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# LAPAROSCOPIC NEPHROURETERECTOMY FOR UPPER TRACT TRANSITIONAL CELL CANCER: THE WASHINGTON UNIVERSITY EXPERIENCE

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## ABSTRACT

Purpose: Laparoscopic nephroureterectomy has only recently been done to treat patients with upper tract transitional cell carcinoma. We retrospectively evaluated our experience with and long-term followup of laparoscopic nephroureterectomy, compared our results to those of contemporary series of open nephroureterectomy and reviewed the literature.

Materials and Methods: We reviewed the charts of and followed up by telephone 25 patients who underwent laparoscopic nephroureterectomy between May 1991 and June 1998, and 17 who underwent open nephroureterectomy between March 1990 and January 1997. Demographic, perioperative and followup data were compared. We performed a MEDLINE search and reviewed the literature on laparoscopic nephroureterectomy for upper tract transitional cell carcinoma.

Results: Laparoscopic nephroureterectomy required twice the operating time of open nephroureterectomy (7.7 versus 3.9 hours). However, patients who underwent the laparoscopic procedure had a 74% decrease in analgesia requirements (37 versus 144 mg. morphine sulfate equivalent), a 63% shorter hospital stay (3.6 versus 9.6 days) and a 72% more rapid convalescence (2.8 versus 10 weeks). Subsequent bladder transitional cell carcinoma and overall cancer specific survival were similar at a mean followup of 2 years. There was no sign of trocar site or peritoneal seeding after laparoscopic nephroureterectomy.

Conclusions: Although laparoscopic nephroureterectomy is a longer operation, it has the same efficacy and is better tolerated by patients than open nephroureterectomy for upper tract transitional cell carcinoma. As operating time decreases due to surgeon experience and the recent development of hand assisted laparoscopy, laparoscopic nephroureterectomy may soon become the procedure of choice for the ablative management of upper tract transitional cell carcinoma.

KEY WORDS: carcinoma, transitional cell; kidney; nephrectomy; laparoscopic surgical procedure

Open complete nephroureterectomy with excision of the ipsilateral ureteral orifice and a periureteral cuff of bladder is accepted standard operative therapy for most patients with upper tract transitional cell carcinoma.[1] This major operation involves 1 or 2 long abdominal incisions that cause significant postoperative discomfort and a lengthy convalescence. In recent years minimally invasive, antegrade or retrograde endoscopic management has become an acceptable option under highly select circumstances, such as solitary kidney, renal insufficiency, bilateral tumors or when there is a high anesthetic risk.[2] However, minimally invasive management of upper tract tumors remains controversial in patients with 2 functional intact kidneys even when the tumor is of low stage and grade.[3] In the majority of these patients open radical nephroureterectomy remains the standard of care.

Laparoscopic nephrectomy is a recognized form of therapy for patients with benign renal disease.[4] Recently the laparoscopic approach has been extended to include the management of renal cell cancer by radical or complete nephrectomy.[5] In an attempt to minimize patient morbidity from open nephroureterectomy for upper tract transitional cell carcinoma the initial clinical laparoscopic nephroureterectomy was performed at our institution in May 1991, followed by a series of 10 cases completed in July 1994.[6,7] To date 25 patients with upper tract transitional cell carcinoma have been treated with laparoscopic nephroureterectomy at our institution. We describe our current method of laparoscopic nephroureterectomy, retrospectively review our experience with and long-term followup of this procedure, compare our results to those of contemporary series of open nephroureterectomy and review the literature on laparoscopic nephroureterectomy for upper tract transitional cell carcinoma.

