

# Advanced Sealing and Dissecting Devices in Laparoscopic Adrenal Surgery

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## ABSTRACT

**Objectives:** This study sought to analyze the impact of advanced sealing/dissecting devices on operative and postoperative outcomes in laparoscopic adrenalectomy.

**Method:** Patients were divided into three groups according to the devices used during their procedures [electrothermal bipolar vessel system (EBVS), ultrasound shears (US), and monopolar electrocautery (ME)]. A comparison of the perioperative outcomes was performed.

**Results:** Conversion rates and intraoperative and postoperative complication rates did not differ among the three groups. Major blood loss that required transfusion was registered in only two cases, all of which were performed with ME. Procedures with EBVS were shorter than those with US or ME. For left adrenalectomies only, operative times were similar for US and EBVS. The use of EBVS was found to be an independent predictor of decreased operative time.

**Conclusion:** The use of advanced sealing devices was associated with reduced operative time, with particular benefits in left adrenalectomy. EBVS and US may provide better hemostasis than ME.

**Key Words:** Surgical hemostasis, Laparoscopy, Adrenal-ectomy, Postoperative complications, Instruments.

## INTRODUCTION

Laparoscopic adrenalectomy has become the gold standard approach to treat a broad spectrum of adrenal diseases. Since its first introduction in 1992,<sup>1</sup> several advanced dissecting devices that would have helped the surgeon reduce operative time, postoperative complication rates, and possibly costs have been introduced.

Several papers analyze the impact of new devices broadly in all fields of general surgery.<sup>2,3</sup> However, only a few studies have been published on the influence of new technologies in laparoscopic adrenalectomies; all of them were characterized by a small number of cases.<sup>4-10</sup> In addition, a single analysis comparing the two most commonly used advanced devices with the standard laparoscopic sealing/dissecting instruments has never been conducted.

In this context, we focus attention on the use of new sealing devices with the aim of conducting a simple and useful analysis of their impact on operative and postoperative outcomes in laparoscopic adrenalectomy.

## MATERIALS AND METHODS

From a prospectively collected adrenal database we performed a retrospective analysis of all patients submitted to unilateral adrenalectomy from July 2002 to January 2012 in a tertiary university institution.

Patients were divided into three groups according to the device used during the procedure. Those included electrothermal bipolar vessel system (EBVS), ultrasound shears (US), and monopolar electrocautery (ME). Then, we compared the groups' operative and postoperative outcomes.

Intraoperative complication was defined as any adverse event that occurred at the time of surgery; postoperative complication was defined as any adverse event within the first 30 days from the date of surgery.

The lateral transabdominal approach was used in all patients. An absorbable hemostatic clip was used for the adrenal vein in all cases. All the procedures were performed or assisted by the same expert surgeon. Low-

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pressure pneumoperitoneum (8 mm Hg) was routinely adopted. A drain was always placed at the end of the procedure and removed after 48 hours. Patients were encouraged to full mobilization and free eating on the first postoperative day.

**Statistical Analysis**

Each continuous variable with normal distribution was presented as mean and 95% confidence interval (95% CI) of the mean. Not normally distributed continuous variables were presented as median and interquartile range (IQR). Normality of the distribution of variables was determined using the D’Agostino–Pearson test. ANOVA or Kruskal–Wallis test, when appropriate, was used to compare continuous variables among the three groups. In addition,  $\chi^2$  test was used to compare categorical variables. Multiple regression analysis in a stepwise manner was carried out to identify independent predictor variables of operative time. This was performed considering only the subgroup of cases free from intraoperative complication or conversion to laparotomy. All tests were two-sided. Statistical analysis was performed with statistical software for biomedical research (MedCalc Software for Windows version 10.2.0.0, MedCalc Software, Ostend, Belgium).

**RESULTS**

Demographics and detailed patients’ characteristics are described in **Table 1**.

Overall, the mean age of the study population was 51.8 years (CI 95% 49.8–53.7, range 19–83 years). The male/female ratio was 1:1 (85 female vs. 80 male), and it was comparable among the three groups (**Table 1**). Likewise, ASA score, BMI, and the percentage of patients who had undergone previous upper abdominal surgery were similar among the study groups (**Table 1**). A significantly higher number of left-sided adrenalectomies were performed in the EBVS and in the US group if compared with the ME group (59.6% vs. 65.2% vs. 42.2%,  $P < .001$ ). The size of the tumor was comparable among the three groups (**Table 1**), and the median for all cases was 3.4 cm (IQR 2.2–4.75 cm, range 0.5–14 cm). In terms of preoperative diagnosis, a significantly lower percentage of aldosteronoma was found in the EBVS group.

