

Partial Nephrectomy using Parenchymal Compression without Renal Pedicle Clamping

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Purpose: The hemostasis and closure of the collecting system are still problems to be overcome during a partial nephrectomy. Herein, our initial experience of a parenchymal compression technique, without clamping of the renal pedicle during an open partial nephrectomy, is reported.

Materials and Methods: Between May 2000 and August 2005, 10 patients underwent an open partial nephrectomy, without pedicle clamping, for a renal mass. The open partial nephrectomy was performed under regional ischemia, which was achieved by parenchymal compression using a long curved vascular clamp. Several parameters were retrospectively assessed, including the tumor size, location, pathology, estimated blood loss, preoperative and postoperative serum creatinine, complications, and tumor recurrence.

Results: The mean mass size was 23.8mm, ranging between 12 and 55mm, and the tumors were located in the upper, mid and lower poles in 2, 3 and 4 cases, respectively. Pathological examinations revealed renal cell carcinomas in 6, an angiomyolipoma in 1, and complicated renal cysts in 3 patients. In all the patients with renal cell carcinoma, the frozen and permanent sections analyses confirmed negative margins. There were no differences between the preoperative and postoperative creatinine levels, with no significant complications observed, including urinary leak and bleeding, during the recovery period. No patient developed a local recurrence or distant metastasis during the mean follow-up period of 17.2 months.

Conclusions: This technique is simple, and can be easily practiced by any urological surgeon, without concerns relating to the ischemic time and complications. It is suggested that the regional parenchymal compression is an efficient technique for hemostasis and repair of the collecting system during an open partial nephrectomy. (*Korean J Urol* 2007;48:265-269)

Key Words: Nephrectomy, Kidney neoplasms, Ischemia

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PURPOSE

Radical nephrectomy has been considered the standard treatment for localized renal cell carcinoma with normal contra-lateral kidney. Unlike radical nephrectomy, Nephron-sparing surgery was usually preferred only for patients with bilateral disease, solitary functioning kidney or the abnormal opposite kidney.¹⁻³ However, the widespread use of imaging

modalities including ultrasonography, computed tomography, and magnetic resonance imaging. Consequently, such fine imaging modalities enable us to more frequently detect small-sized incidental masses and the partial nephrectomy to be more amenable.

The conventional partial nephrectomy was performed with pedicle occlusion and renal cooling achieved by ice placed on the kidney surface. However, there have been still accompanying technical difficulties in getting adequate hemostasis

and a watertight closure of the collecting system with concerning about ischemic damage to the kidney. Here, we report our initial experiences of a technique of regional parenchymal compression using long curved vascular clamp without renal pedicle occlusion during open partial nephrectomy.

MATERIALS AND METHODS

1. Patients

Ten patients underwent open partial nephrectomy for a renal mass between May 2000 and August 2005. Preoperative workup included chest X-ray, routine laboratory study (serum creatinine, blood count, electrolytes), and abdominal computed tomography (CT) scan. Several parameters were also retrospectively assessed, including tumor size, location, pathology, estimated blood loss, preoperative and postoperative serum creatinine, complication, and tumor recurrence through the medical records.

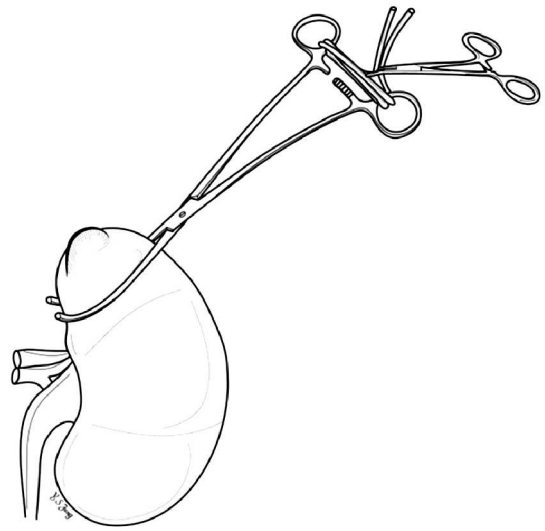


Fig. 1. Selective renal parenchymal clamping circumscribing the tumor, using a long curved vascular clamp. The clamping pressure was controlled, using a vessel loop tied with a Mosquito clamp to avoid crushing the kidney.

