

Single-port Laparoscopic Left Adrenalectomy (SILS): 3 Years' Experience of a Single Institution

Óscar Vidal, MD, PhD, Emiliano Astudillo, MD, PhD,
Mauro Valentini, MD, PhD, Cesar Ginestá, MD, Juan J. Espert, MD, PhD,
Juan C. Gracia-Valdecasas, MD, PhD, and Laureano Fernández-Cruz, MD, PhD

Background: Laparoscopic adrenalectomy by 3 or 4 trocars is a well-established procedure. This report describes the initial experience with single-incision laparoscopic surgery (SILS) using the transperitoneal approach for left adrenalectomy.

Methods: Between April 2010 and January 2013, all consecutive patients with adrenal masses who agreed to undergo SILS adrenalectomy were included in a prospective study. The left 2.5 cm subcostal incision was the sole point of entry. Data of patients undergoing SILS adrenalectomy were compared with those from an uncontrolled group of patients undergoing conventional laparoscopic adrenalectomy during the same study period.

Results: There were 40 patients in each study group. SILS was successfully performed and none of the patients required conversion to an open procedure. In 1 case of SILS procedure, an additional lateral 5 mm port was needed for retraction of the kidney. The mean (SD) duration of the operation was 80 (20) minutes in the SILS group and 75 (8) minutes in the conventional laparoscopic adrenalectomy group ($P = 0.150$). No intraoperative or postoperative complications occurred. Differences between the 2 study groups in postoperative pain, number of patients resuming oral intake within the first 24 hours, final pathologic diagnosis (Conn syndrome, Cushing adenomas, nonfunctioning adrenal tumors), and length of hospital stay were not observed.

Conclusions: SILS left adrenalectomy is a technically feasible and safe procedure in carefully selected patients and seems to have results similar to a conventional approach in our initial comparison.

Key Words: 1-trocar adrenalectomy, laparoscopic single-site surgery (LESS), single-incision laparoscopic surgery (SILS), laparoscopic adrenalectomy, transumbilical access

(*Surg Laparosc Endosc Percutan Tech* 2014;00:000–000)

Laparoscopic adrenalectomy is a feasible and safe surgical option that has been progressively used as an alternative procedure to open removal of the adrenal glands. After the first report of laparoscopic adrenalectomy in 1992, laparoscopic surgery for benign adrenal tumors has become the gold standard of treatment.^{1,2} The benefits of less-invasive surgery

compared with open surgery have led to wide acceptance of laparoscopic adrenalectomy among surgeons and patients.^{3,4}

Single-incision laparoscopic surgery (SILS) in which only 1 incision is made has received increasing attention in recent years and is an area targeted for intensive investigation in abdominal surgery. Other approaches such as natural orifice transluminal endoscopic surgery (NOTES) may represent the final frontier for the minimally invasive revolution surgery without incisions. A number of advantages have been proposed for SILS, including better cosmesis as multiple scars are avoided,^{5–7} less incisional pain, minimization of port-related morbidity,⁸ and the ability to convert to standard multiport laparoscopic surgery if needed.

However, since its first description in 2008,⁵ the single-port laparoscopic adrenalectomy is still limited by the surgical team's adrenal and laparoscopic experience.

We here described our initial experience with SILS left adrenalectomy. The objective of this study was to assess the safety and feasibility of SILS left adrenalectomy using a novel method of establishing single access through existing instrumentation with the addition of the SILS Procedure Kit Plus Components (Covidien, Norwalk, CT) and to compare with standard multiport left adrenalectomy.

PATIENTS AND METHODS

Between April 2010 and January 2013, a total of 141 patients (85 left and 56 right adrenal tumors) were operated upon. Forty patients with functional and nonfunctional adrenal masses admitted to the General & Endocrine Surgery Unit of Hospital Clínic i Provincial, in Barcelona (Spain), who agreed to undergo SILS left adrenalectomy, were included in a prospective study. For comparison purposes, the same number of patients with adrenal tumors undergoing standard multiport adrenalectomy were also prospectively selected. These patients were also consecutively recruited during the 32-month study period. Exclusion criteria were as follows: bilateral adrenal surgery, partial adrenalectomy, concomitant combination with other procedures, and preoperative diagnosis of pheochromocytoma.

