Laparoendoscopic single-site surgery adrenalectomy – own experience and matched case-control study with standard laparoscopic adrenalectomy

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Abstract

Introduction: *At our institution, laparoendoscopic single-site surgery (LESS) has been established as a technique for laparoscopic nephrectomy since 2011, and since 2012 in selected cases for adrenalectomy (AE) as well.*
Aim: *To compare LESS AE with standard laparoscopic AE (SLAE).*
Material and methods: *Between 3/2012 and 7/2014, 35 adrenalectomies were performed. In 18 (51.4%), a LESS approach was chosen. Indications were strictly non-complicated cases (body mass index (BMI) < 34 kg/m^2, tumour ≤ 7 cm, non-malignant aetiology, no previous surgery). All LESS procedures were done by one surgeon. Standard equipment was a 10 mm rigid 0° camera, Triport+, one pre-bent grasper, and a sealing instrument. The approach was pararectal in all cases except one (transumbilical in a slim man). Three patients with LESS were excluded (2 partial AEs only, one adrenal cancer converted to SLAE and then to open surgery). These 15 LESS AE procedures were compared to 15 SLAEs with similar characteristics chosen among 54 SLAEs performed in the period 1/2008–2/2012.*
Results: *In 8 cases (53.3%) of LESS AE, a 3 mm port was added to elevate the liver/spleen. Mean parameters of LESS AE vs. SLAE (Wilcoxon test): maximal tumour diameter 43.7 mm vs. 36.1 mm (p = 0.28), time of surgery 63.3 min vs. 55.3 min (p = 0.22), blood loss 38.0 ml vs. 38.0 ml (p = 0.38), BMI 26.9 kg/m^2 vs. 28.5 kg/m^2 (p = 0.13), discharge from hospital 5.4 days vs. 3.9 days (p = 0.038). There were no complications in either group.*
Conclusions: *The LESS AE is feasible in selected cases, especially small left-sided tumours in thin patients with no history of previous abdominal operations, but requires an additional port in half of the cases.*

Key words: *laparoscopy, adrenalectomy, laparoendoscopic single-site surgery, adrenal tumour.*

Introduction

Laparoscopy has become the gold standard for the surgical treatment of adrenal gland lesions [1–3]. The most common approach is anterior transperitoneal or less commonly retroperitoneoscopic. Striving to further reduce morbidity, alternative approaches are being explored and described: a mini-laparoscopic approach (using instruments 2–3 mm in size), posterior retroperitoneoscopic adrenalectomy (AE) [4, 5], and application of a robotic system [6]. Recently, a single port approach as well (laparoendoscopic single-site surgery – LESS). The LESS was introduced

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in urological laparoscopy in 2007 and to date, many procedures have been performed through this approach [7]. However, nephrectomy remains the main indication [8, 9]. Subsequently, LESS AEs were reported in 2008–2009 [10–12]. In 2013, Hu *et al.* summarised and reviewed 171 cases of LESS AE [13]. Cosmetic outcomes are generally considered superior and constitute one advantage of LESS AE [12, 14–17]. The operation time is reportedly longer for LESS AE [13], the hospital stay shorter and patients suffer less postoperative pain [13]. In view of the seemingly limited advantages, the LESS approach is continuously being discussed. If somebody decides to employ LESS, there remain for them/their patients several questions/issues: (1) selection of appropriate cases, (2) safety, (3) time and (4) cost of surgery, (5) requirement for operation and (6) dexterity of the surgeon.

Aim

By comparing LESS AE to standard (conventional) laparoscopic AE (SLAE), we have tried to contribute some data in order to help to resolve some of these questions.

Material and methods

Between 3/2012 and 7/2014, 35 adrenal operations were performed. In 18 (51.4%), a LESS approach was chosen. The LESS AE was only performed strictly in non-complicated cases (body mass index (BMI) < 34 kg/m^2, tumour ≤ 7 cm, non-malignant aetiology, no previous surgery). All LESS procedures were performed by one surgeon with experience of several hundred open and laparoscopic procedures and even with dozens of LESS nephrectomies. The standard equipment was a 10 mm rigid 0° camera, a Triport+ multichannel port (Olympus), one pre-bent grasper (Olympus), a sealing instrument (Ligasure 35 mm Blunt Tip or Thunderbeat Olympus in 2 cases) (Photos 1–3). The approach was pararectal in all cases except in one slim man where a transumbilical approach was chosen (Photos 1, 4). Three patients who had undergone LESS were excluded (2 partial AE only, one adrenal cancer with rapid progression between time of computed tomography (CT) and surgery converted to standard laparoscopic AE (SLAE) and then to open surgery). In nearly half of cases (for details see Results), one additional 3 mm grasper was inserted directly through the abdominal wall (details of the technique are provided below). For these cases, the term hybrid LESS may be used [9]. These 15 LESS AEs were compared to 15 SLAEs with similar characteristics (including the same surgeon) chosen among 49 SLAEs performed between 1/2008 and 2/2012.