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## PATIENTS AND METHODS

We retrospectively reviewed the charts and followed up by telephone 25 patients who underwent laparoscopic nephroureterectomy for upper tract transitional cell carcinoma between May 1991 and June 1998, and 17 consecutive patients of a contemporary series who underwent open nephroureterectomy between March 1990 and January 1997. Patients underwent laparoscopic or open nephroureterectomy based on surgeon preference at a single institution where 1 group of surgeons exclusively performed laparoscopic and open procedures, respectively. Demographic, perioperative and followup data were recorded and compared. Statistical analysis was done using Student's t test and a commercially available statistical program. We performed a MEDLINE search using the key words, surgical procedures-

laparoscopic, carcinoma-transitional cell, kidney neoplasms and nephrectomy. Reports on laparoscopic nephroureterectomy for upper tract transitional cell carcinoma were reviewed and summarized.

Disease staging, indications and preoperative preparation are largely similar for laparoscopic and open nephroureterectomy. The only exception is that 24 hours before the laparoscopic procedure the patient is placed on a clear liquid diet for 24 hours and given a laxative suppository on the morning of surgery to empty the bowel. The details of our 5 to 6-port transperitoneal technique have been previously reported.[8] However, it is important to emphasize a few points. In all cases a pure laparoscopic approach was used with intact removal via an 8 cm. lower midline or subcostal incision at the end of the procedure. Except for 1 patient in whom a pluck procedure was performed the distal ureter was managed by transurethral ureteral unroofing and electrocoagulation without penetrating the bladder wall just before the laparoscopic procedure. The Foley catheter was maintained in the bladder 2 to 3 days after laparoscopic nephroureterectomy, at which time a cystogram was performed to test bladder cuff closure. When there was no extravasation, the Foley catheter was removed.

The postoperative followup protocol included cystoscopy and urine sampling for cytology every 3 months for 2 years, every 6 months for 2 years and then annually if no bladder tumor recurred. Baseline abdominal computerized tomography was done 2 to 3 months postoperatively. Chest x-ray, abdominal computerized tomography and excretory urography were recommended yearly.

## RESULTS

Data were obtained on 25 and 17 patients who underwent laparoscopic and open nephroureterectomy, respectively. Body mass index and American Society of Anesthesiologists (ASA) risk grade were similar in both groups, although laparoscopy group patients tended to be older (table 1). Laparoscopic excision of the kidney with the ureter and a bladder cuff was successful in all except our initial patient, in whom a 1 cm. ureteral stump remained postoperatively. Pathological evaluation showed no positive margins or lymph node metastasis but the final pathology report revealed renal cell cancer in 1 laparoscopy case.

Total operating time for laparoscopic nephroureterectomy, including ureteral unroofing and repositioning the patient from supine to lateral decubitus, was nearly double that of the open procedure (table 2). On the other hand, estimated blood loss and hospital stay were more than 50% less, and postoperative analgesia requirement (morphine sulfate equivalent), time to oral intake and return to normal activity were less then a third that of open nephroureterectomy (table 2). When determining average hospital stay, we excluded 2 complicated cases in each group for which stay was more than 21 days.

Of the laparoscopic group 2 patients had major postoperative complications (table 2). Bleeding developed in a 73-year-old man (ASA 4). Open surgical exploration 7 hours after the laparoscopic procedure revealed bleeding along the inferior edge of the adrenal gland. The patient received 13 units of blood. Postoperatively the adult respiratory distress syndrome developed but after it resolved the patient had a fatal cardiac arrhythmia on postoperative day 66.

Radiation cystitis developed in a 68-year-old man (ASA 4) with a history of prostate carcinoma treated with external beam radiation therapy 1 year before laparoscopic nephroureterectomy. Postoperatively the patient had hematuria, clot retention and urine leakage from the bladder staple line secondary to clot retention. Cystoscopy and electrocoagulation of several bleeding sites failed, necessitating alum and formalin instillation. Deep venous thrombosis with bilateral lower limb edema then developed, which was treated with anticoagulants. Eventually the bladder leak and lower extremity edema resolved with conservative management, and the patient was discharged home on postoperative day 65.