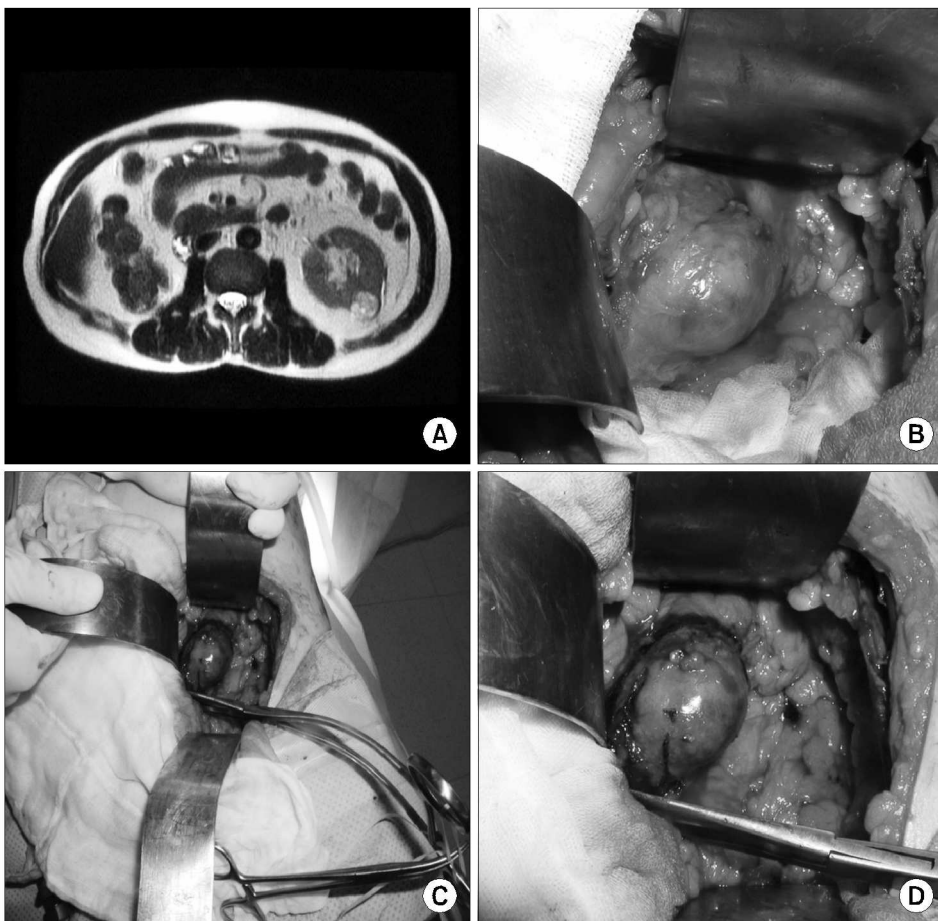


Fig. 2. Contour bulging mass on the lower pole of the left solitary kidney. (A) MRI, (B) renal mass covered with fatty tissue, (C) and (D) parenchymal compression using a vascular clamp and pedicle was not dissected.

2. Surgical technique

The kidney was approached extraperitoneally from standard flank incision between the 11th and 12th ribs and the kidney was mobilized, while perinephric fat overlying the tumor was left intact. Instead of clamping the renal pedicle and cooling renal surface with ice slush, was performed the regional ischemia technique, which selectively clamped renal parenchyma and, as a result, circumscribed the tumor with long curved vascular clamp (Fig. 1, 2). In case of tumor located at mid portion, we applied two vascular clamps, if needed. The renal capsule was sharply incised, leaving 1.5cm margin of normal-appearing parenchyma from the tumor, and then the tumor masses were analyzed and the negative surgical margins were confirmed.

