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Author(s)	Cheung, MC; Lee, FCW; Chu, SSM; Leung, SYL; Wong, BBW; Ho, KL; Tam, PC
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MC Cheung 張文釗
FCW Lee 李燦榮
SM Chu 朱世民
YL Leung 梁耀琳
BBW Wong 王博偉
KL Ho 何崑崙
PC Tam 談寶雛

Laparoscopic nephrectomy: an early experience at Queen Mary Hospital

瑪麗醫院進行腹腔鏡腎臟切除術的早期經驗

Objective. To report our early experience of laparoscopic nephrectomy.
Design. Prospective data collection.
Setting. Queen Mary Hospital, Hong Kong.
Patients. Transperitoneal laparoscopic nephrectomies were performed on 40 patients between July 1997 and December 2002.
Main outcome measures. Demographic and perioperative data including operating time, blood loss, postoperative pain score, analgesic requirement, complications, time to resume oral intake, ambulatory state, and length of hospital stay.
Results. Laparoscopic nephrectomy was performed for 21 solid renal masses, five transitional cell carcinomas, and 14 non-functioning kidneys. Seven (17.5%) patients had previous abdominal surgery. The mean body mass index of the patients was 23.9 kg/m^2 and the mean operating time was 229 minutes. The mean estimated blood loss was 370 mL, and two patients required conversion to open surgery because of intra-operative bleeding. Other complications include diaphragmatic injury, port-site bleeding, chyle leakage, bleeding peptic ulcer, and myocardial ischaemia. The postoperative mean analgesic requirement was 26 mg of morphine sulphate equivalent. The mean time for patients to resume oral diet and full ambulation was 1.3 and 2.8 days, respectively, and the mean length of hospital stay was 6.7 days. The mean diameter of the solid renal tumour was 4.1 cm and the surgical margins of all resected specimen for malignant tumours were negative.
Conclusion. Laparoscopic nephrectomy is a safe and efficacious approach for resection of benign non-functioning kidneys and malignant renal tumours.

目的：報告本院進行腹腔鏡腎臟切除術的早期經驗。
設計：前瞻性的數據搜集。
安排：瑪麗醫院，香港。
患者：1997年7月至2002年12月期間，40名於本院接受腹膜腹腔鏡腎臟切除術的病人。
主要結果測量：有關病人和圍手術期的數據，包括手術所需時間、血液流失量、術後疼痛指數、鎮痛劑用量、併發症、術後等待重新用口進食的時間、病人可走動的程度，以及留院期。
結果：40名病人中，21位切除腎囊腫塊、5位切除移行細胞癌、14位摘除失功腎。7名病人（17.5%）曾接受腹部手術。病人的平均體重指數為23.9千克／平方米，手術平均需時229分鐘。平均失血量估計為370毫升，2名病人在手術期間出血，須開刀完成切除手術。其他併發症包括膈肌受損、開孔處出血、乳糜滲漏、消化性潰瘍併發出血，以及心肌缺血。術後平均須用相當於26毫克硫酸嗎啡的鎮痛劑。病人平均在手術後1.3天可重新用口進食、2.8天後可行動自如，6.7天後出院。腎囊腫塊實體直徑平均為4.1厘米，所有切除的腫瘤樣本邊緣均呈陰性。

Key words:
Kidney neoplasms;
Laparoscopy;
Nephrectomy;
Surgical procedures, minimally invasive

關鍵詞：
腎囊腫物；
腹腔鏡術；
腎臟切除術；
手術步驟，微創的

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Division of Urology, Department of Surgery, Queen Mary Hospital, 102 Pokfulam Road, Hong Kong
MC Cheung, FRCS (Edin), FHKAM (Surgery)
FCW Lee, FRCS (Edin), FHKAM (Surgery)
SM Chu, FRCS (Edin), FHKAM (Surgery)
YL Leung, FRCS (Edin), FHKAM (Surgery)
BBW Wong, FRCS (Edin)
KL Ho, MRCS
PC Tam, FRCS (Edin), FHKAM (Surgery)

Correspondence to: Dr MC Cheung (e-mail: mccheunguro@mac.com)

結論：我們的經驗顯示，採用腹腔鏡腎臟切除術切除良性失功腎和惡性腎腫瘤，是安全且有效的方法。

Introduction

Since the initial report of laparoscopic nephrectomy by Clayman et al in 1991,[1] the safety, efficacy, reduced morbidity, and rapid convalescence of this procedure have been reported in several large series.[2-4] The long-term cancer control and techniques of laparoscopic radical nephrectomy and nephroureterectomy for renal malignancy have also been published.[5,6] We did our first laparoscopic nephrectomy in 1997 and it was initially performed sporadically and mainly for the treatment of benign non-functioning kidneys. With maturing techniques, availability of better laparoscopic instruments, and favourable oncological outcomes reported by several large series, laparoscopic nephrectomy has now become a routine procedure in our centre for suitable patients having benign or malignant diseases. Here we report our early experiences of laparoscopic nephrectomy.

