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Repeat Partial Nephrectomy on the Solitary Kidney: Surgical, Functional, and Oncologic Outcomes

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Abstract

Purpose—To examine the outcomes of patients with recurrent or de novo renal lesions treated with repeat partial nephrectomy on a solitary kidney.

Methods—We reviewed the records of patients who underwent nephron-sparing surgeries at the NCI from 1989 to 2008. Patients were included in the analysis if they underwent a repeat partial nephrectomy on a solitary kidney. Perioperative, functional, and oncologic outcomes were assessed. Functional outcomes were evaluated using the MDRD equation for eGFR. Oncologic efficacy was examined by the need for subsequent repeat renal surgery and development of metastatic disease.

Results—Twenty-five patients were included in the analysis. The median number of tumors resected was 4; with median EBL of 2,400ml, and median operative time of 8.5 hours. Perioperative complications occurred in 52% of the cases and included one mortality, and the loss of 3 renal units. There was a decline in eGFR ($p < 0.01$) on the first follow up visit within 3 months after surgery, but at the 1 year follow up, the difference was not significant ($p = 0.12$). Surgical interventions were recommended to eight patients (38%) for recurrent or de-novo tumors at a median time of 36 months, while metastasis-free survival of the cohort at an average of 57 months (range 3–196, median 50 months) was 95%.

Conclusions—Repeat partial nephrectomy for patients with a solitary kidney is a high risk alternative. Although the complication rates are high and there is a modest decline in renal function, most patients remain free from dialysis with acceptable oncologic outcomes at intermediate follow up.

Keywords

Repeat partial nephrectomy; solitary kidney; treatment outcome; complications

Renal cell carcinoma in a solitary kidney presents a unique clinical challenge to urologic surgeons. The use of partial nephrectomy in this setting has demonstrated good oncologic and renal functional outcomes with acceptable complication rates.^{1,2} In 1990, Novick et al showed that preservation of long-term renal function can be achieved with partial nephrectomy in a solitary renal unit.³ Subsequently, others have reported their experience with patients who underwent partial nephrectomy for tumor in a solitary kidney. The

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majority of patients had excellent cancer specific survival and retained sufficient renal function to avoid permanent hemodialysis.⁴⁻⁷

The management of patients with familial renal cancer syndromes and those with multifocal renal tumors is further complicated by the recurrent or persistent nature of the disease, especially in those with only one kidney remaining. Even when these patients are treated with aggressive nephron sparing surgery they are still at risk for de-novo tumor formation or recurrence in the remaining renal unit. As many as 85% of patients with VHL will experience tumor recurrence at 10 years.⁸ Such patients are likely to require multiple surgical interventions.^{9,10} While ablative therapy may be useful in select patients with local recurrences, in others repeat partial nephrectomy remains the most appropriate treatment modality.¹¹

Performing surgery on a previously operated kidney can be difficult as well as technically demanding.^{9,10} We have previously reported outcomes of those patients who have had repeat or salvage (three or more partial nephrectomies on the same renal unit), but with further experience in aggressive surgical management of those with multifocal renal masses, we can now concentrate on the cohort of patients who have required reoperative surgery on a solitary kidney. To our knowledge, there are no published data on the outcomes of a repeat partial nephrectomy in patients with a solitary renal remnant. In this paper we report the perioperative, functional and oncological outcomes in this specific cohort of patients.

Material and Methods

A review of the National Cancer Institute (NCI) renal cell carcinoma database between 1989 and 2009 identified 25 patients who underwent a repeat open partial nephrectomy for recurrent or de novo renal masses on a solitary kidney. Surgery was recommended when the largest solid tumor was approximately 3cm. All patients were evaluated on an NCI institutional review board approved protocol.

Preoperative assessment included physical exam, routine laboratory studies, and abdominal computed tomography or magnetic resonance imaging. Baseline clinical characteristics such as age, gender, height and weight were recorded on each patient along with steroid requirement and previous abdominal surgeries. Operative data included the need for renal hilar clamping, renal ischemia time, procedure duration (start of anesthesia to transfer to PACU or ICU) and burden of disease (number of renal lesions, lesion size and pathological grade).

Perioperative outcomes were assessed by EBL, transfusion requirement, and visceral or vascular injuries. Postoperative outcomes were measured by the need for blood transfusion, prolonged urinary leakage (defined as a need for drain at the time of the discharge), renal unit loss, the need for subsequent reoperation, cardiovascular events and the need for acute or chronic hemodialysis.