Of the open nephroureterectomy group 5 patients had major complications postoperatively (table 2). Pneumonia and acute renal failure in a 73-year-old man (ASA 3) were managed conservatively. The patient was discharged home on postoperative day 23. In a 64-year-old man (ASA 2) intraoperative injury to the spleen necessitated transfusion of 3 units of blood, although splenectomy was not required. Subsequently myocardial infarction was managed conservatively and the patient was discharged home on postoperative day 13. A 28-year-old woman (ASA 2) with a pleural injury that required a chest tube was discharged home on postoperative day 6. Pneumonia and atrial fibrillation in an 83-year-old man (ASA 4) were treated medically, and he was discharged home on postoperative day 10. A 38-year-old man (ASA 2) received antibiotic treatment for pneumonia and was discharged home on postoperative day 8.

In a patient with a preoperative diagnosis of transitional cell carcinoma on ureteroscopy the final pathological evaluation revealed multifocal granulomatous inflammation. At 23 months a small bladder lesion was fulgurated but not biopsied. At 38 months of followup he has no evidence of disease.

At surgery 2 patients had urothelial atypia. One patient underwent percutaneous resection of the primary tumor before laparoscopic nephroureterectomy. At 6-month followup there was bladder recurrence and transurethral bladder tumor resection was done. Pathological evaluation showed a grade 1, T1 lesion. He subsequently received a course of bacillus Calmette-Guerin and had no recurrence in the next 5 years. In the other patient ureteroscopic resection of the tumor before laparoscopic nephroureterectomy demonstrated grade 1 transitional cell carcinoma. Subsequently a stage Ta tumor that recurred in the bladder was resected 17 months later. The patient was doing well until he died of a cardiac event 50 months after laparoscopic nephroureterectomy.

Pathological evaluation revealed a grade 1 tumor in 7 patients, of whom 4 had no recurrence at an average followup of 75 months (range 70 to 79). One patient who underwent transurethral resection of a recurrent stage Ta bladder lesion at 23 months is doing well at 32 months of followup. One patient with a grade 1, stage T2 primary tumor had lung metastases at 7-month followup. Cisplatin, methotrexate and vinblastine chemotherapy was administered, and there was no progression at 29 months of followup. He was lost to followup after October 1997, although at that time chest x-ray showed no metastatic lesions. The remaining patient with a grade 1 primary tumor died 2 months after laparoscopic nephroureterectomy. In another case the final pathological evaluation revealed renal cell carcinoma.

A total of 13 patients who underwent laparoscopic or open nephroureterectomy had a tumor grade 2 or greater as well as long-term followup (table 3). Followup was insufficient in 1 and 4 cases in the laparoscopic and open groups, respectively. At a mean cystoscopic followup of 24 months for laparoscopic and 43 months for open nephroureterectomy the rate of lower tract recurrence was 23% and 54%, respectively

TABLE 1. *Demographic data*

| | Laparoscopic Nephroureterectomy | Open Nephroureterectomy | p Value |
|---|---|---|---|
| No. pts. | 25 | 17 | |
| No. men/women | 14/11 | 11/6 | |
| Av. age (range) | 69.7 (50–87) | 62 (28–84) | 0.08 |
| Av. body mass index | 28.4 (20.5–47.3) | 24.8 (17.1–33.6) | 0.8 |
| Av. ASA score | 2.84 (2–4) | 3 (2–4) | 0.5 |

