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Results of our laparoscopic partial nephrectomy without ischemia: the first ten cases

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Abstract

Laparoscopic partial nephrectomy (LPN) without ischemia is a new method that can only be performed in selected cases. We presented results of patients who underwent LPN without ischemia for renal mass in our clinic. The demographic characteristics, perioperative and postoperative surgical results, complications and renal functions were retrospectively reviewed for patients who underwent LPN without ischemia between March 2014 and September 2015. Renal function was assessed using the estimated glomerular filtration rate (GFR) calculated by the Modification of Diet in Renal Disease (MDRD) equation. Complications were assessed according to modified Clavien classification. Ten cases of LPN without ischemia were performed. The mean age was (year) 50.6 ± 8.6 , the mean mass size (mm) 37.9 ± 23 , the mean RENAL score was 6.4 ± 1.2 . The mean operation time (minute) 110.5 ± 41 , the mean bleeding amount (ml) 191 ± 198 , the mean hemoglobin (mg/dl) preoperative 13.86 ± 1.28 , postoperative 12.2 ± 1.2 , the mean creatinine (mg/dl) preoperative 0.95 ± 0.19 , postoperative 0.85 ± 0.2 , 1-Year 0.91 ± 0.1 , GFR (ml/min) preoperative 77.6 , postoperative 1.day 79.6 , 1.Year 81.2 , hospitalization duration (day) 2.9 ± 0.7 . Two patients underwent blood transfusion (According to modified Clavien classification grade 2). LPN without ischemia is a new method that can only be performed in selected cases in experienced clinics.

Keywords: Laparoscopy, partial nephrectomy without ischemia, renal cell carcinoma

Introduction

Nephron-sparing surgery for the removal of small renal masses delivers equivalent oncological outcomes and better functional outcomes compared with those associated with Radical Nephrectomy (RN) [1,2]. After nephron-sparing surgery, long-term renal function relies on three fundamental factors: baseline renal function, volume of preserved nephrons and ischemia time (IT) [3,4]. For tumors smaller than 4 cm the gold standard treatment is partial nephrectomy (PN), PN is performed with two well-known procedures; open and laparoscopic. The laparoscopic approach has the advantage of a better cosmetic result, less analgesic requirement and shorter hospitalization, but has a longer warm ischemia and a learning disadvantage [5].

The oncologic results of PN are similar to RN and postoperative renal function (PRF) is better than RN due to nephron preservation [6,7]. Better protection of PRF prevents end-stage renal failure and reduces long-term non-cancer-related deaths [6-8]. Two parameters must be observed during surgery to preserve PRF in the PN. The

first is to leave the renal parenchyma at the maximum level and to avoid parenchymal atrophy. In the past it was suggested to remove the border with non-tumorous parenchymal tissue about 1 cm around the sac to avoid local recurrence. It is recommended in the current literature that normal parenchymal tissue up to 1-2 mm is enough for removal to avoid local recurrence. To avoid parenchymal atrophy, it is recommended to keep the ischemic time short and to avoid deep parenchymal suturation [9-11].

In this paper, we present our initial experience in our first 10 consecutive patients. We evaluated the perioperative and postoperative results, complications and PRF of LPN cases performed without ischemia between March 2014 and September 2015. The aim of this paper is to describe the perioperative outcomes of the LPN technique; intermediate and long-term renal function outcomes will be the subject of subsequent communications.

Material and Method

Study population

We retrospectively reviewed for patients who underwent LPN without ischemia for renal mass in our center between March 2014 and September 2015. Data were collected retrospectively and entered into an Institutional Review Board-approved database. Inclusion criteria comprised all patients with a single, clinical T1

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tumor deemed to be candidates for PN. Excluded were medically high-risk patients with severe, preexisting cardiopulmonary, cerebrovascular, or hepatorenal dysfunction. No patient was excluded because of the technical complexity of the tumor. Patient demographics are presented in Table 1. Patients' consent was received before surgery.