Assessment of renal function was performed by comparing preoperative and postoperative serum creatinine and estimated glomerular filtration rate (eGFR) in all patients. The eGFR (ml/minute/1.73m²) was estimated using the abbreviated Modification of Diet in Renal Disease (MDRD) study equation: $eGFR = 186 \times (\text{serum creatinine}^{-1.154}) \times (\text{age})^{-0.203}$ from which the result is multiplied by 0.742 for female patients and multiplied by 1.212 for black patients.¹² Postoperative eGFR were obtained at least 4weeks and then 12 months after the surgery. A 2-tailed Student t-test was performed to compare renal functional outcomes with $p < 0.05$ considered statistically significant.

Patients were followed initially at 1 or 3 months after surgery, and then every 6–12 months with abdominal and chest imaging. Oncological outcomes were assessed by evaluating for the presence of metastatic or locally advanced disease on imaging, and the need for reoperation for recurrent or de-novo solid renal lesions approaching 3 cm in the largest dimension. The last follow up date was established as the date of the most recent imaging.

Results

Table 1 lists the clinical characteristics of the 25 patients studied. Thirteen of the 25 patients were men and the median patient age at the time of procedure was 51 years. Nineteen out of 25 patients had VHL and all 25 patients had prior contralateral radical nephrectomy for cancer. Median time interval between first partial nephrectomy and present surgery on ipsilateral kidney is 99 months (range 13 to 200). Median intraoperative blood loss (EBL) was 2,400 mL (range 800 to 14,000), with 19 patients (76%) who required intraoperative transfusions with a median of 5 units (range 2 to 26). Renal hilar clamping was performed in 12 patients (48%) at a surgeon's discretion or when the bleeding was too brisk for adequate visualization during tumor dissection. Surface hypothermia with ice slush during renal ischemia was utilized in all 12 patients with a median cold ischemia time of 46 minutes (8–120). Median operative time was 8.5 hrs (range 4.8 to 11).

Perioperative outcomes are shown in table 2. Perioperative complications developed in 13 patients (52%). The most frequent intraoperative complication was vascular injury occurring in 6 patients (25%). Two patients had successful repair of a renal vein lacerations, one required repair of IVC, and three patients had injuries of the main renal artery. The arterial injuries included arterial tear, intimal tear, and renal artery transection. The injuries occurred during hilar dissection due to extensive scarring. All three attempts of arterial repair failed, resulting in losses of the three solitary renal units. Two kidneys were lost intraoperatively, while the third kidney was removed 1 week later due to a failure of anastomosis.

The most common postoperative complication was prolonged urine leak, which occurred in 5 patients (20%). Three patients were treated with ureteral stenting while the rest were treated with expectant management leading to spontaneous resolution. The most severe complication was an intraoperative myocardial infarction resulting in postoperative expiration of the patient. This patient was 70 years of age at the time of the procedure and her medical history was complicated by multiple abdominal surgeries, long-standing hypertension and extensive VHL manifestations.

Renal functional outcomes are listed in table 3. Eighty-eight percent of patients did not require hemodialysis. As previously mentioned, three patients (12%) became permanently dependent on hemodialysis after subsequent completion nephrectomy. These patients were not included in the analysis of renal functional outcomes. The median serum creatinine level was 1.5 mg/dL preoperatively and increased to 1.7mg/dL ($p = 0.004$) at first follow up visit after the surgery, with corresponding decrease of eGFR from 53mL/min/1.73m² to 42.5 mL/min/1.73m², ($p=0.003$). At 12 months, while the median serum creatinine was statistically significantly changed 1.55 mg/dL up from 1.5 mg/dL, ($p = 0.05$), the eGFR change was not statistically significant (49 L/min/1.73m² from 53mL/min/1.73m²), ($p = 0.115$).

Discussion

The persistent nature of multifocal RCC presents a challenging clinical problem. Aggressive surgical interventions must balance adequate cancer control against the risk of end-stage renal failure. While NSS has become the procedure of choice for patients with a surgically naïve solitary kidney, little data exists regarding the feasibility of repeat NSS in a cohort of

patients with multifocal RCC and solitary kidney. To our knowledge, only three series have examined the role of repeat NSS.^{9,10,13} However, the cohorts in these studies are not exclusively limited to patients with a solitary kidney. The current study evaluated our 21 year experience with surgical, functional and oncological outcomes of repeat partial nephrectomy in patients with a recurrent RCC with a previously operated solitary kidney.