TABLE 2. *Operation and convalescence data*

| | Laparoscopic Nephroureterectomy | Open Nephroureterectomy | p Value |
|---|---|---|---|
| Av. hrs. ureteral unroofing and stent placement (range) | 0.7 (0.25–1.3) | | |
| Av. hrs. overall operating time (range) | 7.7 (4.4–11) | 3.9 (2.1–6) | <0.001 |
| Av. cc estimated blood loss (range) | 199 (25–400) | 441 (150–1000) | 0.002 |
| Pathological grade/stage | 1–4/pTa–pT3 | 2–4/pT1–pT3 | |
| Av. gm. specimen wt. (range) | 445 (110–1,350) | 380 (132–895) | 0.5 |
| Av. mg. morphine equivalent (range) | 37 (0–168) | 144 (24–365) | <0.01 |
| Av. hrs. to oral intake (range) | 23 (6–72) | 116 (72–288) | <0.001 |
| Av. days hospital stay (range): | | | |
| All pts. | 6.1 (2–65) | 12 (4–34) | 0.108 |
| Excluding major complications | 3.6 (2–7) | 9.6 (4–34) | <0.001 |
| Wks. to normal activity (range) | 2.8 (1–9) | 10 (4–16) | 0.002 |
| No. complications (%): | | | |
| Major | 2 (8) | 5 (29) | |
| Minor | 10 (40) | 5 (29) | |

TABLE 3. *Pathology and followup data*

| | Laparoscopic Nephroureterectomy | Open Nephroureterectomy |
|---|---|---|
| No. grade 2 disease or greater | 13 | 13 |
| Final pathological grade: | | |
| 2 | 6 | 8 |
| 3–4 | 7 | 4 |
| Mos. cystoscopic followup (range) | 24 (4–77) | 43 (23–70) |
| No. lower tract recurrences (%) | 3 (23) | 7 (54) |
| No. recurrence location: | | |
| Bladder | 3 | 6 |
| Urethra | 0 | 1 |
| No. transitional cell Ca metastasis | 4 (31%) | 3 (23%) |
| No. metastatic location: | | |
| Retroperitoneum | 2 | 0 |
| Pelvis | 1* | 0 |
| Liver | 1 | 1 |
| Lung | 1* | 1† |
| Bone | 0 | 1† |
| Diffuse | 0 | 1 |
| Wks. to transitional cell Ca recurrence | 76 (28–250) | 92 (32–224) |
| No. crude survival (%) | 10 (77) | 9 (69) |
| No. specific survival (%) | 10 (77) | 10 (77) |

* Same patient.
† Same patient.

(table 3). However, at 24 months there were only 4 lower tract recurrences (24%) in the open group, similar to that in the laparoscopic group. All of these cases were treated with transurethral resection.

There were 3 cases of retroperitoneal metastases in the laparoscopic group (table 3). Despite adjuvant chemotherapy for a grade 4, stage T3b tumor that developed 9 months postoperatively the patient with metastatic disease died at 12 months. Another patient with grade 3, stage T4 tumor invading the adrenal gland and radiation cystitis had recurrence in the renal bed at 8 months. He received chemotherapy and radiation therapy but died with liver metastases 10 months after surgery. The remaining patient had a grade 4, stage T2 tumor. Ipsilateral pelvic and lung metastases were identified 4 months postoperatively and the patient died at 9 months. To date there has been no port site or intraperitoneal seeding in the laparoscopic group.

Three patients in the laparoscopic group had distant metastases (table 3). One patient with grade 3, stage T4N1 transitional cell carcinoma had liver metastases 8 months postoperatively and died 2 months later. In another patient with grade 4, stage T2 disease ipsilateral pelvic and lung metastases developed. The remaining patient with a grade 3, stage T4 lesion had liver metastases.

No patients in the open group had retroperitoneal recurrence, although distant metastasis developed in 3 (table 3). A patient with a grade 4, stage T3N0 distal ureteral tumor died of diffuse metastatic disease 18 months after surgery. A patient with a grade 2, stage T1N0 lesion who had liver metastases at 23 months died a month later. The remaining patient with grade 2, stage T2Nx disease had bone metastasis 2 months postoperatively. Lung metastases developed and the patient died 4 months later.

In an effort to try to relate the pathological grade and stage of upper tract transitional cell carcinoma to the subsequent development of metastatic disease we divided cases into low (grade 1, T1; grade 1, T2; grade 2, T1; grade 2, T2), medium (grade 3, T1; grade 3, T2; grade 4, T1; grade 4, T2; grade 1, T3; grade 1, T4; grade 2, T3; grade 2, T4) and high (grade 3, T3; grade 3, T4; grade 4, T3; grade 4, T4) risk groups for metastatic disease (table 4). However, in our analysis it was interesting that in each category at least 1 patient had metastatic disease and the risk of bladder transitional cell carcinoma was equivalent in all 3 risk categories.

