

# Transumbilical laparoendoscopic single-site adrenalectomy: A feasible and safe alternative to standard laparoscopy

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**Summary** Objectives: Standard multi-port laparoscopic adrenalectomy (LA) is considered the gold standard for benign adrenal tumors. Single-site LA has been proposed as a feasible and safe alternative because of lower invasiveness, improved cosmetics, less pain and shorter hospital stay. The objective was to evaluate and compare results of single-site transumbilical laparoendoscopic adrenalectomy with standard LA for adrenal tumors.

Materials and methods: One hundred consecutive adrenalectomies from 93 patients, performed between March 2009 and June 2017, were laparoscopically excised: 59 by standard multi-port LA (group 1) and 41 by transumbilical laparoendoscopic single-site adrenalectomy (group 2). Data gathered included demographics, comorbidities, preoperative imaging, tumor characteristics, perioperative data, surgical complications, pathology and follow-up. IBM SPSS Statistics 23 software was used and  $p$  value  $< 0.05$  was considered significant.

Results: Patients of group 2 were younger ( $48.7 \pm 13.9$  versus  $59.7 \pm 15.1$  years;  $p < 0.001$ ) and had fewer comorbidities ( $p < 0.05$ ). Mean tumor diameter in group 2 was lower than those of group 1 ( $27.52 \pm 14.3$  versus  $47.9 \pm 30.6$  mm;  $p < 0.001$ ). Tumor laterality did not influence the choice of technique nor the surgical morbidity. All procedures were successfully completed, although one standard LA needed conversion to open surgery. Mean operative time, hemorrhagic losses, postoperative opioid analgesic requirement and hospital stay were not statistically different between groups. Most patients in group 2 (31 patients, 85.4%) did not require drainage, compared to 14 (25.4%) patients of group 1 ( $p < 0.001$ ). Patients who underwent single-site LA resumed normal diet earlier ( $1.0 \pm 0.2$  versus  $1.6 \pm 0.7$  days;  $p < 0.001$ ). There were no reoperations and no perioperative mortality. Overall mean follow-up time was  $94.9 \pm 3.1$  months, not statistically different between groups ( $p = 0.7$ ).

Conclusions: Our results revealed that transumbilical approach for laparoendoscopic single-site adrenalectomy for adrenal tumors is a feasible and safe alternative to standard laparoscopic adrenalectomy.

**KEY WORDS:** Standard multi-port laparoscopic adrenalectomy; Laparoendoscopic single-site surgery; Partial adrenalectomy.

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## INTRODUCTION

The first laparoscopic adrenalectomy was performed by Gagner *et al.* (1) in 1992 and, since then, it has become the gold standard procedure for most adrenal tumors.

Standard multiport laparoscopic adrenalectomy (LA) involves the use of typically three to five ports, depending on the complexity of the procedure. Nowadays, laparo-endoscopic single-site surgery (LESS) is exciting the scientific community because it offers the opportunity to do major laparoscopic surgery with no visible scars and with potential reduced postoperative pain and hospital stay (2). LESS has been used for cholecystectomy (3), appendectomy (4) and several urological surgeries (5), but the high degree of difficulty and the longer learning curve tends to make its widespread difficult. LESS surgery through the umbilicus is the most appealing approach, as it truly avoids any new scar, with the multichannel port being placed through a 1.5 to 2 cm incision at the deep edge of the obliterated embryonic orifice. Partial adrenalectomy has been a promising surgical technique mainly in functioning lesion in a solitary adrenal gland or in bilateral hereditary or sporadic tumors with the goal of reducing endocrinopathy. However, it has a relapse risk that we always have to remember (6).

Here, we present our experience with transumbilical LESS adrenalectomy comparing with standard multiport laparoscopic multiport, showing our results with partial adrenalectomy too.

## MATERIAL AND METHODS

Between March 2009 and June 2017, 100 adrenal glands from 93 patients underwent transperitoneal laparoscopic adrenalectomy at the Urology and Renal Transplantation Department of Coimbra University Hospital Center: 59 (59%) underwent standard multi-port laparoscopy (group 1) and 41 (41%) underwent transumbilical laparoendoscopic single-site adrenalectomy (group 2). Standard multi-port laparoscopy included three to four ports. The multichannel port (*Triport*) and bent laparoscopic instruments were supplied by Olympus Surgical (KeyMed House, Stock Road, United Kingdom).

