Original Article

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Retroperitoneoscopic nephrectomy using a GelPort as the main access platform with a muscle-splitting approach: initial clinical experience

Abstract  Objective: To describe our initial experience with retroperitoneoscopic nephrectomy utilizing a GelPort as the main access platform together with a muscle-splitting approach.

Patients and methods: Between March and August 2009, we performed 8 retroperitoneoscopic nephrectomies utilizing a GelPort. A transverse incision was made along the skin fold, and the flank abdominal muscles were split without cutting. We used standard straight instruments throughout the dissection process.

Results: The median operative duration and median estimated blood loss were 215 min (range 140–380 min) and 65 ml (range 20–280 ml), respectively. All cases were completed without conversion or serious complications. Complete convalescence took a mean of 24.8 +/- 6.5 days. Postoperative follow-up at 1 month showed good cosmetic appearance of wounds as well as high patient satisfaction.

Conclusion: Retroperitoneoscopic nephrectomy utilizing a GelPort together with a muscle-splitting approach is technically feasible. The required convalescence period is short, and excellent cosmesis is achievable.

Key words: retroperitoneoscopic, nephrectomy, GelPort, muscle-splitting approach

Introduction

In 1991, Clayman et al. described the first laparoscopic nephrectomy, which revolutionized the field of urology. Since then, advances in surgical techniques and equipment have allowed less invasive approaches in this procedure to be developed, which have shorter convalescence periods and reduced morbidity compared to open approaches.

In this procedure, dissection of the specimen is accomplished through several trocar sites, each of which requires a small incision, which risks morbidity from bleeding, hernia, and/or internal organ damage. Furthermore, it is necessary to elongate one or more of the sites in order to extract the specimen intact, which may reduce cosmesis or place a strain on the patient.

Recently, the laparo-endoscopic single site (LESS) nephrectomy procedure has become an exciting area of surgical development. It provides the performance of major surgery via a single small incision, which can be made at various sites, most of which are in the umbilicus or through a Pfannenstiel incision, producing nearly scar-free results with access to the surgical field through a small, solitary portal of entry into the peritoneum. However, several problems are apparent including the need for specialized equipment such as articulating or pre-bent laparoscopic instruments, more proficient laparoscopic skills to handle these devices, an extended distance from the port to the target, and risk of injury to the intraperitoneal organs.

To overcome these obstacles, we have developed a retroperitoneoscopic nephrectomy utilizing a GelPort as the main access platform together with a muscle-splitting approach. Here, we report this procedure and our initial results.

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Patients and methods

Between March and August 2009, 8 consecutive patients with renal tumors underwent retroperitoneoscopic nephrectomies using a GelPort (Applied Medical, CA, USA) as the main access platform together with a muscle-splitting approach. All data were prospectively accrued in an institutional review board (IRB) approved database. Follow-up information was obtained from office visits.

1. Access
The patient was placed in the full lateral position with slight flexion under general anesthesia. A 1.5-cm skin incision was made just below the tip of the 12th rib. Then, the flank muscle fibers were separated in a non-muscle-cutting fashion, before the anterior thoraco-lumbar fascia was incised to gain entry to the retroperitoneum. Blunt finger dissection was then performed along the anterior surface of the psoas muscles, posterior to Gerota’s fascia, and the retroperitoneal space was inflated using a balloon dissector (PDB™ Balloon, Covidien, CT, USA). The initial skin incision was then elongated along the natural skin fold (about 5 cm in diameter), and the three layers of the flank abdominal muscles were separated from one another without cutting. The GelPort was then mounted on the wound, and a pneumoretroperitoneum of 10 mmHg was created. Three standard non-cutting trocars (two of 12 mm and one of 5 mm in diameter) were placed through the GelPort. A flexible laparoscope was then inserted through one of the 12-mm trocars. An additional incision for a 5-mm trocar, which was manipulated by one of the surgeon’s hands, was made at a crossover site between the subcostal region and the midclavicular line (Fig. 1).

2. Surgical technique
We used standard laparoscopic instrumentation includ-

![Fig. 1](image1.png) **Fig. 1** Port placement of two of 12-mm and one 5-mm trocars through the GelPort. An additional 5-mm trocar was placed outside the GelPort.