## DISCUSSION

In 1995 we reported what is to our knowledge the initial, completely described series in the peer reviewed literature on laparoscopic nephroureterectomy for transitional cell carcinoma of the upper tract.[7] Since then, our experience has increased to 25 patients (table 1). To date only 3 series of laparoscopic nephroureterectomy for upper tract transitional cell cancer have been reported and none provides followup beyond 2 years[9–11] (table 5). Chung et al described 6 cases, including 1 conversion to open surgery, in which the laparoscopic retroperitoneal approach was used for nephrectomy, and an open infraumbilical approach for distal ureter and bladder cuff management as well as for intact specimen removal.[9] They stated that operative time for the laparoscopic part of the procedure was 4.6 hours but unfortunately

TABLE 4. *Risk of bladder recurrence and retroperitoneal or distant metastatic disease according to combined pathological grade and stage*

| Risk | Laparoscopic Nephroureterectomy | | | | Open Nephroureterectomy | | | |
|---|---|---|---|---|---|---|---|---|
| | No. Pts. | Bladder | Retroperitoneal | Distant | No. Pts. | Bladder | Retroperitoneal | Distant |
| Low | 4 | 2 | 0 | 0 | 5 | 3 | 0 | 1 |
| Medium | 2 | 1 | 1* | 1* | 2 | 1 | 0 | 0 |
| High | 4 | 0 | 2 | 1 | 3 | 1 | 0 | 1 |

* Same patient.

TABLE 5. *Laparoscopic nephroureterectomy literature review of reports on more than 2 patients*

| | References | | | |
|---|---|---|---|---|
| | Chung et al[9] | Keeley and Tolley[10] | Salomon et al[11] | Present Study |
| No. pts./No. conversions | 6/1 | 18/3 | 4 | 25 |
| Approach | Retroperitoneal | Transperitoneal | Retroperitoneal | Transperitoneal |
| Ureter handling | Open bladder cuff | Pluck | Open bladder cuff | Stapled |
| Specimen removal | Intact infraumbilical | Intact infraumbilical | Intact Gibson | 17 Intact, 8 morcellated |
| Operating time (hrs.) | 4.6 | 2.6 | 3.6 | 7.7 |
| Estimated blood loss (cc) | Not available | Not available | 220 | 199 |
| Pathological grade/stage | Not available | Not available | 2–3/T2–T3 | 1–4/Ta–T3 |
| Hospital stay (days) | 9 | 5.5 | 5.7 | 3.6 |
| Convalescence (wks.) | 5.9 | Not available | Not available | 2.8 |
| Followup (mos.) | 12.6 | Not available | 18 | 39 |
| No. Recurrences: | 1 | 2 | 1 | 13 |
| Bladder | 1 | Not available | 0 | 7 |
| Local | 0 | 1 | 1 | 3† |
| Metastasis | 0 | 1 | 0 | 3† |

† Ipsilateral pelvis and lung metastases in same patient.

did not indicate pathological tumor stage and grade. During an average followup of 12.6 months they noted only 1 bladder recurrence. They prefer the retroperitoneal approach due to the hypothesized decrease in bowel injury. Chung et al also prefer traditional open bladder cuff removal to avoid the risk of urine leakage and tumor cell implantation in the pelvis, as reported by others after transurethral resection of the ureteral tunnel and plucking the ureter cephalad.[12–14]

Salomon et al used a similar approach to laparoscopic nephroureterectomy in 4 patients with renal pelvic transitional cell carcinoma.[11] To secure the distal ureter and bladder cuff they used the retroperitoneal approach to the kidney and made a Gibson incision. However, instead of opening the bladder the cuff was taken from the outside of the bladder using a large right angle clamp, so that the urinary tract was never opened. By this method they decreased operating time to 3.6 hours. There was no bladder recurrence and 1 local recurrence during the average followup of 18 months.

