Promising early results after hand-assisted laparoscopic partial nephrectomy in carefully selected patients

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ABSTRACT

INTRODUCTION: The incidence of the diagnosis of renal cell carcinoma has increased during the past two decades. Kidney damage occurring beyond 30 min of warm ischaemia is significant and mostly irreversible, even in completely normal renal systems. The aim of this study was to evaluate the role and safety of early removal of renal artery clamps and its influence on warm ischaemia time and renal function. MATERIAL AND METHODS: Data from 15 patients who underwent hand-assisted laparoscopic partial nephrectomy (HALPN) were collected retrospectively. The operative method was as follows. The kidney was dissected using hand-assisted laparoscopic technique, the gerotic fascia was dissected and a complete exploration of the kidney was achieved. A vascular bulldog clamp was removed from the renal artery immediately after the tumour resection bed had been closed with a running suture with Hem-o-Lok clips at either end.

RESULTS: The size of tumours ranged between 2 cm and 7 cm. The mean warm ischaemia time was 11.2 min. The mean estimated glomerular filtration rate had decreased by 7.8 ml/min/1.73 m² (11%) six months after the operation. The estimated blood loss was less than 200 ml. The mean operating time was 119 min and the mean postoperative hospital stay was 3.2 days. There was no need for postoperative blood transfusions, and neither delayed bleeding nor urinary leakage occurred.

CONCLUSION: Early removal of renal artery clamps during HALPN is associated with a considerable decrease in warm ischaemia time and renal function preservation and preand postoperative outcomes are acceptable. **FUNDING:** not relevant.

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The incidence of the diagnosis of renal cell carcinoma has increased during the past two decades because of the incidental detection of small renal tumours owing to increased use of computed tomography (CT) [1, 2]. An open partial nephrectomy (OPN) was first described by Propiglia. This procedure has been associated with long operative time (OT) and longer postoperative hospital stay (HS) [3]. Longer warm ischaemia times (WIT) and a rise in major intra-operative complications associated with the laparoscopic approach have restricted this operation to high-volume academic laparoscopic centres [4]. Weight et al reported a serious association between a decrease in the estimated glomerular filtration rate (eGFR) and an increase in cardiac death after nephrectomy. Partial nephrectomy offers rates of cancer-specific survival equivalent to those of radical nephrectomy [5] and is preferable to a radical nephrectomy for small renal cell tumours, even in patients with normal contralateral renal function [6, 7]. Our intention was to combine the advantages from open procedures with advantages from laparoscopic partial nephrectomy (LPN) with a view to preserving renal function by decreasing the intra-operative WIT. The results from our first 15 patients with this modified technique are described in this paper.

MATERIAL AND METHODS

Between April and September 2011, 20 patients were diagnosed with renal masses of less than 7 cm. Fifteen patients (**Table 1**) met the inclusion criteria for handassisted laparoscopic partial nephrectomy (HALPN): a WHO performance score of 0 or 1, a life expectance of more the ten years, a tumour size less than 7 cm and more than 1 cm distant from the renal hilum as evaluated by CT urography. In two of the 15 patients, there was an absolute indication of a nephron-sparing partial nephrectomy: one due to bilateral tumours and one due to a solitary kidney. All patients were evaluated by the same operating team that consisted of two surgeons.

Among the five patients not conforming to the inclusion criteria, one was converted to a hand-assisted radical nephrectomy as the tumour could not be recognized intra-operatively, clinically or by ultrasound; one was scheduled to cryotherapy and another to watchful waiting due to considerable co-morbidity and, finally, two patients had tumours close to the renal hilum.

Locations of tumours were evaluated and listed according to the preoperative aspects and dimensions used for an anatomical (PADUA) score [8]. The OT was defined as the exact surgical time. WIT was defined as the time from the placement to the removal of bulldog clamps. Postoperative HS was defined as the primary postoperative stay, including transfers to another de-

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1

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TABLE 1

Intra- and postoperative data after hand-assisted laparoscopic partial nephrectomy.

