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Original Research Article

Partial Nephrectomy as a Modality of Treatment for Renal Cell Carcinoma - Clinical Profile and Outcomes

Ravi Patel

Department of Urology, Zydus Hospitals, Ahmedabad, Gujarat, India

Corresponding Author: Dr Ravi Patel

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ABSTRACT

Objective: Partial nephrectomy (PN) is increasingly important as a true alternative to radical nephrectomy in localised renal cell carcinoma (RCC). In this study, we observed indications, intraoperative, postoperative, and long-term complications of partial nephrectomy.
Material and Method: Thirty patients were enrolled over two years who presented with symptoms suggestive of RCC (such as hematuria or a lump in the loin area) or had imaging studies indicating RCC, at our outpatient or inpatient department. They underwent partial nephrectomy, and we studied their demographic, clinical, and pathological features, along with complications and long-term follow-up.
Results: The average age was 56.3 ± 8.46 years. Preoperative mean creatinine was 1.11mg/dl,, and during follow-up, it was 1.23 mg/dl. The mean eGFR preoperatively was 86.71 ml/min/1.73 m2, declining to 76.44 ml/min/1.73 m2 at follow-up. Functional outcomes were good, with no patients requiring dialysis. The average operation duration was 183.43 minutes, warm ischemia time 27.44 minutes, ice slush time 12.1 minutes, and intraoperative blood loss 289 ml. The mean drain removal day was 3.47 ± 1.11 days, sutures were removed around 13.53 ± 1.07 days, and the average postoperative hospital stay was 4.17 ± 0.87 days.
Conclusion: For patients with small, localised, unilateral renal tumors, elective open NSS is feasible, safe, and offers excellent long-term local control and oncological outcomes, along with functional benefits.

Keywords: *partial nephrectomy, renal cell carcinoma, nephron-saving surgery*

INTRODUCTION

Although Radical nephrectomy (RN), as described by Robson *et al*.[1] Although it has long been the 'gold standard' treatment for patients with Renal Cell Carcinoma (RCC), there is a growing trend towards nephron-sparing surgery (NSS) and minimally invasive approaches. Whenever preservation of renal parenchymal function is important, nephron-sparing surgery is preferred to radical nephrectomy. [2] Nephron-sparing surgery is indicated for cases in which a radical nephrectomy would render the patient anephric with a subsequent immediate need for dialysis. Such cases include synchronous bilateral RCC, tumors in a solitary kidney, and unilateral tumour with a poorly functioning contralateral kidney (imperative indications). Typical reasons for a solitary organ are prior removal, renal agenesis, or irreversible impairment from a benign disorder. Further indications for partial

nephrectomy are patients with unilateral RCC and those with a functioning opposite kidney with an uncertain future function. The main reasons for the latter condition include renal artery stenosis, hydronephrosis, chronic pyelonephritis, and systemic diseases such as diabetes and hypertension that result in arteriosclerosis and nephron-affecting impairment. Another indication includes patients with a small (4 cm or less in diameter) unilateral tumour and a healthy contralateral organ (elective indication) [3]. NSS is not recommended in patients with tumors that would prevent the surgeon from achieving negative surgical margins. This includes patients with extensive renal masses or extension into the renal vein or inferior vena cava. The main perceived benefit of partial nephrectomy over RN in patients with absolute or relative indications is the preservation of maximal renal parenchyma to avoid end-stage renal disease. This benefit, however, must be balanced against the need for adequate cancer control. This study focuses on the indications, contraindications, advantages and disadvantages of NSS.