Similar to prior reports of reoperative intervention on the kidney, these surgeries had a high rate of perioperative complications. The outcomes of both published series on partial nephrectomy on surgically-naïve solitary kidneys and the present study are described in table 4.^{4-7,14} The present study demonstrates that repeat renal surgery on a solitary unit is associated with longer operative times, higher EBL, higher postoperative urine leak, greater need for postoperative dialysis, and highest overall complication rate. The surgical complications in the current series are similar in type to those of other series with prolonged urine leak being the most common adverse postoperative event (table 4). The overall complication rates of nearly 50% is almost identical to the complication rate of 46% observed patients with VHL treated with salvage partial nephrectomy (at least 3 NSS on the same renal unit).⁹ However, the rate of a renal unit loss was almost double for salvage procedures when compared to the present series (23% vs 12%, respectively). Additionally, with the use of modern hemostatic agents, and our experience in reoperative renal surgeries, renal reconstruction, and postoperative management, we have observed a decrease in major complications in our most recent cases, when compared to our earlier experience almost 2 decades before. We find that minimizing hilar dissection and attempting to control the hilum en-block during initial or repeat intervention may provide the safest approach in minimizing the number of vascular injuries. Occasionally, ultrasound may be useful in identifying non-palpable arterial pulsation due to fibrosis, but a surgeon's anticipation of altered reoperative anatomy and readiness to address vascular injury is of utmost importance. Should arterial injury occur intraoperatively due to either renal artery transection or thrombosis, proximal control should be obtained immediately. The kidney should then be flushed with heparinized saline and placed on ice prior to repairing the artery. Although not successful in this series, we have been able to save renal units in other instances of arterial injuries.

Mageral et al. also studied the efficacy of repeat NSS in 18 patients with a solid renal mass.¹³ Although their complication rate in the repeat NSS group (28%) is lower than that reported in the current series, these authors did not report the overall complication rate specifically to those with a solitary kidney. Nonetheless, they concluded that repeat NSS may be appropriate for patients with imperative indications such as those with a solitary renal unit.

Several factors in our study may have contributed to a higher overall complication rate when compared to those of other series listed in Table 4. First, while trying to balance our ability to resect multiple renal masses and maximally preserve residual function in the remaining renal parenchyma, we often delay or avoid renal hilar clamping. While this technique has the advantage of minimizing renal ischemia, its main disadvantage is higher rates of intraoperative transfusion. The use of this technique explains the highest EBL in the present series and the overall lowest renal hilar clamping rate of only 48%. The higher blood loss and more extensive intraoperative fluid shifts are known to be a risk factor for almost every surgical procedure. Second, most patients in our cohort had multiple renal lesions resected (median = 4) at the time of surgery, and this may have prolonged the overall operating time as well as increased the EBL. Finally, unlike other series in table 4 which involved patients with a surgically naïve kidney, all of our patients had a prior partial nephrectomy on their remaining renal unit. Surgical interventions in these cases are often complicated by extensive fibrosis and scarring leading to a challenging surgery.

Despite higher rates of perioperative complications, the preservation of renal function was achieved in the vast majority of our cohort. Indeed, 88% of patients in our series were able to avoid dialysis with only a minimal decline in renal function at 1 year. Among those whose renal units were kept, we were able to preserve at least 80% of the preoperative renal function. Similar to other reports, our study also demonstrated that a slight deterioration in renal function is associated with partial nephrectomy on a solitary kidney. For example, Saranchuk et al studied renal function in 54 patients with a solitary kidney treated with nephron-sparing surgery and found an increase in median serum creatinine from 1.4 mg/dL before the surgery to 1.5 mg/dL after 24 months.⁷ Interestingly, in our series, when compared to first postoperative follow up, there was some recovery of renal functions at 12 month after the surgery, signified by a non-statistical difference in eGFR before surgery and eGFR at 12 months. (The 12 month follow up data was not available for two patients due to insufficient follow up, but when the analysis included only those 19 patients with available follow up data at 1 and 12 months, the initial significant decline in renal function at 1 month disappeared at 12 months (data not shown)).

