

## Laparoscopic Partial Nephrectomy for Renal Tumours: Early Experience in Singapore General Hospital

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### Abstract

**Introduction:** To review the perioperative and short-term outcome of all laparoscopic partial nephrectomies (LPN) performed in a single institution. **Materials and Methods:** Thirteen consecutive patients who underwent LPN since the beginning of the programme in March 2002 to January 2008 were enrolled. Demographic, perioperative and follow-up data were retrospectively collected. Transperitoneal approach was used in all cases, and vascular control was achieved with the use of a laparoscopic Satinsky clamp or vascular tape. The tumour was excised using cold scissors. Transected intrarenal vessels were suture ligated and the parenchymal defect was closed primarily with absorbable suture over a bolster. **Results:** Thirteen patients underwent a total of 14 LPN. The median age of patients was 60 years (range, 41 to 77). The mean tumour size was  $24 \pm 11.4$  (2SD) mm. The mean operative time was  $228 \pm 129$  (2SD) minutes and median warm ischaemia time was 35 minutes (range, 24 to 68). Postoperatively, serum haemoglobin level decreased by a mean of  $1.4 \pm 2.5$  (2SD) gm/dL and serum creatinine increased by a mean of  $22.5 \pm 25.8$  (2SD) umol/L. Twelve out of 13 (92%) patients achieved their baseline serum creatinine level within 1 month postoperatively. There was 1 open conversion (7%), and 2 patients (14%) required blood transfusion perioperatively. Two patients (14%) had transient fever postoperatively due to basal atelectasis. No other complications were encountered. Median patient hospital stay was 4 days (range, 2 to 10). Eleven out of 14 (79%) of the tumours were renal cell carcinoma (RCC). At a median follow-up of 12 months (range, 6 to 53), all except 1 patient with RCC were disease-free. **Conclusions:** Our experience has shown that laparoscopic partial nephrectomy is a safe, feasible technique in our centre for patients with small exophytic renal tumours. Patients can be discharged early with preservation of renal function and good early cancer control.

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**Key words:** Laparoscopy, Partial nephrectomy, Renal tumours

### Introduction

With the increasing availability of ultrasound and computed tomography scans, more patients are being diagnosed with incidental renal tumours. Up to 80% of tumours <4 cm turn out to be RCC upon histological examination.<sup>1</sup> Nephron sparing surgery (NSS) is an established curative treatment in patients with single, small (4 cm) and localised RCC.<sup>2,3</sup>

Laparoscopic NSS is only recently accepted as an alternative to open NSS, owing to the lack of standardised technique and variable experience. Aron and Gill reviewed the literature on laparoscopic partial nephrectomy (LPN) over the past 10 years, and found that in expert hands,

besides significantly reduced patient morbidity, early cancer cure and renal function outcomes after LPN are similar to the open approach.<sup>4</sup> Medium to long-term data have also recently been published. Lane and Gill reported 5-year outcomes in 37 patients who underwent LPN for RCC in the Cleveland Clinic.<sup>5</sup> They found that after 5 years, the overall and cancer specific survival were 86% and 100%, respectively.

Despite increasing global acceptance, LPN is a technically challenging procedure and is being performed by select centres only. In this study, we review our early experience with LPN.

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## Objectives

To review the perioperative and short-term outcome of all LPNs performed in our hospital from March 2002 to January 2008.

## Materials and Methods

### Patient Population

All patients who underwent LPN from the beginning of our programme in March 2002 to January 2008 were enrolled. Patients were identified via a central computerised database (Operating Theatre Management, OTM system) which captured operative data.

Details on patient demographics, medical history, clinical presentation, imaging findings, indication for surgery, perioperative details, histological report, postoperative outcome and follow-up information were retrospectively collected from a computerised patient information clinical database and patient case folders. Patients with pre-existing renal impairment were defined as having preoperative serum creatinine of  $>85$   $\mu\text{mol/L}$  in women and  $>110$   $\mu\text{mol/L}$  in men. The pathological stage was assigned according to the 2002 American Joint Committee on Cancer (AJCC) TNM Staging.

