Intra-operatively, we recorded the operative time, any difficulties and intraoperative complications such as bleeding, hematoma formation, leakage and organ injury. Postoperatively, all the patients were assessed postoperatively as regards the length of postoperative hospital stay, postoperative complications such as hemorrhage, hematoma formation, leakage, abscess formation, collection formation, fever $>38^{\circ}\text{C}$.

Results

The patients in this study were 37 patients. The

Ligasure group contained 20 patients, 17 females (85%) and 3 males (15%) aged from 19 to 55 years with mean 36.65 ± 10.10 years and the Harmonic group contained 17 patients, 12 females (70.6%) and 5 males (29.4%) aged from 22 to 49 years with mean 34.88 ± 8.07 years. In the Ligasure group the mean patients' BMIs was 50.55 ± 4.63 kg/m² and in the Harmonic group the patients' was mean 49.64 ± 5.74 kg/m².

The operative time in the Ligasure group ranged from 82.0 to 162.0 minutes with mean 100.50 ± 15.95 minutes and in the Harmonic group ranged from 85.0 to 120.0 minutes with mean 97.71 ± 8.21 minutes.

The time of devascularization of greater curvature in Ligasure group ranged from 19.0 to 35.0 minutes with mean 23.70 ± 3.50 minutes while in Harmonic group ranged from 17.0 to 25.0 minutes with mean 22.59 ± 2.27 minutes.

Almost all of the cases had no intraoperative complications except in 2 cases (10%) of the Ligasure group when we faced difficulty in devascularization of the gastrosplenic ligament that caused an injury to the splenic capsule, both were controlled by application of absorbable hemostat (Surgicel®). Regarding the intraoperative bleeding from the staple line we had (two cases of Ligasure group vs. one case of Harmonic group) all of them were controlled by clipping the staple-line. Regarding the hematoma formation we noted one case in each group that were controlled by suction irrigation then good hemostasis by the device itself. No intraoperative leakage was detected in both groups.

Postoperative complications were observed from day 1 till the patients were discharged from the hospital.

In Ligasure group one case suffered from bloody discharge from the abdominal drain about 300 cc which was managed by supportive measures with no need for exploration, another case suffered from leakage and intraperitoneal abscess formation which was managed by endoscopic mega stent insertion for the leakage with pigtail insertion in the collection, and two cases complained of low grade fever around 38.5°C. In Harmonic group there were no postoperative complications except two cases that suffered from fever around 38.5°C.

In Ligasure group the postoperative hospital stay ranged from 2.0 to 21.0 days with mean 3.90 ± 4.10 days and in harmonic group ranged from 2.0 to 4.0 with mean 3.0 ± 0.50

Discussion

Our results in this study are almost the same as the study of Tsamis et al³ in 2015 that compared the usage of the Ligasure and Harmonic scalpel in LSG that included 94 patients of which 37.2% were men and 62.8 % were women. Forty three of them were operated on using Ligasure and the other 51 patients were operated on using Harmonic scalpel.³ the total number of the our patients was 37 patients 8 of them (21.7%) were males and 29 (78%) were females, 20 patients were operated on using Ligasure and the other 17 patients were operated on using Harmonic scalpel.

In our Ligasure group the patients' mean BMI was 50.55 ± 4.63 kg/m² and in Harmonic group was 49.64 ± 5.74 kg/m², while in Tsamis et al³ the mean BMI in Ligasure group was 45.2 ± 8 kg/m² and in Harmonic group was 45.7 ± 6.07 kg/m².³

Our mean operative time in Ligasure group was slightly higher than Harmonic group (100.50 ± 15.95 vs 97.71 ± 8.21 min, $p=0.519$) which showed no significant difference. Overall our operative time is much higher than Tsamis et al³ which also did not significantly differ between both groups (45.0 ± 15.0 vs 40.0 ± 20.0 min, $p=0.199$).³

The difference in the mean operative time is most probably due to low BMI of the patients, the large number of cases and surgeons' experience in Tsamis et al³ study.