In the present series, we provided GFR as part of the assessment of renal functional outcomes in conjunction with serum creatinine. Estimated GFR is regarded as the best overall measure of kidney function in both healthy and diseased population, as it takes into account other factors such as sex, age, race and body mass, which have been shown to have an important impact on the determination of renal function.^{12,15} Furthermore, a clinically relevant reduction in kidney function has been observed in patients with normal serum creatinine. Therefore, the estimation of GFR from the four-variable MDRD formula was used to assess renal functions in this study. While none of our patients had a preoperative serum creatinine above 2.0 mg/dL, 16 patients (64%) had pre-existing renal insufficiency (GFR < 60 mL/min per 1.73m²). This is not surprising since all of our patients had prior contralateral nephrectomy and a history of prior surgical interventions on the remaining kidney, thus reducing the amount of functional renal parenchyma. Postoperatively, the number of patients with GFR less than 60 mL/min per 1.73m² increased to 18 patients while only 7 of them had serum creatinine level greater than 2.0 mg/dL.

Out of the 25 patients in this cohort, oncologic outcomes were assessed in 22 individuals since 1 patient died perioperatively and two others had stable mediastinal disease prior to intervention. Among these 22 patients, the metastasis-free survival was 95% at an average follow up of 57 months (3–196), median 50 months. One patient was found to have metastasis to a retroperitoneal lymph node, which was subsequently successfully resected almost 28 months later. Surgical interventions were recommended to eight patients (38%) for a recurrent or de-novo tumor on the solitary kidney at a median time to intervention of 36 months (range 8 – 93). Three successful salvage partial nephrectomies were performed at 33, 39 and 44 months. One patient chose to have RFA performed on a 2.5 cm renal mass at 13 months. Two other patients required a completion nephrectomy at 8 and 28 months: one for infected kidney with persistent renal mucormycosis and the other aforementioned patient with lymph node metastasis who rapidly developed a new 3cm lesion in the kidney and a positive lymph node. Surgical interventions was offered to the remaining two patients at 78 and 93 months after repeat NSS; one refused further interventions and the other opted for completion nephrectomy and renal transplant at a different institution. It is of paramount importance to recognize that assessing oncologic outcomes in patients with a solitary renal remnant and multifocal disease is challenging. Since most of these patients had prior contralateral nephrectomy as well as ipsilateral partial nephrectomy, the “primary drivers” of oncologic outcomes in this cohort may have been the tumors removed at the time of contralateral nephrectomy or from the same renal unit during the original surgery. This is reflected in this very cohort, where 2 patients were excluded from analysis of oncologic outcomes, as they had evidence of distant disease at least 2 years prior to their most recent

surgery. Nevertheless, 95% of this cohort had not developed any new metastatic disease at an average follow up of 57 months (3–196), which may support our aggressive surgical approach in treatment of these patients. An additional challenge in assessment of oncologic outcomes comes from differentiating recurrences from incomplete resection of *de novo* tumors. We feel that most of these repeat surgeries were performed for *de novo* lesions. If these were truly incompletely resected tumors that once again reached a size of 3 cm threshold, we would anticipate a higher rate of metastatic disease as previously described by Duffey and colleagues.¹⁶ However, the most compelling argument that these were indeed *de novo* lesions comes from the study of patients with VHL or HPRC, estimating hundreds of microscopic lesions throughout the kidney.^{17,18}

In light of findings of the current series demonstrating that repeat partial nephrectomy in patients with a solitary kidney is a technically challenging procedure associated with a high complication rate, one may wonder why this morbid surgery has not been abandoned at the NCI. Some may even say the present study provides compelling arguments for not doing a repeat partial nephrectomy in this setting, considering EBL, OR time and complication rates. Perhaps, several recent publications may support our aggressive strategy for nephron sparing. Go et al demonstrated a graded and increased risk of hospitalization, cardiovascular events and death from any cause with graded decrease in eGFR.¹⁹ A study by Thompson et al. suggested that nephron-sparing surgery, even in patients with an intact contralateral kidney, may offer an overall survival advantage when compared to radical nephrectomy.²⁰ The implications of these findings are crucial in that the maximal preservation of renal function through nephron-sparing surgery may prevent the morbidity and mortality associated with CKD. Furthermore, several studies highlighted the importance of preserving residual renal function even in dialysis patients, as it facilitates the maintenance of fluid balance, electrolytes control and removal of uremic toxins ultimately leading to a better survival outcome.^{21–23} For example, each additional 250 mL of urine output a day in peritoneal dialysis patients was associated with a 36% reduction in overall mortality, and loss of residual renal function was a powerful predictor of mortality.^{23–26}

