



Original Article

Prediction of Postsurgical Pain from Hand-Assisted Laparoscopic Nephroureterectomy

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Abstract

Objective: We retrospectively reviewed the medical records of patients who underwent hand-assisted laparoscopic nephroureterectomy using a retroperitoneal or transperitoneal approach at National Taiwan University Hospital. Early postsurgical pain scores and the amount of morphine equivalents consumed were evaluated.

Patients and Methods: From July 2001 to June 2005, a total of 96 patients who underwent hand-assisted laparoscopic nephroureterectomy and bladder cuff resection were retrospectively evaluated. Perioperative parameters, postoperative opioid dose, and daily pain score based on a 10-point visual analog scale (VAS) were recorded prior to discharge. Potential predictive factors included patient age, gender, body mass index, comorbid conditions, surgical time, patient controlled analgesia (PCA) use and surgical access. These were analyzed with regard to pain based on a daily VAS score and morphine dose (equivalents).

Results: The daily VAS score decreased from 4.7 ± 1.5 on the day of surgery to 2.0 ± 0.7 on postoperative day (POD) 6. Only the operation time was associated with a high VAS score on POD1 ($p < 0.01$). On univariate analysis, a longer operation time ($p = 0.04$) and PCA use ($p < 0.01$) were associated with higher intake of morphine equivalents. Patients with end-stage renal disease (ESRD) required less morphine postoperatively ($p = 0.02$). On multivariate analysis, PCA use ($p = 0.04$), ESRD ($p = 0.045$), and operation time ($p = 0.049$) were independently associated with postoperative morphine dosage. Women had a trend of increased postoperative morphine use ($p = 0.06$). The postoperative daily VAS score and opioid dosage were comparable in patients receiving trans- and retroperitoneal access.

Conclusion: Patients who had a longer operation had a significantly higher POD1 pain score. PCA use and prolonged operation time were predictive factors for a higher dosage of morphine. (*Tzu Chi Med J* 2008;20(2): 130–135)

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1. Introduction

With its minimally invasive characteristics, laparoscopic surgery has gained wide acceptance since its initial use. Laparoscopic surgery has been reported to have the advantages of earlier convalescence, shorter hospital stays, and less postoperative pain compared with open surgery (1,2). It is well established that laparoscopic surgery also leads to significantly reduced use of postoperative opiate medications.

Proponents of hand assistance during laparoscopic surgery stress that it does not compromise the minimally invasive characteristics of laparoscopic surgery and it enables less use of analgesic medications (3,4). Pain associated with hand-assisted and pure laparoscopic surgery is comparable. Also, hand assistance shortens surgeons' learning curve in laparoscopic surgery and decreases the length of the operation. During hand-assisted radical laparoscopic nephroureterectomy, a skin incision is required for placement of a hand port and for intact specimen retrieval. In clinical practice, some patients still suffer severe postoperative pain around the incision. However, studies of predictive factors of postoperative pain after hand-assisted laparoscopic surgery remain scarce. In addition to advantageous early postoperative pain detection, the incidence and severity of pain can be successfully managed via specific medications and procedures. Therefore, the present study focused on identification of predictive factors associated with postsurgical and subsequent opiate medication. Our goal was to enable more aggressive use of postsurgical analgesic treatment.

2. Patients and methods

2.1. Patients

We retrospectively reviewed 114 consecutive patients who underwent laparoscopic unilateral nephroureterectomy with bladder cuff resection for upper urinary tract urothelial carcinoma between July 2001 and June 2005 done by six surgeons at National Taiwan University Hospital. In this non-randomized study, we selected patients who had trans- or retroperitoneal hand-assisted laparoscopy according to the surgeon's preference. All surgeons did trans- or retroperitoneal laparoscopic hand-assisted procedures according to their standard routine. All patients were thought to have disease confined to the unilateral upper urinary tract, based on preoperative imaging. Patient data and perioperative parameters were recorded and analyzed. Body mass index (BMI) was defined as body weight (kg)/body height squared (m^2). Kidney volume (mL) and specimen weight (g) were recorded from pathological

reports. The kidney volume was calculated with the ellipsoid formula: volume (cm^3)=length (cm) \times width (cm) \times thickness (cm) $\times\pi/6$.

