

# Clipless and Sutureless Laparoscopic Surgery for Adrenal and Extra-adrenal Tumors

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## ABSTRACT

**Background:** Newer, energy-based devices like the ultrasonic coagulator (Harmonic Scalpel, Ethicon Endo-Surgery, Inc., Cincinnati, OH) and the LigaSure vessel-sealing system (Valleylab, Boulder, CO) are increasingly being used in advanced laparoscopic procedures. Use of these devices has resulted in shorter operative time, less blood loss, and lower conversion rates. We present our experience with these devices for laparoscopic removal of adrenal and extra-adrenal tumors.

**Methods:** Ten patients with adrenal tumors and 4 with extra-adrenal tumors were operated on laparoscopically with the ultrasonic shears and LigaSure vessel-sealing system. The entire surgery was carried out using these energy-based devices without using any clips or sutures.

**Results:** No conversions were necessary. None of the patients experienced any major intraoperative or postoperative bleeding. The mean size of the tumor was 6.2 cm (range, 3 to 8). The mean operative time was 123 minutes (range, 80 to 210), and the mean blood loss was 70 mL (range, 10 to 150). Histopathology revealed pheochromocytomas in 7 patients.

**Conclusions:** Use of the LigaSure vessel-sealing device along with ultrasonic shears for laparoscopic removal of adrenal and extra-adrenal tumors is safe and effective.

**Key Words:** Laparoscopic adrenalectomy, Extra-adrenal tumor, Vessel sealing, Clipless.

## INTRODUCTION

Laparoscopic adrenalectomy, first reported by Gagner et al,<sup>1</sup> is the standard of care for management of adrenal diseases. Recent technological advances in the form of newer energy sources, such as ultrasonic shears and the vessel-sealing system, have made performance of such advanced laparoscopic surgical procedures safer. These devices have led to decreased operative blood loss and risk of thermal injuries compared with blood loss and thermal injuries with conventional electrocoagulation. They provide an excellent alternative to clips, sutures, and staplers, both during open and laparoscopic surgery. The vessel-sealing system is a bipolar system that uses thermal energy to permanently seal vessels, including 7 mm in diameter without dissection.<sup>2</sup> We report our initial experience with clipless and sutureless laparoscopic surgery using ultrasonic shears and the vessel-sealing system for removal of adrenal and extra-adrenal tumors.

## MATERIALS AND METHODS

Between March 2004 and May 2007, we operated on 10 patients who had adrenal tumors and 4 patients who had extra-adrenal tumors by using the laparoscopic ultrasonic shears and the LigaSure vessel-sealing system. Of the 10 patients with adrenal tumors, 8 had a mass in the right adrenal and 2 had in the left adrenal. There were 7 males and 3 females in the adrenal group. Three of 4 patients with extra-adrenal masses were males, and all 3 presented with hypertension. In 2 patients, the extra-adrenal tumor was located in the para-aortic region, inferior to the hilum of the left kidney. In the remaining 2 patients, the tumor was located in the pre-aortic and para-aortic regions. The demographic, clinical, and operative details of the patients are listed in Table 1.

Clinical features of pheochromocytoma were present in 10 of 14 patients. All patients underwent a detailed workup, including history, physical examination, laboratory evaluation, and estimation of 24-hour urinary catecholamines. Ultrasound, contrast enhanced computed tomography (CECT) and magnetic resonance imaging (MRI) were used as imaging methods for localization. Meta-iodo-benzyl-guanidine (MIBG) scans were also used in all the patients with suspected pheochromocytoma.

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**Table 1.**  
Clinical and Operative Data

Number of Patients	
Males	10
Females	4
Mean Age (Range)	30.7 years (range 8 to 60)
Adrenal Tumors	
Right	8
Left	2
Extra-adrenal Tumors	4
Pre-aortic	1
Para-aortic	1
Left renal hilum	2
Preoperative Diagnosis	
Pheochromocytoma	10 (7 adrenal and 3 extra-adrenal tumors)
Other	4
Mean Size (range)	6.2 cm (range 3 to 8)
Mean Operative Blood Loss (range)	70 mL (range 10 to 150)
Mean Operative Time (range)	123 min (range 80 to 210)
Conversions and Complications	None

The patients underwent laparoscopic surgery via a transperitoneal approach with the patient in the lateral position. Dissection was done using ultrasonic shears and the LigaSure vessel-sealing system. No clips or sutures were used during the entire surgery in any of the patients.