Methods

Patient selection

The selection criteria for laparoscopic nephrectomy was not based on the sex, age, or body build of the patient. Patients who had previous abdominal surgery were not excluded from laparoscopy. All patients having benign non-functioning kidney requiring nephrectomy were offered the laparoscopic approach. Only patients with organ-confined tumours were selected for laparoscopic nephrectomy for renal cell carcinoma or other solid renal masses of unknown aetiology. Restriction on tumour size was not imposed, but in our very early cases, the tumour size was generally below 5 cm. For transitional cell carcinoma of the upper urinary tract, organ-confined disease was the only selection criteria for the laparoscopic treatment.

Surgical techniques

The bowel was prepared using polythene glycol given the evening before the operation. A broad-spectrum intravenous antibiotic was administered on induction of general anaesthesia. The patient was positioned in a lateral flexed position with the operating side up. Both upper limbs were supported over the head in a partially extended position and all pressure points were padded. Transperitoneal approach was adopted. Four ports were generally used and additional lower abdominal ports might be needed in the case of nephroureterectomy. A 10-mm camera port was placed using the open technique at the lateral border of ipsilateral rectus muscle about the level of the umbilicus. Two additional 12-mm ports were placed cranially and caudally to the camera port respectively under laparoscopic control. An optional 5-mm port was positioned over the flank for tissue retraction. The procedure was performed using a 30^{o} laparoscope under 12 mm Hg of pneumoperitoneum.

The colon was reflected medially by an incision along the line of Toldt, and the lienorenal ligament or the triangular ligament of liver was incised to expose the corresponding kidney. This was followed by hilar dissection for early vascular control with the lateral attachment of the kidney kept intact until the completion of this step. The ureter was dissected distally and divided. Mobilisation of the rest of the kidney was then completed by ultrasonic dissector. The kidney was placed in an impermeable plastic bag and was then retrieved from the lowermost wound after enlargement of the opening to about 5 cm; a drain was not routinely needed. The kidney within the surrounding Gerota's fascia was removed all at once in case of malignancy, and the adrenal gland was removed only in cases of an upper pole renal tumour. In the case of nephroureterectomy, the distal end of the ureter was dissected off the bladder by a standard intravesical technique and the specimen was removed via the lower abdominal wound.

Postoperatively, the patient was given indomethacin suppository for pain control, oral dextropropoxyphene and parenteral narcotics were given as supplements. Mobilisation and normal oral intake were usually allowed the next day. Patients were discharged home when pain control was satisfactory and full self-ambulation was resumed.

Data collection and analysis

Demographic and pathological data, operative details, postoperative pain score (visual analog scale from 0 to 10), analgesic requirement (morphine sulphate equivalent), complications, time to resume oral intake, ambulatory state, and length of hospital stay were recorded prospectively. Continuous variables were expressed as the mean and standard deviation.

Results

From July 1997 to December 2002, 40 laparoscopic nephrectomies were performed on 20 male and 20 female patients with a mean age of 64.2 (standard deviation, 14.4) years. Seven (17.5%) patients had previous abdominal surgery. The mean body mass

Table 1. Postoperative parameters of patients having laparoscopic nephrectomy

	All patients Mean (SD)	Patients without complications Mean (SD)
Pain scores*		
Day 1	2.3 (2.3)	2.3 (2.1)
Day 2	1.6 (1.8)	1.5 (1.8)
Day 3	1.5 (1.8)	1.1 (1.7)
Analgesic requirement (mg)†	26 (25.1)	23.7 (24.9)
Time to resume oral diet (days)	1.3 (0.9)	1.1 (0.4)
Time to resume full ambulation (days)	2.8 (1.7)	2.3 (1.1)
Duration of hospital stay (days)	6.7 (3.6)	4.8 (1.9)