Preoperative and postoperative work-up

The preoperative work-up comprised medical history, physical examination, and routine laboratory tests. Serum creatinine was recorded baseline preoperative, postoperative at 1 day and 1 year. Overall renal function was assessed by glomerular filtration rate (GFR), which was calculated according to the Modification of Diet in Renal Disease (MDRD) equation ($\text{ml per minute per } 1.73 \text{ m}^2 = 186 \times \text{sCr}^{-1.154} \times \text{age}^{-0.203} \times (0.742 \text{ if female}) \times (1.210 \text{ if black})$). For all patients, baseline preoperative, postoperative (1 day and 1 year) GFR values were evaluated. A dedicated three-dimensional abdominal computed tomography (CT) or magnetic resonance (MR) imaging scan with 2–3-mm cuts were performed to delineate the details of tumor location, depth and proximity to collecting system; the arterial and venous phases were used to evaluate extrarenal hilar renal arterial and venous anatomy. Patients were graded according to the RENAL scoring system by examining preoperative imaging techniques (CT or MR). The RENAL nephrometry score consists of five anatomic radiologic properties: (R) radius / maximal tumor diameter, (E) exophytic/endophytic properties, (N) nearness to the collecting system or

sinus, (A) Not anterior or posterior (x) descriptor, and (L) location relative to the polar line. For each variable except, 1 to 3 points are assigned, which yields a total of 4 points for the least complex and 12 points for the most complex mass. The sentence should be 'Masses are classified as low complexity (RENAL scores 4-6), moderate complexity (scores 7-9), or high complexity (scores 10-12) [12].'

Surgical Procedure

We prefer the transperitoneal approach as it allows us more space and is easier for suturation. The patients were administered general anesthesia and placed in the modified lateral position. Three ports in the anterior abdominal were applied. The line of Toldt is incised along a relatively avascular plane to mobilize the bowel. Then the renal was mobilized as necessary to expose the tumor completely (Figure 1A). Before resection of the tumor, the renal artery and vein were dissected without clamping (Figure 1B). Scissors were used to open the renal capsule 2-3 mm away from the tumor and further cuts were made deep into the renal cortex around the tumor (Figure 1C and 1D). Monopolar coagulation was applied when small arterial bleeding occurred. After complete excision of the tumor, the parenchymal defect was closed using Hem-o-lok clips to tighten and secure the sutures at each exit point (Figure 1E). Pneumoperitoneum pressure was temporarily increased to 15 mmHg during saturation. Hemostatic agents were used at the end of the procedure (Figure 1F).