Overall intraoperative complications in our both groups showed no statistically significant difference (25% vs. 11.7% with $p=0.800$) as well as there was no significant difference in both groups as regard the post-operative complications (25% vs. 11.7% with $p=1.000$) This result is comparable to Tsamis et al³ study which also showed no statistically significant differences between these two devices. But a trend for more intraoperative complications was seen in the group operated on by Ligasure (32.6 vs. 15.7%, $p=0.054$), and a trend for more postoperative complications was revealed for Harmonic scalpel group (4.7 vs. 17.6 %, $p=0.051$).³ Overall our intraoperative and post-operative complications compared to those of Tsamis et al³ are summarized in **Table I**.

Table I Comparison between our study and the study of Tsamis et al³

Complications	Our Study			Tsamis et al		
	Ligasure	Harmonic	FE _p	Ligasure	Harmonic	FE _p
	No. (%)	No. (%)		No. (%)	No. (%)	
Intraoperative	5 (25%)	2 (11.7%)	0.800	14 (32.6%)	8 (15.7%)	0.054
Bleeding	2 (10%)	1 (5.9%)	1.000	10 (23.3%)	8 (15.7%)	0.353
Hematoma formation	1 (5%)	1 (5.9%)	1.000	2 (4.7%)	0 (0%)	0.207
Organ injury	2 (10%)	0 (0%)	0.489	1 (2.3%)	0 (0%)	0.999
Leakage	0	0 (0%)	-	1 (2.3%)	0 (0%)	0.457
Postoperative	5 (25%)	2 (11.7%)	1.000	2 (4.7%)	9 (17.9%)	0.051
bleeding	1 (5%)	0 (0%)	1.000	3 (5.9%)	0.247	0.247
Hematoma formation	0 (0%)	0 (0%)	-	0 (0%)	0 (0%)	-
Leakage	1 (5%)	0 (0%)	1.000	0 (0%)	0 (0%)	-
Abscess formation	1 (5%)	0 (0%)	1.000	1 (2.3%)	2 (3.9%)	0.999
Collection formation	0 (0%)	0 (0%)	-	0 (0%)	1 (2.0%)	0.999
Fever >38°C	2 (10%)	2 (11.8%)	1.000	1 (2.3%)	0.622	0.622

The issue of safety and efficacy of both devices is more studied in thyroid surgery and less in haemorrhoidectomy, but there are also few studies examining laparoscopic colectomies. In most of these studies comparing the two shears, there are no significant differences in complication rates, operative time, pain medication requirements and total cost.^{7,8} When both of these vessel sealing systems are compared with conventional thyroidectomy techniques, they display reduced operative time, less blood loss, smaller incision length, shorter length of hospital stay, less postoperative pain and similar complication rates.^{9, 10} A large meta-analysis from Garas et al. in 2013 revealed that Harmonic scalpel had lower risk for postoperative hypoparathyroidism than Ligasure, but both shears had recurrent laryngeal nerve paralysis more often than clamp-and-tie technique.⁷

In laparoscopic colorectal surgery, some non-randomized studies tended to show comparable results of Ligasure and Harmonic scalpel in complication rate and operative time.¹¹ Later, randomized studies like the one from Rimonda et al. with 140 consecutive patients failed to show a significant difference in terms of intraoperative and postoperative complications and operative time.¹² In fact, other studies as Campagnacci et al¹³ and Takada et al¹⁴ also failed to show clear advantages of Ligasure device over Harmonic scalpels in laparoscopic colorectal surgery.^{13,14}

Conclusions

In conclusion this prospective randomized study

failed to demonstrate any statistically significant advantage of the Ligasure or the Harmonic in laparoscopic sleeve gastrectomy in terms of operative time, and complications. Both Ligasure and Harmonic provide the surgeon comfort, time saving, safety and efficacy in such a demanding operation. Choice between these two devices lies within the surgeon's preference.

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