Large vessels were suture-ligated and collecting systems were closed precisely using a running or single suture with 4-zero absorbable sutures. After the release of the compression clamp, only a few additional sutures were needed to achieve hemostasis, provided any prominent vessels were identified. For additional hemostasis, cut surface was cauterized with the argon beam coagulator and sealed with fibrin glue (Tissel, Baxter) and covered with oxidized cellulose (Surgicel). At the end of surgery, closed suction drain was placed.

All cases were staged according to 2002 TNM criteria and nuclear grading was confirmed according to criteria guideline by Fuhrman et al. On the 5th postoperative day, the creatinine in the fluid in the closed drain was chemically analyzed to exclude urine extravasation. Patients were followed up with the

level of serum creatinine, chest X-ray and kidney CT every 6 months after surgery for the first two years and then annually thereafter. Statistical comparisons of serum creatinine value were performed using the Kruskal-Wallis test.

RESULTS

Nine of ten patients were presented without any symptom while one case was associated with flank discomfort and microscopic hematuria. The patients' characteristics are summarized in Table 1. The mean age was 59 years old with the range between 44 and 65 and the mean tumor size, which was determined by preoperative CT scan, was 23.8mm with the range between 12 and 55. Seven patients had a solid lesion and on the other hand, three patients had a cystic lesion. The tumors were located in the different places; 3, in the upper pole, 3 in the mid-kidney, and 4, in the lower pole. One patient (No. 6) had a solitary kidney, which resulted from the previous history of radical nephrectomy for renal cell carcinoma of right kidney and other patient (No. 8) had a small sized kidney opposite to tumor side. The rest of eight patients had a contralateral normal kidney.

Partial nephrectomy was successfully performed using parenchymal compression. The mean operative time was 110 minutes ranging from 80 and 130. Intraoperative blood loss was minimal and the mean estimated blood loss, measured by blood volume in the suction drain, was 158 with the range between 50 and 300 and, as a result, none of patients required blood transfusion postoperatively. Mean preoperative creatinine was

Table 1. The patients' characteristics

No.	Side	Location	Size (mm)	Character	Pathology	Stage	Blood loss (ml)
1	Rt	Lower	20	Solid	RCC	PT1aN0M0	200
2	Lt	Lower	22	Solid	RCC	PT1aN0M0	180
3	Rt	Mid	30	Solid	RCC	PT3aN0M0	200
4	Lt	Lower	55	Solid	RCC	PT1bN0M0	300
5	Lt	Upper	23	Solid	AML	—	100
6	Lt	Upper	20	Cystic	Complicated cyst	—	50
7	Lt	Lower	13	Solid	RCC	PT1aN0M0	150
8	Rt	Mid	12	Solid	RCC	PT1aN0M0	200
9	Rt	Mid	20	Cystic	Complicated cyst	—	50
10	Lt	Upper	23	Cystic	Complicated cyst	—	150

RCC: renal cell carcinoma, AML: angiomyolipoma

Table 2. The pathological examination results

Pathologic diagnosis	Number
Renal cell carcinoma	6
Stage pT1	5
Stage pT3	1
Grade 2	5
Grade 3	1
Angiomyolipoma	1
Complicated renal cyst	3

1.1 ± 0.3 mg/dl (range 0.8 to 1.7), postoperative 5th day's was 1.1 ± 0.3 mg/dl (range 0.7 to 1.7), and creatinine 3 months post-operatively was 1.1 ± 0.3 mg/dl (range 0.8 to 1.9). There were no differences between the preoperative and postoperative creatinine levels ($p=0.936$). No complication was observed, including urinary leak confirmed with closed drain or renal dysfunction during recovery period. The pathological examination was summarized in Table 2. The frozen and postoperative permanent section analysis confirmed negative margins in all patients with renal cell carcinoma. The mean follow-up of our study population was 17.2 months (range 8 to 39). No patients developed local recurrence or distant metastasis at the last follow-up.

