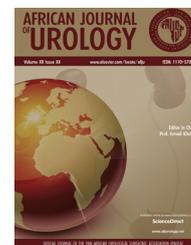




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*Original article*

# Complications and renal functional deterioration in patients with co-morbidities following laparoscopic partial nephrectomy



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### KEYWORDS

Partial nephrectomy;  
Co-morbidities;  
Complications

### Abstract

**Objectives:** To study the incidence of complications and the association between preoperative co morbidities and follow up renal function following laparoscopic partial nephrectomy.

**Subjects and methods:** After due approval from a local ethical committee, retrospective analysis of the records of 68 consecutive laparoscopic partial nephrectomies was performed for renal malignancy during the decade (2005–2015). The data acquisition was done with regard to the demographic data, Charlson co-morbidity score, and perioperative complications using modified Clavian-Dindo scale, margin positivity status, disease free survival and postoperative eGFR using CKD-EPI equation.

**Results:** The cohort consisted of 63 males and 5 females with a mean age of 51 years (3rd to 8th decade). The tumor size varied from 1 to 7 cm with a mean of 3.8 cm. The follow up was available for a period ranging from 3 months to 180 months with a mean of 40.7 months. There were a total of 14 complications in 12 patients. The overall complication rate in our series was 20.58%, majority 10 (14.70%) being minor complications (grades 1 & 2); there were 3 (4.41%) grade 3a complication and one (1.47%) grade 3b complication.

The co-morbidities were assessed with Charlson Co-morbidity score (CCS) and the relation between CCS and follow up eGFR values was also assessed. There was a statistically significant association between the CCS and follow up eGFR, the deterioration being highest in those eight patients with CCS of 6 & 7; the lowest being in those with low CCS.

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**Conclusion:** Laparoscopic partial nephrectomy for renal malignancy is safe surgery with low complication rate and there is a definite association between the preoperative co-morbidities and renal functional deterioration postoperatively.

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## Introduction

Partial nephrectomy is now preferred over radical nephrectomy as treatment of choice for patients with renal cell carcinoma where tumor is amenable to safe surgical resection as the long term results have proved that oncological survival is as good as radical nephrectomy [1–3]. The advantages of partial nephrectomy over radical nephrectomy are renal parenchymal preservation and prevention of long term renal functional deterioration [4,5]. However, it is not immune from complications as it involves parenchymal resection after renal pedicle clamping, and also involves reconstruction. Post partial nephrectomy complications could be bleeding, renal pedicle injury, urine leak, hematoma, positive surgical margins, recurrence, a v fistula formation and renal dysfunction or renal loss.

We look at the operative complications following partial nephrectomies in 68 patients performed during a decade from 2005 to 2015. We also attempt to analyze the association between co morbidities and long term renal functional deterioration.

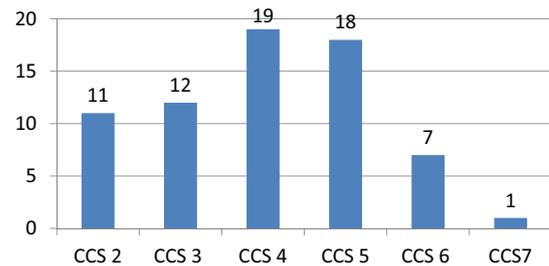
## Subjects and methods

After due approval from a local ethical committee, the hospital records of 68 consecutive patients who underwent laparoscopic partial nephrectomy for renal malignancy performed between January 2005 to March 2015 were retrospectively studied with an aim to evaluate the complications arising out of surgery and long term renal functional deterioration in them during the follow up. The follow up ranged between 3 to 180 months (mean 40.7 months). The patients were followed up every 3 months with history, clinical examination, renal function tests and imaging like chest X ray, CT/MRI abdomen, Ultrasonography of abdomen. The estimated GFR (eGFR) of the patients was calculated using CKD-EPI equation [6]. Software SPSS version 20 was used to analyze the data.

## Results

Out of a total of 68 patients, 63 (92.64%) patients were male and 5 females (7.35%) with a male to female ratio of 12.6:1. Mean age of the patients was 51 years (3rd to 8th decade).

