LESS living donor nephrectomy: Surgical technique and results

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Abstract

Purpose: We present the findings of 50 patients undergoing pure trans-umbilical laparo-endoscopic single-site surgery (LESS) living donor nephrectomy (LDN), between February 2010 and May 2014.

Materials and Methods: Laparo-endoscopic single-site surgery LDN was performed through an umbilical incision. Different trocars were used, namely Gelpoint (Applied Medical, Rancho Santa Margarita, CA) SILS port (Covidien, Hamilton, Bermuda), R-port (Olympus Surgical, Orangeburg, NY) and standard trocars, inserted through the same skin incision but using separate fascial punctures. The standard laparoscopic technique was employed. The kidney was pre-entraped in a retrieval bag and extracted trans-umbilically. Data were collected prospectively including questionnaires containing patient reported oral pain medication duration and time to recovery.

Results: LESS LDN was successful in all patients. Mean warm ischemia time was 6.2 min (3–15), mean procedure time was 233.2 min (172–300), and hospitalization stay was 3.94 days (3–7) with a visual analogue pain score at discharge of 1.32 (0–3). No intraoperative complications occurred. The mean time of oral pain medication was 8.72 days (1–20) and final scar length was 4.06 cm (3–5). Each allograft was functional.

Conclusion: Although challenging, trans-umbilical LESS LDN seems to be feasible and safe. Hence, LESS has the potential to improve cosmetic results and decrease morbidity.

Key Words: Laparo-endoscopic single-site surgery, laparoscopy, living donor nephrectomy, minimally invasive, single port

INTRODUCTION

Since laparoscopic living donor nephrectomy (LDN) was described in 1995 by Ratner et al.,[1] it has become the reference for many academic centers because it offers similar rates of complication and transplant success.[2,3] Classically, this technique uses three to five small incisions for the placement of the trocars as well as an iliac incision of about 6–8 cm to extract the kidney.

In 2007, a new minimally invasive approach was developed by using a single multi-trocar valve that allows interventions in a pure trans-umbilical way.[4] The so-called laparo-endoscopic single-site surgery (LESS) LDN technique was first carried out at the Cleveland Clinic by using 2 mm instruments introduced with a Veress needle (Covidien, Hamilton, Bermuda).[5] In this report, we present our experience of pure trans-umbilical LESS LDN.
MATERIALS AND METHODS

Between February 2010 and May 2014, 50 patients that had volunteered to donate a kidney to a close relative underwent trans-umbilical LESS LDN. All donors were evaluated by a multidisciplinary team to gather donor criteria. Demographic and biological data, as well as complications (Clavien classification), were collected in a prospective way during the initial hospitalization and again during follow-up.

The functional evaluation was based on creatinine level and Modification of the Diet in Renal Disease (MDRD) clearance (MDRD = 186 * (serum creatinine) 1.154 * (age) 0.203* (0.742 for women) * (1.212 for patients of African origin) ml/min/1.73 m²)(6,7).

The pain was evaluated using the visual analogue pain scale based on four daily measures and a daily average. After discharge, patients completed a questionnaire concerning the duration of oral analgesic used, the occurrence of any complications, and the time to 100% recover from the physical after effects of the surgery. In the case of complications, patients were seen again for evaluation and treatment in addition to the control consultations at 1 and 3 months.

Trocars
For the first patient, two trocars were used: The SILS port (Covidien, Hamilton, Bermuda) and R-port (Olympus Surgical, Orangeburg, NY). For the subsequent six procedures, standard trocars were used (one 12 mm, one 10 mm, and two 5 mm). Then, for the remaining ones, we used either the SILS port or the Gelpoint (Applied Médical, Rancho Santa Margarita, CA).

Optics
During the first intervention, an Olympus Endoeye camera was used. For the subsequent six ones, we used a standard camera and one 10 mm optic, 30° (Storz, Tuttligen, Germany). For the remaining ones, we used one 5 mm optic, 30° (Storz, Tuttligen, Germany).

Instruments
Curved, but not articulated instruments were used for the first patient (HiQ LS hand instruments, Olympus Surgical). For the others, standard laparoscopic instruments were used.

Technique
Patients were placed in a 45° flank position. Skin incision was carried out in the umbilicus vertically at approximately 3 cm visually (smoothing out the umbilicus corresponded to a real length of 4–5 cm). The incision was slightly diverted at the bottom to avoid detaching the umbilicus. The 5–6 cm vertical midline anterior rectus fasciotomy was then performed. The absence of adhesions was checked.