### Operative Technique

The transperitoneal approach was used in all cases. The standard laparoscopic port sites for radical nephrectomy were used. Additional ports were placed in the iliac fossa for vascular control.

In our early experience, we selected cases whereby the renal tumour was exophytic so that the risk of pelviclyceal system entry is minimal. As such, we did not routinely perform preoperative ureteric catheterisation. The renal hilum was exposed and prepared for vascular control, which was achieved by the use of a laparoscopic Satinsky clamp or vascular tape.

The kidney was then mobilised to expose the tumour. The renal parenchyma was scored using electrocautery along the proposed line of resection, keeping at least a 0.5 cm gross margin. The suture materials were meanwhile prepared, including Surgicel bolsters.

The renal hilum was then clamped, before excision of the tumour using cold scissors. If the pelviclyceal system was entered, this would be sutured first. This was followed by suture ligation of any transected intrarenal vessels. The parenchymal defect was then closed, using absorbable sutures over Surgicel bolsters. To minimise knot tying, Hemolok clips were used to secure the ends of the suture.

Further haemostasis, if required, was achieved using

biological glue such as FloSeal and Tisseal. The specimen was placed in a laparoscopic bag before being removed via the camera port. An abdominal drain was placed prior to closing the wound.

## Results

There were 13 patients undergoing a total of 14 LPN during the study period (Table 1). One patient had bilateral renal tumours and underwent staged bilateral LPN. The median age of the patients was 60 years (range, 41 to 77). Ten out of 13 patients (77%) were hypertensive, while only 2 (15%) had pre-existing renal impairment. Most (85%) of the patients had no symptoms while the other 2 (15%) presented with macroscopic haematuria. All patients had a contrast-enhanced computed tomography (CT) scan performed prior to surgery. In addition, 2 patients had a Magnetic resonance (MR) imaging to further characterise the renal lesion. Two out of 14 (14%) renal lesions were characterised as Bosniak III, another 2 (14%) were Bosniak IV while the rest (10 patients or 72%) were solid masses. Mean renal tumour size seen on imaging were  $24 \pm 11.4$  (2SD) mm. All were exophytic tumours with 6 (42.8%) located in the upper pole, 4 (28.6%) in the midpole and 4 (28.6%) in the lower pole.

The mean preoperative serum creatinine was  $89.5 \pm 44.5$  (2SD)  $\mu\text{mol/L}$ . The mean operative time was  $228 \pm 129$  (2SD) min and median warm ischaemia time was 35 minutes (range, 24 to 68). Postoperatively, serum haemoglobin level decreased by a mean of  $1.4 \pm 2.5$  (2SD) gm/dL and serum creatinine increased by a mean of  $22.5 \pm 25.8$  (2SD)  $\mu\text{mol/L}$ . Most (12 out of 13) patients achieved their baseline serum creatinine level within 1 month postoperatively.

There was 1 open conversion (1/14 or 7.1%) due to bleeding and major defect of the pelviclyceal system. Postoperatively, 2 patients had transient fever ( $<48$  hours) owing to basal atelectasis. Two patients required blood transfusion intra and postoperatively due to bleeding. No further intervention was required in these patients. No other perioperative complications were encountered. The abdominal drain was kept for a mean of  $3.7 \pm 4.9$  (2SD) days, and the patient was started on solid oral intake at a mean of  $2.0 \pm 1.7$  (2SD) days. Median hospital stay was 4.0 days (range, 2 to 10).

Of the 14 renal tumours excised, 3 out of 14 (21%) were benign, the histology being capillary haemangioma, angiomyolipoma and oncocytoma. The other 11 tumours were RCC, with 9 clear cell and 2 papillary histological subtype. Mean tumour size was  $22 \pm 18.4$  (2SD) mm on histological examination. All except one patient with RCC had pT1 disease; this single patient had a 17-mm tumour involving the perinephric fat (pT3a). All except 1 patient had negative margins, with resection margins of 1 to 5mm.