![Fig. 2](image2.png) **Fig. 2** The GelPort was removed, and an entrapment bag was introduced into the retroperitoneal space. The specimen was then extracted intact.

ing the following: laparoscopic scissors, a monopolar electrocautery, suction-irrigation, a Soft Wand retractor (ACMI Corp., USA), a SonoSurg (Olympus, Tokyo, Japan), a LIGASURE™ (Covidien), a MULTI-FIRE ENDO TA™ 30 (Covidien), and Hem-o-lok clips (Teleflex Medical, NC, USA). No pre-bent or articulating instruments were applied. The laterocohal fascia was incised at the level between the crura of the diaphragm and the bifurcation of the aorta. While the kidney was retracted anteriorly, blunt dissection in the avascular area of the loose areolar fatty tissue along the anterior surface of the psoas muscle was performed so that the renal hilum was exposed. The renal artery was then circumferentially mobilized, occluded with Hem-o-lok clips, and then transected. Subsequently, the renal vein was mobilized, controlled with MULTI-FIRE ENDO TA™ 30 and Hem-o-lok clips, and then transected. The ureter was clipped and divided, and the remaining perinephric attachments were taken using a combination of blunt and sharp dissection. If the tumor was located in the upper portion of the kidney, concomitant adrenalectomy was performed. After it had been confirmed that the specimen had been completely freed from the surrounding tissue, the seal cap of the GelPort was removed, and a LAPSAC® (Cook Medical, IN, USA) was introduced through the site. The specimen was then entrapped in the bag and extracted intact (Fig. 2). Hemostasis was confirmed under lowered pneumoretroperitoneum, and a temporary drainage tube was inserted through the 5-mm trocar site. Fascial closure of each layer of the flank abdominal muscles was performed, and the incised skin was closed.

Results
The intraoperative data are detailed in Table 1. The median operative duration and median estimated blood loss was 215 min (range 140–380 min) and 65 ml (range 20–280 ml), respectively. The median tumor size was 40
Table 1  Patient demographics, tumor characteristics, and intraoperative data.

<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Sex</th>
<th>BMI (kg/m²)</th>
<th>Tumor size (mm)</th>
<th>Operative duration (min)</th>
<th>EBL (ml)</th>
<th>Pathology</th>
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</thead>
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<tr>
<td>1</td>
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<td>21.3</td>
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<td>230</td>
<td>210</td>
<td>RCC</td>
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<tr>
<td>2</td>
<td>65</td>
<td>M</td>
<td>28.4</td>
<td>50</td>
<td>200</td>
<td>50</td>
<td>RCC</td>
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<tr>
<td>3</td>
<td>77</td>
<td>F</td>
<td>26.7</td>
<td>37</td>
<td>200</td>
<td>40</td>
<td>RCC</td>
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<td>22.5</td>
<td>30</td>
<td>380</td>
<td>280</td>
<td>RCC</td>
</tr>
<tr>
<td>5</td>
<td>64</td>
<td>M</td>
<td>23.8</td>
<td>65</td>
<td>300</td>
<td>80</td>
<td>RCC</td>
</tr>
<tr>
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<td>65</td>
<td>F</td>
<td>26.9</td>
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<td>F</td>
<td>17.8</td>
<td>43</td>
<td>155</td>
<td>20</td>
<td>RCC</td>
</tr>
</tbody>
</table>

EBL : estimated blood loss, RCC : renal cell cancer

Fig. 3  Photograph of a representative patient at 1 month after surgery.

mm (range 33–65 mm). Concomitant en bloc adrenalectomy was performed in 2 patients. In all patients, the dissection was completed without an intraperitoneal or an open conversion, and intact extraction was achieved without extension of the primary site. Postoperative bleeding was observed in one patient and was managed conservatively without transfusion. The mean times to first oral intake and ambulation were 2.0 ± 0.4 days and 2.0 ± 0.5 days, respectively. Only 2 patients needed painkillers in addition to regional epidural anesthesia (a mixture of bupivacaine and a small amount of morphine), which was routinely administered. The mean time to complete convalescence was 24.8 ± 6.5 days. Postoperative follow-up at 1 month showed well-healed skin incisions that were hardly visible and had integrated well with the natural folds of the skin (Fig. 3). Patients’ satisfaction with the appearance of their scars was excellent.

All specimens were histopathologically confirmed as renal cell cancer with negative surgical margins. After a median follow-up of 14 months (range 11–16 months), neither local renal fossa nor port site recurrence had occurred, and no incisional hernia formation was observed.