Overall conversion rates and intraoperative and postoperative complication rates were 6%, 6.6%, and 2.4%, respectively, and they did not differ among the three groups (**Table 2**). Major blood loss requiring transfusion was registered in only two cases in the ME group (**Table 2**). Operative time was the only outcome variable that was significantly different among the three groups; all the

**Table 1.**  
General Characteristics of the Patients Included in the Study

	EBVS	US	ME	P Value
Patients	52	23	90	
Sex (%) Female	28 (53.8)	10 (43.4)	47 (52.2)	.5
Age mean (range)	51.2 (22–83)	52.3 (41–74)	51.8 (19–76)	.7
ASA mean (range)	2 (1–3)	2 (1–3)	2 (1–3)	.6
BMI median (IQR <sup>a</sup> )	26 (22–28)	29 (26–34)	28 (25–31)	.2
Previous upper abdominal surgery (%)	5 (9.6)	2 (8.7)	12 (13.3)	.7
Side (%) left	31 (59.6)	15 (65.2)	38 (42.2)	.04
Size median (IQR <sup>a</sup> )	3.5 (2.3–5.5)	3.5 (2.5–4.7)	3.1 (2–4.6)	.2
Adrenal-sparing resection (%)	5 (9.6)	2 (8.69)	4 (4.4)	.45
Aldosteronoma (%)	9 (17.3)	8 (34.7)	34 (37.8)	.04
Pheochromocytoma (%)	11 (21.1)	4 (17.4)	14 (15.5)	.7
Cortisol-producing adenoma (%)	9 (17.3)	4 (17.4)	12 (13.3)	.8
Metastasis (%)	5 (9.6)	3 (13)	10 (11.1)	.9
Incidentaloma (%)	18 (34.6)	3 (13)	21 (23.3)	.1

<sup>a</sup>IQR: Interquartile range (numerical difference between the 25th and 75th percentile).

**Table 2.**  
Operative and Postoperative Data

	EBVS	US	ME	P Value
Patients	52	23	90	
Operative time (min) median; IQR <sup>a</sup>	95 (68.75–120)	110 (105–130)	120 (100–153.75)	.04
Blood loss requiring transfusion (%)	0 (0)	0 (0)	2 (2.22)	.3
Conversion (%)	3 (5.8)	2 (8.7)	5 (5.5)	.8
Intraoperative complications (%)	4 (7.7)	2 (8.7)	5 (5.5)	.8
Postoperative complications (%)	1 (1.9)	1 (4.3)	2 (2.2)	.8

<sup>a</sup>IQR: Interquartile range (numerical difference between the 25th and 75th percentile).

**Table 3.**

Multiple Regression Analysis of Factors Influencing the Operative Time

Independent variables <sup>a</sup>	Coefficient	Standard Error	t	P
Use of EBVS	-24.3640	7.7066	-3.16	.0022
Metastasis	34.3779	16.9984	2.02	.0466

<sup>a</sup>Variables not included in the model in a stepwise manner: age, sex, BMI, side, size of the tumor, previous upper abdominal surgery, aldosteronoma, pheochromocytoma, incidentaloma, cortisol-producing adenoma, parenchymal-sparing adrenalectomy, use of monopolar electrocautery, and use of ultrasonic shears.

procedures performed with EBVS were shorter than those performed with US or EC (95 minutes vs. 110 vs. 120 minutes,  $P = .04$ ).

This was confirmed by multiple regression analysis of operative time conducted on all cases in which no intraoperative complications occurred or conversions to laparotomy were required: in particular, the use of EBVS was found to be an independent predictor of decreased operative time (**Table 3**). In the same analysis, metastasis was demonstrated to be a predictor of longer procedure (**Table 3**).

## DISCUSSION

Adequate hemostasis and delicate tissue dissection are two main requirements for safety and efficiency in all kinds of surgery. Despite the demonstration of monopolar as a safe and effective device in major laparoscopic procedures,<sup>11</sup> advanced dissecting devices are now commonly used by most surgeons. The first paper analyzing the outcomes of new dissecting devices in laparoscopic adrenalectomy was published by Valeri et al<sup>4</sup> 10 years

after the first description of the technique by Gagner et al.<sup>1</sup> In that retrospective analysis of 91 patients, the authors reported a shorter operative time when the procedure was performed with new ultrasonic shears than with the traditional electric hook (92 minutes vs. 125 minutes,  $P = .0001$ ).<sup>4</sup>

In 2008, Guerreri et al<sup>5</sup> published a prospective study about the comparison between EBVS and ultrasonic shears (assisted by monopolar high-frequency) in laparoscopic adrenalectomy in a cohort of 50 patients. The authors demonstrated a significant difference in operative time only for left-sided adrenalectomies and overall decreased blood losses in the EBVS group.