		Warm	Postop.	eGFR, ml/min/1.73 m ²			Estimated	
	Op. time,	ischaemia	hospital		6 months	Tumour	blood loss,	
Patient no.	min	time, min	stay, days	preop.	postop.	size, cm	ml	
1	125	8	2	66	70	3.5	150	
2	180	26	6	34	42	2.5	100	
3	150	13	5	76	77	3	200	
4	95	10	5	61	56	2	150	
5	100	10	2	90	74	3	130	
8	120	8	2	45	43	2.5	120	
7	130	13	3	94	81	7	110	
6	120	8	1	45	45	2.5	160	
9	100	12	2	50	43	2.5	120	
10	125	15	3	81	67	3.5	110	
11	150	8	5	97	83	5.5	180	
12	110	9	3	97	85	3.5	150	
13	95	9	2	89	88	2.5	150	
14	85	9	3	82	56	3	200	
15	100	9	5	67	47	2,5	200	
Mean	119	11.2	3.2	71.6ª	63.8ª	3.3	148	
aGER = estimated glomerular filtration rate								

a) Statistically insignificant.

partment or hospital and any readmissions within thirty days. The eGFR was calculated before the operation and six months after the operation according to the formula: eGFR (ml/min/1.73 m²) = 175 × (serum creatinine) – 1.154 × (age) – 0.203 × (0.742 if female) × (1.212 if African American) (conventional units) [9]. Postoperative complications were classified according to the Clavien Dindo classification of postoperative surgical complications [10]. A paired t-test was used to compare the distribution between eGFR before and after the operations. p < 0.05 was considered significant. All patients were followed at least six months after the operation. Trial registration was not relevant.

Operation technique

The patient was placed in the left or right lateral decubitus position. The table was flexed and the patient was safely supported on the table. Initial access to the peritoneal cavity was obtained via a subcostal incision on the left side and an inguinal incision on the right side (Figure 1), the length of which corresponded to the glove size of the primary surgeon plus 1 cm (9 cm for a size eight surgical glove); a GelPort device (Applied Medical, Rancho Santa Margarita, CA) was placed in this incision. A 12 mm trocar was inserted directly to the GelPort device and gas insufflations were started. Next, three accessory (12 mm) trocars were placed on the left side and one 5 mm and three 12 mm trocars were placed on the right side; the 5-mm trocar was used to support the liver. All trocars were inserted under visual control, and 10-15 ml marcain of 2.5 mg/ml permeated to all trocar incisions.

The colon and spleen were dissected from the left kidney and the colon, duodenum and liver from the right kidney. If the tumour was located at the lower or middle pole, then the ureter was dissected and traced to the renal pelvis; otherwise, the dissection was continued against the gerotic fascia and a complete exploration of the kidney was achieved. The renal artery and vein were dissected carefully and an elastic tape was placed around each. The tumour was identified and the renal capsule was scored circumferentially by scissors with a 5-mm margin around the tumour (Figure 2A). A vascular bulldog clamp was placed on the artery (Figure 2B) and a timer was started to monitor WIT. The tumour resection was performed using laparoscopic "cold" scissors (no cautery) to allow for clear visualization of normal parenchyma during excision. An assistant surgeon used a water irrigator for traction and to keep the field clear (Figure 2C). The excised tumour mass was deposited in a safe place around the liver or spleen; then the tumour resection bed was closed with uninterrupted 2-0 Vicryl sutures of 20 cm with Hem-o-lok clips at either end (Figure 2D). The bulldog clamp was removed carefully and 3-4 interrupted 0 Vicryl was used to close the parenchymal defect with Hem-o-lok clips at either end (Figure 2E). All patients received 1-2 Tachosil mesh on the parenchymal defect (Figure 2F) as well as a drain tube at the operation bed. No double J catheter was placed. Fascia related to the GelPort incision were closed by PDS-0 suture.

We did not perform preoperative bowel cleansing. An intra-operative nasogastric tube was inserted as needed, and no prophylactic antibiotic was planned preoperatively. A bladder drainage catheter was inserted for all patients and removed on the first postoperative day, and a drain tube was planned to be removed when there was less than 150 ml accumulation within the first postoperative day.

Trial registration: not relevant.

RESULTS

The mean age of the patients who underwent HALPN was 63.4 years (range 51-74 years); there were nine females and six males. The mean tumour size was 3.3 cm (range 2-7 cm). Eleven patients had left-sided kidney tumours and four had right-sided tumours. Four tumours were at the lower pole, six in the middle of the kidney and five at the upper pole. Seven tumours involved the renal collecting system, one tumour was endophytic and three tumours were at the posterior aspect of the kidney. The PADUA score was six in four patients, seven in five patients, eight in two patients, nine in another two patients, ten in one patient and 12 in another. The mean WIT was 11.2 min (range 8-26 min) and distributed to 26 min for one patient and 15 min for a second; for the rest, the ischaemia time was less than 13 min. The mean intra-operative estimated blood loss (EBL) was 149 ml (range 100-200 ml). The mean OT was 119 min (range 85-180 min). The drain tube was removed on the first postoperative day in 13 patients and on the second postoperative day in two patients. The mean HS was 3.3 days (range 1-6). Clavien classification concerning postoperative complication was one in 12 patients and two in three patients due to a high fever that was treated with antibiotics. Histological results revealed 13 cases with renal cell carcinoma, one oncocytoma and one angiomyolipoma. One patient had a microscopically positive surgical margin.