Keeley and Tolley reported 18 cases, including 3 conversions to open surgery, in which they used the pluck technique for the bladder cuff and removed the specimen intact via a lower port extension.[10] The pluck technique essentially involves thorough transurethral resection of the ureteral orifice and intramural ureter to allow the distal ureter to be easily detached from the bladder after the kidney and proximal ureter are mobilized. Total operating time was 2.6 hours, which is rapid (table 5). Pathological tumor stage and grade were not indicated for all of their patients and followup was not stated. During followup they observed only 1 bladder and 1 retroperitoneal recurrence in a patient with a stage pT3 ureteral tumor. In 3 patients with mid and/or distal ureteral tumors the ureter and bladder cuff were managed through an open lower abdominal incision at the end of surgery. In obese patients Keeley and Tolley performed hand assisted laparoscopy via a 7 to 10 cm. incision into which a plastic sleeve was placed. This maneuver resulted in an even shorter operating time of less than 2 hours.

Open nephroureterectomy for upper tract transitional cell carcinoma includes removal of a generous cuff of bladder with the ureter. In this regard there have been concerns about using titanium staples to secure the bladder cuff in laparoscopic nephroureterectomy. However, Figenshau et al established that the laparoscopic endoscopic gastrointestinal anastomosis tissue stapler reliably secures the bladder cuff.[15] This technique minimizes the risk of tumor spillage since the bladder cuff just caudal to the ureter is secured and occluded with 6 rows of titanium staples before it is incised. Postoperative followup cystography confirmed a watertight bladder closure with this technique. To our knowledge neither animal studies nor clinical reports have indicated any problems associated with staples, including our series with followup of just greater than 7 years. In 1 patient 2 titanium staples were visible in the ureteral stump. Cystoscopy 3½ years after laparoscopic nephroureterectomy showed no signs of encrustation or infection. Titanium is well tolerated in the urinary tract due to its corrosive resistant nature, low toxicity, and excellent tissue and fluid biocompatibility.[16, 17]

During the years we have modified our technique. Specifically we believe that the entrapped specimen may be treated differently for ureteral tumors and when biopsy of a papillary grade I noninvasive renal pelvic tumor is largely excisional. For ureteral tumors the bladder cuff may be clipped with a 9 mm. clip to the mouth of the entrapment sack, so that when the mouth of the sack is delivered onto the abdominal wall the bladder cuff side of the specimen is delivered simultaneously. The whole ureter may then be pulled from the sack, clipped and cut proximally. The ureter is then opened away from the operating table. Provided that the whole ureteral tumor has been retrieved the remaining kidney is morcellated via a 12 mm. port site, precluding enlargement of the port site to 7 to 10 cm. This maneuver holds true for grade 1, low stage transitional cell carcinoma. In these cases the neck of the sack is triple draped, and a high-speed electrical tissue morcellator is used to fragment and evacuate the specimen. Urban et al reported that a commercially available laparoscopy sack, which is constructed of a double layer of plastic and nondistensible nylon, is impermeable and remains so even after specimen morcellation.[18] Thus, currently our policy is to remove only higher grade or higher stage renal pelvic tumors intact because in these cases accurate staging and grading may lead to effective adjunct chemotherapy.

We observed that the oncological efficacy of laparoscopic nephroureterectomy is largely equivalent to that of open nephroureterectomy. In each group cancer specific survival was similar, metastatic disease was diagnosed within 2 years of surgery and the lower tract recurrence rate was similar at 24 months of followup (table 3). However, it is disconcerting that in our laparoscopic group 3 of the 7 patients with grade 4, stages T2 to 4 disease had local retroperitoneal tumor metastasis. None of the 4 patients with a similar grade of disease who underwent the open procedure had evidence of retroperitoneal recurrence. In this regard it is noteworthy that patients who present with upper tract transitional cell carcinoma with extension of the disease outside of the kidney and/or ureter have a high rate of local recurrence and a median survival of only 6 months. Our only laparoscopic group patient with stage T4 disease died 10 months after surgery.[19] Despite the seemingly higher incidence of retroperitoneal recurrence in the laparoscopic group, the incidence of metastatic disease, and crude and cancer specific survivals were similar in each group.