All patients were fully informed about the characteristics of the SILS procedure and other surgical options, including open adrenalectomy and standard laparoscopic adrenalectomy, as well as the possibility of requiring conversion to an open procedure or standard laparoscopic adrenalectomy at the time of operation. The study was approved by the Ethics Committee of our institution. Written informed consent was obtained from all the participants.

Surgical Procedure

All patients followed the same preoperative protocol, with antibiotic prophylaxis before operation. All SILS and

Received for publication August 5, 2013; accepted April 15, 2014.

From the General and Endocrine Surgery Unit, Department of General and Digestive Surgery, Digestive Diseases and Metabolism Institute, Hospital Clínic i Provincial, Universitat de Barcelona, Barcelona, Spain.

The authors declare no conflicts of interest.

Reprints: Oscar Vidal, MD, PhD, General and Endocrine Surgery Unit, Department of General and Digestive Surgery, Digestive Diseases and Metabolism Institute, Hospital Clínic i Provincial, Universitat de Barcelona, Villarroel 170, 9th stair, 4th floor, E-08036, Barcelona, Spain (e-mail: ovidal@clinic.ub.es).

Copyright © 2014 by Lippincott Williams & Wilkins

conventional laparoscopic operations were performed by the same experienced laparoscopic surgeons.

Operation was performed under general anesthesia and the patient was placed in the flank position, with the left side elevated 70 degrees. The surgical strategy followed the conventional transperitoneal laparoscopic adrenalectomy.⁹ The surgeon stood on the patient's right side, and the assistant stood on the right side of the surgeon, with the monitor placed on the opposite side. To perform the conventional laparoscopic left adrenalectomy, we usually use 3 trocars (one 12 mm for the camera and two 5 mm trocars to insert the instruments); the only difference with SILS is that in this case we reduced the number of incisions from 3 to 1, and we put the SILS-port device up through an approximately 2.5 cm subcostal skin incision in the place of the port site that contains the camera. The technique included 3 access ports inserted into the device to obtain a good visualization of the surgical field, and 2 working pipes that can be used with conventional laparoscopic instruments and flexible instruments from SILS Procedure Kit Plus Components (Covidien). A 30-degree 5 mm laparoscope was used for inspection of the abdominal cavity. The instruments used included 5 mm graspers (Roticulator EndoGrasp, Roticulator Endo Dissect; Autosuture, Ascot, UK), flexible scissors (Roticulator Endo MiniShears; Autosuture), and pencil-grip handle hook electrocautery (Endopath Surgery Probe Plus-II; Ethicon Endo-Surgery, Cincinnati, OH). In this technique, all instruments (including the laparoscope) must be parallel and closely introduced through 1 small hole; this fact reduces motion possibilities and the surgeon has to be adapted to an eventual crossing of instrument shafts at the point of entry into the abdominal cavity. This crossing increases the difficulty of surgical dissection compared with conventional laparoscopic surgery.

The steps to perform the operation are the same for both approaches. The Toldt line was initially incised from the splenic flexure of the colon down to the sigmoid junction; the left colon was then reflected medially. The pancreatic tail and spleen were carefully separated. The Gerota fascia was incised, and the adrenal vein connected to the renal vein was identified, clipped using 5 mm Endoclip III (Covidien), and sealed using ALTAS-Ligasure.

A total adrenalectomy was performed using ALTAS-Ligasure without difficulty. The specimen was retrieved through the abdominal incision. The fascia and subcutaneous tissue were closed with 2-0 and 3-0 Vicryl (Ethicon Inc.) interrupted suture, respectively. Then skin closure was completed with a running subcuticular 3-0 Prolene suture.

Assessment

For all patients, the following variables were recorded: demographics (age, sex), date of admission to the hospital, clinical features, duration of operation (min), intraoperative complications, scar length, estimated blood loss, transfusion requirements, postoperative complications, postoperative pain on day 1 using a 10 cm visual analogue scale (VAS) options ranging from 0 (no pain) to 10 (worst pain imaginable), time of starting oral diet, length of hospital stay, and final pathologic diagnosis (Table 1).