The multichannel port was placed through a 2-cm incision at the inner edge of the umbilicus and a bent instrument on the left hand was used to create the operative angle. In 30% of cases, it was needed a forceps with no port to move the liver away from the operative field. All transumbilical laparoendoscopic single-site adrenalectomy

tomies were executed by one surgeon while standard LA were performed by more than one surgeon. Data gathered included demographics, comorbidities, preoperative imaging, tumor characteristics, perioperative data, surgical complications, length of stay, need for analgesia, pathology and follow-up. All patients were evaluated by the Endocrinology team with a standard protocol. Written informed consent was obtained from all patients and the study was performed according to the Declaration of Helsinki. Data were collected retrospectively and processed with IBM SPSS Statistics 23 software. Groups were compared using the chi-square test and t Student test for categorical and continuous variables, respectively. Survival analysis was done through Kaplan-Meier survival curve. Statistical significance was set at p value of < 0.05, and all reported p-values are two-sided.

**RESULTS**

Patient demographic data are shown in Table 1. Patients elected for transumbilical LESS adrenalectomy were younger and with less comorbidities.

Preoperative tumor data are shown at Table 2. The laterality of the lesion didn't have any impact in the choice of the surgical technique. 52.5% of the cases submitted to standard multi-port LA were incidentally diagnosed non-functioning enlarged adrenals. In group 2, arterial hypertension was the main initial symptom and elevated aldosterone was the most common finding. Only 24.4% of the tumors submitted to transumbilical LESS adrenalectomy were non-functioning.

Perioperative data are shown in Table 3. There was no difference between groups concerning operative time and estimated blood loss. 29.3% of transumbilical LESS surgeries were partial adrenalectomies: no one was done by standard multi-port laparoscopy. Seven (7%) patients were submitted to bilateral adrenalectomies, two by multi-port LA and five by transumbilical LESS technique. Drainage was placed in a minority of cases submitted to transumbilical LESS technique while the majority of patients submitted to standard multi-port laparoscopy underwent drainage placement. One case of multi-port LA was converted to open surgery due to the

**Table 1.**

*Demography and comorbidities between groups. Group 1: patients submitted to standard multi-port laparoscopy adrenalectomy. Group 2: patients submitted to transumbilical approach for laparoendoscopic single-site adrenalectomy.*

Demographic data	Group 1	Group 2	P-value
Patients (n)	57 (61.3%)	36 (38.7%)	
Number of adrenal glands	59 (59%)	41 (41%)	
Age at surgery (years)	59.7 ± 15.1	48.7 ± 13.9	p < 0.001
Sex			NS (p: 0.8)
Male	39.0%	36.6%	
Female	61.0%	63.4%	
Cardiovascular disease	20.3%	2.4%	p: 0.013
Diabetes mellitus type 2	27.1%	7.3%	p: 0.02

NS: Non-significant.

**Table 2.**

*Preoperative tumour data between groups. Group 1: patients submitted to standard multi-port laparoscopy adrenalectomy. Group 2: patients submitted to transumbilical approach for laparoendoscopic single-site adrenalectomy.*

Tumor data	Group 1 (n = 57)	Group 2 (n = 36)	P-value
Laterality			NS (p: 0.6)
Left	61.0%	61.0%	
Right	39.0%	39.0%	
Presentation			p: 0.02
Incidental	52.5%	31.7%	
Arterial hypertension	35.6%	39.0%	
Cushing disease	5.1%	24.4%	
Metastasis	0%	2.4%	
Pain	6.8%	2.4%	
Functioning adenoma			p: 0.01
Yes	50.8%	75.6%	
No	49.2%	24.4%	
Produced hormone			p: 0.002
Non-functioning	49.2%	24.4%	
Aldosterone	11.9%	34.1%	
Catecholamines	28.8%	14.6%	
Cortisol	8.5%	26.8%	
DHEA	1.7%	0%	
Mean imaging diameter on CT (mm)	47.9 ± 30.6	27.52 ± 14.3	p < 0.001
Mean imaging diameter on CT > 40 mm	56.4%	15.2%	p < 0.001
Maximum diameter (mm)	120	80	

DHEA: Dehydroepiandrosterone; NS: Non-significant.

**Table 3.**

*Comparison of perioperative data between groups. Group 1: patients submitted to standard multi-port laparoscopy adrenalectomy. Group 2: patients submitted to transumbilical approach for laparoendoscopic single-site adrenalectomy.*

Perioperative data	Group 1 (n = 57)	Group 2 (n = 36)	P-value
Partial adrenalectomy			p < 0.001
Yes	0%	29.3%	
No	100%	70.7%	
Bilateral adrenalectomy			NS (p: 0.06)
Yes	3.6%	14.3%	
No	96.4%	85.7%	
Operative time (min)			
- Unilateral adrenalectomy	93.1 ± 42.1	87.9 ± 46.4	NS (p: 0.9)
- Bilateral adrenalectomy	82.5 ± 17.6	111 ± 36.8	NS (p: 0.09)
Estimated blood loss (mL)	34.9 ± 152.6	23.6 ± 87.7	NS (p: 0.4)
Drainage tube			p < 0.001
Yes	74.6%	14.6%	
No	25.4%	85.4%	
Need to convert to open surgery	1.8%	0%	NS (p: 0.4)
Perioperative complications	3 diaphragm injuries 1 postoperative retroperitoneal hematoma	0	NS (p: 0.1)
Postoperative opioid analgesic requirement			NS (p: 0.2)
Yes	44.1%	31.7%	
No	55.9%	68.3%	
Hospital length of stay (days)	3.2 ± 2.5	2.5 ± 1.4	NS (p: 0.09)
Time to resume normal diet (days)	1.6 ± 0.7	1.0 ± 0.2	p < 0.001

NS: Non-significant; Postop: Postoperative.

