Original Article

# Fully perfused laparoscopic partial nephrectomy: surgical technique and outcomes

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**Keywords:**
Full perfusion, partial nephrectomy, laparoscopic surgery

## Abstract

**Objective:** To present a surgical technique and outcome of fully perfused laparoscopic partial nephrectomy (LPN).

**Material and Method:** Fifteen patients underwent fully perfused LPN between January 2014 and January 2018 for renal masses. We studied a subgroup of patients who underwent fully perfused LPN (non-clamp). Our technique was utilized for exophytic, non-hilar masses that had a diameter of less than 2 cm. We developed our technique to avoid ischemia reperfusion renal injury while minimizing bleeding.

**Results:** We reviewed 15 cases of fully perfused LPN. Utilizing a non-clamp procedure resulted in an average blood loss of 100 ml, 2 days of hospital stay, and minimal change in serum creatinine.

**Conclusion:** Fully perfused LPN is a feasible procedure for the treatment of renal masses. Benefits of this procedure are its minimal invasiveness and prevention of ischemic reperfusion kidney injury.

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**Received:** .....
**Revision received:** .....
**Accepted after revision:** .....

## Introduction

Nephron sparing surgery (NSS) for renal cell carcinoma has been increasingly appreciated due to its excellent oncologic outcome and preservation of kidney function[1]. Lower wound morbidity, shorter hospital stay, and better cosmetic outcome have made for the acceptance of laparoscopic partial nephrectomy (LPN)[2].

The safety and feasibility of LPN depend on the surgeon's experience and the size and position of the mass. Although LPN has become an established treatment for small renal masses, multiple studies have demonstrated a negative impact of warm ischemic time (WIT) on renal function[3]. Patel and Eggener proved that a warm ischemic minute has an addictive effect in the development of acute kidney injury and deterioration of renal function[3]. The 3 main variables contributing to renal function after partial nephrectomy are: the baseline renal function preoperatively, the length of WIT, and the amount of remaining parenchyma left postoperatively[4]. From this result, establishing a zero ischemic time technique for LPN can eliminate any potential harmful effects of warm ischemia during the procedure[5]. Nevertheless, there is no consensus on the length of WIT that usually does not lead to the deterioration of the renal function after partial nephrectomy. It was reported by multiple studies that up to 40 minutes of WIT is safe and sufficient for the resection of the mass, and performing renorrhaphy[6,7]. There are multiple ways to assess function of the kidney, and each technique has some advantages and disadvantages. Measurement of serum creatinine and renal scan are the most commonly utilized investigations to assess renal function[8]. On the other hand, other studies have used the glomerular filtration rate (GFR) to measure renal function[2,8].

Spending more days at the hospital postoperatively does not only increase the cost of health care, but it also carries the risk of developing other medical complications, such as lung problems and deep vein thrombosis (DVT). Prolonged hospital stay is usually indicated when patients get big wounds that generate pain, hinder movement, and require additional care. Therefore, the earlier the patients are discharged home in a comfortable status, the better they will be. Blood transfusion in the setting of losing large amounts of blood during the surgeries carries certain hazards to the patients like cross reactions and infections with blood-borne organisms[9].

We performed the fully perfused technique, whenever that was possible, to minimize renal ischemic injury and prevent some of the incidents related to hilar dissection and clamping during LPN. In our study, we present our experience with fully perfused laparoscopic partial nephrectomy and demonstrate the selection criteria and the outcome of this technique.

## Material and Method

After Institutional Review Board approval, we reviewed the medical records of 15 patients who underwent LPN with the fully perfused technique at Phramongkutklao Hospital between January 2014 and January 2018. All cases were performed by the same surgeon. Patient demographics, main outcome variables (preoperative and postoperative serum creatinine values, estimated blood loss (EBL), length of hospital stay), and tumor histopathological results, size, site, side, and grade were collected. Serum creatinine, as a renal function indication, was measured 3 times: preoperative, immediately (within 48 hours) postoperative, and long-term postoperative (3-6 months). The fully perfused technique was utilized in patients who had exophytic, solid masses with a maximum base diameter of 2 cm or less and were suspicious for malignancy (more than 15 Hounsfield unit enhanced from contrasted computerized tomography), as seen in Figure 1.

