ORIGINAL ARTICLE

POST OPERATIVE COMPLICATIONS OF OPEN PARTIAL NEPHRECTOMY WITH RESPECT TO TUMOUR LOCATION

Muhammad Shahzad, Muhammad Nasir Jamil, Hamza Ashraf, Raja Asim Shafique, Muhammad Faridullah Thaimur, Ehsan ul Islam

Department of Urology, Ayub Medical College, Abbottabad-Pakistan

Background: Partial Nephrectomy has been the go-to approach for the treatment of small sized renal tumours for years now. Like any other surgical procedure, it is associated with post-operative complications. The study was aimed at determining the post-operative complications of open partial nephrectomy concerning tumour location. **Methods**: This descriptive cross-sectional study was done on 45 patients as per inclusion criteria. The patients were managed as per department protocols and were observed for the development of immediate post-operative complications during hospital stays. RESULTS: Post-operative complications were observed in 4 (8.9%) patients and included haemorrhage (n=1; 2.2%) and urine leak (n=3; 6.7%). There was a statistically significant association between post-operative complications of partial nephrectomy and central tumour location (p=0.008, OR=14.52 and LR=5.70) and increased age (p=0.04, LR=5.40 and OR=8.90). **Discussion**: Increased age and tumour location may play a significant role in determining the likelihood of post-operative complications in patients who have undergone surgery for renal tumours.

Keywords: Renal tumours; Nephron Sparing Surgery; Partial Nephrectomy; OPN, Radical Nephrectomy; Urine Leak; Haemorrhage

Citation: Shahzad M, Jamil MN, Ashraf H, Shafique RA, Thaimur MF, Islam EU. Post-operative complications of open partial nephrectomy with respect to tumour location. J Ayub Med Coll Abbottabad 2023;35(3):466–70.

DOI: 10.55519/JAMC-03-12286

INTRODUCTION

Partial nephrectomy has emerged as a recommended therapeutic modality for the management of small renal tumours classified as TNM stage T1a-b.[1] In recent years, robotic or laparoscopic approaches have been widely adopted in numerous medical centers for performing partial nephrectomy.[2] Nevertheless, open partial nephrectomy remains a viable alternative for the treatment of small-sized renal tumours.[3,4] The increased utilization of abdominal ultrasound and computerized tomography (CT) scans for imaging has contributed to the increased incidence of primary renal cell cancer.[1] The incidental diagnosis of renal masses has led to early-stage detection in up to 50% of cases, resulting in improved overall mortality rates.[5–8]

The adoption of minimally invasive techniques, such as laparoscopic or robotic partial nephrectomy, in urologic surgery has led to reduced perioperative morbidity. However, the functional, oncological, and perioperative outcomes of open partial nephrectomy are comparable to those of robotic and laparoscopic approaches.[1,9–12] Notably, open partial nephrectomy has been associated with shorter ischemia times compared to minimally invasive procedures, as reported in the literature.[12]

Open partial nephrectomy is associated with a number of potential risks and complications. These may encompass issues related to anaesthesia, delayed wound healing, the necessity for blood transfusion, infection, the formation of hematomas, thromboembolic events and the development of seromas.[13–15] Additionally, due to the increased technical demands of the procedure in comparison to radical nephrectomy, there may be a higher incidence of complications such as bleeding, urinary leakage and impaired renal function. Urinary leak and bleeding are the two main post-operative complications after a nephron sparing surgery.[16] Blood transfusions are required in 4.3%-20% cases where open partial nephrectomy is used as nephron sparing surgery.[16,17] A retrospective analysis of 200 cases of laparoscopic partial nephrectomy revealed the occurrence of the following complications: Haemorrhage: 19 patients (9.5%), Urine leakage: 9 patients (4.5%), Intraoperative complications such as haemorrhage, ureteral injury, and inferior epigastric artery injury: 11 patients (5.5%), postoperative complications such as haemorrhage, urine leakage, renal insufficiency, epididymitis and haematuria: 24 patients (12%), Delayed complications such as haemorrhage and renal insufficiency: 31 patients (15.5%).[18]

An overwhelming majority of small solid renal masses are located peripherally and in either kidney. They can be found at any place in the kidney, but seldom in the hilar region. [19] An increased

incidence and severity of post-operative complications have been associated with the presence of central renal tumours.[20]

Considering the limited local literature on post-operative complications following open partial nephrectomy for renal tumours, this descriptive cross-sectional research sought to evaluate the post operative complications of open partial nephrectomy associated with tumour location in patients diagnosed with renal tumours, aiming to provide a foundation for subsequent studies in this domain.