**Table 4.**

Pathological data between groups.

Group 1: patients submitted to standard multi-port laparoscopy adrenalectomy.

Group 2: patients submitted to transumbilical approach for laparoendoscopic single-site adrenalectomy.

Tumor data	Group 1	Group 2	P-value
Mean pathological diameter (mm)	42.4 ± 27.2	26.50 ± 16.3	p < 0.001
Adenoma	41.4%	48.8%	p: 0.04
Benign pheochromocytoma	20.7%	12.2%	
Malignant pheochromocytoma	6.9%	2.4%	
Intermediate pheochromocytoma	1.7%	2.4%	
Cortical hyperplasia	0%	17.1%	
Carcinoma	10.3%	4.9%	
Myelolipoma	6.9%	0%	
Metastatic lesion ab initio	1.7%	4.9%	
Ganglioneuroma	0%	2.4%	
Cavernous hemangioma	1.7%	0%	
Cyst	3.4%	0%	
Undetermined	5.2%	4.9%	

**Table 5.**

Characteristics of the tumours submitted to transumbilical partial LESS adrenalectomy.

Tumor data	Value
N	9
Laterality	
Left	41.7%
Right	58.3%
Bilateral	
Yes	55.6%
No	44.4%
Presentation	
Cushing disease	41.7%
Arterial hypertension	33.3%
Incidental	25%
Functioning adenoma	
Yes	100%
No	0%
Produced hormone	
Cortisol	58.3%
Aldosterone	41.7%
Mean Imaging diameter on CT (mm)	21.8 ± 10.3
Mean Imaging diameter on CT > 40 mm	0%
Pathological data	
Adenoma	50%
Cortical hyperplasia	41.7%
Unknown cause	8.3%
Operative time (minutes)	100.4 ± 31.3
Hemorrhagic losses < 200 cc	100%
Need of drainage	25%
Resume to normal diet (days)	1 ± 0.1
Hospital length of stay (days)	2.8 ± 1.4
Reoperation; Perioperative complications; Relapse	0
Improved or normalized arterial pressure	88.8%
Postoperative need for replacement medical therapy	16.7%
Follow-up (months)	17.4 ± 10.6

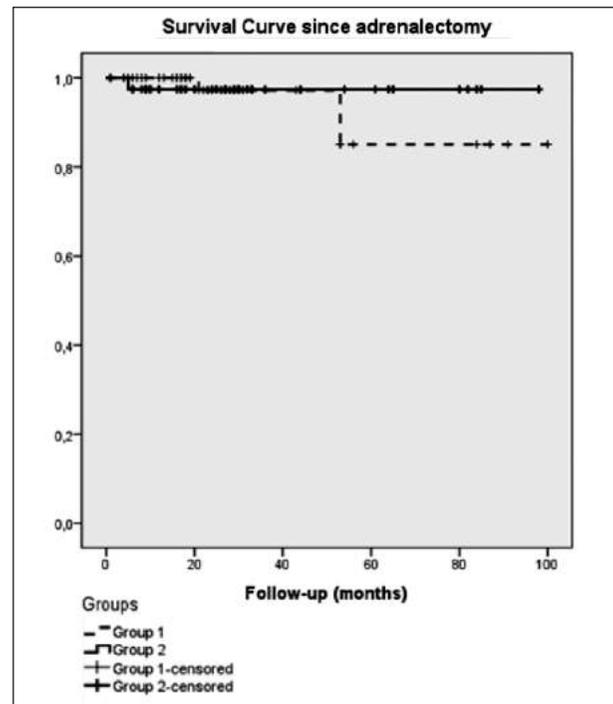
absence of surgical plans in a lesion that revealed to be posteriorly a melanoma metastasis. There were four perioperative complications, all of them during or after a standard multi-port laparoscopic adrenalectomy. There was no difference concerning postoperative opioid analgesic requirement and hospital length of stay. The hospi-

**Figure 1.**

Survival curves between groups.

Group 1: patients submitted to standard multi-port laparoscopy adrenalectomy.

Group 2: patients submitted to transumbilical approach for laparoendoscopic single-site adrenalectomy.



tal length of stay was mainly conditioned by medical or hormonal issues more than the surgery itself. However, the time to resume normal diet was lower in group 2. There were neither reoperations nor perioperative mortality and the tumor laterality did not influence surgical morbidity (p > 0.05).