Statistical Analysis

Data of patients undergoing SILS and patients undergoing conventional multiport left adrenalectomy were compared. The χ^2 test was used for the comparison of categorical variables, and the Mann-Whitney *U* test was

TABLE 1. Comparison of Demographic and Surgical-related Variables Between the SILS and the Conventional Laparoscopic Adrenalectomy Groups

Data	Surgical Procedure		P
	SILS Adrenalectomy	Conventional Laparoscopic Adrenalectomy	
Patients (n)	40	40	
Men/women	15/25	10/30	NS
Age [mean (range)] (y)	43 (33-78)	47 (32-70)	NS
Duration of operation [mean (range)] (min)	80 (30-125)	75 (30-100)	NS
Blood loss (< 10 mL) [n (%)]	10 (100)	10 (100)	NS
Conversion to open surgery	None	None	NS
Intraoperative complications	None	None	NS
Postoperative complications	None	None	NS
Postoperative pain, VAS, median (25th-75th percentile)	3 (2-6)	3 (3-7)	NS
Oral intake after surgery (< 24 h) [n (%)]	40 (100)	40 (100)	NS
Length of hospital stay [mean (range)] (d)	3 (2-4)	3 (2-3)	NS
Pathologic diagnosis			
Conn syndrome	18	12	NS
Cushing adenomas	15	15	NS
Nonfunctioning adrenal tumors	16	14	NS

NS indicates not significant; SILS single-incision laparoscopic surgery; VAS, visual analogue scale.

used for continuous variables. Statistical significance was set at $P < 0.05$.

RESULTS

A total of 80 patients (30 men and 50 women) with adrenal diseases underwent laparoscopic left adrenalectomy. Forty patients (15 men and 25 women) were included in the SILS group, and the remaining 40 (10 men and 30 women) in the conventional multiport laparoscopic group. The mean age (SD) of the study population was 46 (9.5) years. All the patients were classified as belonging to the American Society of Anesthesiology (ASA) class II. The mean duration of operation was 80 (20) minutes (range, 30 to 125 min) in the SILS group and 75 (8) minutes (range, 30 to 100 min) in the conventional laparoscopic group ($P = 0.150$). The estimated blood loss in both the study groups was minimal. The operation was successfully completed for all patients and conversion to open surgery was not required. In 1 patient undergoing the SILS procedure, the use of additional lateral 5 mm port was needed for retraction of the kidney, and in another patient in the conventional multiport procedure, the use of an additional lateral 10 mm port was necessary for safe clipping of the adrenal vein using 10 mm Endoclip III (Covidien).

Pathologic examination of the resected specimens demonstrated nonfunctioning adrenal tumors in 30

patients, Conn syndrome in 20 patients, and Cushing adenomas in 30 patients.

The median (25th to 75th percentile) VAS for postoperative pain intensity was 3 (range, 2 to 6) in the SILS adrenalectomy group and 3 (range, 3 to 7) in the conventional laparoscopic group. All patients resumed oral intake within the first 24 hours after surgery. The mean length of hospital stay was similar in both study groups, with a mean of 3 (1) days in the SILS group and 3 (1) days in the conventional laparoscopic group.

There were no intraoperative or postoperative complications.

DISCUSSION

The advantages of laparoscopically performed operations in comparison with the same procedures performed through an open approach has led to an increasing interest for developing lesser invasive procedures,^{10–12} as well as in reducing the size of laparoscopic instruments for an evolving field in which suitable instruments were lacking. Unlike NOTES, which faces obvious hurdles in safety¹³ and reproducibility, single-incision laparoscopy is ready for widespread implementation. SILS adrenalectomy can already be implemented and promising results with this procedure have been recently reported.^{14–16}

