Laparoendoscopic single site surgery in urology: A single centre experience

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Abstract

OBJECTIVE: To analyze our experience of 87 cases with single port surgery, which is also known as laparoendoscopic single site surgery (LESS).

MATERIALS AND METHODS: Case records of all LESS procedures performed between December 2007 and June 2010 were analysed. The procedures performed were donor nephrectomy (n=45), simple nephrectomy (n=27), radical nephrectomy (n=5), pyeloplasty (n=9), and ureteroneocystostomy (n=1). Parameters analysed were operating room (OR) time, estimated blood loss (EBL), visual analogue score (VAS), and complications in all patients undergoing LESS procedure and additionally, warm ischaemia time (WIT) and graft outcome in patients undergoing LESS donor nephrectomy. In reconstructive procedures, the functional assessment was performed with a diuretic renogram at 6 months.

RESULTS: In LESS donor nephrectomy, the mean WIT was 6.9 ± 1.9 min. Mean serum creatinine in recipients at 1 month was 0.96 ± 0.21 mg%. We encountered one instance each of renal artery injury, renal vein injury, large bowel injury, minor cortical laceration at the upper pole and two instances of diaphragmatic injury. In LESS simple nephrectomy, the average OR time was 148.7 ± 52.2 min and hospital stay was 3.7 ± 1.2 days. There was one instance of large bowel injury during specimen retrieval. In LESS radical nephrectomy, the average OR time was 202.5 ± 35.7 min and average hospital stay was 4.2 ± 1.3 days. 6 patients of LESS pyeloplasty completed follow up with a diuretic renogram showing a good drainage. LESS ureteroneocystostomy could also be performed successfully without any complications.

CONCLUSION: LESS surgery can be accomplished safely in nephrectomy and reconstructive procedures such as pyeloplasty and ureteroneocystostomy with equivalent outcomes as standard laparoscopy and with added benefits of cosmesis and quicker convalescence. LESS donor nephrectomy is a technically feasible procedure; current status of procedure needs to be proved with randomised controlled studies.

Key words: Laparoendoscopic single site surgery, single incision laparoscopic surgery, urology

INTRODUCTION

The first laparoscopic nephrectomy was performed by Ralph Clayman[1] in 1991 and the benefits of minimally invasive urological surgery have been repeatedly confirmed and established since then. In laparoscopic surgery, each port inserted has a risk of complications like bleeding, infection, pain, hernia, visceral injury and compromised cosmetic outcome.[2] Single site laparoscopic surgery began as a concerted effort in 2007 and Rane A, Rao P, Raman JD, Cadeddu JA and coworkers are credited with being the pioneers in developing LESS in urology.[3,4] The rationale behind LESS procedures is that these problems can be overcome with single port access with equivalent outcome as standard laparoscopy.

There have been multiple terminologies used for this procedure, which include single port access surgery (SPA), single incision laparoscopic surgery (SILS). To avoid confusion with nomenclature and multiple terminologies, the term laparoendoscopic single site surgery (LESS) was coined at the “LESSCAR (Laparo-Endoscopic Single Site Surgery Consortium...
LESS has been reported in variety of urological surgeries such as nephrectomy,[6,7] radical nephrectomy,[7,8] pyeloplasty,[6,7] simple prostatectomy[7,9] and donor nephrectomy.[10,11] These procedures have been performed at few centres worldwide.

In this article, we present our experience with LESS. We analyze the results of LESS in terms of surgical outcome in urological surgeries.

MATERIALS AND METHODS

Prior to initiating the study, an approval from the institutional review board (IRB) was obtained. The data of all LESS procedures performed between December 2007 and June 2010 was prospectively recorded and analysed. All surgeries were performed by one of the following surgeons Dr MRD, Dr APG and Dr AK. All procedures were performed using the R-port™ (Advanced Surgical Concepts, Ireland). The characteristics of this port have already been described.[10,11] In present series we have been using the Triport™ as well as the Quad port™ variants of this multichannel single port. The Olympus endoeye™ camera which was used in all the cases. This camera has a coaxial light cable which reduces the cluttering and clashing of instruments. In all the cases, standard laparoscopic instruments were used except at the upper pole where sometimes a longer suction cannula and or an extra long harmonic scalpel (Johnson and Johnson Ltd, Piscataway, NY, USA) was used.