There was no significant difference between the eGFR before and six months after operation, with a mean of 71.6 ml/min/1.73 m² (range 34-97) and 63.8 ml/min/1.73 m² (range 42-88), respectively (p = 0.27).

There was no need for postoperative blood transfusions, no delayed bleeding or urinary leakage occurred, and none of the included cases needed re-operation.

DISCUSSION

In our study with early removal of the renal artery clamp, the WIT was reduced to a mean of 11.2 min, which is a pronounced reduction compared with other studies, where the mean WIT was 27, 33, 23.2 and 22.4 min associated with HALPN, OPN, LPN and robot-assisted partial nephrectomy (RPN), respectively [11, 12]. Irreversible kidney damage is described beyond 30 min of WIT, even in completely normal systems [13]. Gill et al [14] reported 18% kidney function loss after 32 min of WIT.

FIGURE 2

Placement of trocars in hand-assisted laparoscopic partial nephrectomy (HALPN). **A.** Right side. **B.** Left side. 1) GelPort; 2) 12 mm trocar for surgeon; 3) 12 mm trocar for camera; 4) 12 mm trocar for assistant; 5) 5 mm trocar to support liver.



The mean eGFR loss six months after HALPN was 7.8 ml/min/1.73m² (11%); this is an improvement compared with the decrease in eGFR during LPN (16.6 ml/ min/1.73 m² associated with a 27-min WIT) and RPN (11.2 ml/min/1.73m² associated with a 22.4-min WIT) [5, 12]. The improvement may be owed to the reduced WIT achieved with this technique. Long et al reported that WIT is an important predictor of postoperative eGFR [15]. Given the concern for the serious cardiovascular complications associated with chronic renal failure [5], HALPN with early removal of the renal artery clamp should be considered with a view to maximizing the preservation of kidney function.

A low postoperative complication rate (Clavien classification was one in 12 patients and two in three patients) and a small EBL (149 ml) associated with our technique is comparable to LPN and RPN, where the mean EBL was 325 ml and 280 ml, respectively [12]. This indicates that HALPN with early removal of renal artery clamps can be performed safely.

FIGURE 2

Operation step by step. A. Tumour identified and a renal capsule scored circumferentially. B. A vascular bulldog clamp placed on the artery. C. Tumour resection performed. D. Tumour resection bed closed. E. Kidney parenchymal defect closed. F. Tachosil mesh placed on the parenchymal defect.



In this study, the mean OT was 119 min, which is less than reported by other studies, where OT was 161 min with LPN and 230 min with OPN. The mean HS in our 15 patients was 3.3 days, which is less than reported with LPN with a mean of five days, and comparable to OPN [11, 16].

Two patients (13%) had benign tumours histologically; this is comparable to another study with 19.3% benign tumours after LPN [11]. A preoperative kidney biopsy allowed a diagnosis in 89% of cases [17], but 6% false negatives was reported by Wood et al. [18]. There is no consensus on this matter.

We observed a high microscopic positive margin rate of 7.6% (one patient) compared with other studies: 0% positive margin after HALPN (6.6% needed intra-operative re-excision), 5% after OPN and 3% positive margin after LPN [11, 16]. This may be due to the fact that the study period covers our initial experiences with this technique and it may be due to the small sample size in this paper. A positive surgical margin does not necessarily mean that cancer remains in the renal remnant in most cases [19]. We plan to use an intra-operative ultrasound technique in the future.

The patients in this study were carefully selected concerning the learning curve for this new technique in our department of urology.

CONCLUSION

Early removal of renal artery clamps during HALPN is associated with a considerable decrease in WIT and with improved preservation of the kidney function as estimated from eGFR. HALPN is a safe and effective treatment for carefully selected patients with small renal cell tumours, but more studies with longer observation times are needed to evaluate the renal function outcome after HALPN.

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CONFLICTS OF INTEREST: none

LITERATURE

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