Different studies describing adrenalectomy have been published in the literature. Many of them report single-access retroperitoneoscopic adrenalectomy.^{17–20} Some authors consider that the retroperitoneal approach is more challenging to learn than the transabdominal anterior or flank approach and that there is a higher possibility for surgeons to become disoriented.²¹ However, the retroperitoneoscopic route may be a better option in patients with previous abdominal surgery.²²

The evaluation of postoperative cosmetic outcomes is a challenge, because of the absence of a reliable objective scale. The combination of multiple contributing factors, potential observer bias, and variations in patients' expectations contributes to difficulties in assessing cosmetic outcomes. It has been suggested that the ideal access for various SILS operations should be through the umbilicus.^{7–9,23} For transabdominal SILS adrenalectomy, Castellucci et al⁵ reported the first single-access laparoscopic transabdominal left adrenalectomy using 3 ports introduced through a supraumbilical incision. Jeong et al²⁴ described a synchronous bilateral LESS adrenalectomy using the umbilicus as a sole point of entry. Recently, different authors have reported that a single-site insertion placed in a subcostal suprapubic localization improves accessibility to the viscera,^{14,25,26} although with the disadvantage of less satisfying cosmetic results. In the technique described here, the single-skin umbilical incision is substituted by an incision in the subcostal region. By making a 2.5 cm incision following the Langer's lines, an excellent cosmetic result with mild postoperative pain was obtained. The transumbilical approach is cosmetically more attractive for the patient, but it implies a greater challenge for the surgeon in the case of a large organ or a heavily built patient.²⁷

The results obtained in the present clinical series of 40 patients undergoing SILS left adrenalectomy are comparable to those reported for laparoscopic adrenalectomy.²⁸ In our study, the mean duration of operation in the SILS group was 80 (20) minutes, not significantly higher than 75 (8) minutes in the conventional laparoscopic adrenalectomy and agree

with the figures reported in other series.^{9,16} From our point of view, the SILS approach does not seem to be more complex than multiport laparoscopic adrenalectomy. Our conversion to open surgery rate (0%) is slightly lower than 2.5% and 7.0% reported by others,⁹ and is consistent with a recent experience of Walz and Alesina.¹⁸

Blood loss was negligible in both groups (< 10 mL) and none of the patients required blood transfusion. In relation to postoperative pain on day 1, the median VAS of 3 for SILS and 3 for conventional laparoscopy is similar to 3 reported by others.²⁴ In contrast, oral intake was initiated within the first 24 hours in all patients and the mean length of hospital stay of 3 days is also in agreement with the expected duration of hospitalization for this group patients.

In summary, SILS left adrenalectomy is a technically feasible and safe procedure in carefully selected patients and seems to have results similar to conventional approach in our initial comparison. However, further studies are necessary to clearly identify the risks and benefits of this promising approach to adrenalectomy.

ACKNOWLEDGMENT

The authors thank Covidien Spain, S.L., for logistic support, and to Marta Pulido, MD, for editing the manuscript.

REFERENCES

- Gagner M, Lacroix A, Bolté E. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. *N Engl J Med*. 1992;327:1033.
- Smith CD, Weber CJ, Amerson JR. Laparoscopic adrenalectomy: new gold standard. *World J Surg*. 1999;23:389–396.
- Hansen P, Bax T, Swanstrom L. Laparoscopic adrenalectomy: history, indications, and current techniques for a minimally invasive approach to adrenal pathology. *Endoscopy*. 1997; 29:309–314.
- Herd A, Harman R, Taylor E. Surgical outcomes following laparoscopic adrenalectomy for treatment of Conn's syndrome (primary hyperaldosteronism) between 1999 and 2006. *N Z Med J*. 2010;123:50–56.
- Castellucci SA, Curcillo PG, Ginsberg PC, et al. Single port access adrenalectomy. *J Endourol*. 2008;22:1573–1576.
- Cuesta M, Berends F, Veenhof A. The "invisible cholecystectomy": a transumbilical laparoscopic operation without a scar. *Surg Endosc*. 2007;22:1211–1213.
- Vidal O, Valentini M, Espert JJ, et al. Laparoendoscopic single-site cholecystectomy: a safe and reproducible alternative. *J Laparoendosc Adv Surg Tech A*. 2009;19:599–602.
- Vidal O, Valentini M, Ginestà C, et al. Laparoendoscopic single-site surgery appendectomy. *Surg Endosc*. 2010;24:686–691.
- Zacharias M, Haese A, Jurczok A, et al. Transperitoneal laparoscopic adrenalectomy: outline of the preoperative management, surgical approach, and outcome. *Eur Urol*. 2006;49:448–459.
- Kaouk JH, Haber GP, Goel RK, et al. Single-port laparoscopic surgery in urology: initial experience. *Urology*. 2008; 71:3–6.
- Tagaya N, Rokkaku K, Kubota K. Needlescopic cholecystectomy versus needlescope-assisted laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech*. 2007;17: 375–379.
- Marks JM, Ponsky JL, Pearl JP, et al. PEG "Rescue": a practical NOTES technique. *Surg Endosc*. 2007;21:816–819.
- Palanivelu C, Rajan PS, Rangarajan M, et al. Transumbilical flexible endoscopic cholecystectomy in humans: first feasibility study using a hybrid technique. *Endoscopy*. 2008;40: 428–433.