MATERIALS & METHODS

Ethical approval was taken from the institutional ethics committee prior to the commencement of the study. Informed consent was obtained from all patients included in the study. Over two years, 30 patients were enrolled in the study who either presented with symptoms suggestive of RCC, such as hematuria or a lump in the loin region, or had imaging studies suggestive of RCC, in OPD or IPD at our institute. Inclusion criteria: patients with an age of more than 18 years, those who gave consent for inclusion in the study, patients with synchronous bilateral RCC, tumors in a solitary kidney, unilateral tumor with a poorly functioning contralateral kidney or unilateral tumor with a healthy contralateral kidney. Exclusion criteria include patients with tumors involving adjacent structures, tumors with lymph node involvement or metastasis, or for whom surgery cannot achieve negative surgical margins. Each patient was thoroughly evaluated using proper history-taking, clinical examination, blood investigations, and radiological investigations to assess whether they were suitable for partial nephrectomy in accordance with our inclusion criteria.

Operative technique: All patients were given general anaesthesia with an epidural catheter for postoperative pain relief. The patient was placed on the table in a standard lateral (kidney) position with the operating table maximally flexed. The eleventh rib incision was used as a standard for all procedures, and the 11th rib was excised to improve exposure. The tumor is excised with the aim of achieving a gross negative surgical margin and sent for histopathological examination. The renal defect was closed by approximating the transacted cortical edges in one or two layers, sometimes after placement of hemostatic agents (surgical bolster). The cortical edges were sutured together with an interrupted suture or continuous suture with the application of clips. A closed tube drain was left in the retroperitoneal space. Intraoperative findings observed included blood loss, duration of operation, whether the clamp was used or not, ischemia time, and, if ice slush was used, the ice slush time. Immediate postoperative complications observed were haemorrhage, urinary fistula/leakage, pleural effusion, wound complications, perinephric hematoma, and pneumothorax, while late complications observed were renal insufficiency and recurrence of malignancy. All procedures were performed by expert surgeons at our institute, thereby eliminating learning-curve errors. All patients were followed up with clinical examination, ultrasound, contrast-enhanced CT (CECT) of the abdomen, and chest x-ray to look for recurrence or metastasis.

Statistical Analysis

The data obtained were analysed using SPSS version 17.0. Continuous variables were expressed as mean ± SD value. Appropriate statistical (paired t-test) tests were used to study the role of partial nephrectomy cases in

renal cell carcinoma. The probability value (p-value) was used to determine the level of significance. A p-value <0.05 was considered significant, and a p-value < 0.01 was considered highly significant.

RESULT

In the present study, the majority of patients (30%) were in the 56-60-year age group, followed by 20% each in the 61–65-year and 51-55-year age groups, respectively. The mean age of the study population was 56.3 ± 8.46 years, with an age range of 32–69 years. With a male: female ratio of 1.3:1, there were 56.7% (17) males and 43.3% (13) females. In the present study, 36.63% presented with pain, 9.99% with hematuria, and 6.66% with fever. An incidental finding was observed in 46.67% of cases. 53.28% of patients presented with symptoms, while 46.67% were asymptomatic. (Table 1)

Table 1 - Distribution of presenting complaints

Presenting complaints	Present		Absent	
	Frequency	Percent	Frequency	Percent
Incidental	14	46.67	16	53.28
Hematuria	3	9.99	27	89.91
Pain	11	36.63	19	63.27
Fever	2	6.66	28	93.24

Eighteen patients had right renal RCC (60%), whereas 12 (40%) had left RCC. In the present study, the mean creatinine during the preoperative period was 1.11mg/dl, and during follow-up, it was 1.23 mg/dl. Pre-operatively, 2 cases had creatinine levels more than 1.5 mg/dl and continued to remain more than 1.5mg/dl even in the post-operative period. It was also observed in the present study that the mean eGFR during the pre-operative period was 86.71ml/min/1.73 m2, and the mean eGFR during follow-up was 76.44 ml/min/1.73 m2. (Table 2)

Table 2 - Comparison of Mean creatinine and eGFR preoperatively and postoperatively.