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted at the Sami Medical Centre, Abbottabad from February 2022 to July 2022. Consecutive non-probability sampling was used to select the study participants. Patients presenting at the hospital with renal masses up to 4 cm in either kidney and a functioning contralateral kidney during the study period were consecutively enrolled. Patients with renal masses larger than 4 cm in diameter, concomitant diseases such as diabetes, hypertension, bleeding disorders, ischemic heart disease, or blood thinning drugs were excluded.

The sample size for this descriptive cross-sectional study with a prevalence of post-operative complications of 4.5%, a confidence interval of 95%, and a margin of error of 7% (0.07) was calculated using the following formula:

n = (Z2 * P * (1-P)) / (E2)

Where:

- n is the sample size
- Z is the Z-score for the desired confidence level (1.96 for a 95% confidence interval)
- P is the prevalence of urine leak following open partial nephrectomy18, (0.045 in this case)
- E is the margin of error (0.07 in this case)

Plugging the values into the formula, we get:

$n=0.0721.962\times0.045(1-0.045)\approx45$

The needed sample size of 45 was determined for this study.

The study was approved by the medical ethics committee of Sami Medical Centre Abbottabad. Informed consent was obtained from all the participants or their legal representatives before data collection. Confidentiality and privacy of the participants' information were maintained throughout the study. Data was collected from medical records of eligible patients who underwent open partial nephrectomy during the study period. The following data was collected: age, gender, tumour location (upper pole, middle pole, lower pole), length of hospital stay, postoperative complications (such as bleeding, infection, urinary leakage, prolonged ileus, and wound infection), and need for blood transfusion. Continuous variables such as age and duration of hospital stay were described as mean±SD, and frequency and percentages were used for describing categorical variables. The postoperative complications were reported for each tumour location (upper pole, middle pole, lower pole). The outcome variable, i.e., post-operative complications was stratified by age, sex, and tumour location to see effect modification. A post-stratification chi-square test was done and a *p*-value of ≤0.05 was taken as significant.

RESULTS

In this study, the patients had a mean±SD age of 50.40±8.01 years, with a range of 39-62 years. The mean±SD duration of hospital stay was 10.20±3.15 days with a range of 5–17 days (Table-1).

Majority of the patients, i.e., 26 (57.8%) were male and the rest, i.e.,19 (42.2%) were female. In terms of tumour location, 10 (22.2%) patients had tumours in the hilar region while 35 (77.8%) had peripheral tumours. Additionally, 24 (53.3%) patients had tumours in the upper pole, 10 (22.2%) in the middle, and 11 (24.4%) in the lower pole.

Post-operative complications were observed in 4 (8.9%) patients and included haemorrhage (1 patient; 2.2%) and urine leak (3 patients; 6.7%). The patient with a haemorrhage required a blood transfusion. A detailed tabulated presentation of the variables is given in table-2.

There was a statistically significant association between post-operative complications of partial nephrectomy and tumour location (central vs peripheral) with a *p*-value of 0.008, an odds ratio of 14.52 and a likelihood ratio of 5.70. Increased age was also significantly associated with post-operative complications with a *p*-value of 0.04, a likelihood ratio of 5.40 and an odds ratio of 8.90.

Although there was an increased likelihood ratio associated with an increased length of hospital stay and post-operative complications, the association was not statistically significant with a p-value greater than 0.05. The association between individual post-operative complications such as haemorrhage and urine leak and factors such as age, sex, and length of hospital stay was not statistically significant ($p>0.05$).

Table-1: Descriptive statistics of study participants

	N	Mean	Std Dev	Minimum	Maximum
Age (years)	45	50.40	8.01	39	62
Length of Hospital stay (days)	45	10.20	3.15	5	17

Table-2: Frequency of different categorical variables in our study population.