* Visual analog scale (0-10)
† Morphine sulphate equivalent

Table 2. Pathology of the nephrectomy specimen

Pathology	No. of case(s)
Non-functioning kidney	
PUJ* stricture	7
Obstructing stone†	6
Ureteric stricture	1
Solid renal mass	
Renal cell carcinoma‡	17
Benign renal tumour	4
Transitional cell carcinoma†	5

* PUJ pelvi-ureteric junction
† Three kidneys had xanthogranulomatous pyelonephritis associated with an obstructing stone or with transitional cell carcinoma of the ureter
‡ Two angiomyolipoma, one benign stromal tumour, and one pseudotumour

index was 23.9 (4.1) kg/m^2. Indications for nephrectomy included 21 solid renal masses, five transitional cell carcinomas, and 14 non-functioning kidneys. Out of the nephrectomies performed, 19 were on right kidney and 21 on the left. The mean operating time was 229 (70) minutes. The estimated mean blood loss was 370 (388) mL and two patients required conversion to open surgery because of intra-operative bleeding. A further three patients had intra-operative bleeding but haemostasis was achieved laparoscopically. One patient had a diaphragmatic injury resulting in a small pneumothorax that was treated conservatively without pleural drainage despite a prolonged hospital stay of 10 days. Excluding those patients with intra-operative complications, the mean operating time was 228 (65) minutes and the estimated mean blood loss was 241 (193) mL. Drains were required in 18 (45%) patients. The mean weight of the resected specimen was 303 (206) g and the mean diameter of the solid renal masses was 4.1 (1.8) cm.

Postoperative pain scores, analgesic requirement, length of hospital stay, time to resume oral diet and ambulation of the patients are shown in Table 1. There were four postoperative complications that occurred in four different patients, which included bleeding peptic ulcer requiring endoscopic treatment, port-site bleeding requiring re-exploration, chyle leakage resolved by conservative treatment, and myocardial ischaemia. No patient had long-term morbidity. The pathological diagnoses of the resected specimen are shown in Table 2. Surgical margins of the specimens from malignant renal tumours were all negative. There was no port-site, local, or systemic metastasis occurring in our patients that had undergone laparoscopic radical nephrectomy or nephroureterectomy at the time of writing.

Discussion

Since the introduction of laparoscopic nephrectomy in 1991, this procedure has been widely popularised as a standard approach for nephrectomy. The advantages of decreased blood loss, reduced postoperative pain, short hospital stay, and rapid convalescence had been demonstrated in several reports,[2-4] and these issues are particularly important for geriatric patients who undergo major urological surgery.[7] Indeed, serum markers of surgical stress in laparoscopic surgery were shown to be markedly lower compared with those in open surgery.[8] The low incidence of major complications also gives supports to laparoscopic nephrectomy as the current standard treatment.[9] Although financially more expensive during the learning curve, with increased operator experience and efficiency, laparoscopic radical nephrectomy and nephroureterectomy were less expensive than open surgery techniques.[10]

The present series reports our initial experiences of this technique. Laparoscopic nephrectomy was initially used to treat benign renal diseases but the indication was subsequently extended to renal malignancy. The majority of the operations (85%) were performed in the later part of the study period (2001-2002). The high incidence of complications was compatible with the steep learning curve; however, the results of less postoperative pain, short hospital stay, and rapid convalescence were comparable to other studies. Table 3 shows our complications and open conversion rate compared with a large multi-institutional review from the United States,[11] which also represented their early experience. Training in a skilled laboratory, practising with animal models,

Table 3. Complications and open conversions of laparoscopic nephrectomy

	Gill et al[11] (n=185)	Present series (n=40)
Access-related		
Hernia at trocar site	2	-
Abdominal wall lesion	1	-
Trocar injury to kidney	1	-
Intra-operative		
Vascular injury		
Renal vein	1	2
Renal artery	-	1
Gonadal vein	-	2
Inferior vena cava	1	-
Superior mesenteric artery	1	-
Splenic laceration	1	-
Pneumothorax	1	1
Postoperative		
Gastro-intestinal		
Ileus	4	-
Bleeding peptic ulcer	1	1
Enterocutaneous fistula	1	-
Cardiovascular		
Congestive heart failure	3	-
Atrial fibrillation	2	-
Myocardial infarction/ischaemia	1	1
Genitourinary		
Urinary retention	3	-
Epididymitis	1	-
Respiratory		
Pneumonitis	3	-
Pulmonary embolism	1	-
Musculoskeletal		
Brachial nerve injury	1	-
Lateral nerve of thigh	1	-
Miscellaneous		
Clotted arteriovenous fistula	1	-
Acute tubular necrosis	1	-
Confusion	1	-
Chylous leak	-	1
Port-site bleeding	-	1
Total No. of complications	34 (18.4%)	10 (25.0%)
Open conversion	10 (5.4%)	2 (5.0%)