	Pre-Operative		Post Operative		*p* value
	Mean	SD	Mean	SD	
Creatinine	1.11	0.21	1.23	0.18	<0.001
eGFR	86.71	23.31	76.44	21.14	<0.001

In the present study, it was observed that the mean duration of operation was 183.43 minutes, the mean warm ischemia time was 27.44 minutes, the mean ice slush time was 12.1 minutes, and the mean intraoperative bleeding was 289 ml. (Table 3)

Table 3 - Distribution of intra-operative data

	Mean	Std. Deviation	Minimum	Maximum
Duration of Operation	183.43	16.81	155.00	216.00
Warm Ischemia Time	27.44	6.46	16	40
Ice Slush Time	12.1	2.37	10	15
Intraoperative Bleeding Volume	289	41.4	180	370

The renal artery was clamped for vascular control in 18 patients (60%), whereas ice slush was given in 10 patients (33.3%). In the present study, 23.3% had pleural injury, followed by 16.7% with pleural effusion, 13.3% with hematuria, 6.7% with wound infection, and 3.3% each with bleeding and urinary fistula as postoperative complications. It was observed that the mean drain removal day was 3.47 ± 1.11 days, the mean suture removal was done on 13.53 ± 1.07 days, and the mean postoperative stay was 4.17 ± 0.87 days.

DISCUSSION

Standard indications for NSS fall into three categories: absolute, relative, and elective. [4] Absolute indications include circumstances where radical nephrectomy would render the patient anephric, with a subsequent immediate need for dialysis. This includes patients with bilateral RCC or RCC involving a solitary functioning kidney. Relative indications for NSS include patients with unilateral RCC and a functioning contralateral kidney when the contralateral kidney is affected by a condition that threatens its future function, e.g. calculus disease, chronic pyelonephritis. It also includes patients with hereditary forms of RCC, such as von Hippel-Lindau disease (VHL). Elective indications for NSS include patients with localised unilateral RCC and a normal contralateral kidney.[4]

In the present study, the majority of patients (30%) were in the 56-60-year age group, followed by 20% each in the 61–65-year and 51-55-year age groups, respectively. The mean age of the study population was 56.3 ± 8.46 years, with an age range of 32–69 years. Epidemiological studies have shown that the mean age at diagnosis for RCC is 70 years [5]. The lower mean age in our study compared to the other studies could be attributed to the fact that most of our patients are diagnosed at an early stage due to increased use of radiological imaging.

In the present study, of 30 patients, 17 (56.7%) were males, and 13 (43.3%) were females. The male-to-female (M: F) sex ratio was 1.3:1. Epidemiological studies indicate that RCC is more often diagnosed in males than in females, with an M:F ratio of 1.5:1 [5].

In 60% of cases, RCC presented on the right side, compared with 40% on the left. No epidemiological studies have demonstrated a predilection of RCC for one side. It occurs in either kidney at an equal rate. Guo S [6] et al found that right-sided RCC was associated with early stage, low-grade disease and showed better cancer-specific survival than left RCC. However, we could not find such a correlation, as the study was small and conducted in a single centre.

In the present study, 36.63% presented with pain, 9.99% with hematuria, and 6.66% with fever. An incidental finding was observed in 46.67% of cases. Asymptomatic patients comprised 14 (46.67%) of 30, and symptomatic patients comprised 16 (53.23%) of 30 in the study. Over the past three decades, the frequency of incidentally diagnosed tumors has increased, with a larger proportion of smaller RCCs being detected. This was mostly related to increased use of cross-sectional imaging [7]. Incidentally diagnosed tumors now comprise up to 50% of all tumors diagnosed, and most are found on CT scans of the abdomen performed for unrelated diseases and symptoms [8].