Transumbilical LESS technique allowed for a completely hidden scar in all cases, with excellent cosmesis.

The final pathology is shown in Table 4. The mean pathological diameter was inferior in the group 2 and, in both groups, benign adenoma was the most common diagnosis. In the next table (Table 5), there is a brief summary on our experience with partial adrenalectomy. All of them were submitted to transumbilical LESS technique and all lesions were hormone producing. More than half were bilateral and presented mostly with symptoms of Cushing disease and arterial hypertension. The pathological data revealed mainly adenoma and cortical hyperplasia.

Overall mean follow-up time was 94.9 ± 3.1 months (group 1 = 92.1 ± 5.7 months versus group 2 = 95.6 ± 2.4 months with no statistically difference between groups, p = 0.7), as shown in Figure 1.

## DISCUSSION

Laparoendoscopic single-site adrenalectomy is a minimally invasive surgical technique that is being increasingly used. Transumbilical route offers the opportunity to remove the adrenal gland or only the adrenal tumor with only one hidden incision. Therefore, the level of patient with the scar cosmetics is expected to be better.

Wang *et al.* (7) concluded that laparoendoscopic single-site adrenalectomy caused less postoperative pain, albeit, requiring a longer surgical time (55-206 minutes). Other positive factors in favor of laparoendoscopic single-site adrenalectomy are reduced length of hospital stay and improved postoperative aesthetics (8). Jeong *et al.* (9) compared transumbilical LESS with standard LA to remove a benign adrenal adenoma and concluded that there were no differences concerning operative time, estimated blood loss and hospital stay but the sample was only nine patients.

Our results showed that transumbilical approach for laparoendoscopic single-site adrenalectomy for adrenal tumors is a feasible and safe alternative to standard laparoscopic adrenalectomy: operative time, hemorrhagic losses, postoperative opioid analgesic requirement and hospital stay were similar, yet normal diet was resumed earlier. More standard LA cases were drained, but this difference to transumbilical LESS may have been promoted by a stronger focus on cosmetics.

The coordination between the surgeon and assistant is vital for this procedure to avoid clashing of instruments with the camera: for that reason, bent instruments were used for the left surgeon hand, along with a flexible camera. Operative time was the same for the two techniques, but patient selection could be a bias to the analysis: patients submitted to laparoendoscopic single-site adrenalectomy were typically younger, with less comorbidities and with lesions of adrenal gland with a smaller diameter. The rate of perioperative complications and the need for conversion to open surgery was zero in the laparoendoscopic single-site adrenalectomy and only one case of the standard multi-port laparoscopic adrenalectomy need conversion due to absence of surgical safer plans. Again, patient selection is extremely important to choose the laparoscopic approach instead of the open approach.

The high degree of difficulty and the alleged longer surgical learning curve makes this surgical approach only feasible for experienced laparoscopic surgeons. In our institution, a single urologist performed the transumbilical laparoendoscopic single-site adrenalectomies and standard laparoscopic adrenalectomies were executed by several urologists. The reduced drainage need and the faster recovery of normal diet in transumbilical LESS adrenalectomies could be biased for that reason.

LESS approach can be implemented in partial adrenalectomy (10). We started to do partial adrenalectomy and all of them were done by transumbilical LESS technique and all were hormonal active adrenal tumors. During the last years, partial adrenalectomy has been accepted for adrenal tumors in unilateral glands or in patients with hereditary syndromes. Our experience is limited, the follow-up is short to see if there is any relapse and only two patients are not corticoid-free of medical therapy. Partial adrenalectomy is especially done in Conn's syndrome and in pheochromocytoma. In our series, no pheochromocytoma was submitted to partial adrenalectomy probably because of the multifocal nature of the disease that could explain the relatively high recurrence rate in hereditary pheochromocytoma (10) and for that reason we did not perform partial adrenalectomies in these patients. Nagaraja *et al.* (6) found that the overall recurrence rate was 8% and 85% of the patients were steroid-free. In our series, no relapse

was found and 83.3% of patients did not need any substitutive therapeutic after surgery. More experience and more time are needed to evaluate if this technique could be a good alternative to total adrenalectomy. Although LESS partial adrenalectomy may be a well-tolerated and feasible procedure to reduce endocrinopathy, studies proving long-term outcome and controlled trials are missing: earlier publications suggested that only one-third of one gland is sufficient to avoid hormonal deficiency (6).

## CONCLUSIONS

Transumbilical approach for laparoendoscopic single-site adrenalectomy for adrenal tumours could be a good alternative to standard laparoscopic adrenalectomy. Our results showed similar perioperative data, less drainage, quicker return to normal diet and with no reoperations or perioperative mortality.

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