Additionally, despite much progress, current renal replacement therapy remains a significant source of morbidity and mortality. Patients receiving long-term hemodialysis have a mortality rate due to cardiovascular disease 10 to 30 times higher than the general population.²⁷ When examining the fatality rate from myocardial infarctions alone, the overall survival of dialysis patients was considerably worse than those without kidney failure, even compared to subjects with comorbid conditions such as diabetes without end-stage renal disease. Although renal transplantation prevents the need for dialysis, as many as 33% of renal allografts will fail at 5 years post-transplant.²⁸ Of importance, 19 out of 25 patients (76%) in our cohort retained sufficient renal function thereby avoiding dialysis at an average follow-up of 57 months. Furthermore, in most institutions, patients with renal cell cancer are not eligible for renal transplantation without a 2 year waiting period, thus requiring a period of dialysis of at least 2 years. While no prospective data exist on utilization of renal transplantation for patients with multifocal RCC that become anephric, we have utilized renal transplantation as early as 6 weeks after nephrectomy, provided there was availability of a living donor. This may be a reasonable approach in patients without evidence of metastatic disease or recent surgery for large, poorly differentiated renal tumors. The option of renal transplantation is discussed with our patients preoperatively, and is especially stressed prior to embarking on repeat renal intervention.

Active surveillance as well as in-situ ablative techniques, such as radiofrequency ablation or cryotherapy, have recently been investigated as an alternative to partial nephrectomy in selected patients because of its potential to improve perioperative outcomes and decrease complication rates.^{29,30} We have utilized active surveillance protocol for more than a

decade, but decided to intervene in our cohort to minimize the risk of metastatic disease that is increased as the tumors reach 3 cm.^{16,31} While ablation may also be an option, in a recent study of 16 patients with RCC who underwent RFA on a solitary kidney, 37% of patients experienced significant complications, including anuria, perinephric bleed, urethral stricture and chronic renal failure.¹⁴ Although some may advocate ablation on a previously operated kidney, the use of ablative technology may have a very limited role in cases of multifocal recurrent RCC; especially when the location of the tumor or near-by viscera may preclude a safe and complete ablation. Additionally, some have described that complete tumor ablation is frequently achieved with partial destruction of the surrounding normal renal parenchyma, which further questions the utility of ablation, especially in a setting of a solitary renal unit.³² Finally, a recent study by Kowalczyk et al. describes the limitations of probe-ablative technologies for patients with multifocal hereditary renal cancer.¹¹ In our institution we typically reserve ablation for patients who are medically fragile, have disease phenotype with limited number of tumors in locations amenable to ablation, or desirous to avoid surgery at any cost. Those patients with a larger exophytic tumor amenable to ablation and several smaller tumors located in challenging-for-ablation locations are typically offered a nephron-sparing procedure in order to avoid a “double” intervention of ablation with an impending need for surgery in a post-ablative field.

Our study is small and possesses the inherent limitations of any retrospective series. The relatively small number of our patients did not allow us to perform analyses to identify patients requiring subsequent intervention. These analyses are planned in the future on a larger cohort of patients. Nevertheless, this work provides important information on challenges of reoperative renal surgery as well as demonstrates the ability of a solitary kidney maintaining majority of its function even after repeated assaults. Facing limited alternatives for this patient cohort, our data argues that despite high morbidity, repeat nephron-sparing surgery in those with a solitary renal remnant is a reasonable option that allows adequate cancer control and preservation of native kidney function.