In majority of the patients 53 (77.94%) the tumors were incidentally detected on US or CT scan done for some other medical condition and 15 (22.05%) patients presented with symptoms consisting of flank pain and hematuria. A total of 39 patients (57.35%) had right sided tumors and 29 (42.64%) left sided with 2 patients presenting with bilateral synchronous tumors (2.94%). None of the patients had solitary kidney. The mean size of the tumor was 3.8 cm (1–7 cm). Mean operative time was 165 min (127–216 min). Average warm ischemia time was 18 min (15–30 min). Mean hospital stay was 6 days (range 4–13 days).



**Chart 1** Charlson co-morbidity scores.

The co-morbidity was assessed using Charlson co-morbidity score (CCS) [7] with scores varying from 2 to 7. Eleven patients had CCS of 2, twelve patients had CCS of 3, nineteen patients had CCS of 4, eighteen patients had CCS of 5, seven patients had CCS of 6 and one patient had CCS of 7 (Chart 1)

Partial nephrectomy was done laparoscopically, hilar clamping was done with laparoscopic satinsky clamp before excision of tumor. Pelvicalyceal system was repaired when required. The renal parenchyma was approximated in two layers with surgicel bolsters.

The complications were classified in to two groups namely, immediate postoperative (within one week after surgery) and delayed postoperative depending on the timing of the complications after surgery (one week to 30 days after surgery). In the immediate postoperative period we had bleeding in 3 patients, urine leak in one patient, lower respiratory infection in one patient, fever of more than one day duration was recorded in 4 patients, prolonged ileus was seen in 2 patients, one patient had port site bleeding for which re exploration was done (Table 1).

Amongst the delayed post operative complications, hematuria with pseudo aneurism formation and parietal wall abscess was seen in one patient each (Table 2). Overall there were 12 early postoperative and 2 delayed post operative complications. Total number of complications was 14. Fifty six patients had normal postoperative course. The complications were graded according to Clavien-Dindo classification of surgical complications [8]. Majority had grade 1 (7), grade 2 complications was seen in 3, grade 3A complications were seen in 3 and one patient had grade 3B complication (Table 3).

On T staging out of a total of 68 tumors resected, 37 were T1a, 28 were T2b and three were T3a. On histo pathological examination 59 tumors were of clear cell type, 5 were papillary, 3 were chromophobe where one tumor was an oncocyoma (Table 4). Twenty six patients had capsule positivity and three patients had sinus positivity. Surgical margin positivity was seen in six patients. The first patient had tumor of 3 cm sized (T1a) tumor at the lower pole of clear cell histology. He underwent re resection of the kidney. The

**Table 1** Immediate post operative complications.

Serial no.	Complications	No. of patients	Intervention
1	Bleeding	3 (4.41%)	Blood transfusion
2	Urine leak	1 (1.47%)	D/J stenting
3	Lower respiratory infection	1 (1.47)	Antibiotic change
4	Fever > 1day	4 (5.88%)	Antibiotic change
5	Prolonged ileus	2 (2.94%)	Conservative
6	Port site bleeding	1 (1.47)	Exploration
Total		12 (17.64%)	

**Table 2** Delayed post operative complications.

Serial no.	Complications	No. of patients	Intervention
1	Hematuria/pseudoaneurysm	1 (1.47%)	Super-selective angioembolization
2	Parietal wall abscess	1 (1.47%)	Incision & drainage
Total		2 (2.94%)	

**Table 3** Clavien-Dindo classification of surgical complications.

Serial no.	Clavien-Dindo grading	No. of patients
1	I	7 (10.29%)
2	II	3 (4.41%)
3	IIIA	3 (4.41%)
4	IIIB	1 (1.47%)
Total		14 (20.58%)

second patient had a 6 cm sized tumor in the mid portion of clear cell histology. This patient was followed up. Third patient had 6 cm sized tumor at the upper pole of papillary type. This patient was followed up. The fourth patient had 7 cm tumor at the lower pole of clear cell type. He was followed up. Fifth patient had 2 cm sized tumor at the mid pole of clear cell type. This patient was followed up. The sixth patient had 1.5 cm sized tumor at the mid pole of clear cell histology. This patient died due to GI bleed 11 months after surgery (Table 5).