and attending overseas training courses with live demonstrations by experienced surgeons have provided us with invaluable experiences.

Laparoscopic nephrectomy can be performed either transperitoneally or retroperitoneally. Most laparoscopic surgeons are familiar with the transperitoneal route because it is the standard technique used during the laparoscopic training. Gaur et al[12] developed the retroperitoneal approach by insufflation of a balloon catheter in the retroperitoneal cavity to create space for dissection. The retroperitoneal approach has the advantage that patients who have had previous open abdominal surgery or peritonitis can be operated on; however, the working space for dissection is limited. In contrast, the transperitoneal approach allows a large operating space, and the anatomical landmarks are easier to identify. We routinely adopted the transperitoneal approach for nephrectomy and did not find that the previous abdominal surgery notably hindered the transperitoneal access, which has also been confirmed by other studies.[13,14] For the transperitoneal approach, open placement of the first port and careful adhesiolysis will help to reduce visceral injury in the presence of peritoneal adhesion. Higher complication rates were found if only the Veress needle was used for the first access to a previously operated abdomen.[15] In our series, we did not encounter any visceral injury when placing the first operative port using the open method. Late-onset bowel obstruction due to adhesions also did not occur in any of our patients, but this was probably because of the relatively short follow-up period. Furthermore, no notable differences in operating time, complication rate, analgesic requirement, and hospital stay were found between the transperitoneal and retroperitoneal approaches in published comparative studies.[3,16]

Laparoscopic radical nephrectomy is now almost the standard treatment for clinically localised renal cell carcinoma. With a new procedure becoming popular in oncological surgery, the issue of long-term cancer control is of utmost importance. Studies have proven the oncological safety of this technique by the negative surgical margins in most patients and the low local recurrence rate.[17,18] Chan et al[19] reported that the 5-year disease-free and actuarial survival rate (95% and 86%, respectively) were not significantly different from those of open radical nephrectomy. Portis et al[5] compared a group of patients who had undergone laparoscopic radical nephrectomy with a comparable group of patients who had open radical nephrectomy. They demonstrated that the recurrence-free and cancer-specific 5-year survival rates for the laparoscopic radical nephrectomy were 92% and 98%, respectively, and for open radical nephrectomy they were 91% and 92%, respectively.

The safety and efficacy of laparoscopic radical nephroureterectomy for the treatment of upper tract transitional cell carcinoma had been confirmed by a large multicentre study involving 116 patients,[20] and the cancer-specific 2-year survival data were encouraging. A smaller series with 34 patients had shown that there was no notable difference in the disease-free survival compared with open radical nephroureterectomy.[21] Port-site recurrence had also been reported.[22] The relationship to the known seeding risk of transitional cell carcinoma is unknown. Longer follow-up regarding oncological safety is still

needed before laparoscopic radical nephroureterectomy can be considered as a standard treatment.

Tsivian and Sidi[23] reviewed all reported port-site metastases of their urological laparoscopic surgery. Only five cases of port-site recurrence were reported in over thousands of cases of laparoscopic nephrectomy for cancer. Port-site metastasis is a rare event although the incidence may be under-reported. Risk factors for port-site recurrence include the biological aggressiveness of the tumour, not entrapping the specimen prior to retrieval or tearing of the entrapment bag, and morcellation of the specimen.

Because the number of our patients was small and the postoperative follow-up was rather short, the oncological outcome of our patients having laparoscopic radical nephrectomy or nephroureterectomy is not reported at the present moment. The cancer-specific survival of our patients at this stage may be misleading and a later report on this will be more meaningful when our experience becomes more extensive.

Conclusion

From our early experience, we found that laparoscopic nephrectomy is a safe and efficacious approach for resection of benign non-functioning kidneys and malignant renal tumours, although the long-term cancer control is still uncertain.

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