## RESULTS

Laparoscopic surgery was completed in all 14 patients. No conversions were necessary. Surgery could be completed in all the cases by using the energy devices—ultrasonic shears and the LigaSure vessel-sealing system. No clips or sutures were used in any of the procedures. The mean operative blood loss was 70 mL (range, 10 to 150). Blood loss could be defined as minimal (not requiring suction during the procedure; <10 mL), mild (infrequently requiring suction during the procedure; 10 mL to 50 mL), moderate (frequent suction during the procedure; 50 mL to 150 mL) and severe (>150 mL). Two patients had minimal blood loss, 9 had mild blood loss, and 3 had moderate blood loss. None of the patients had severe blood loss, and none required blood transfusion. The mean operative time was 138 minutes (range, 90 to 210).

Histopathological examination (**Table 2**) revealed pheochromocytoma in 7 patients, 6 with adrenal masses and one with an extra-adrenal mass. Of the 4 extra-adrenal tumors, one patient had pheochromocytoma, and the remaining 3 had benign nerve sheath tumors, though 2 of these patients had presented with hypertension and other clinical features of pheochromocytoma. Of 10 adrenal tumors, 6 turned out to be pheochromocytomas. The histopathological examination in other patients with adrenal tumors included cortical adenoma in 2 patients and angioliipoma in 1 patient. One adrenal specimen was found to be normal on final pathology. This young patient, a physician by profession, had clinical features of pheochromocytoma and an MIBG scan suggestive of adrenal pheochromocytoma. However, his 24-hour urinary catecholamines were normal. Moreover, the mass was small and of doubtful significance. The patient was extensively counseled before he opted for surgery.

Four patients with pheochromocytoma developed significant hypotension in the immediate postoperative period. They were kept overnight in an intensive care unit and treated with fluids and inotropic support. All patients had an uneventful recovery following surgery and were discharged from the hospital after an average postoperative stay of 2 days (range, 1 to 7).

## DISCUSSION

Since Gagner et al<sup>1</sup> performed the first laparoscopic adrenalectomy (LA) in 1992, this approach has been used extensively for the treatment of adrenal pathology and is considered the standard of care. The advantages of laparoscopy over the open approach have been discussed in a number of reports.<sup>3-5</sup> These include less pain, minimal blood loss, shorter operative time, faster recovery of bowel function, and reduced hospital stay. The surgery has been made easier by the introduction of newer energy sources for hemostasis like the LigaSure vessel-sealing system and ultrasonic coagulator.

The LigaSure system is a unique bipolar system that seals

**Table 2.**  
Postoperative Final Histopathological Diagnosis (n = 14)

Pheochromocytoma	7 (6 adrenal and 1 extra-adrenal)
Benign Nerve sheath tumor	3
Cortical adenoma	2
Angioliipoma	1
Normal	1

vessels up to 7 mm by application of precise pressure and thermal energy. It uses thermal energy to breakdown the elastin and collagen of the vessel wall leading to apposition of the vessel wall. This process operates under the control of a feedback mechanism and stops when the vessel gets completely sealed off. The seal is permanent and reliable. In experimental studies, this seal has been reported to have burst strength comparable to that of mechanical devices like clips and ligatures.<sup>2</sup>

During laparoscopic adrenalectomy, control of adrenal veins requires precise dissection and isolation before clips can be applied. During this process, these fragile veins may get avulsed and lead to troublesome bleeding and probable conversion. Moreover, clips are prone to dislodgement during operative manipulation. The use of the LigaSure vessel-sealing system does not require isolation of the adrenal veins. Moreover, it produces a seal of partially denatured protein with no risk of dislodgement as the lumen of the vessel gets obliterated.