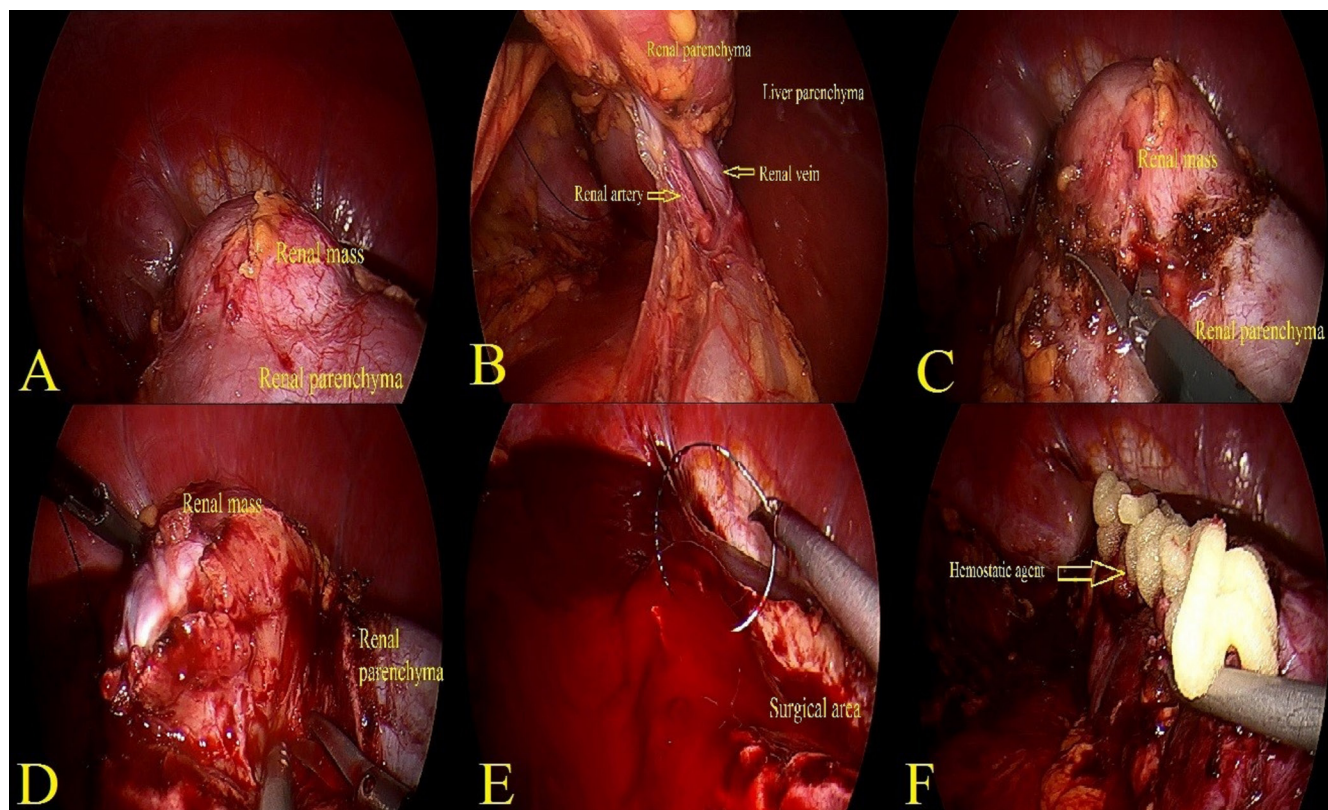


Figure 1. Surgical procedure of laparoscopic partial nephrectomy without ischemia

Results

Ten cases of LPN without ischemia were performed. All surgeries were completed laparoscopically, and no patients had ischemia during the operation. Six patients were female, and four patients

were male. Six had the renal mass at the right kidney, four at the left kidney. The mean age was 50.6 ± 8.6 years, the mean mass size was 37.9 ± 23 mm, the mean RENAL score was 6.4 ± 1.2 , length of hospitalization was 2.9 ± 0.7 days, the mean operation time was 110.5 ± 41 min, the mean amount of bleeding was 191 ± 198 ml

(Table 1). Two patients underwent blood transfusion according to the modified Clavien classification (grade 2). Pathologic diagnoses: four patients had angiomyolipoma, three patients had clear cell, two patients had chromophobes, one patient had type 1 papillary cell renal cell carcinoma, one patient had surgical margin positive and the mean Fuhrman grade was 2.5 (over six patients with RCC diagnosis). The mean hemoglobin preoperative was 13.86 ± 1.28 , postoperative 12.2 ± 1.2 ; the mean creatinine preoperative was 0.95 ± 0.19 , postoperative 0.85 ± 0.2 , 1 year 0.91 ± 0.1 ; the mean GFR preoperative was 77.6, postoperative 1 day 79.6, 1 year 81.2 (Table 2).

Table 1. Demographic features, clinical and tumor parameters and operative data (n=10)

Parameters	Values
Age (years)	50.6 ± 8.60
Gender (Male/Female)	4/6
Median Tumor size (mm)	37.9 ± 23
Tumor Side (Right/Left)	(6/4)
Number of polar location (Upper/Mid/Lower)	2/5/3
Hospitalization length (days)	2.9 ± 0.7
Operation time (min)	110.5 ± 41
Bleeding amount (ml)	191 ± 198
Complication (Clavien classification)	2 (grade2)
Pathological diagnosis	
Angiomyolipoma	4
Clear cell	3
Chromophobe cell	2
Papillary cell (type 1)	1
RENAL Score	6.4 ± 1.2

Table 2. Preoperative and postoperative outcomes

Parameters	Preoperative	Postoperative 1. day	Postoperative 1. year
Hemoglobin	13.8 ± 1.2	12.2 ± 1.2	13.2 ± 1.2
Serum creatinine (mg/dl)	0.95 ± 0.1	0.85 ± 0.2	0.91 ± 0.1
Estimated GFR (ml/min per 1.73 m ²)	77.6	79.6	81.2

GFR = glomerular filtration rate.

* Data presented for patients without complications to eliminate confounding factors.

Discussion

For localized renal tumors, PN was accepted as the gold standard approach in renal masses smaller than 4 cm due to similar oncological outcomes to RN [1-4]. Several approaches have been developed to reduce the loss of renal function related to IT [3], as well as for demonstrating the benefits of nephron preservation with regard to morbidity and mortality as much as possible without giving up oncologic principles. The main types of these approaches are cold ischemia rather than warm ischemia, shortening of the ischemic period, selective segmental artery clamping and performing non-ischemic PN.