2.2. Clinical evaluation and surgical methods

Of 114 consecutive patients who underwent hand-assisted laparoscopic nephroureterectomy, 18 patients had incomplete or missing records and were excluded from further analysis. The remaining 96 patients had undergone hand-assisted laparoscopic nephroureterectomy and bladder cuff resection and had met the prerequisites for participation in our study. Forty-six patients received hand-assisted retroperitoneoscopic surgery in a flank position. After a 7-cm Gibson incision, the ipsilateral bladder cuff was resected and the urinary bladder was closed in layers. A hand-assisted device (Hand-Port™ System; Smith & Nephew, MA, USA) was applied on the open incision, with a 12-mm working port and a 12-mm camera port created at the subcostal level of the middle and posterior axillary lines, respectively.

Fifty patients received hand-assisted transperitoneal laparoscopic surgery in a semi-flank position. After a 7-cm Gibson incision and bladder cuff resection, a hand-assisted device (Hand-Port™ System; Smith & Nephew) was applied on the open wound and a 12-mm camera port was created at the umbilicus. In left-sided surgery, the working port was placed at the umbilical level of the left anterior axillary line. In right-sided surgery, the working port was placed at the subcostal level of the mid-clavicular line.

Postsurgically, patients received intramuscular meperidine (25 or 50 mg every 4–6 hours, as needed), intramuscular morphine (5 or 10 mg every 4–6 hours, as needed) or patient-controlled analgesia (PCA; 2 mg of intravenous morphine, as needed) for management of postsurgical pain. The dosage of opioid analgesia, including meperidine and morphine, was recorded in all cases. Meperidine 7.5 mg was considered to be equivalent to 1 mg of morphine. After patients resumed oral intake of medications, acetaminophen (500 mg every 6 hours) was given for pain control.

The 10-point visual analog scale (VAS) has been verified to be a useful tool for quantifying subjective pain levels. We used the 10-point VAS (0=no pain, 10=worst pain ever experienced) to measure postsurgical pain. The VAS was recorded postoperatively after the patients were discharged from the recovery room and daily at 8 am on morning rounds. Data were obtained from the day of surgery to the sixth day after surgery. The time of first intake of medication and the length of hospital stay were recorded and analyzed.

2.3. Statistical analysis

Data were analyzed by commercial statistical software (Medcalc®, version 9.3, USA). Demographic and perioperative parameters were compared via independent samples *t* test (continuous demographic variables) and χ^2 test (nominal data). The potential predictive factors evaluated included patient age, gender (male *vs.* female), side (right *vs.* left), BMI, time in surgery, hypertension, end-stage renal disease (ESRD), surgical access (retroperitoneoscopic *vs.* transperitoneal laparoscopic), method of postoperative analgesia (PCA *vs.* as-needed analgesia) and operation time. These were analyzed using independent samples *t* test (for nominal data), correlation test (for continuous demographic variables) and multiple regression with regard to postsurgical morphine equivalent consumption and daily VAS score. A *p* value of less than 0.05 was considered statistically significant.

3. Results

Patient data and perioperative parameters are listed in Table 1. No significant differences in patient characteristics, mean time to oral intake or length of hospital stay were observed between the trans- and retroperitoneal laparoscopy groups. Patients who underwent the retroperitoneoscopic approach spent significantly longer times in surgery ($p=0.02$), had

higher perioperative blood loss ($p=0.01$) and had larger kidney volumes ($p=0.02$). Perioperative and postoperative complications are listed in Table 1. Postoperative prolonged ileus (defined as an inability to tolerate water or food for longer than 7 days postoperatively) occurred in one patient. One patient who underwent a retroperitoneal procedure had hemodynamic shock during surgery due to an inadvertent injury to the inferior vena cava. Another patient who had a transperitoneal approach experienced an inadvertent injury to the inferior epigastric vessels, resulting in an abdominal wall hematoma.