14. Boone BA, Wagner P, Ganchuk E, et al. Single-incision laparoscopic splenectomy: preliminary experience in consecutive patients and comparison to standard laparoscopic splenectomy. *Surg Endosc*. 2013;27:587–592.
15. Walz MK, Groeben H, Alesina PF. Single-access retroperitoneoscopic adrenalectomy (SARA) versus conventional retroperitoneoscopic adrenalectomy (CORA): a case-control study. *World J Surg*. 2010;34:1386–1390.
16. Miyajima A, Hattori S, Maeda T, et al. Transumbilical approach for laparo-endoscopic single-site adrenalectomy: initial experience and short-term outcome. *Int Urol*. 2012;19:331–335.
17. Hirano D, Minei S, Yamaguchi K, et al. Retroperitoneoscopic adrenalectomy for adrenal tumors via a single large port. *J Endourol*. 2005;19:788–792.
18. Walz MK, Alesina PF. Single access retroperitoneoscopic adrenalectomy (SARA)—one step beyond in endocrine surgery. *Langenbecks Arch Surg*. 2009;394:447–450.
19. Desai MM, Berger AK, Brandina R, et al. Laparoendoscopic single-site surgery: Initial hundred patients. *Urology*. 2009;74:805–812.
20. Ryu DS, Park WJ, Oh TH. Retroperitoneal laparoendoscopic single-site surgery in urology: initial experience. *J Endourol*. 2009;23:1857–1862.
21. Karanikola E, Tsigris C, Kontzoglou K, et al. Laparoscopic adrenalectomy: where do we stand now? *Exp Med*. 2010;220:259–265.
22. Fernández-Cruz L, Saenz A, Taura P, et al. Retroperitoneal approach in laparoscopic adrenalectomy. Is it advantageous? *Surg Endosc*. 1999;13:86–90.
23. Vidal O, Valentini M, Ginestà C, et al. Single incision laparoscopic appendectomy (SILS): initial experience. *Cir Esp*. 2009;85:317–319.
24. Jeong CW, Park YH, Shin CS, et al. Synchronous bilateral laparoendoscopic single-site adrenalectomy. *J Endourol*. 2010;24:1301–1305.
25. Vidal O, Ginestà C, Valentini M, et al. Suprapubic single-incision laparoscopic appendectomy: a nonvisible-scar surgical option. *Surg Endosc*. 2011;25:1019–1023.
26. Targarona EM, Balague C, Martinez C, et al. Single-port access: a feasible alternative to conventional laparoscopic splenectomy. *Surg Innov*. 2009;16:348–352.
27. Targarona EM, Pallares JL, Balague C, et al. Single incision approach for splenic diseases: a preliminary report on a series of 8 cases. *Surg Endosc*. 2010;24:2236–2240.
28. Berber E, Tellioglu G, Harvey A, et al. Comparison of laparoscopic transabdominal lateral versus posterior retroperitoneal adrenalectomy. *Surgery*. 2010;146:621–626.