Operative technique

The patient is under general anaesthesia with a urethral catheter and he/she is placed in a lateral decubitus position with a slight table break at the waist (Photo 1). Through an approximately 3 cm small pararectal laparotomy, a Triport+ multi-channel single port (Olympus) (with one 10 mm port and three 5 mm ports) is inserted (Photo 1). We employ a standard rigid straight full HD laparoscopic 10 mm 0° camera and only two 5 mm working instruments at the same time. One pre-bent grasper (during the whole operation, Photo 2) and one standard straight instrument – mainly any sealing device (Ligasure 35 mm Blunt Tip or Thunderbeat – Photos 2, 3 – or EnSeal). The straight instrument is sometimes replaced with suction, a hook with electrocautery, a clip applicator, bipolar forceps or scissors. The dorsal peritoneum is incised laterally to the colon. Gerota's fascia is

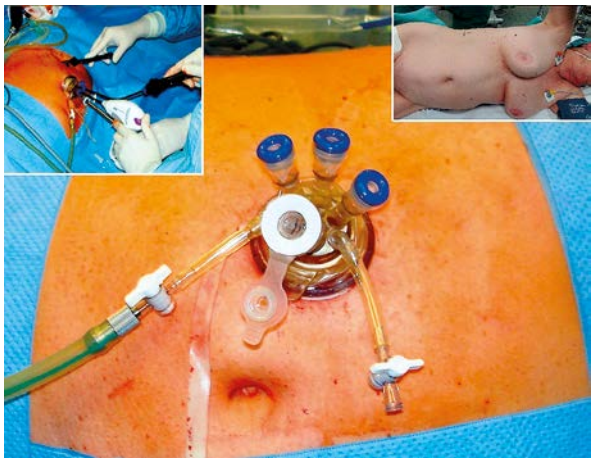

Photo 1. Right side LESS AE. Flank position (right upper corner), multi-channel port (3 × 5 mm – blue and one 10 mm – white) Quadport+ in short pararectal incision is introduced. In the left upper corner, three instruments in the port (rigid straight 10 mm 0° camera, one pre-bent grasper and Ligasure 35 mm Blunt Tip sealing instrument; one 5 mm port remains free during the whole surgery) and in the subcostal region, an additional 3 mm grasper

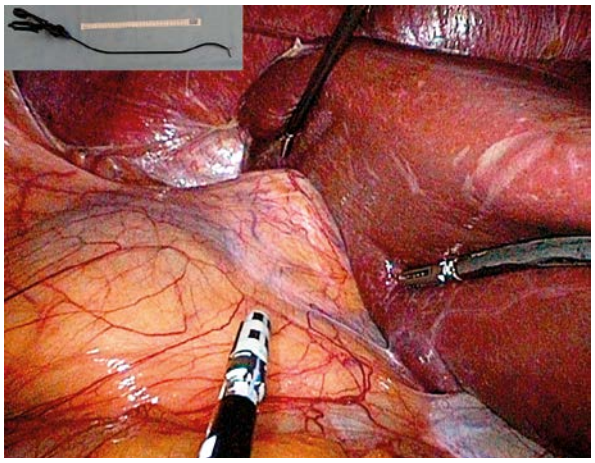

Photo 2. Right side LESS AE, laparoscopic view. Under the liver (elevated by pre-bent grasper and by additional 3 mm grasper) the tumour of the right adrenal gland is visible. Upper left corner – photo of pre-bent grasper