DISCUSSION

The classic concept of surgery for renal cell carcinoma was wide excision such as radical nephrectomy due to concerns about multicentricity and local recurrence.⁴ Recently, many studies demonstrated that nephron sparing surgery could provide oncological results comparable to those of radical surgery for patients with smaller (less than 4cm) renal tumor.⁵⁻⁸ Consequently, nephron-sparing surgery has gained lots of interest as the preferred surgical management of small renal masses. The surgical options for nephron-sparing surgery are enucleation, wedge resection, segmental resections and other intervention involving cryotherapy or radiofrequency ablation.⁹⁻¹¹ The basic principles in performing partial nephrectomy are preservation of renal function, complete tumor excision with negative surgical margins, watertight closure of the collecting system, careful hemostasis and secure closure of the renal parenchyma. Among them, careful hemostasis of resected surface is the most difficult procedure to achieve.

The hemostasis has been obtained classically by pedicle vascular occlusion and renal cooling achieved by placing ice around the renal surface. However, there were a couple of disadvantages in that procedure. First, access to renal pedicle is time-consuming and potentially dangerous. Second, due to the renal ischemia, pedicle clamping greatly limited the surgery time for a series of surgery processes such as suturing bleeding vessels and closing the collecting systems.

During the past two years, we have performed partial nephrectomy achieving local renal ischemia by parenchymal compression with long curved vascular clamp and never requiring cooling the renal surface with ice slush and anti-ischemic prophylactic treatment. The resultant benefits were the decreasing surgery time and the smaller incision. Since localized ischemia did not affect the remainder of the renal parenchyma, we had enough time to perform hemostasis and close the collecting system without concerns about ischemic time. Furthermore, this technique is so simple that most of urologists, even inexperienced ones, can easily practice it.

Up to now, we used various techniques to achieve hemostasis during partial nephrectomy, including temporary vascular occlusion, vessel suture ligation, renal compression and special surgical equipment such as the argon beam coagulator. To our knowledge, there have also been similar techniques, described by Gill et al using a tourniquet, and by Cariou and Mejean using clamps.¹²⁻¹⁴

There were a couple of limitations in our procedure. First, in cases of hilar tumor or tumor close to the pedicle, we chose the classic technique with renal artery occlusion than our procedure. Second, the renal parenchyma was so fragile that it could be easily damaged by compression. Thus, it was very important that clamping pressure should be controlled to avoid crushing the kidney by vessel loop tied with Mosquito clamp (Fig. 1). Furthermore, there is another possible risk of the slippage of vascular clamp off the kidney. Maintaining the clamping pressure is prerequisite to prevention of the slippage and securing enough distance between clamping and incising the kidney is more essential procedure. In case of short distance between them, the vascular clamp is liable to slip off the kidney.

When any small bleeding vessels were identified after releasing the compression clamp, the additional procedures were needed to achieve hemostasis. We usually cauterized the cut surface with the argon beam coagulator and sealed with

fibrin glue. The argon beam coagulator was used for hemostatic and oncologic reasons, which could easily provide a further 1mm thickness of parenchymal coagulation.¹⁵ Fibrin glue as a powerful hemostatic sealant, is utilized in various urological procedures, including pyeloplasty, urinary tract fistula treatment and open partial nephrectomy.¹⁶⁻¹⁹

CONCLUSIONS

Recently, partial nephrectomy has been regarded as the preferred surgical management of small sized renal masses. Our technique described above is so simple that it can be easily practiced by any urologic surgeon without concerns about ischemic time and complications. Taken together, localized renal parenchymal clamping is an efficient technique for open partial nephrectomy, provided tumor is located at peripheral portion of kidney.

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