In addition, in both groups metastatic disease was diagnosed within less than 24 months postoperatively. Therefore, the longer followup in the open group does not necessarily

suggest that the laparoscopic group will have more metastatic disease at a longer followup. Overall the laparoscopic group had 3 retroperitoneal recurrences and 1 case more than the open group with metastatic disease. However, 54% of the laparoscopic group and only 38% of the open group had grade 3 or 4 disease. Also, the only patient with stage T4 disease was in the laparoscopic group and he had metastatic disease.

From an efficiency standpoint laparoscopic nephroureterectomy was far inferior to open nephroureterectomy. Operating time for the laparoscopic procedure was twice as long as for open surgery (table 2). Part of the problem in this regard is the relative lack of surgeon experience with laparoscopic nephroureterectomy. As we became more experienced, operating time decreased by 21% to 6 hours. In addition, time-saving maneuvers may be used. Using pluck ureterectomy with a hand assisted approach Keeley and Tolley achieved an operating time equivalent to that of open nephroureterectomy.[10]

Laparoscopic nephroureterectomy had several benefits over open nephroureterectomy in regard to patient equanimity. Patients lost half as much blood, required 4-fold less morphine sulfate equivalent for postoperative analgesia, resumed oral intake 6 times more rapidly, were discharged from the hospital almost 3 times sooner and returned to normal activity 2 times sooner. In our series the major complication rate was lower for laparoscopic nephroureterectomy (table 2). Notably there was a higher incidence of pulmonary complications in the open than in the laparoscopic group (4 of 17 cases or 24% versus 0%). This finding is similar to that reported by Keeley and Tolley, who noted pulmonary complications in 19% and 4.5% of patients in the open and laparoscopic groups, respectively.[10] The difference may correlate with postoperative pain and splinting due to the subcostal incision made for the renal portion of 2-incision open nephroureterectomy as well as with the tendency of patients treated laparoscopically to hyperventilate to avoid hypercarbia.

## CONCLUSIONS

At this time the efficacy of laparoscopic nephroureterectomy for upper tract transitional cell cancer appears to be similar to that of open nephroureterectomy in regard to bladder recurrence, metastatic disease, and crude and cancer specific survival. While concerns over port site and intraperitoneal seeding have been voiced and duly noted, to our knowledge this complication has not developed to date. A disconcerting point involves the higher incidence of retroperitoneal recurrence in the laparoscopic group. Whether this incidence is due to the laparoscopic approach or the high grade and stage of disease treated in our series cannot yet be determined due to our small number of cases and limited followup. In this regard the importance of the accurate reporting of grade and stage, and the need for thorough meticulous followup cannot be overemphasized. Given the small number of cases of upper tract transitional cell carcinoma, it is important for investigators interested in laparoscopic nephroureterectomy to present data in a consistent fashion to allow the proper pooling of information.

Laparoscopic nephroureterectomy provides patients with obvious benefits, including fewer pulmonary complications, less postoperative discomfort, a shorter hospital stay, a better cosmetic result and a brief convalescence. The major drawback to is the longer operating time, although our operative approach continues to evolve to address this issue. We recently began to take advantage of the incision required for intact specimen removal to allow hand assistance for mobilizing the kidney and ureter. We believe that with increasing surgeon experience and greater acceptance of hand assisted laparoscopy operating time will markedly decrease. When operating time decreases and if the question of retroperitoneal seeding is answered satisfactorily, laparoscopic nephroureterectomy may well become the procedure of choice for the ablative management of upper tract transitional cell carcinoma.

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