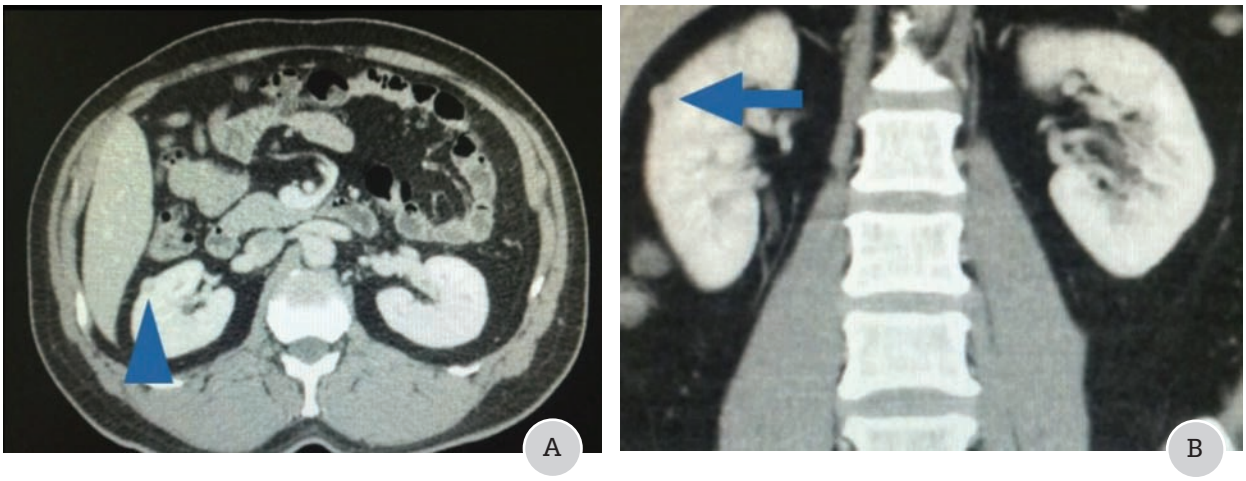


**Figure 1.** Computerized tomography present small and exophytic renal mass that proper for fully perfused LPN (arrow)

## Surgical technique

After the mobilization of the white line of Toldt, Gerota fascia was identified and opened in only the area above the mass, as seen in Figure 2. When Gerota fascia was removed, the tumor was exposed, as seen in Figure 3. The kidney was mobilized as necessary to expose the tumor. Laparoscopic Metzenbaum scissors was used in the coagulation mode for marking the location around the mass, as seen in Figure 4. Resection was done with Metzenbaum scissors using the wedge resection technique, as seen in Figure 5. Bleeding during resection was stopped by the coagulation mode via Metzenbaum scissors. No 1 Vicryl stitches were introduced into the tumor bed under vision in the continuous locked fashion (by M sized laparoscopic plastic clip), as seen in Figure 6. No hemostatic agents were used in our procedure. Bleeding was checked again; then Jackson-Pratt silicone No 10 (flat type) was placed at the surgical site before laparoscopic port removal and abdominal closing.