We used the LigaSure system in 10 patients with adrenal tumors and 4 patients with extra-adrenal tumors. In most patients, ultrasonic shears were also used for initial dissection followed by the use of the vessel-sealing system. All tumors were removed laparoscopically by using the transperitoneal approach with the patient in the lateral position. The retroperitoneal approach for removal of adrenal tumors at our institution including pheochromocytomas has been described.<sup>2,6,7</sup> However, we prefer the transperitoneal approach for laparoscopic removal of larger tumors. One of the extra-adrenal tumors located inferior to the left renal vein was removed by using a novel transperitoneal, transmesocolic approach without mobilization of the left colon.<sup>8</sup> No conversions were necessary in our series. The conversions during laparoscopic adrenalectomy are mainly due to uncontrollable bleeding, large tumor size, and periadrenal fibrosis. The blood loss in our series ranged from 10 mL to 150 mL. Thus, there was no case with excessive bleeding, and the use of the LigaSure device and harmonic shears played an important role in minimizing blood loss.

Only 2 reports in the literature<sup>9,10</sup> describe the use of the LigaSure vessel-sealing device during laparoscopic adrenalectomy. In both of these studies, the LigaSure device was the sole instrument used for hemostasis. In a series of 23 laparoscopic adrenalectomies in which the LigaSure device was used, the reported operative time was 57 minutes (range, 30 to 75) for unilateral adrenalectomy.<sup>9</sup> However; the average size of the adrenal mass in this series was 4 cm. The higher operating time in our series

(mean, 138 minutes) can be attributed to the fact that the average size of the adrenal tumors was 6.2 cm and that half of the cases were pheochromocytomas. These tumors tend to be larger and more vascular. Another reason for longer operating time for pheochromocytomas is that the surgery has to be frequently halted due to intraoperative blood pressure fluctuations. Similar results have been reported for pheochromocytomas in a series of 100 cases of laparoscopic adrenalectomy.<sup>11</sup> The average tumor size and the operative time for pheochromocytomas in this series were 6.3 cm and 2.5 hours, respectively. The mean operative time for the whole group was 123 minutes (range, 80 to 210).

There are a number of reports on the use of the LigaSure system for laparoscopic splenectomy (LS).<sup>12-16</sup> Romano et al<sup>12</sup> reported less blood loss and a lower conversion rate in 10 patients who underwent splenectomy performed with this device. Only one case was converted. The average blood loss reported was 80 mL. No clips or sutures were used in this series. The authors concluded that use of the LigaSure device results in less blood loss, lower operative time, and increased safety when used for splenectomy. Moreover, compared with the ultrasonic coagulator, endostapler, and even clips if disposable clip applicator is used, it is more cost-effective.<sup>12</sup> Gelmini et al<sup>13</sup> reported that use of the LigaSure vessel-sealing system is associated with less operative time and increased safety. In their series of 63 consecutive patients who underwent laparoscopic splenectomy (LS), the conversion rate was 7.9%, which was mainly due to hilar bleeding. The mean operative blood loss was 65 mL. The LigaSure vessel-sealing system was the only instrument used for hemostasis. According to the authors, the low operative blood loss was mainly attributable to the use of this bipolar vessel-sealing system.

The LigaSure system has also been used for several other thoracic and abdominal procedures, both open and laparoscopic.<sup>17-22</sup> Its use has been reported for nephrectomy, donor-nephrectomy, colectomy, adrenalectomy, hepatic resection, hysterectomy, and appendectomy.

## CONCLUSION

The LigaSure vessel-sealing system has made surgery easier to perform with a decrease in operating time. It also leads to a lower conversion rate, possibly as a result of decreased bleeding.

Various factors contribute to the efficacy of the LigaSure vessel-sealing system. The device effectively seals the ves-

sels ranging from 1 mm to 7 mm. The instrument is not only effective for sealing blood vessels; it can be used for dissection as well. Thus, its use leads to less exchange of instruments during surgery. The precise feedback control mechanism ensures minimal lateral spread of energy, limited to less than 1.5 mm beyond the area of application. In obese patients with fat around vessels, individual dissection, and isolation of blood vessels is not required, which can minimize the chances of their avulsion and troublesome bleeding. There is minimal charring and neuromuscular stimulation. The contraindications for using the vessel-sealing system are few and include a large vein on the right side.

Based on our initial experience, we feel that newer energy devices like ultrasonic shears and the LigaSure vessel-sealing system are useful tools that facilitate safe laparoscopic excision of adrenal and extra-adrenal tumors. Their use during these advanced laparoscopic procedures leads to reduced blood loss, shorter operating time, and a lower conversion rate.

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