Table 1. Patient Characteristics

Pt. No.	Age (y)	Sex	Tumour side	Tumour size on imaging (mm)	Tumour classification	Vascular clamping (min)	Complication	Pathology, Grade of RCC, pathological stage	Margin status	Follow-up (months)	Status
1	63	M	R	24	Solid	28	Fever	RCC, Gd 3, pT3a	Neg	53	Died of brain and lung metastases
2	77	F	L	18	Solid	30	Nil	RCC, Gd 2, pT1a	Neg	37	Disease free
3	46	M	R	20	Solid	46	Nil	RCC, Gd 2, pT1a	Pos	42	Disease free
4	60	M	R	30	Solid	39	Nil	RCC, Gd 2, pT1a	Neg	34	Disease free
			L	27	Solid	NA	Blood transfusion, conversion, radical	RCC, Gd 1, pT1b	Neg	36	Disease free
							nephrectomy				
5	61	M	R	37	Bosniak IV	40	Nil	Capillary haemangioma	NA	NA	NA
6	47	F	R	20	Bosniak III	68	Nil	RCC, Gd 2, pT1a	Neg	12	Disease free
7	50	M	L	12	Solid	35	Nil	RCC, Gd 2, pT1a	Neg	12	Disease free
8	55	M	R	26	Bosniak IV	35	Nil	RCC, Gd 2, pT1a	Neg	7	Disease free
9	63	M	L	20	Solid	24	Fever	RCC, Gd 1, pT1a	Neg	6	Disease free
10	65	F	R	26	Solid	45	Blood Transfusion	Oncocytoma	NA	NA	NA
11	41	M	R	22	Solid	35	Nil	RCC, Gd 2, pT1a	Neg	6	Disease free
12	47	F	L	35	Bosniak III	35	Nil	RCC, Gd 2, pT1a	Neg	6	Disease free
13	61	F	L	16	Solid	23	Nil	Angiomyolipoma	NA	NA	NA

F: female; L: left; M: male; NA: not applicable; Neg: negative; Pt. No.: patient number; Pos: positive; R: right

The patient with positive resection margin had a 1.7 cm papillary renal cell carcinoma, Furhrman Grade 2.

Median follow-up was 12 months (range, 1 to 53). The patient with pT3a disease and negative resection margin developed systemic recurrence 26 months after surgery. He had Furhrman grade 3 clear cell RCC. He succumbed to the disease 53 months after surgery. The rest of the patients with RCC are disease free, including the only one with positive resection margin (at 42 months follow-up).

## Discussion

With better access to medical care and the latest imaging modalities, up to 50% of patients are being diagnosed with incidental renal tumours.<sup>1</sup> Of these, about 15% may prove benign upon histological examination.<sup>1</sup> Subjecting these patients to radical nephrectomy may be over-treatment, especially when the tumours prove benign later. The role of preoperative biopsy is controversial. Volpe in a review article, reported that at specialised centres, percutaneous biopsy is safe and leads to an accurate diagnosis in more than 90% of renal masses.<sup>6</sup> However, a recent survey of 325 consultant urologists in the UK showed that the majority believe that it confers no additional benefit, largely due to concerns about its safety and accuracy.<sup>7</sup>

NSS has been shown to reduce the risk of progression to chronic renal insufficiency.<sup>8,9</sup> In a matched comparison study, Lau found that after 10 years, 12.4% of patients who underwent radical nephrectomy had renal insufficiency (defined as increase in serum creatinine to >2mg/dL) compared to just 2.3% of NSS cases.<sup>8</sup> This benefit will be even more apparent in a rapidly ageing society such as ours.

As NSS is proving to be a safe and effective procedure, indications for NSS have widened and more NSS has been performed.<sup>10-12</sup> A single centre experience over a 2 decade period have shown that the rate of NSS has increased from 3.1% to 46.9%.<sup>1</sup>

LPN for renal tumours was first reported in 1993.<sup>13</sup> Since then, many centres have published their own experience.<sup>14-16</sup> With increasing expertise, the laparoscopic technique is now able to duplicate the established open technical steps.<sup>12,17</sup> As mentioned previously, in expert hands, the perioperative results, cancer cure and renal function outcomes of LPN are similar to the open approach.<sup>4,5</sup>

After having at least 3 years' experience with laparoscopic radical nephrectomy, we performed our first LPN under a proctor in March 2002. Since then, 13 other LPN have been performed in our centre. We selected only patients with exophytic tumours which will be easily visible upon mobilising the kidney. We also limited the tumour size seen on CT or MR imaging to 4 cm, and use reconstructed 3-D or coronal views for preoperative planning.