3.1. The 10-point VAS for subjective pain measurement

The 10-point VAS scores from the day of operation to postoperative day (POD) 6 are shown in Fig. 1. No significant difference in daily VAS score was observed between the retro- and transperitoneal approaches (all $p>0.05$). Postoperative pain scores, age, BMI, gender, surgery time, method of postoperative analgesia (PCA *vs.* as-needed analgesia) and surgical approach (trans- *vs.* retroperitoneal) were all analyzed. On univariate and multivariate analysis, only a longer operation time was associated with a higher VAS score on POD1 ($p<0.01$). No significant association was observed between operation time and VAS score on the other days (all $p>0.05$).

Table 1 — Demographic and perioperative data*

Risk factors	Transperitoneal (n=50)	Retroperitoneal (n=46)	Total (n=96)	<i>p</i>
Mean age (yr)	69±11	66±12	68±11	0.18
BMI	24±4	24±4	24±4	0.50
Male/female	23/27	26/20	49/47	0.31
Left/right	22/28	27/19	49/47	0.15
Hypertension	17 (34)	16 (35)	33 (34)	0.94
Diabetes mellitus	9 (18)	11 (24)	20 (21)	0.48
ESRD	6 (12)	4 (9)	10 (10)	0.60
Previous abdominal surgery	7 (14)	3 (7)	10 (10)	0.24
Cigarette smoking	10 (20)	9 (20)	19 (20)	0.96
Operative time (min)	212±74	252±87	231±82	0.02
Specimen weight (g)	130±69	155±60	142±66	0.08
Kidney volume (cm ³)	106±61	134±59	119±61	0.02
Blood loss (mL)	114±217	495±1238	296±714	0.01
Morphine equivalents (mg)	8±7	10±9	9±8	0.40
Time to oral intake (hr)	40±22	45±19	43±21	0.25
Time to discharge (d)	8±2	9±4	8±3	0.19
Open conversion	0 (0)	2 (5)	2 (2)	0.21
Complications				
Prolonged ileus		1	1	
Delirium	1		1	
Hematoma formation	1		1	
Hemodynamic shock		1	1	

*Data are expressed as mean±standard deviation or *n* or *n* (%). BMI=body mass index; ESRD = end-stage renal disease.

3.2. Postsurgical morphine equivalent consumption

The mean cumulative consumption of morphine equivalents was 8.5 ± 6.7 mg and 9.9 ± 9.4 mg for the trans- and retroperitoneal approaches, respectively ($p=0.40$). Eighty-three (86.5%) of the 96 patients received as-needed opioid analgesia and 13 (13.5%) received PCA postoperatively. Tables 2 and 3 show the results of univariate analysis with regard to consumption of morphine equivalents. In univariate analysis, PCA ($p<0.01$) and longer operation times ($p=0.04$) were associated with higher consumption of morphine equivalents. Women tended to use more morphine equivalents ($p=0.06$). Patients with ESRD used less morphine postoperatively ($p=0.02$). In multivariate analysis, PCA ($p=0.04$), ESRD ($p=0.045$) and operation time ($p=0.049$) were independently associated with use of postoperative morphine equivalents. Women had a trend of using more postoperative morphine equivalents on multivariate analysis ($p=0.06$).

4. Discussion

In the management of upper tract transitional cell carcinoma, laparoscopic nephroureterectomy and bladder cuff resection have become the standard of care. A significant reduction in postsurgical morphine consumption was observed in the laparoscopic series compared to open surgeries. In our patients, the average consumption of morphine equivalents was 9.1 ± 8.0 mg. Our study revealed a postsurgical pain score of 4.7 ± 1.5 on the day of surgery which then decreased to 2.0 ± 0.7 by POD6. No patients reached

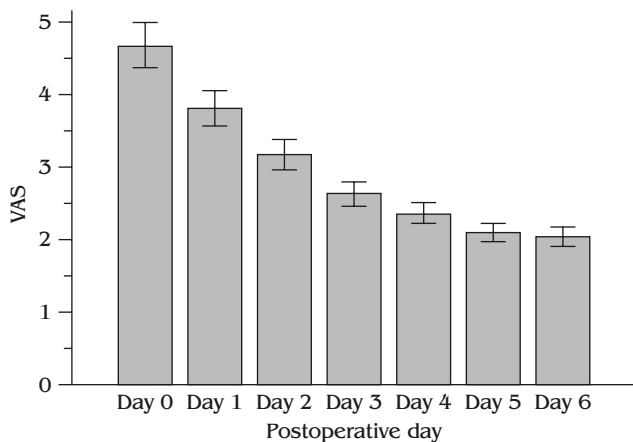


Fig. 1 — Postsurgical pain scores on visual analog scale (VAS) from the day of operation (day 0) to postoperative day 6 (day 6).