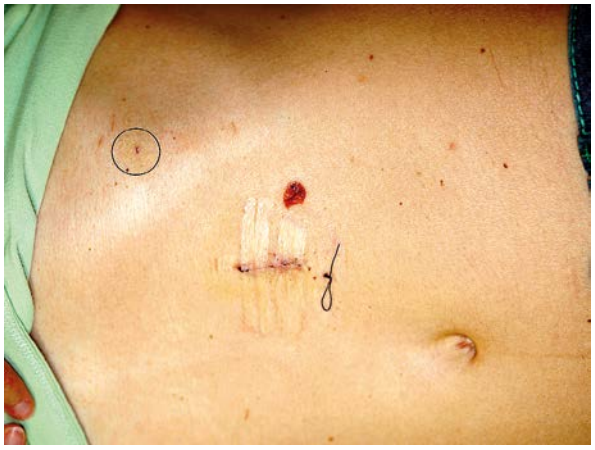

Photo 4. Hybrid LESS AE (one additional 3 mm port/grasper), 7th postoperative day. Intradermal stitch. Completely healed incision from 3 mm grasper (in the circle)

opened above the adrenal gland. The adrenal vein is identified and divided with Hem-o-lok Weck plastic clips, Teleflex, size M with applicator of gauge 5 mm only. The adrenal gland is then gradually divided with a sealing device (Photo 2). In some cases when there is a need to elevate the liver or spleen, a 3 mm grasper is inserted directly through the abdominal wall (without the need for a trocar) in the hypochondrium close to the end of the 12th rib with a previous opening of the peritoneum with 3 mm scissors (Photos 1, 2). Following complete liberation of the adrenal gland, a 10 mm camera is replaced with a 5 mm camera and a 10 mm port is used to introduce a disposable Spec-

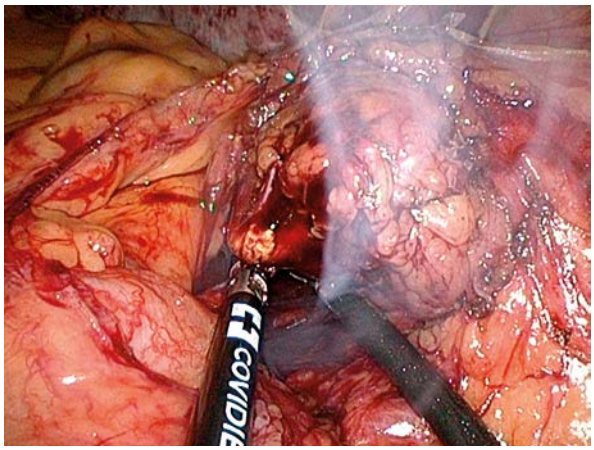

Photo 3. Left side LESS AE with two instruments only, left-handed surgeon: Ligasure Blunt Tip 35 mm (left hand) and pre-bent grasper

imen Pouch Endo Catch Gold Covidien. The whole Triport+ port is removed with the specimen in a bag. Minilaparotomy is closed without insertion of a drain. In contrast, we drain the adrenalectomy bed in all SLAE cases (a soft rubber drain = Penrose drain).

Results

In 8 cases (53.3%, among first 9 cases) of LESS AE, a 3 mm port was added to elevate the liver/spleen. Parameters of both groups are summarised in Table I.

The only difference was the side of surgery and stay in hospital (Table I). We have no obvious explanations for this side difference, but it may be a source of bias of this study. Discrepancies in laterality can be found in the literature as well and even a predominance of the left side [13, 18]. We and others suggest one possible explanation for this: renal/adrenal surgery is probably easier to perform on the left side [19]. In addition, Vidal *et al.* performed 40 LESS AEs on only the left side [20]. The histopathological diagnoses in the group of patients who underwent LESS AE were: 10 adrenocortical adenomas, 3 pheochromocytomas and 2 metastases of clear renal cell carcinoma (CRCC) from the contralateral kidney. In the SLAE group the diagnoses were: 12 adrenocortical adenomas, 2 pheochromocytomas and one metastasis of CRCC.

A comparison of the cost of LESS AE and SLAE is relatively easy. There is almost identical duration of the surgical procedure, the same number of staff, the same sealing device, clips and an extraction bag.