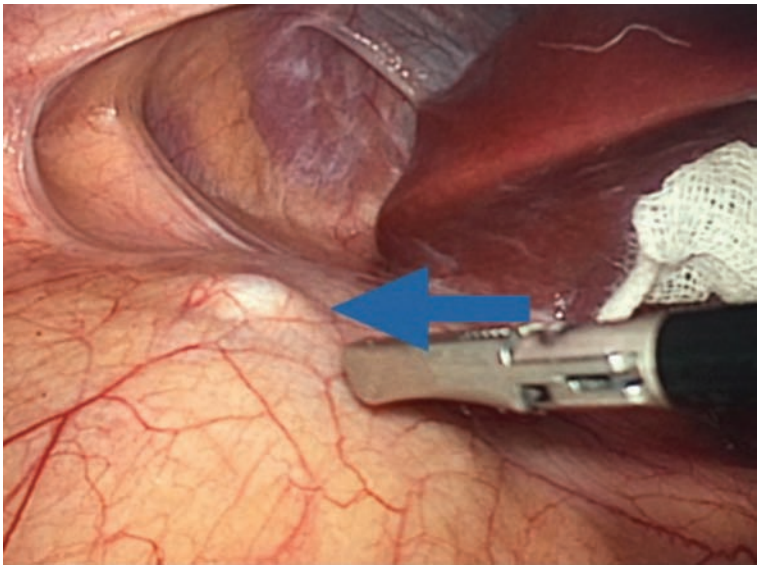

**Figure 2.**
Exophytic mass is identified after mobilization of white line of Toldt.

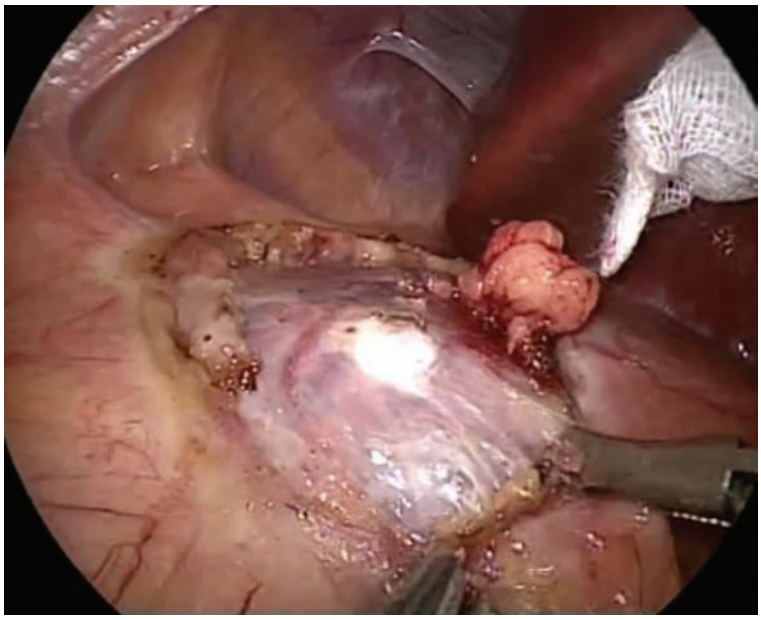

**Figure 3.**
Gerota fascia is opened only around area of protruded mass.

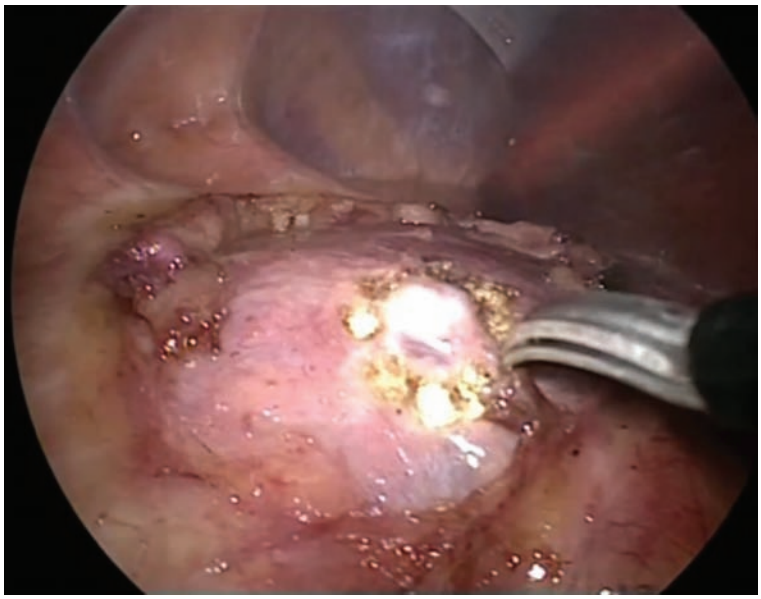

**Figure 4.**
Metzenbaum is used for marking area of dissection.

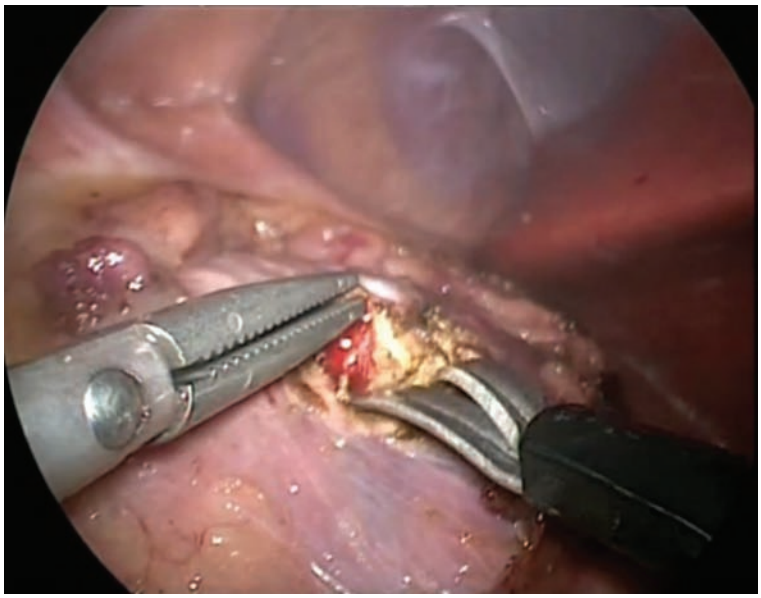

**Figure 5.**
Wedge resection is technique in our procedure for tumor removal.