VAS=0 by POD6. To our knowledge, no other study has investigated predictive factors of early postoperative pain after hand-assisted laparoscopic nephroureterectomy. Our study demonstrated that prolonged operation time is associated with higher postoperative pain scores on POD1. PCA and prolonged operation time were independently associated with higher morphine consumption. Patients with ESRD required less analgesia postoperatively. Women tended to use more morphine equivalents on univariate and multivariate analysis.

Persistent arguments over whether to use a trans- or retroperitoneal approach in the management of upper tract urothelial carcinoma remain unresolved (3,5). Despite a transperitoneal approach being associated with a larger working space and with familiar anatomy, some surgeons prefer a retroperitoneal approach to avoid intraperitoneal contamination which could result in the spread of cancer and bowel injury (6). A review of previous studies did not show a significant difference in postoperative consumption of morphine equivalents (1). Although patients who underwent a retroperitoneal approach had more mean blood loss and longer mean operative times, there were no

Table 2 — Effect of dichotomous risk factors to analgesic use on univariate analysis

Risk factors	n	Morphine mg equivalence (mean±SD)	p
Sex			0.06
Male	49	7.6±7.1	
Female	47	11±8.8	
Side			0.53
Left	49	8.6±7.6	
Right	47	9.7±8.6	
Access			0.40
Transperitoneal	50	8.5±6.7	
Retroperitoneal	46	9.9±9.4	
Hypertension			0.80
Positive	33	8.9±8.1	
Negative	63	9.3±8.1	
Diabetes mellitus			0.26
Positive	20	12±11	
Negative	76	8.5±6.9	
ESRD			<0.01
Positive	10	3.7±4.6	
Negative	86	9.8±8.2	
Previous abdominal surgery			0.39
Positive	10	13±14	
Negative	86	8.7±7.2	
Cigarette smoking			0.32
Positive	19	8.6±5.1	
Negative	71	9.2±8.4	
PCA			<0.01
Positive	13	15.3±9.2	
Negative	83	8.3±7.6	

ESRD = end-stage renal disease; PCA = patient-controlled analgesia.

significant differences in postsurgical consumption of morphine equivalents and daily pain score between trans- and retroperitoneal access groups in our study. To our knowledge, our study is the first to compare postoperative pain scores between trans- and retroperitoneal hand-assisted laparoscopic surgery.

Postsurgical pain after laparoscopic surgery has visceral origins (due to surgical manipulation and diaphragm irritation) and somatic origins (from incisions in the abdominal wall for the hand port and trocars). Disputes over whether pain from visceral or somatic origin plays a larger role postoperatively after laparoscopic surgery have been discussed in several studies (7,8). In hand-assisted laparoscopic donor nephrectomy, pain around the incision was thought to be the main component of postsurgical pain (9). In hand-assisted laparoscopic nephroureterectomy, pain around the incision accounted for most postsurgical pain. Although laparoscopic nephroureterectomy is less painful than open surgery, previously published studies did not describe the postsurgical pain score in detail. Our study thoroughly detailed the daily postsurgical pain scores (Fig. 1).

Hand assistance may make laparoscopic surgery more attractive to urologists without much laparoscopic surgery experience. Also, hand assistance improves manipulative ability and tactile sense during surgery and facilitates intact specimen retrieval (4). In National Taiwan University Hospital, radical laparoscopic nephroureterectomy is mainly done using hand assistance. Hand assistance appears to have a shorter learning curve than standard laparoscopic techniques without compromising the beneficial characteristics of minimally invasive surgery. However, the incision wound for installing the hand port accounts for the major part of postsurgical pain in hand-assisted laparoscopic nephroureterectomy and pain of visceral origin might account for a minor portion. Retraction of the Gibson incision wound is required during an open bladder cuff resection and the long time involved in placement of the hand port at the incision wound may result in local ischemia and injury to the wound, resulting in pain that is classified as postsurgical pain. Also, prolonged irritation and surgical manipulation may aggravate postsurgical pain. In our study, prolonged time of surgery correlated

with a higher postoperative pain score on POD1 and higher consumption of morphine equivalents. The surgical time was associated with the VAS score on POD1 but not on the day of surgery, possibly because analgesic agents used during anesthesia may interfere with the pain score on the day of surgery.