The most recent article published about new hemostatic devices in laparoscopic adrenalectomy was conducted in 2010 by Sartori et al.<sup>6</sup> They reported their experience of 46 patients undergoing laparoscopic adrenalectomy with EBVS or US: the authors failed to demonstrate any differences in the outcomes between the two groups and concluded that hemostatic device choice is up to surgeon's preference.<sup>6</sup>

In this study we report postoperative outcomes similar to those in the literature. In our series the use of US seemed not to affect operative time when compared with other modalities, nor did it have any effect in singular comparison with ME (110 vs. 120,  $P = .2$ ). Nevertheless, in the present study, the operative time in US group was comparable with those reported in the literature.<sup>6</sup> Valeri et al<sup>4</sup> reported a significantly reduced operative time with the use of US, but this might be due to their rare use of hemostatic clips for the adrenal vein.

Moreover, in this study, among only left adrenalectomies, operative time was similar between US (median 105 minutes; IQR 82.5–117.5 minutes) and EBVS groups (median 90 minutes; IQR 67.5–117.5 minutes) ( $P = .36$ ), but it

significantly decreased when US was compared with ME (median 132 minutes; IQR 105–176 minutes) ( $P = .01$ ). Conversely, among right adrenalectomies, the results were similar to those of the overall study population.

Interestingly, Rieder et al,<sup>12</sup> analyzing a cohort of 163, showed that the mean operative time for a right-sided laparoscopic adrenalectomy was significantly shorter than that for the left-sided. On this basis, our results add further indications for the use of advanced dissecting devices in case of left-sided laparoscopic adrenalectomy.

It must be highlighted that the study groups in our study were not comparable according to the number of laparoscopic adrenalectomies performed for aldosteronoma. We believe this difference did not affect the results. On the contrary, it might reinforce the concept that the use of EBVS is associated with shorter procedures: in our series, in fact, aldosteronoma ( $n = 51$ ) was associated with smaller masses (median 1.65 cm, IQR 1.15–2.50 cm), and it was the only adrenal tumor in which we did not register any conversions to laparotomy.

We were unable to formally demonstrate the superiority of advanced sealing devices in achieving better hemostasis compared with monopolar electrocautery. Nevertheless, in our opinion, EBVS and US guarantee a safer and more accurate dissection than EC. We believe that at least two cases of postoperative bleeding requiring transfusion might have been avoided with the use of advanced devices. One case required reoperation due to severe hemorrhage from a tiny periadrenal vessel in the perirenal fat, which occurred in the first postoperative day after a right laparoscopic adrenalectomy performed with the diathermy hook. We surmise that in this particular case an advanced sealing device, with its ability to seal small vessels without dissection or isolation, would have helped to avoid such a complication. The second patient required a conversion to laparotomy for a splenic injury and subsequent transfusions for postoperative bleeding. In this case, EBVS and US might have achieved an effective dissection with less tension on the surrounding tissues minimizing trauma for adjacent organs.

In the literature there are several articles confirming the superiority of these new devices in terms of hemostasis in most surgical fields.<sup>2,3</sup> Regarding laparoscopic adrenalectomies, Guerrieri et al<sup>5</sup> published the only study demonstrating reduced blood loss with the use of an advanced sealing device; the other reports<sup>7–10</sup> are only single series, without comparisons of standard hemostatic techniques, but significant blood loss was not registered in any of them.

Our study demonstrated also that metastasis is a predictive factor for longer procedures. This finding was confirmed by a recent article published by our group.<sup>13</sup> However, to evaluate the performance of the instruments in standard cases accurately, our analysis was limited to those patients who did not have intraoperative complications or conversions to laparotomy.

In the case of intraoperative complication, no significant difference in operative times was seen between the study groups: the median was 235, 280, and 180 minutes in the US, EBVS, and ME groups, respectively ( $P = .16$ ).

Research has already demonstrated that short operative time, which is linked to the use of advanced dissecting devices in laparoscopic adrenalectomy, is associated with decreased costs to the institution.<sup>4</sup> In our study we did not assess the specific costs associated with the different procedures, but in our opinion the cost–benefit analysis performed by Valeri et al<sup>4</sup> can be applied similarly to our data.

The limits of this article are all related to its retrospective nature; a randomized clinical trial, as has already been carried out in other fields of general surgery,<sup>2,12,14</sup> would help to finally demonstrate the superiority of advanced sealing devices over standard hemostatic techniques in laparoscopic adrenalectomy.

We are aware that the surgeon may be a confounding factor effecting bias in this study. However, all the procedures were performed or directly assisted by the chief surgeon (TGAM) who was already experienced in the technique at the beginning of the study. In addition, our endocrine surgery team has remained constant throughout the study period. We therefore believe that the impact of this variable on the outcomes, if present, is minimal.

In conclusion, we have demonstrated that the use of advanced sealing devices is associated with a reduced operative time, with particular benefit in left adrenalectomies. The specific use of EBVS in standard operations was found to be a predictor of shorter procedures as shown by multiple regression analysis. Moreover, both EBVS and US might guarantee better hemostasis when compared with ME.

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