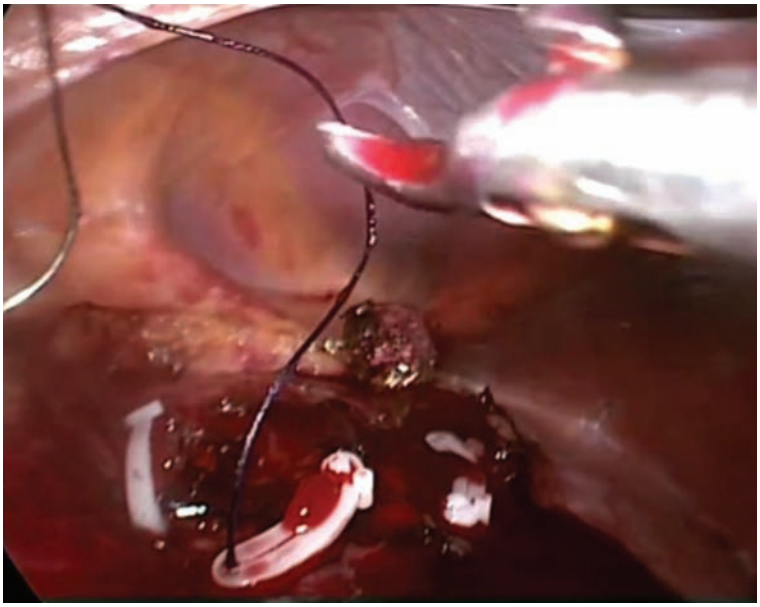

**Figure 6.**
No 1 Vicryl is used for closing the defect with continuous with locked fashion.

## Results

### Patient demographics

A total of 15 patients participated in our study; the mean patient age was 55.4 years (range: 31-82). Nine from 15 patients were males (60%).

### Lesions characteristics

Histopathology clear cell renal cell carcinoma (n=12, 80%), small cell carcinoma (n=1, 6.67%), angiomyolipoma (n=1, 6.67%), and benign complex cyst (n=1, 6.67%).