Discussion

Laparoscopic nephrectomy is generally considered less invasive than open procedures, and several surgical approaches have been tested. Transperitoneal laparoscopic nephrectomy provides a larger working space; however, the risk of injury to the abdominal organs cannot be overlooked. On the other hand, the retroperitoneal approach allows direct, unencumbered, and rapid access to the renal hilum and by avoiding bowel handling may potentially minimize ileus and expedite patient recovery. Nevertheless, it has not found uniform acceptance because of the smaller working space, lack of well-defined anatomical landmarks and difficulty in removing large specimens. To expand the working space in retroperitoneoscopic nephrectomy, we employed a dilator balloon, and the lateroconal fascia was incised widely between the crura of the diaphragm and the bifurcation of the aorta. Furthermore, flexible readjustment of the trocar position within the GelPort during the procedure abrogates the difficulties regarding access to the surgical field and manipulation of the retroperitoneum.

In conventional laparoscopic nephrectomy, the specimen is often removed via an incision, which is made by extending the skin incision between several trocar sites. In this fashion, however, the elongated incision might become longer than required or intersect with natural skin folds. Otherwise, an additional incision in a different region apart from the trocar sites must be made after the dissection has been performed. In our experience, the main incision was made so that it ran along the skin fold, and both dissection and intact extraction were achieved through the primary site without extension being required. Therefore, we believe that our procedure has the significant advantage regarding cosmesis compared to conventional laparoscopic nephrectomy.

LESS nephrectomy has been advocated by several urologic specialists. Although the early experience of LESS is promising, more proficient laparoscopic skills such as handling of articulating or pre-bent laparoscopic instruments are essential for the safe and effective completion of surgery. In addition, the majority of LESS nephrectomy procedures have been performed.
using a transperitoneal approach. Recently, Ryu DS et al. reported their initial experience of several types of laparoscopic urologic surgical procedures including nephrectomy via a retroperitoneal approach with a single port\textsuperscript{12}. Although their surgical results were excellent, they used flexible instruments for the dissection, and the specimens were extracted through separate low Gibson incisions. Although our procedure was not a ‘single-site’ surgical procedure in the strict sense, only one additional small trocar site, where a temporary drain was later placed, was employed. Under this method, triangulation was easily achieved without using specialized instruments, and the internal and external clashing of instrument shafts was minimal. Moreover, by one month after surgery, every patient in the current study had become almost ‘scar-less’ and acquired an acceptable degree of convalescence, which seemed comparable with the results for LESS procedures\textsuperscript{13, 14}.

Incisional hernia (IH) may occur as a delayed complication of laparoscopic radical nephrectomy. This complication most commonly develops at the extraction site. Bird et al. demonstrated that using a paramedian extraction was a significant risk factor for IH in patients with a high body mass index\textsuperscript{15}. They postulated that the higher incidence of IH associated with that extraction site was due to the relative lack of abdominal wall fascia for wound closure. Another study of IH rates after hand-assisted laparoscopic nephrectomies showed that midline incisions had a higher IH rate\textsuperscript{16}. In our procedure, the peritoneum is preserved intact, the three layers of the flank abdominal muscles are separated without cutting, and each fascial closure is performed. This may account for the result that no IH formation was observed in the current study although longer follow-up is needed.

It should be noted that for large tumors, performing nephrectomy with our technique is still challenging. In the current report, the patients were limited to T1 (according to the 2002 American Joint Committee on Cancer (AJCC) stages) tumors. With larger tumors, entrapment of the specimens may be difficult in the somewhat smaller retroperitoneal space. Desai et al. demonstrated the feasibility of intentional high anterior peritoneotomy with the final entrapment performed within the larger intraperitoneal space\textsuperscript{17}. Another crucial point is how to extract large specimens. It may be difficult to extract them intact through the primary incision without extending it. Although intracorporeal mechanical morcellation is a possible alternative, it is still controversial. Critics state that morcellation does not allow for adequate tumor staging and margin status and that there is a concern over port site and extraction site tumor seeding\textsuperscript{18}. Several reports, however, have demonstrated that there were no discernible differences between intact specimen removal and morcellation with regard to oncological efficacy\textsuperscript{19, 20}.

**Conclusion**

This preliminary report suggests that retroperito-

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**References**


son of different extraction sites used during laparoscopic radical nephrectomy. J Urol 181: 1565-1570