Table I. Parameters of LESS AE versus SLAE

Parameter	LESS AE	SLAE	Statistical significance*
Age	59.3 ±13.3 (34.2–80.5)	60.2 ±11.9 (34.3–77.7)	$p = 0.690947$
Maximal diameter of tumour [mm]	43.7 ±19.5 (8–85)	36.1 ±14.6 (13–65)	$p = 0.280539$
Time of surgery [min]	63.3 ±13.8 (44–95)	55.3 ±20.8 (32–115)	$p = 0.22205$
Side of surgery (left to right)**	2:13 (86.7% vs. 13.3%)	4:11 (26.7% vs. 73.3%)	***
Time of surgery [min] by side – left/right (number of cases)	64.9 ±14.1 (44–95)/ 53.5 ±4.9 (50–57) (13/2)	70.5 ±31.5 (45–115)/ 49.7 ±13.4 (32–75) (4/11)	***
Blood loss [ml]	38.0 ±40.7 (0–100)	38.0 ±103.9 (0–400)	$p = 0.386277$
BMI [kg/m^2]	26.9 ±4.3 (18.5–34.0)	28.5 ±2.0 (26–33)	$p = 0.139766$
Discharge from hospital [days]	5.4	3.9	$p = 0.038309$
Complications	0	2x Clavien 1****	***

**Wilcoxon matched pairs test. **SLAE cases were selected from a group of 49 miniinvasive AEs; ratio of left to right side was 24:25 (49.0% vs. 51.0%). LESS AE cases were selected from a group of 35 mini-invasive AEs (3/2012 to 7/2014), left to right ratio 26:9 (74.3% vs. 25.7%). ***It cannot be statistically compared. ****Clavien-Dindo classification of complications [17]*

The difference is only the multichannel port vs. standard ports. The 3 mm grasper added in some cases is reusable and is not charged. The price of Triport+ in the Czech Republic is € 305, and the price for 4 standard ports (but we use for the 10 mm camera a re-usable port not counted here) with Veress needle is € 174. Hence, the price difference is € 131. Of course, the longer hospital stay (mean 1.5 days) in LESS increases the cost. We cannot easily explain this difference. In the literature, an even shorter hospital stay is characteristic for patients who have undergone LESS AE [13].

Discussion

The topic of LESS AE has been the subject of several discussions and some controversy in the literature and has been reviewed recently [13, 21]. We have focused on these selected questions: indications for LESS AE – yes or no, and if yes, in which cases, with what approach, and with what equipment?

Arguable advantages of LESS have been mentioned in the Introduction. Suffice to say that they are limited. We decided to perform LESS AE following successful introduction of a LESS approach in nephrectomy [9]. But we apply LESS AE only in selected cases. We never indicate LESS AE in cases where there are any complicating factors (e.g. obesity, large tumour) and if surgery is to be performed by a less experienced surgeon. A cut-off BMI of 34 kg/m^2 was chosen to exclude significantly obese patients, in which the operative complexity increases [22]. Instead of BMI, special indices (total fat area (TFA) and visceral fat area (VFA)) can be employed, and these are more sensitive indicators of increasing technical difficulty than BMI [22].

Paramount questions when deciding to perform a LESS is the site of incision and equipment. The approach can be not only laparoscopic, but also retroperitoneoscopic [3, 23–26]. We perform nearly all upper urinary tract laparoscopies through the transperitoneal approach, and we also apply it in LESS AE. With the exception of only one slim man, we preferred a pararectal incision to a transumbilical one. The cosmetic effect is less optimal, but the approach to the adrenal gland is easier. However, some investigators have chosen the transumbilical route as standard [27–29], whereas some authors have used the transumbilical approach in only a limited number of cases [19, 30]. On the issue of what is the preferred equipment for LESS, one can conclude that the spectrum of specialised systems for LESS surgery from different companies is broad [7, 31]. We have found in the literature attempts to perform LESS AE with conventional ports and instruments labelled by some authors as "home-made" [3, 12, 32, 33]. In our view, it is important to choose a system that requires only a short incision. This is so because the specimen is in most cases small, and an incision of up to 3 cm is adequate even for extraction of the resected specimen. We use Triport+, because the in-

cision is short and we are experienced in working with this type of system from our LESS nephrectomies (Quadport+ Olympus) [9]. In addition, only one pre-bent instrument is required. Following surgery, no drainage is used routinely [34].

A LESS approach can be implemented in partial adrenalectomy as well [23]. We have used a LESS approach in two such cases. The disadvantage in these cases was that the 3 cm incision for LESS was unnecessarily wide for extraction of small resected specimens (< 2 cm).

