Incisional lumbodorsal hernias following retroperitoneal robotic partial nephrectomies for small renal masses at a high-volume tertiary referral center

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Incisional Lumbodorsal Hernias Following Retroperitoneal Robotic Partial Nephrectomies for Small Renal Masses at a High-Volume Tertiary Referral Center

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Abstract

Introduction: Herein we evaluate the incidence of incisional lumbodorsal hernia (ILDH) after retroperitoneal robotic partial nephrectomy (RRPN) and associated patient-specific and tumor-specific risk factors. Furthermore, we aim to evaluate the role of routine lumbodorsal fascial closure for the prevention of ILDH.

Methodology: This is a retrospective review of our robotic partial nephrectomy database of all RRPNs performed at Washington University School of Medicine from 2000 to 2020. Postoperative imaging was reviewed for evidence of ILDH. A clinically significant hernia was defined as the protrusion of visceral organ(s) through the lumbodorsal fascia. Patient and tumor characteristics, and fascial closure techniques were analyzed to determine predictors of ILDH.

Results: In total, 150 patients underwent RRPN between 2007 and 2020 with an average follow-up of 4.9 (1–37) months. Twelve (8%) ILDHs were identified. Ten (6.7%) patients had herniated retroperitoneal fat whereas 2 (1.3%) patients had herniated colon. All were asymptomatic and managed conservatively. On matched cohort comparison, patients with ILDH had larger tumors than patients without an incisional hernia (3.9 cm vs 2.8 cm, \(p=0.029\)). In general, patient factors were no different between patients with and without ILDH. However, coronary artery disease (CAD) was more prevalent in patients with ILDH (33.3% vs 10.9%, \(p=0.028\)). Patients with ILDH were more likely to have a port site extended for specimen extraction (66.7% vs 38.2%, \(p=0.069\)). Lumbodorsal fascial closure and type of suture material were not associated with prevention of ILDH (\(p=0.545\), \(p=0.637\)).

Conclusion: The radiographic incidence of lumbar incisional hernias after RRPN without routine fascial closure of the extraction incision was 8%. All were asymptomatic and did not require surgical repair. Larger tumor size and CAD were associated with ILDH.

Keywords: retroperitoneal robotic partial nephrectomy, incisional hernia, lumbodorsal hernia, small renal masses

Introduction

The anatomical definition of a lumbodorsal hernia is a protrusion of a visceral organ or fat within the lumbar region bordered superiorly by the 12th rib, medially by the erector spinae muscle, inferiorly by the iliac crest, and laterally by the external oblique muscle. The first literature report of lumbodorsal hernias as a result of surgical incisions was published in 1951 by Herman L. Kretschmer, MD, Professor of Urology at Rush Medical College. In this report, he presented a series of 11 patients who developed an incisional lumbodorsal hernia (ILDH) after open flank incision for kidney surgery.

Since Kretschmer’s initial report, several other articles have described similar incisional hernias of the lumbodorsal space after open renal surgery for malignancy as well as for donor renal allografts. The incidence of ILDH after open retroperitoneal surgery falls in the range of 20% to 30%. Retroperitoneal laparoscopic radical nephrectomies have mitigated the risk of ILDH by omitting the need for a large incision for surgical exposure. Yet an ILDH after retroperitoneal laparoscopic radical nephrectomy can still occur at the extraction site incision, with an estimated incidence of 11%.

In the modern era of minimally invasive surgery, extraction incisions are significantly smaller owing to earlier detection of renal cell carcinoma (consequently favorable stage...
migration) as well as a general trend toward nephron sparing approaches resulting in smaller surgical specimens. To this day, there have been no published reports on the incidence of ILDH after retroperitoneal robotic partial nephrectomy (RRPN). Herein we present the incidence of ILDH after RRPN and associated patient-specific and tumor-specific risk factors. Furthermore, we aim to evaluate the role of routine lumbodorsal fascial closure of the extraction incision in preventing ILDH.

Methods

Institutional review board approval was obtained before the study. This retrospective review fell under the Washington University School of Medicine Urology Data Repository IRB No. 201304085. We performed a review of our robotic partial nephrectomy database and included patients who underwent RRPN at Washington University School of Medicine in St. Louis from 2007 to 2020. Patients were included in the study if postoperative surveillance imaging was available within our electronic medical record for review.