LESS donor nephrectomy was performed by the technique already described. The results were analysed[11] [Figures 1 and 2a-b].

LESS pyeloplasty [Figures 3a-c] was commenced by placement of 4Fr pigtail catheter. Standard laparoscopic instruments were used and dismembered Anderson-Hynes pyeloplasty was performed in all. The pigtail catheter was replaced by

![Figure 1](image1.png)  
**Figure 1:** Scatter diagram showing post-operative creatinine trend in donors

![Figure 2](image2.png)  
**Figure 2:** (a) Weck clip being applied during Right LESS donor Nephrectomy, (b) Surface view of LESS donor

![Figure 3](image3.png)  
**Figure 3:** (a) Renal pelvis dissected by LESS approach for LESS pyeloplasty (b) LESS pyeloplasty (c) Post-operative scar of LESS pyeloplasty
6/26 Fr Double-J stent at end of procedure. The follow-up functional study by a diuretic renogram was scheduled at 6 months.

LESS ureteroneocystostomy was performed in a 29-year-old female who had an iatrogenic injury to left ureter following a caesarean section. The patient was placed in supine oblique position. The R port™ was inserted through an umbilical incision. Once the sigmoid colon was reflected, the dilated ureter was identified, dissected and transected. The bladder was adequately mobilised and ureteroneocystostomy was performed with interrupted 4-0 Vicryl™ suture. A Double-J stent was placed at the end of procedure.

All the procedures were individually evaluated and analysed. The factors analysed in all procedures were body mass index (BMI), operating room time (time from port insertion to abdominal exit), estimated blood loss (suction fluid volume subtracted from the irrigation fluid volume used), VAS score (visual analogue score) for pain relief, immediately postoperatively and at 2 weeks was recorded by the patient, with assistance if required, on a numerical scale ranging from 1 to 10 and complications. In donor nephrectomy, the outcome was evaluated with regard to the donor VAS and the recipient serum creatinine at 1 month and 1 year. In reconstructive procedures, the functional assessment was done with a diuretic renogram at 6 months.

RESULTS

We have done 87 LESS urological procedures (donor nephrectomy-45, simple nephrectomy-27, radical nephrectomy-5, pyeloplasty-9, ureteroneocystostomy-1 [Table 1]. In donor nephrectomy, patients who had a minimum of 3 months follow up were analysed.

LESS donor nephrectomy (n=45) [Tables 1-4]: The mean operating room (OR) time was 179.3 ± 42.2 min. The mean estimated blood loss (EBL) was 119.74 ± 56.2 ml. The mean VAS score was 3.1 ± 0.7. The mean warm ischaemia time was 6.9 ± 1.9 min. We have done LESS donor nephrectomy in donors with retro-aortic renal vein (n=2), double renal artery (n=2), right side donors (n=4). On the right side, an Endo-GIA stapler was used for securing the renal vein in three cases and Hem-O-Lok™ clip in one case. One instance each of renal artery injury, renal vein injury, upper polar cortical laceration, bowel injury and two instances of diaphragmatic injury were encountered. The bowel injury was detected 1 week later and required laparotomy and colostomy. There was a renal vein laceration during retrieval in one case on the right side which required on bench reconstruction with donor gonadal vein. [Table 4] The mean donor creatinine at last follow up was 0.90 ± 0.19 mg% (follow up period ranging from 3 to 12 months). Scatter diagram as shown in Figure 1 reveals that the trend line is showing a decreasing trend as the follow up of the patients is increasing. The mean serum creatinine in recipients at 1 month was 0.96 ± 0.21 mg% and at 3 months was 1.01 ± 0.22 mg%.

LESS simple nephrectomy (n=27) [Tables 1-4]: The mean OR time was 148.7 ± 52.2 min. The mean estimated blood loss (EBL) was 138 ± 74.3 ml. The mean VAS score was 2.7 ± 0.7. Mean hospital stay was 3.7 ± 1.2 days. There was one large bowel injury during specimen retrieval which was detected immediately and it required on-table resection anastomosis, which could be completed from the umbilical incision itself [Table 4].