Many articles dealing with LESS AE in relation to SLAE have studied several variables, such as mean operating time, blood loss, resumption of oral intake, grade of pain, requirement of analgesics, cosmetics, satisfaction score, length of scar, hospital stay, complications, etc. In a review article, Wang *et al.* [21] concluded that LESS AE is safe and a feasible alternative to SLAE, with decreased postoperative pain noted, albeit with a longer operative time. As a promising and emerging minimally invasive technique, however, the current evidence has not verified other potential advantages (cosmesis, recovery time, convalescence, port-related complications, etc.) of LESS AE. We focus here on the time of surgery (Table II). The spectrum of mean operation time is very broad: 55–206 min (range: 41–360 min). In most studies, the time of SLAE is shorter than LESS AE. In addition, the extension of time increases the cost of surgery, and this is one factor that should be considered. In our study, the duration of both approaches was similar, and in only one study has the operating time for LESS AE been shorter than in our series (55 min vs. 63 min) [16].

Last but not least, we have to stress the potential biases of this study: matched case-control study

Table II. Time of LESS or standard laparoscopic adrenalectomy – review of the literature

Author	LESS AE		SLAE
	Approach, number of cases	Mean time of LESS AE [min]	Mean time [min]/ number of cases
Jeong *et al.* 2009 [12]	Laparoscopic (= transperitoneal), 9	169 (89–289)	144.5 (70–300)/15
Cindolo *et al.* 2010 [11]	Laparoscopic, 3	200 (150–240)	–
Miyajima *et al.* 2011 [28]	Laparoscopic, 12	121.2 ±7.8	110.2 ±7.3/12
Yoshimura *et al.* 2011 [19]	Laparoscopic, 7	178 (108–291)	–
Shi *et al.* 2011 [16]	Retroperitoneoscopic, 19	55	41.5/38
Beiša *et al.* 2012 [3]	Retroperitoneoscopic, 5	144 ±88	91 ±23/6
Luo *et al.* [33]	Retroperitoneoscopic, 40	68 (30–140)	–
Hattori *et al.* 2012 [18]	Laparoscopic, 58	133 ±54 (Combination of LESS and SLAE)	
Wang *et al.* 2012 [30]	Laparoscopic, 13	148.5	112.9/26
Sasaki *et al.* 2012 [29]	Laparoscopic, 1	76	–
Ishida *et al.* 2013 [27]	Laparoscopic, translumbilical, 10	91.2	74.3/10
Bhandarkar *et al.* 2014 [32]	Laparoscopic, 1	70	–
Landgenhuijsen *et al.* 2013 [35]	Retroperitoneoscopic, 7	68 ±9.3	–
He *et al.* 2014 [26]	Retroperitoneoscopic, 16	68.1 (41–125)	–
Yuan *et al.* 2014 [25]	Retroperitoneoscopic, 21	167.4	125.5
Inoue *et al.* 2014 [15]	Laparoscopic, 11 (from 19)	206.2 (124–360)	177.0 (90–415)/54 from 104
Hirasawa *et al.* 2014 [14]	Laparoscopic, 70	109.9 ±34.8	109.1 ±32.3/140
Hora *et al.* 2014 (present study)	Laparoscopic, 15	63.3 ±13.8 (44–95)	55.3 ±20.8 (32–115)/15

only; not strict standardised criteria for indication of LESS approach; predominance of left side surgery in LESS AE group; LESS approach was applied later and the surgeon was probably more experienced in laparoscopy.

Conclusions

Based on our experience, LESS is a feasible surgical alternative in selected cases (BMI < 34 kg/m^2, tumour ≤ 7 cm, non-malignant aetiology, no previous surgery). The left side is preferred more frequently. We did not detect any significant differences, including duration of surgery, between LESS AE and SLAE. The hospital stay was longer in the LESS group (in contrast with previously reported data). The price increase is only € 131 for LESS AE due to the multi-channel port. However, the longer hospitalisation in the LESS group affected the total cost. Subjectively assessed, since intraoperative complications in LESS are more difficult to handle, LESS AE should be performed by experienced laparoscopic surgeons. Any significant gain for the patients is somewhat questionable and not substantiated in this study. Future studies should compare the two techniques in a prospective randomised setting where lateralisation should be a stratifying component.

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