Our surgical approach is as follows. After induction of general anesthesia, all patients were placed in the full flank position and the bed was flexed to fully expand the space from the iliac crest to the tip of the 12th rib. Retroperitoneal access was obtained by making a 1.5 cm horizontal incision just caudal to the tip of the 12th rib. The incision is carried down to the level of the flank musculature. A large hemostat is then used to bluntly penetrate the lumbodorsal fascia and the retroperitoneal space is created with a combination of blunt digital dissection to accommodate a 12 mm balloon dilating trocar that is used as a 12 mm camera port. Additional 8 mm ports are placed in a linear manner into the retroperitoneal space. A 12 mm Airseal port is placed between the 12 mm trocar that is used as a 12 mm camera port. Additional 8 mm ports are placed in a linear manner into the retroperitoneal space. A 12 mm Airseal port is placed between the 12 mm camera and immediate anterior working 8 mm port (Figure 1; left-sided retroperitoneal partial nephrectomy). All cases were completed with pneumoperitoneum established at 15 mm Hg.

Tumors were routinely extracted by extending the 12 mm camera port laterally as needed for accommodation of the renal mass. After tumor extraction, the operating bed was leveled to remove tension on port site incisions before closure. Routine lumbodorsal fascial closure of the extraction site was not done. Fascial closure of the 12 mm Airseal port and the 8 mm robotic ports was also omitted. A subcutaneous closure of all port site incisions was completed with 4-0 Monocryl in a running manner followed by a surgical skin adhesive.

The most recent postoperative surveillance CT and MRI reports were reviewed for findings of “incisional hernia,” “lumbar hernia,” “trocar-site hernia,” or “lateral/posterolateral abdominal wall hernia.” Radiographic images were reviewed for confirmation of documented ILDH. A clinically significant hernia was defined as the protrusion of visceral organs through the lumbodorsal fascia, whereas a clinically insignificant hernia was defined as a protrusion of retroperitoneal fat through the lumbodorsal fascia. Patients with hernias were characterized as either symptomatic or asymptomatic.

Operative reports were reviewed to determine whether extension of the camera port site incision was required for specimen extraction, whether the lumbodorsal fascia was closed, and the type of suture used for fascial closure.

Patient characteristics including age, gender, and medical comorbidities, as well as tumor characteristics including clinical size and nephrometry score were analyzed to determine predictors of ILDH. Extension of the camera port site for tumor extraction, lumbodorsal fascial closure, and suture type was also compared between patients who developed ILDH and those who did not.

Wilcoxon rank-sum test and Fisher’s exact test were used to assess statistically significant differences for quantitative and qualitative variables, respectively. All analyses were performed using R version 3.5.2. Statistical significance was set to \( p < 0.05 \).

Results

We identified 183 patients who underwent RRPN between 2007 and 2020, which encapsures the experience of three robotic urologic surgeons. Thirty-three patients did not have available follow-up imaging for review and were excluded from the study. Mean follow-up as determined by time from surgery to most recent surveillance imaging was 4.9 (1–37) months. Of these patients, 12 (8%) had incidental hernias within the lumbodorsal region identified on surveillance imaging. ILDH was diagnosed on average 6.4 (3–15) months after RRPN. Ten (6.7%) patients had herniated retroperitoneal fat and were classified as clinically insignificant ILDH, whereas two (1%) patients had clinically significant hernia with herniated portions of colon. All patients were asymptomatic.

The two patients with herniated colon did not develop a bowel obstruction or require herniorrhaphy. Apart from a palpable reducible hernia on examination, both patients were asymptomatic. Patient 1 was a 59-year-old male with a left 3.9 cm renal mass. The port site incision was extended and the lumbodorsal fascial closure was completed with a running 0-Vicryl. In both cases, the peritoneum was not violated. The herniated colon was diagnosed 5 months postoperatively (Fig. 2). The patient is now 6 years out from surgery and has not requiring herniorrhaphy. Patient 2 is a 62-year-old male with a right 5 cm renal mass. The camera port site incision was extended and the lumbodorsal fascial closure was...
completed with a running 0-Vicryl, without evidence of peritoneal violation. Evidence of retroperitoneal fat herniation was identified 3 months after surgery. A portion of herniated colon was not seen until 23 months after RRPN (Fig. 3). The patient is now 4 years out from surgery and is being managed conservatively.

On matched cohort comparison, patients with ILDH on average had larger tumors than patients without incisional hernia ($3.9 \text{ cm} vs 2.8 \text{ cm}, p = 0.029$). The nephrometry score was slightly higher in patients with ILDH than in those without hernias ($8.3 vs 7.1, p = 0.061$).

Patient factors including age, gender, body mass index (BMI), diabetes mellitus (DM), hypertension (HTN), chronic obstructive pulmonary disease (COPD), ≥stage 4 chronic kidney disease (CKD), and Charleston comorbidity index were not statistically different between patients with and without ILDH. Whereas coronary artery disease (CAD) was more prevalent in patients with ILDH (33.3% vs 10.9%, $p = 0.047$) (Table 1).