The accepted practice during NSS has been to limit warm

ischaemia time to 30 minutes. Although our median warm ischaemia time was 35 minutes (range, 24 to 68), most of our patients (12 out of 13 or 92%) achieved their baseline serum creatinine level within 1 month postoperatively. The main time-consuming step during warm ischaemia is knot tying. Orvieto and Rubinstein have described using surgical clips to minimise knot tying. Orvieto uses an absorbable clip (Lapraty) at the terminal end of the suture to prevent it from pulling through the renal parenchyma.<sup>18</sup> After the suture is passed, he uses another clip to secure both ends and obviate the need for knot tying. Rubinstein described the Cleveland Clinic technique of having a Hemolok clip on the terminal end of the suture to prevent it from pulling through before knot tying is performed.<sup>19</sup> We used a similar technique to the Cleveland Clinic, and may use additional Hemolok clips if the compression after knot tying was deemed inadequate.

Tissue glue was used in about half (6 out of 13 cases, excluding 1 patient with open conversion) of our patients, depending on the surgeon's assessment intraoperatively. We had 1 other patient who required blood transfusion postoperatively and no tissue glue was applied in her case. The bleeding episode however resolved without having to resort to adjunct procedures such as angioembolisation or exploration. We believe that the mainstay of achieving haemostasis is via suturing, and tissue glue can be used as an adjunct if the haemostasis was less than satisfactory. In a prospective study between 2 groups of patients (total 44 patients), an Italian group concluded that fibrin glue and collagen fleece should be considered an adjuvant to haemostasis, with suture being the key point in achieving haemostasis.<sup>20</sup>

We had 1 open conversion. This happened in a 60-year-old diabetic and hypertensive patient with bilateral renal tumours and a baseline creatinine of 101 umol/L. Screening ultrasound showed bilateral renal tumours. CT kidneys revealed a 3 cm exophytic tumour on the lower pole of the right kidney and an mildly exophytic 3 cm tumour of the midpole of the left kidney. He then underwent LPN of the right renal tumour. Postoperative course was uneventful and serum creatinine postoperatively was 130 umol/L.

He subsequently underwent surgery for the contralateral tumour 5 weeks later. However, during the second surgery, the tumour was actually 4 cm in size and most of the tumour was endophytic. After excising the tumour using cold scissors, we encountered a major pelvicalyceal system defect as well as large intraparenchymal vessels. Upon conversion, we were unable to repair the defect safely and radical nephrectomy was performed. Early postoperative serum creatinine was in the range of 185 to 210 umol/L. Three years after the second surgery, he is still dialysis free although his serum creatinine is now in the range of 600

umol/L. On hindsight, we felt that there were 2 things that could be done differently. One was to repeat the CT before the second operation as by then almost 3 months had passed since the first CT. Secondly, after laparoscopic exposure of the tumour and visualising that most of the tumour was endophytic and in the midpole region conversion to open excision could have been done early.

The positive margin rate after LPN has been reported to be in the range of 1.8% to 2.4%.<sup>21,22</sup> We had 1 patient with positive surgical margin. He had a 1.7-cm Furhrman grade 2 papillary RCC. Although he was offered completion radical nephrectomy, the patient opted for observation. Close follow-up with regular CT kidneys and chest X-ray showed no local or distant recurrence after 42 months. Permpsonol showed that surveillance may be a reasonable approach provided vigilant monitoring is done.<sup>21</sup> He found that although longer follow-up is necessary, the mid-term outcomes of patients with positive margins after LPN parallel those with negative margins.

### Conclusion

Our experience has shown that laparoscopic partial nephrectomy is a safe, feasible technique in our centre for patients with small exophytic renal tumours. Patients can be discharged early with preservation of renal function and good early cancer control.

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