LESS radical nephrectomy (n=5) [Tables 1-4] [Figures 4a-d]: The mean OR time was 202.5 ± 35.7 min. The mean VAS score was 2.5 ± 1. Mean hospital stay was 4.2 ± 1.3 days. Size of the tumor removed was 4.5 ± 2.7 cm (3-8 cm) and the weight of the specimen was 384.6 ± 151.1 g (202-597 g). Three tumors were T1a and 1 each was T1b and T2a. Histopathology revealed three tumors to be conventional renal cell carcinoma (RCC) and two chromophobe RCC.

LESS pyeloplasty (n=9) [Tables 1-3]: A total of 9 cases of LESS pyeloplasty have been performed. The mean OR time was 204.6 ± 71.5 min. The mean VAS score was 2.6 ± 0.9. Mean hospital stay was 3 ± 0.7 days. Among the 9 patients, the functional outcome at 6 months is available in only 6 patients which showed good and unobstructed drainage.

LESS ureteroneocystostomy (n=1) [Tables 1-3]: The OR time was 140 min. The estimated blood loss was 250 ml. The mean VAS score was 4 at discharge.

**Table 1: Demographic data (n=87)**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Age (years) Mean ± SD (range)</th>
<th>Sex ratio M/F</th>
<th>Side (R/L)</th>
<th>BMI (kg/m²) Mean ± SD (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donor nephrectomy (n=45)</td>
<td>43.8 ± 10.3 (25-66)</td>
<td>13/32</td>
<td>4/41</td>
<td>22.1 ± 3.3 (16.8-29.8)</td>
</tr>
<tr>
<td>Simple nephrectomy (n=27)</td>
<td>31.7 ± 18.6 (1-68)</td>
<td>16/11</td>
<td>13/13 Bilateral 1</td>
<td>20.02 ± 4 (12-27.2)</td>
</tr>
<tr>
<td>Radical nephrectomy (n=5)</td>
<td>46 ± 15.2 (29-69)</td>
<td>3/2</td>
<td>2/3</td>
<td>22.8 ± 2.8 (12-29.56)</td>
</tr>
<tr>
<td>Pyeloplasty (n=9)</td>
<td>17.6 ± 9.7 (5-29)</td>
<td>7/2</td>
<td>3/6</td>
<td>16.2 ± 3.2 (11.9 – 21.7)</td>
</tr>
<tr>
<td>Ureteroneocystostomy (n=1)</td>
<td>29</td>
<td>0/1</td>
<td>0/1</td>
<td>28.1</td>
</tr>
</tbody>
</table>
DISCUSSION

LESS procedure challenges the basis of the “law of triangulation”. A variety of modifications in the instruments, port specifications have been suggested to achieve this “triangulation” of standard laparoscopy. Our initial experience suggests that as in any procedure, LESS also has a learning curve which needs to be surpassed.

Although specialised instruments have been described for performing the procedure, but as observed in our series the majority of dissection can be performed with routine laparoscopy instruments. The articulating instruments have been designed with curves to allow the principle of triangulation to be reestablished. In our series, the long harmonic scalpel was of particular use at the upper pole. A non articulating bent instrument was useful for retracting the lower pole during donor nephrectomy. A recent development in the optics is the work on magnetically anchored guiding system (MAGS). This emerging technology has the potential to free one of the channels in a multichannel port and reducing the cluttering and clashing of the instruments. As in our series, the Olympus endoeye camera has a coaxial light cable; hence, unlike the routine cameras and telescopes the light pillar does not clash with the working instruments and helps to improve dissection and retraction.

A variety of single access ports are available such as UNI–X, R port. In our opinion, the R-port has the following advantages, it offers atraumatic abdominal entry, it is elastic and hence provides entry to multiple instruments with relative ease.
As single port surgery or LESS is still an evolving technique, the learning curve has not yet been overcome and the procedure is evolving daily. Since our initial case series,[11] we have learnt a number of lessons and accordingly have incorporated several modifications.