When the R-port or SILS port was used, the fascia was partially closed with an oversuturing of vicryl to avoid CO₂ leakage around the single port and to prepare for the kidney extraction. The single port was then introduced by an incision (manually with the SILS port and with a dedicated ancillary for the R-port).

When using conventional trocars, the fascia was opened only to place the 10 mm trocar for the optics. Other trocars (2 mm × 5 mm; 1 mm × 12 mm) were placed through the same trans-umbilical cutaneous incision but used a separate fascia puncture. The usual LDN technique was then carried out. In doing so, the descending colon, spleen, and tail of the pancreas are mobilized generously, such that they retract medially.

The ureter and gonadal vein were then located and elevated off the psoas. The gonadal vein was left intact and followed to the renal vein. The renal vein was skeletonized, and the adrenal vein was clipped with a Hem-O-Lock® clips (Teleflex Medical, Research Triangle Park, NC, USA) and divided. The renal vein was then dissected until the level of the inter-aortocaval region and the artery was dissected to its aortic origin. The ureter was clipped and divided under the iliac artery, and the kidney was freed from its attachments.

The kidney was then placed in a retrieval bag that was partially closed, leaving only the artery and vein outside and taking care not to compromise its vascularization. The section of vessels began only when the table to prepare the transplant was ready with the transplanting surgeon available to prepare the kidney.

Two Hem-O-Lock® clips, as well as one metal clip (Endo clip by Covidien, Hamilton, Bermuda), were placed on the artery before transection. For the renal vein, two Hem-O-Lock® clips were placed before transection. The kidney was extracted by activate the closure of the extraction bag, having already loosened the fascial oversuturing to allow for an extraction without compression. The transplanting surgeon was responsible for the preparation and transplantation.

When using several trocars, an incision was made between the two most distant trocars to open the fascia widely. For that purpose, the pneumoperitoneum was left in position to facilitate the incision. The fascia was then partially closed to allow for the establishment of a new single port to check for hemostasis.

Closure was carried out after parietal infiltration by the NAROPIN with two hem oversuturing of braided absorbable 0 suture for the fascia, an oversuturing the subcutaneous tissue by
braided absorbable 3–0 suture and for the skin a subcuticular stitches with absorbable monofilament 3–0 suture.

RESULTS

All procedures took place successfully. Table 1 presents the demographic characteristics of our patients. Open surgery was not necessary. However, in five cases, an additional 5 mm trocar was added to free the upper pole; in two cases, the kidney was extracted by median incision; and in three cases, the kidney was extracted iliacally after the introduction of a hand in the incision to facilitate the dissection of the pedicle (presence of two veins, with receiver ready for the transplantation). No perioperative complications were noticed, and all kidneys were transplanted with a good functional result.

The operating data are shown in Table 2. The average operating time was 233.2 min, and average duration of warm ischemia was 6.2 min with an average blood loss of 71 ml (20–150). The trends of warm ischemia and body mass index are presented in Figures 1 and 2. Average hospitalization was 3.94 days. From the point of view of postoperative pain, average EVA on the 1st day was 3.26 (1.5–5) and 1.32 (0–3) on the day of discharge with an average duration of oral analgesia of 8.72 days (1–20). Complete recovery after intervention occurred after 40.32 days (17–90).

The final size of the visible scar was 4.06 cm (3–5). Postoperative complications included eight infected wounds treated by local treatment (Grade I), a patient with nausea, treated medically (Grade I), one phlebitis of the lower limb (Grade II), treated medically, and one incisional hernia, treated surgically (Grade III). All allograft transplantations were successfully performed with functioning kidney.

DISCUSSION

Living donor nephrectomy is the most stressful intervention in urology because, by definition, it involves healthy patients performing an altruistic donation. There are two objectives, which cannot be compromised: To obtain a transplantable kidney in an optimal way and to maximize donor safety. When these conditions are met, we can focus on the morbidity and cosmetic aspect in order to improve the comfort and experience of the donor. During trans-umbilical LESS LDN morbidity remains a concern, including epigastric vessel injury, herniation, and pain. Furthermore, Pfannenstiel extraction incision is not completely benign.[8,9]

The trans-umbilical LESS approach delivers a trauma similar to a mesh-free umbilical hernia repair usually performed on an outpatient basis. In the case of technical difficulties during LESS LDN, the addition of one or several trocars is easy and quick, thereby assuring a safe procedure.