The cohort with ILDH was more likely to have the camera port site extended for specimen extraction but this relationship did not reach statistical significance (66.7% vs 38.2%, $p = 0.069$). Lumbodorsal fascial closure was not associated with development of an ILDH (75% vs 64.7%, $p = 0.545$). Although the suture material was documented in the operative note, a running technique vs interrupted technique was not and may have differed depending on surgeon preference. There was no difference in the type of suture material used (0 Vicryl or 0 Polydioxanone) for fascial closure, ($p = 0.637$) (see Table 2 for comparison).

**Discussion**

Patients undergoing retroperitoneal surgery can commonly develop bulging of the flank musculature (pseudohernias)

---

**Table 1. Comparison of Patient and Tumor Characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Incisional hernia = no</th>
<th>Incisional hernia = yes</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>57.7</td>
<td>61.1</td>
<td>0.283</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>12.1</td>
<td>6.4</td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>31.5</td>
<td>31.4</td>
<td>0.719</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>7.6</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>43.5%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Male</td>
<td>56.5%</td>
<td>75.0%</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>No</td>
<td>74.6%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>25.4%</td>
<td>33.3%</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>No</td>
<td>42.0%</td>
<td>41.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>58.0%</td>
<td>58.3%</td>
<td></td>
</tr>
<tr>
<td>CCI</td>
<td>0</td>
<td>49.3%</td>
<td>50.0%</td>
</tr>
<tr>
<td>1</td>
<td>18.1%</td>
<td>16.7%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>15.3%</td>
<td>8.3%</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>17.4%</td>
<td>25.0%</td>
<td></td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>91.3%</td>
<td>83.3%</td>
<td>0.311</td>
</tr>
<tr>
<td>No</td>
<td>8.7%</td>
<td>16.7%</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10.9%</td>
<td>33.3%</td>
<td></td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>No</td>
<td>89.1%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>10.9%</td>
<td>33.3%</td>
<td></td>
</tr>
<tr>
<td>Preoperative GFR &lt;30</td>
<td>No</td>
<td>97.8%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Yes</td>
<td>2.2%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Current or former smoker</td>
<td>No</td>
<td>55.8%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Yes</td>
<td>44.2%</td>
<td>66.7%</td>
<td></td>
</tr>
<tr>
<td>Nephrometry score</td>
<td>Mean</td>
<td>7.1</td>
<td>8.3</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.8</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical tumor size</td>
<td>Mean</td>
<td>2.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>1.2</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CCI = Charleston comorbidity index; GFR = Glomerular Filtration Rate.

$p = 0.069$). Lumbodorsal fascial closure was not associated with development of an ILDH (75% vs 64.7%, $p = 0.545$). Although the suture material was documented in the operative note, a running technique vs interrupted technique was not and may have differed depending on surgeon preference. There was no difference in the type of suture material used (0 Vicryl or 0 Polydioxanone) for fascial closure, ($p = 0.637$) (see Table 2 for comparison).

**FIG. 2.** Patient 1 with herniated portion of the descending colon.

**FIG. 3.** Patient 2 with herniated portion of the ascending colon through the extraction site (extended camera port incision).
that may be inaccurately diagnosed as a true ILDH.\textsuperscript{4,5} Pseudohermia describes a weakening of the flank musculature resulting in laxity of the lumbar region. The primary pathogenesis is believed to involve a denervation injury to the lateral abdominal wall secondary to transection of intercostal and subcostal nerves.\textsuperscript{4,5} The injury can arise from traction injury or division/ligation of the nerve, which occurs when the nerves are not readily identified.\textsuperscript{10,11} Denervation injury leads to gradual thinning of the muscle and fascia that then predisposes patients to herniation.\textsuperscript{12}

In our study, to accurately detect truly clinically significant ILDH after RRPN, we performed a radiographic review of surveillance CT and MRI imaging and found the incidence to be \(~1\% \ (n=2)\). In both instances, both patients had asymptomatic colonic herniation with no clinical manifestations including the absence of pain or gastrointestinal symptoms. In both cases, the IDLH was observed without adverse outcomes. In contrast, clinically significant hernias can be found up to 11% of the time after transperitoneal robotic partial nephrectomy.\textsuperscript{13}

In our study, larger tumors (3.9 cm or greater) are a major risk for development of ILDH and this finding may imply that proper fascial closure should be done in such cases. However, fascial closure did not appear to be protective against ILDH when analyzed independently. Furthermore, calculated neophometry score was found to be higher in patients with ILDH (8.3 vs 7.1, \(p=0.061\)) although the higher calculated complexity is reflective of large tumor size rather than tumor location and endopchicity. Although this finding did not reach significance, it further suggests risk of herniation for extraction of larger tumors.