### Tumor location

Eight tumors were on the right side (53.33%); the remaining 7 (46.67%) were in the left kidney. The average tumor size was 1.5 cm (range: 0.8-2.0). The tumor was located on the lower pole in 10 patients (66.67%), on the middle pole in 1 patient (6.67%), on the lower pole in 4 patients (26.67%), and 100% of masses were on the anterior aspect of the kidney.

### Surgical outcome

All patients had negative surgical margins, and no recurrence was observed during the average follow-up of 20 months (range 4-40). Mean preoperative serum creatinine was 0.83 mg/dl (range 0.44-2.3 mg/dl), and mean early postoperative serum creatinine was 1.03 mg/dl (range 0.42-2.4 mg/dl). The short-term postoperative was 0.97 mg/dl (range 0.4-2.7 mg/dl). The average blood loss was 100 ml (range 50-400 ml) and no transfusion was needed. The average hospital stay was 2 days (range 1-4 days). We found that all the study variables, age, gender, and tumor characteristics, such as type, size, and grade of tumor had no significant association with the estimated intraoperative blood loss and the length of hospital stay. There were no delayed complications, such as urine leak or delayed bleeding. There was no need to convert any of the cases to the clamped technique or to open surgery. Additionally, no recurrence was encountered during the follow-up period, ranging from 4 to 40 months (average 20 months).

## Discussion

LPN is a minimally invasive nephron sparing surgery that has become a favored option by many surgeons and many patients, as it has shown good oncologic outcome while at the same time maintaining good kidney function10. This study concluded that fully perfused LPN is a feasible and safe approach for certain solid small renal masses up to 2 cm in size. Furthermore, fully perfused LPN is a practical approach for selected patients with a wide variety of both benign and renal cancer.

Thompson and colleagues have shown that the off-clamp technique in partial nephrectomy can reduce the hazards of both acute and chronic renal disease7. This paper is supported by other studies which have shown that warm ischemia can be avoided in many cases of partial nephrectomy, and should be implemented when possible[11,12].

A clamped time of 28-40 minutes was reported by different studies to be safe and sufficient for the resection of the mass and performing renorrhaphy[6,7]. On the other hand, some studies have shown that LPN under warm ischemia had less blood loss than the off-clamp one[13], no difference in hospital stay[11], and better renal function[11,13]. Thompson and colleagues concluded that 2 percent of their off-clamp cohort group developed excessive blood loss in comparison to 5% in the hilar clamping group[11]. In addition, they found that urinary leakage was higher in the hilar clamping group (5%) in comparison with the non-clamp group (1%)[13]. The little change in renal function was due to avoiding ischemia and a minimal proportion of the resection of the renal parenchyma along with the tumor.

Lower pole mass is easier for this technique in accession and mobilization. We don't recommend our technique in an upper pole mass or mass located near the renal hilar. It is easier for fully perfused LPN in small renal masses, especially less than 2 cm in diameter. Smaller masses also tend to have less blood supply and less renal tissue attachment, contributing to the minimal bleeding we experienced.

Four years of fully perfused LPN in Phramongkutklao Hospital supports this feasible technique which has a good oncologic outcome for certain mass sizes in certain locations. It combines the advantages of the minimally invasive technique with the objectives of partial nephrectomy, such as nephron sparing and tumor control. Minimally invasive surgery was clearly demonstrated through the significant change in kidney function, short hospital stay, and less blood loss. The implemented technique for fully perfused LPN was used in cases of exophytic masses less than 2 cm in diameter. After the tumor is excised, the suture (No 1 Vicryl) can be tightened quickly and continuously in a locked fashion (V loc plastic clip size M is used in every stitches) to prevent any potential bleeding.

Our study was retrospective and utilized creatinine levels instead of GFR. Serum creatinine levels can be affected by different factors, such as medications, protein intake, hydration status, and renal tubular absorption and secretion. However, serum creatinine has been used to calculate the renal function in many studies, and deemed sufficient[1,7].

## Conflict of interest

The authors declare no conflict of interest.

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