Table 1: Demographic characteristics

| Characteristics                  | Mean       |
|----------------------------------|------------|
| BMI                              | 23.5 (18.8-29.6) |
| Age (years)                      | 51 (35-67) |
| Histories of abdominal surgery (%)| 26 (52)    |
| ASA score                        | 1.15 (1-2) |

BMI: Body mass index, ASA: American Society of Anesthesiologists

Table 2: Operating and clinical data

| Operating and clinical data                  | Mean       |
|----------------------------------------------|------------|
| Operative duration (min)                     | 233.2 (172-300) |
| Duration of warm ischemia (min)              | 6.2 (3-15) |
| Blood loss (ml)                              | 71 (20-150) |
| Length of stay (days)                        | 3.94 (3-7) |
| Duration of analgesic use (days)             | 8.72 (1-20) |
| Final size of scar (cm)                      | 4.06 (3-5) |
| Operative complications                      | 0          |
| Postoperative complications (%)              |            |
| Grade I                                       | 9 (18)     |
| Grade II                                      | 1 (2)      |
| Grade III                                     | 1 (2)      |
| Evolution of EVA                              |            |
| Day 1                                         | 3.26 (1.5-5) |
| Day 2                                         | 2.2 (1-3.5) |
| Discharge day                                 | 1.32 (0-3) |
| Time to 100% recovery (days)                 | 40.32 (17-90) |

EVA: Evolutionary anthropology

Figure 1: Warm ischemia time according to body mass index

Figure 2: Warm ischemia time: Trend over time
During LDN, the time of warm ischemia must be minimized to avoid kidney injury. The reported time of warm ischemia varies from 2.6 to 6 min. However, <10 min, no degradation of the kidney function is noticed. A previously published warm ischemia time under the LESS LDN approach was 6.31 min, which is similar to our series.

Various technical possibilities exist to reduce this time of warm ischemia. First, the fascia is open widely in order to minimize extraction time. When normal trocars or SIRS ports are used, a temporary continuous suture is performed to avoid CO₂ leakage. When the Gelpoint is used, the fascia is left open ready for the kidney extraction. Then, the kidney is preentrapped in a retrieval bag before the pedicle transection. It is also essential not to compress the transplant during the extraction by opening the fascia and skin for an atraumatic extraction. In the near future, robotics may allow surgeons to bypass these technical difficulties with specific systems for LESS.

Concerning operating morbidity, the laparoscopic approach decreases the duration of hospitalization, postoperative pain, and blood loss while assuring a functional result similar to open surgery. Under the LESS approach, postoperative pain is further decreased compared with laparoscopy, where trocars can push into the abdominal muscles and cause pain during movement. The passage of trocars in a transmuscular way is thought to be responsible for postoperative pain. For example, a reduction in the size of the trocars used in classic laparoscopy decreases operating morbidity. Mostafa et al. compared patients who were operated on with 2 mm instruments with those operated on by using classic instruments. The former group had, on average, shorter hospital stays (1.3 vs. 3.2 days), a lower use of analgesic, and a faster return to normal activities. The average duration of analgesic intake was 8.72 days in our study, which is similar to the published results, compared with approximately 20 days for classic laparoscopies.

The psychological aspect of healthy patients is also important. Indeed, it is current practice to notice that the pain felt by living donors is more important than that felt by cancer patients, even when they underwent the same type of intervention. With the trans-umbilical LESS approach, the fact that the final scar is hidden in the umbilicus and thus almost invisible plays a role in the fast recovery of patients.

Convalescence is also shorter with LESS: 5 weeks in our study, 3 weeks in Gill et al.’s series, and 7 weeks with conventional laparoscopy. This decrease in convalescence time with a faster return to work can represent a socioeconomic advantage.

Other LESS LDN approaches have also been described. Andonian et al. presented a LESS technique that uses a single port transumbilical (E-NOTES) donor nephrectomy. The initial results seem to be encouraging with a mean warm ischemia time of 3 min and a hospital stay of 24 h.

In addition, it is necessary to underline that in France in 2009, approximately 10,675 patients were awaiting kidney transplants with only 10% of allografts coming from living donors. We hope that an improved donation experience with the trans-umbilical LESS LDN approach will lead more people to become kidney donors.

CONCLUSION

Trans-umbilical LESS LDN, although technically difficult, provides very promising results. In addition to the cosmetic improvement, concerning the cosmetic improvement, it seems to be less painful and have a shorter convalescence time. Nevertheless, a larger number of studies, particularly comparative and prospective studies, remain necessary to define the LESS.

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