In the present study, the mean creatinine level during the preoperative period was 1.11 mg/dl, and during follow-up, it was 1.23 mg/dl. Creatinine was higher during post-operative follow-up than pre-operatively ($p < 0.05$). Pre-operatively, two cases had creatinine levels above 1.5 mg/dl, and these levels remained above 1.5 mg/dl even in the post-operative period. The study also observed that the mean eGFR during the pre-operative period was 86.71 ml/min/1.73 m², decreasing to 76.44 ml/min/1.73 m² during follow-up. Mean eGFR was lower during post-operative follow-up than pre-operatively. During follow-up, only two cases had creatinine levels greater than 1.5 mg/dl, managed conservatively, with no patients requiring dialysis either post-operatively or during follow-up. Sankin A[9] et al. also evaluated renal function after partial nephrectomy and found no harmful effect on eGFR, supporting our findings. The effects of surgery on kidney function are most evident within six months post-surgery. It has been shown that patients with chronic kidney disease (CKD) six months after surgery are unlikely to improve over time [10]. NSS offers specific advantages for patients with normal contralateral kidneys, including the potential to reduce the risk of progression to chronic renal insufficiency and end-stage renal disease by maximizing

nephron preservation. Recent studies by Furqani et al. [11] and McKiernan et al. [12] indicate that RN is associated with a higher incidence of renal insufficiency (serum creatinine > 2 mg/dl) compared to NSS. In our cohort, no case progressed to renal insufficiency at a mean follow-up of 6 months, demonstrating the functional benefits of NSS. While the long-term functional benefit of NSS with a normal contralateral kidney remains to be definitively proven, it is believed to lower the risk of progression to chronic renal insufficiency and end-stage disease. The renal function outcomes after NSS in our study align with findings from other studies. Fergany et al. [13] reported that NSS in RCC delays the onset and progression of chronic renal insufficiency. The current study found a mean operative time of 183.43 minutes, a mean warm ischemia time of 27.44 minutes, and a mean ice slush time of 12.1 minutes, with intraoperative bleeding averaging 289 ml. Clamping was performed in 60% of patients, and ice slush in 33.3%. The choice of vascular control method, its technique, and ischemia type depended mainly on the surgeon's preference, with no correlation to tumor size. Dominguez Esteban et al.[14], reviewing 280 patients undergoing NSS, reported that arterial clamping (using hypothermia if ischemia time was expected to exceed 30 minutes) was standard and omitted only in patients with small peripheral tumors, with recent literature suggesting a 20-minute clamp time as a strong protective factor for renal function.[15] Despite variations in vascular control and ischemia methods, all our patients maintained normal kidney function postoperatively and during follow-up. Ebbing et al. [16], in a review of 36 patients who underwent NSS for elective indications, reported no change in renal function with either cold or warm ischemia. Postoperative complications included pleural injury (23.3%), pleural effusion (16.7%), hematuria (13.3%), wound infection (6.7%), and bleeding and urinary fistula (3.3% each). Except for one patient (3.3%) with urinary leakage requiring reoperation for DJ stenting, all others had minor issues. Pasticer et al. reported urinary leakage in 10.1% of 127 patients, while Dominguez Esteban et al. found an 8.8% rate among 83 patients. Various hemostatic methods were employed, such as FloSeal™ and others like Surgicel, Tachosol, and Tissucol, with only one patient (3.3%) experiencing postoperative bleeding managed conservatively. Richter et al[17] didn't report postoperative bleeding following the usage of FloSealTM matrix hemostatic sealant from BEXTER for hemostasis during NSS in 25 patients. The oncological outcomes were favorable, with all patients remaining alive and recurrence-free at follow-up. Hafez et al. [18] reported a 100% disease-free survival rate.

CONCLUSION

In patients with small, localised, unilateral renal tumors, elective open NSS can be attempted safely and provides excellent long-term local control and oncological efficacy, while preserving renal function. Preservation of nephrons achieved with open partial nephrectomy reduces the long-term risk of renal failure and delays, or even avoids, the need for hemodialysis in these patients. These benefits outweigh the risks of local recurrence, which can be effectively detected with radiological imaging during postoperative surveillance.

Declaration by Authors

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