LPN for oncological reasons was first described by McDougall EM et al. [13]. In the early period, renal arterioclamps were placed under complete ischemia, followed by the selective segmental arterial clamping technique, the early declamping technique, and in recent years, totally non-ischemic studies have been reported. It has been suggested that because ischemia affects the renal

function negatively in the long term, LPN should be done with the shortest ischemic time and it should not exceed 25 minutes [14,16]. Thompson et al. have shown that every minute of ischemia increases the risk of CRF by 6% in the long term [16].

Today, many open surgical approaches have ceded place to a laparoscopic approach. However, because of the difficulty in suturing and lack of depth perception in surgery, surgery with LPN has a high level of difficulty. Additionally, when done without ischemia, the hemorrhage in the surgical area increases the degree of this difficulty. Although technological developments have partially reduced this difficulty, it is suggested that LPN should be performed in experienced centers specialized in laparoscopic surgery [17].

Studies have compare LPN with and without ischemia. In the study of Koo HJ et al (ischemic (n: 10) and non-ischemic (n: 11)), the urinary leakage and surgical time were higher in the ischemic group whereas the blood transfusion requirement and PRF were not different between the two groups [18]. Smith et al. reported that although the average amount of bleeding (300 ml) was higher in the non-ischemic group, the oncologic outcome was similar and renal function was better preserved in the non-ischemic group [19]. GFR in the subgroup (solitary renal patients) of the same study was 21% in the ischemic group at 1 year, whereas it was 4% in the non- ischemia group. Less bleeding, shorter surgery and hospitalization and less urinary leakage were reported in non-ischemic group by Petrasz et al., George found similar results in his study [20,21]. In Salmi et al.'s study, in which non-ischemic LPN was performed there were nine patients with a mean mass size of 3.2 cm, the mean duration of surgery was 131 min, the mean amount of bleeding was 250 cc, complications developed in 22% of the patients, no blood tx was required in any patient and the change in PRF was not significant [22]. However, a 10-item meta-analysis revealed high blood transfusion rates in ischemia-free PN, a smaller rate of complications, less surgical margin positivity and a better preserved PRF [23].

Luigi Mearini et al. found in 2016 that laparoscopic and robot-assisted LPN surgery was superior to open surgery in terms of duration of operation, amount of bleeding, ischemia and complication rate in a study comparing three different approaches (open, laparoscopic and robot-assisted laparoscopy) for non-ischemic PN [24]. In this study, ischemia was required in three patients (4.5%), there were 66 cases of non-ischemic LPN with a mean tumor size of 2.7 (0.9-14) and PADUA scoring 7 (6-10), the mean hospitalization time was 2 (1-5), postoperative GFR reduction was 2%, and the average duration of surgery was 177.5 (95-280). Postoperative bleeding and port site hernia was observed in one patient. The importance of preoperative assessment of PADUA scoring was emphasized in the study, in which residual complications using the PADUA scoring increased independently of the surgical technique.

Morphometric scoring systems (RENAL nephrometry score, PADUA score, and C-index) used to express the difficulty level of renal masses in a standard and objective manner can be used to predict the duration of hot ischemia [25-27]. Generally, as the scoring increases, there is a tendency towards using the PN procedure under more open and hot ischemia, if possible. Esen et al. evaluated the choice of surgical approach by scoring the

statistical significance of the open ischemic PN procedure on certain threshold values (6.5 for the RENAL score and 7.5 for the PADUA score) [28]. Hong-Kai Wang et al have shown that non-ischemic LPN is safe and feasible for those with a RENAL score of 4 [29].

Although the number of patients was limited in our study, the duration of surgery, bleeding amount and complication rate were compatible with literature, and at 1 year the amount of PRF change had increased to 3.6.

Conclusion

PN should be performed in the purpose of preserving maximum renal parenchyma with safe oncological borders under zero or the shortest ischemic period. LPN without ischemia is a new method that can only be performed in selected cases in experienced clinics. There is a need for large series to demonstrate the safety and effectiveness of PN without ischemia.

Competing interests

The authors declare that there is no conflict of interests regarding the publication of this article.

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