The contemporary key issues regarding donor nephrectomy are the following:

a) Safe and easy graft retrieval, b) Whether adding an extra port adds to the morbidity of this procedure? and c) Is there an objective evidence of improved cosmesis and better post-op analgesia in these patients?

Our technique of LESS donor nephrectomy has already been described.[11] A variety of techniques have been described for graft retrieval such as using an endocatch bag, retrieval through a single access port placed through a pfannenstiel incision.[15] In our series, we have retrieved the grafts manually after introducing the hand partially. An extra 5 mm port inserted subcostally is useful for safe retrieval. Once the hilum is clipped and secured, this port helps to bring the graft near the umbilicus, so that the graft can be delivered safely with hand. In the past few cases, we have used an endocatch bag which is inserted through the R-port™ after the vessels are clipped. The graft is entrapped in the sac and retrieved without closing the endocatch bag™. This has helped in a comparatively quicker retrieval of the graft.

Although we have used the R-port through the umbilicus, studies have described the procedure with the ports being inserted through the pfannenstiel incision. The authors in this series used the flexible endoeye™ camera apart from flexible instruments for the purpose of dissection; when the graft was ready to be harvested, it was retrieved through the Pfannenstiel incision.[15]

In our experience, a xiphoid-umbilical length of more than 17 cm and BMI of more than 25 makes the dissection of the upper pole challenging. In our opinion, currently donors having xiphoid-umbilical length of more than 17 cm, BMI of more than 25, multiple vessels, an abnormal anatomy such as rterocaval ureter and an inexperienced donor surgeon should be contraindications for LESS donor nephrectomy. Among the major complications that we encountered, bowel injury was as a result of thermal energy dissipation to the bowel during dissection. The injury was recognised on the 7th post operative day. The patient required laparotomy and a colostomy. In the second case, an arterial injury occurred in a donor with double vessel. This patient was explored immediately through a flank incision and the bleeding controlled, the graft was salvaged without any sequel evident at 3 months follow up. In one case, a renal vein laceration in a right side donor nephrectomy required reconstruction with gonadal vein.

The recipient outcome in our series is encouraging. An ongoing randomised study at our centre comparing standard laparoscopy with LESS approach would help in answering the contemporary issues raised earlier in this section.

Ponsky et al presented their initial clinical experience for LESS radical nephrectomy. The authors found that LESS radical nephrectomy can be performed safely and effectively using standard laparoscopic instrumentation and with minimal blood loss and short hospitalisation.[8] The average size of tumors removed by us was 4.5 cm and majority of these were T1 tumors. We feel LESS radical nephrectomy has a role in selected cases of T1 and T2 tumors which are not candidates for nephron sparing surgery.

LESS pyeloplasty offers the benefit of virtually scarless surgery. The current issues regarding LESS pyeloplasty are the surgical expertise required for intracorporeal suturing, the surgeon should be prepared for single hand suturing if required. In 3 of our cases, a 3 mm retracting port was introduced to assist suturing. In these cases, a 1.9 mm grasper was introduced through a 3 mm retracting port to assist suturing. Our perception is that adding a port does not have an adverse cosmetic sequel. The LESS approach was also employed in a case with obstructive megaureter. The ability of the port to rotate on its own axis helps in dissection as well as suturing. Bilateral LESS pyeloplasty can be performed with same umbilical incision.[7]

CONCLUSION

LESS surgery is the recent addition in the armamentarium of minimally invasive surgery. It can be completed safely and effectively in simple nephrectomy and pyeloplasty and reconstructive procedures such as ureteroneocystostomy providing equivalent outcomes as standard laparoscopy and offers an additional benefit of better cosmesis and quicker convalescence.

LESS donor nephrectomy is a technically feasible procedure; however, the issue of prolonged warm ischaemia needs to be resolved. The status of the procedure needs to be defined with the currently ongoing randomised study at our centre. Multicentre studies will be of benefit in this direction. LESS surgery has definitely got a steep learning curve and hence it is essential that before embarking on this procedure, the operator should have adequate surgical expertise in standard laparoscopy.
REFERENCES


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