Out of 57 patients who had normal creatinine (1.5 mg%) preoperatively 3 patients developed progressive rise in creatinine. Whereas out of 11 patients who had creatinine more than 1.5 mg% preoperatively, 8 patients developed progressive rise in creatinine.

We analyzed the association between the preoperative CCS and eGFR on follow-up. Eleven patients whose preoperative CCS was 2, had a mean follow-up eGFR of 88.54 with a standard deviation of 17.49. Twelve patients whose preoperative CCS was 3, had a mean follow-up eGFR of 82.18 with a standard deviation of 17.40. Nineteen patients whose preoperative CCS was 4, had a mean follow up eGFR of 71.22 with a standard deviation of 16.73. Eighteen patients whose preoperative CCS was 5, had a mean follow up eGFR of 68.11 with a standard deviation of 22.11. Eight patients whose preoperative CCS was 6 and 7, had a mean follow up eGFR of 44.75 with a standard deviation of 17.32 (Table 6).

High CCS was associated with lower follow up eGFR. The difference of follow up eGFR between CCS groups was statistically significant ( $P$  value 0.005).

**Table 4** Tumor characteristics.

Histological variant	No. of patients	Percentage	T1a	T1b	T3a
Clear cell	59	86.76	32	24	3
Papillary	5	7.35	4	1	
Chromophobe	3	4.41		3	
Oncocytoma	1	1.47	1		
Total	68	100	37	28	3

**Table 5** Margin positivity.

Serial no.	Tumor size	TNM stage	Location	Histological type	Intervention	Recurrence
1	3	T1aN0M0	L	Clear cell	Re-resection	No
2	6	T1bN0M0	M	Clear cell	Follow up	No
3	6	T1bN0M0	U	Clear cell	Follow up	No
4	7	T1bN0M0	L	Clear cell	Follow up	No
5	2	T1aN0M0	M	Clear cell	Follow up	No
6	1.5	T1aN0M0	M	Clear cell	Death due to GI bleed	

**Table 6** Association between CCS and follow up eGFR.

CCS score	No. of patients	Mean of follow up eGFR	Standard deviation
2	11	88.54	17.49
3	12	82.18	17.40
4	19	71.22	16.73
5	18	68.11	22.11
6 & 7	8	44.75	17.32

On follow up (ranging from 4 to 180 months), 2 patients died due to metastatic disease. One patient died due to another cause. Nine patients were lost to follow up. Fifty six patients were alive at the end of the study.

## Discussion

The surgical management of renal cell carcinoma has changed in recent times with focus shifting from only tumor removal as was done in the past to tumor removal and preservation of renal parenchyma as well. Initially the nephron sparing surgery was done for patients with solitary kidney, bilateral renal tumors or RCC in the setting of chronic renal disease. Long term follow up of patients who underwent partial nephrectomy has revealed that the cancer specific survival is equal to those who underwent radical nephrectomy [9,10]. Additionally the renal function is better preserved in the long term in patients who underwent partial nephrectomy as compared to those who underwent radical nephrectomy [10]. There is decreased risk of chronic kidney disease, decrease in cardiovascular morbidity and increased overall survival in patients undergoing partial nephrectomy verses those who underwent radical nephrectomy [11–14]. Weight et al. reported that the average excess loss of renal function observed with radical nephrectomy was associated with a 25% (95% CI 3–73) increased risk of cardiac death and 17% (95% CI 12–27) increased risk of death from any cause on multivariate analysis [11]. Radical nephrectomy is associated with development of new onset chronic kidney disease and is not advisable for small, renal cortical tumors [4]. With advancement of surgical technique, improvement in instrumentation and energy sources, laparoscopic partial nephrectomy is routinely being done for small renal masses and increasingly being done for larger and centrally placed tumors [9].