Morphine clearance is decreased in patients with decreased renal function or with renal failure, so the analgesic effects of morphine are increased in such patients. In our study, patients with ESRD had a relatively shorter operation time (187 ± 29 minutes *vs.* 236 ± 85 minutes; $p=0.08$) and they required less postsurgical morphine equivalents on univariate analysis despite comparable postsurgical daily pain scores. In consideration of the effects of operation times on postsurgical morphine equivalents, ESRD and operation times were analyzed using multivariate analysis. The results showed that ESRD and operation times were independent factors for morphine equivalents.

Although the postoperative daily VAS scores for women and men were comparable ($p>0.05$) and the women had lower body weights than the men (54.5 kg *vs.* 65.3 kg; $p<0.01$), the women showed a trend of higher consumption of postsurgical morphine equivalents ($p=0.06$ on both univariate and multivariate analyses). Most of our patients (86.5%) received an intramuscular opioid analgesic postsurgically. Men in Asia may have a higher pain tolerance or they may be unwilling to express pain and ask for opioid medication.

Rassweiler et al (1) retrospectively reviewed laparoscopic nephroureterectomy for upper genitourinary tract transitional cell carcinoma. The consumption of postsurgical morphine equivalents ranged from 12 mg to 275 mg, which was higher than the dosage in our series. In a series from Asia, the dosage of morphine equivalents was relatively lower. The reason may be due to a combination of cultural differences, body weight, and/or inappropriate pain management protocols. Asian patients may be unwilling to ask for opioid analgesia if their pain is at all tolerable. Many factors prevent patients from receiving opioid analgesia on an as-needed basis in a consistent manner. In a review by Hudcova et al (10), patients using PCA consumed more opioid medication after surgery. In our study, a total of 13 patients received PCA postoperatively. In patients receiving PCA, higher morphine consumption was

Table 3 — Correlations between continuous or numeric risk factors and analgesic use

Risk factors	Correlation coefficient	95% interval of correlation coefficient	<i>p</i>
Age	-0.0612	(-0.2585) - 0.1410	0.55
BMI	-0.0450	(-0.2443) - 0.1580	0.67
Specimen weight	-0.0097	-0.2175 - 0.1989	0.93
Kidney volume	0.0145	(-0.1865) - 0.2144	0.89
Blood loss	0.1815	(-0.0197) - 0.3686	0.08
Operative time	0.2174	0.0117 - 0.4004	0.03

BMI = body mass index.

observed on univariate and multivariate analyses (all $p < 0.05$) although they had pain scores that were comparable to those who received as-needed analgesia. Therefore, patients on as-needed analgesia received a less than optimal dosage of morphine. PCA provided better pain control than conventional as-needed prescription for opioid analgesia and did not increase the length of hospital stay or the incidence of nausea, vomiting and urine retention. Based on our study, PCA should be considered for better pain control in patients receiving lengthy surgery.

The major limitation in our study was its retrospective nature. Surgical accesses were decided based on the surgeons' preferences. Prospective, randomized studies with longer follow-up of perioperative parameters, pain score, quality of life and long-term outcome are now warranted. However, this study provided valuable data for prediction of postsurgical pain scores and the consumption of morphine equivalents for approximately 1 week after patients underwent hand-assisted laparoscopic nephroureterectomy.

5. Conclusion

Although hand-assisted laparoscopic nephroureterectomy is less painful than open surgery, some patients suffered severe postoperative pain. Patients with longer operative times had significantly higher pain scores on POD1. PCA and prolonged surgery time were independent predictive factors of increased postoperative need for morphine equivalents.

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