Conclusions

Repeat partial nephrectomy for patients with a previously operated solitary kidney is a viable alternative that allows renal preservation in majority of cases. Although the complication rates are high and there is a modest decline in renal function, most patients remain free from dialysis with reasonable oncologic outcomes at intermediate follow up.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Abbreviations

OPN	open partial nephrectomy
LPN	laparoscopic partial nephrectomy
NSS	nephron sparing surgery
VHL	von-Hippel Lindau

HPRC	Hereditary Papillary Renal Carcinoma
eGFR	estimated glomerular filtration rate
MDRD	modification of diet in renal disease formula
RFA	radiofrequency ablation
CKD	chronic kidney disease

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TABLE 1**Clinical characteristics**

No. of patients	25
Median age (range)	51 (27–70)
Median number of tumors resected (range)	4 (1–55)
Men (%)	13 (52)
Median body mass index, kg/m ² (range)	28.3 (20–39)
Right kidney surgeries (%)	16 (64)
Time to present surgery on ipsilateral kidney, month (range)	99 (13 – 200)
Flank approach (%)	22 (88)
Chronic steroid replacement therapy (%)	3 (12)
Median operative time, hours (range)	8.5 (4.8 – 11)
Median EBL, ml (range)	2,400 (800 – 14,000)
Median units transfused (range)	5 (2–26)
Surgeries with renal hilar clamping (%)	12 (48)
Median Fuhrman nuclear grade (range)	2 (1–3)
Median cold ischemia time, minutes (range)	46 (8 – 120)
Median largest solid tumor resected, cm (range)	3.5 (1.4 – 9)
Median follow-up, month (range)	50 (3 – 196)
Clinical diagnosis	
VHL	19 (76)
HPRC	1 (4)
Other	5 (20)

TABLE 2**Perioperative outcomes**

Intraoperative:	
Transfusions (%)	19 (76)
Mesenteric injury (%)	1 (4)
Major vascular injury (%)	6 (25)
Renal unit loss (%)	3 (12)
Postoperative:	
Transfusions (%)	5 (20)
Prolonged Urine leak (%)	5 (20)
Ileus (%)	1 (4)
Acute hemodialysis – less than 30 days (%)	3 (12)
Long-term hemodialysis (%)	3 (12)
Intervention for complications (%)	8 (32)
Completion nephrectomy (within 1week), (%)	3 (12)
Ureteral stenting, (%)	3 (12)
Thoracentesis, (%)	1 (4)
Prolonged intubation, (%)	1 (4)
Cardiovascular events, (%)	4 (16)
Post-op death, (%)	1 (4)

Renal functional outcomes

Table 3

Parameter	Pre-op	First post-op visit [*]	p Value [*]	Post-op at 12 month ^{**}	p Value ^{**}
Median serum creatinine (mg/dL)	1.5 (1 – 2.0)	1.7 (1.1 – 2.9)	0.004	1.55 (1.1 – 2.8)	0.05
Median eGFR (ml/min/1.73m2)	53 (32 – 74)	42.5 (25 – 69)	0.003	49 (21 – 77)	0.115

^{*} Cohort size 21 pt;

^{**} cohort size 19 pt

TABLE 4

Outcomes of renal surgical interventions on a solitary kidney by major series

Authors	Study description	No. of Pts	Median EBL (range)	Renal hilar clamping	Operative duration (range)	Overall complication rate	Urine Leak	Short-term dialysis	Long-term dialysis
Ghavarian et al. (2002)	NSS in surgically native kidney	63 pts	N/A	100%	N/A	Early complication – 23.8%	3.2%	1.6%	3.2%
Saranchuk et al. (2004)	NSS in surgically native kidney	54 pts	600ml (100 – 4,000)	81%	4.03h (2.1 – 11)	26%	9%	1.8%	3.6%
Fergany et al. (2006)	NSS in surgically native kidney	400 pts	N/A	96%	N/A	13%	9%	3.5%	0.5%
Jacobsohn et al. (2007)	RFA (including previously operated kidney)	16 pts	N/A	0%	3.25h (2.9 – 3.6)	37%	0%	0%	6%
Lane et al. (2008)	LPN vs OPN in surgically native kidney	199 pts OPN – 169 pts LPN – 30 pts	OPN – 300 ml (200 – 450) LPN – 200 ml (100 – 300)	OPN – 99% LPN – 100%	OPN – 4.4h (3.8 – 5.1) LPN – 3.4h (2.9 – 4.5)	OPN – 24% LPN – 43%	OPN – 4.7% LPN – 10%	OPN – 0.6% LPN – 10%	OPN – 0.6% LPN – 6.6%
Present series	NSS on previously operated kidney	25 pts (all repeat NSS)	2,400 ml (800 – 14,000)	48%	8.5h (4.8 – 11)	52%	20%	12%	12%

NA= data not available