In our series, there were a total of 14 (20.58%) complications recorded in 12 patients. Fifty six patients (82.35%) had uneventful postoperative course. Using the Clavien Dindo standardized postoperative complications grading system, 10 (14.70%) patients had minor complications (grades 1 and 2) where as 4 (5.88%) patients had grade 3 complications which required endoscopic or surgical intervention. Out of 4 patients who required intervention only one patient with port site bleeding required re exploration under general anesthesia, the remaining three were managed under local anesthesia. Stephenson AJ reported that partial nephrectomy and radical nephrectomy are associated with low rates of morbidity and mortality and though partial nephrectomy had more of procedure related complications, particularly urological, most of them were minor [15,16]. Laparoscopic partial nephrectomy can be performed with equal surgical precision as open partial nephrectomy [17,18]. Earlier in the developmental phase of laparoscopic partial nephrectomy the complication rate was higher as compared to open partial nephrectomy [19,20]. However with standardization of surgical technique and technological advancement in instrumentation, the

complications of laparoscopic partial nephrectomy have come down and are comparable to those of open partial nephrectomy [21–23]. Abouassaly et al. found that after radical and partial nephrectomy complications increased with age and increase in Charlson comorbidity score [24].

Margin positivity was seen in 6 (8.82%). One out these six patients was re-resected, one patient died due to GI bleed, rest of the four patients were followed up and had no recurrence. Frozen section during surgery has no role in deciding surgical management [21,25]. Though positive surgical margins are associated with risk of local recurrence, margin positivity has no effect on tumor specific survival [26,27]. The incidence of residual tumor in the renal remnant with positive margins is reportedly 0–39% [28,29]. Hence a wait & watch policy in these subset of patients seems to be a safe option.

We looked at the renal function pre and post operatively. Two observations were noted in our series. The first observation was that the patients who had normal renal function preoperatively were less likely to present with progressive CRF postoperatively as compared to those who had deranged renal function. Out of 57 patients with normal renal function only 3 (5.26%) patients developed progressive CRF, whereas 8 (72.72%) patients developed progressive CRF out of 11 patients who had deranged renal function (creatinine > 1.5%) preoperatively. In patients with preexisting renal disease every effort should be made to conserve as much renal parenchyma as possible during partial nephrectomy and such patients should not be considered for radical nephrectomy [30].

The second observation is that the higher the CCS preoperatively, worse was the renal function postoperatively. When calculating the CCS, patient's age, diabetic status, preexisting renal disease, and other factors are taken into consideration. Presence of these factors preoperatively raises the CCS for the patients. Malcolm et al compared the rates and risk factors for developing CRF in patient undergoing Partial or radical nephrectomy. They concluded that in addition to radical nephrectomy and age >60 years, diabetes were associated with rise in creatinine postoperatively [31]. Jeon et al evaluated the prognostic factors for chronic kidney disease after curative surgery in patients with small renal tumors, and reported that age, radical nephrectomy, preoperative lower GFR, and diabetes were associated with the development of chronic kidney disease [32]. Our findings are also consistent with the above studies. Increase in age, presence of diabetes and preexisting lower GFR places the patient in higher CCS category preoperatively and therefore these patient presented with lower eGFR postoperatively.

## Conclusion

Laparoscopic partial nephrectomy for renal cell carcinoma is a safe with minimal morbidity and with good oncological outcome. Higher

Charlson co-morbidity score is predictive of renal functional deterioration postoperatively.

### Ethical committee

Approval from a local ethical committee was sought and study conducted with due approval.

### Consent

A detailed & informed consent was taken from each patient to use their clinical details for the study.

### Authors contribution

Sharma Elias: concept, study design, manuscript preparation (email: [eliassharma@hotmail.com](mailto:eliassharma@hotmail.com)).

Chally Poulouse: operating surgeon and data acquisition (email: [poulousechally@yahoo.co.in](mailto:poulousechally@yahoo.co.in)).

Santhosh Srinivasan: data acquisition and reference material search (email: [drsanthosri@gmail.com](mailto:drsanthosri@gmail.com)).

Ratkal Jaideep: manuscript preparation and editing (email: [jaideeppratkal@gmail.com](mailto:jaideeppratkal@gmail.com)).

### Conflict of interest

None declared.

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