At our institution, we do not routinely perform fascial closure of the extraction site for a couple reasons. First, RRPN for a small renal mass when done without violation of the peritoneal cavity should have null risk of visceral herniation with the exception of the retroperitoneal portion of the ascending and descending colon. If herniated, the large diameter of the colon makes it a sliding hernia rather than prone to incarcerate and obstruct. Second, fascial closure may inadvertently ligate intercostal and subcostal nerves between the transversalis and internal oblique fascia that then induce gradual atrophy of the muscle and fascia, acting as a predisposing factor for ILDH. Particularly in a small laparoscopic incision, intercostal and subcostal nerves are not readily identifiable to exclude from the suture lines. In our series, 8 of 11 (72%) patients with clinically insignificant hernias and 2 of 2 (100%) patients with clinically significant hernias had fascial closure done, which further questions whether lumbodorsal fascial closure is protective against or an instigator of lumbodorsal herniation.

Risk factors for lumbodorsal hernias are similar to those of other hernias. Prior published reports of lumbodorsal hernias after open retroperitoneal procedures identified patient risk factors including elevated BMI, tobacco use, DM, HTN, COPD, CAD, and end-stage renal disease.\textsuperscript{14-16} Specifically, a BMI of \(>23\) kg/m\(^2\) has been strongly associated with development of fascial hernias \((p=0.018, \text{ odds ratio} = 16.9)\).\textsuperscript{20} Similar elevated risk ratios were seen in BMI \(>26\) and \(>28\) in separate studies.\textsuperscript{11,15} Notably, our cohort had a higher average BMI of 31. We analyzed similar patient-specific factors. and although we noted higher prevalence of males, older age, DM, HTN, COPD, \(\geq\)stage 4 CKD, and Charleston comorbidity index in the ILDH group, none of these variables reached statistical significance. This further suggests that patients with these existing risk factors should be managed with RRPN if possible as to minimize the risk of ILDH, owing to smaller incisions and less likelihood of flank denervation injury compared with the open approach.

In our study, CAD had a significant threefold prevalence in patients who developed ILDH (33% vs 9%, \(p=0.029\)). CAD is a well-established risk factor for poor wound healing as it effects every phase of the wound healing process. Poor vascularity leads to reduction of neutrophil and lymphocyte infiltration during the inflammatory phase as well as reduction of angiogenic factors and deposition of collagen and extracellular membrane during the proliferation and remodeling phase of healing.\textsuperscript{21} In addition to compromised blood flow, extension of incision may further compromise blood supply required for fascial healing. Further study is needed to determine the significance of CAD as it relates to ILDH.

We recognize several limitations including the inherent bias with data collection associated with the retrospective nature of our methodology. The first limitation relates to our institution as a high-volume tertiary referral center. Our review may not capture the true incidence of ILDH after RRPN as patients will have more recent surveillance imaging with their local urologists. As evident by Patient 2, clinically significant hernia can manifest at a delayed manner, up to 23 months after RRPN. By the same token, longer follow-up analysis is needed beyond our average postoperative follow-up of 4.9 (range 1–37) months. In addition, ILDH can be positional and can potentially be missed with purely supine imaging. Lastly, symptomatology was based on documentation rather than physical examination, which we admit is instrumental and necessitated in a proper evaluation for an incisional hernia.

**Conclusion**

The radiographic incidence of lumbar incisional hernias after RRPN without routine fascial closure of the extraction incision was 8%. All were symptomatic and did not require surgical repair. Larger tumor size and CAD were associated with ILDH.

**Table 2. Comparison of Specimen Extraction and Fascial Closure Technique**

<table>
<thead>
<tr>
<th></th>
<th>Incisional hernia = no</th>
<th>Incisional hernia = yes</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera port site extended for extraction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>88</td>
<td>61.8%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Yes</td>
<td>60</td>
<td>38.2%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Not mentioned</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>35.3%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Yes</td>
<td>95</td>
<td>64.7%</td>
<td>75.0%</td>
</tr>
<tr>
<td>Not mentioned</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 looped PDS</td>
<td>15</td>
<td>15.7%</td>
<td>22.2%</td>
</tr>
<tr>
<td>0 Vicryl</td>
<td>77</td>
<td>84.3%</td>
<td>77.8%</td>
</tr>
<tr>
<td>Not available</td>
<td>58</td>
<td></td>
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References


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Abbreviations Used

BMI = body mass index
CAD = coronary artery disease
CCI = Charleston comorbidity index
CKD = chronic kidney disease
COPD = chronic obstructive pulmonary disease
CT = computed tomography
DM = diabetes mellitus
HTN = hypertension
ILDH = incisional lumbar-dorsal hernia
MRI = magnetic resonance imaging
RRPN = retroperitoneal robotic partial nephrectomy