Sex	**Frequency**	**Percent**
Male	26	57.8
Female	19	42.2
Total	45	100.0
Tumour Location	**Frequency**	**Percent**
Hilar	10	22.2
Peripheral	35	77.8
Total	45	100.0
Tumour Location	**Frequency**	**Percent**
Upper Pole	24	53.3
Middle	10	22.2
Lower Pole	11	24.4
Total	45	100.0
Post Operative Complications	**Frequency**	**Percent**
Present	4	8.9
Absent	41	91.1
Total	45	100.0
Haemorrhage	**Frequency**	**Percent**
Present	1	2.2
Absent	44	97.8
Total	45	100.0
Urine Leak	**Frequency**	**Percent**
Present	3	6.7
Absent	42	93.3
Total	45	100.0
Infection	**Frequency**	**Percent**
Absent	45	100.0
Total	45	100.0
Blood Transfusion	Frequency	Percent
Present	1	2.2
Absent	44	97.8
Total	45	100.0
Wound Infection	**Frequency**	**Percent**
Valid Absent	45	100.0
Total	45	100.0

DISCUSSION

This descriptive cross-sectional study provides valuable insights into the incidence of post-operative complications following open partial nephrectomy. The incidence of post-operative complications was relatively low at 8.9%, with haemorrhage and urine leak being the most common complications. A statistically significant association was found between the incidence of post-operative complications and tumour location (central vs. peripheral) as well as increased age. However, no statistically significant association was found between individual post-operative complications and factors such as age, sex, and length of hospital stay.

The results of this study indicate that age and tumour location may play a significant role in determining the likelihood of post-operative complications in patients who have undergone surgery for renal tumours. To validate these conclusions and to identify additional risk factors for post-operative complications in this group of patients, further investigation is required.

In recent years, the use of advanced radiological techniques has significantly altered the way renal tumours are diagnosed. There is now a tendency to detect smaller, asymptomatic lesions at earlier stages.[21–23] An analysis of more than 1800 cases of nephron sparing surgery conducted by Uzzo RG. and Novick AC. revealed that the full extent of the biological effects of multicentric renal tumours and their consequences for nephron sparing surgery remains unclear.[23] The European Organisation for Research and Treatment of Cancer (EORTC) conducted a prospective, randomized phase-3 study that compared the oncological outcomes of open partial nephrectomy and open radical nephrectomy in the treatment of small renal tumours (<5 cm). The results showed that both groups had comparable oncological outcomes.[24,25] According to an earlier report from the EORTC 30904 trial, the rate of complications for nephron sparing surgery was marginally higher compared to that of radical nephrectomy.[25]

Although post-operative haemorrhage is relatively uncommon following partial nephrectomy (4.2%-6% for laparoscopic partial nephrectomy (LPN)[26] & 6–8.1% for open partial nephrectomy and robotic partial nephrectomy[20]), it remains among the most severe complications. This is particularly true for tumours located centrally.[27,28] The relationship between post-operative bleeding with partial nephrectomy and factors such as patient demographics, surgical techniques, and tumour properties has been studied in the literature.[18] For instance, research by Van Poppel et al. involving 76 patients who underwent open partial nephrectomy revealed that increased tumour size and central tumour location were linked to a higher risk of postoperative haemorrhage.[29] Similarly, Ramani et al. found that patients with central tumours and more extensive infiltration had a higher rate of postoperative bleeding.[18] However, the incidence of haemorrhage in our study population didn't have any statistically significant association with the location of the tumour. Urine leak occurred in 3 out of 4 patients who developed post operative complications in our study. Increased incidence of urine leak is documented elsewhere in the literature. For example, a retrospective review of 127 patients' records revealed that urine leak occurred in 18.5% of patients following open partial nephrectomy.[30] While tumour location and increased size were identified as important associations of urine leak in the review, we didn't observe any statistically significant association with urine leak in our study population. A recent review of 975 cases of partial nephrectomy suggested that open surgery is associated with the incidence of urine leaks.[31] We didn't compare open partial nephrectomy

with laparoscopic or robotic approaches, however, post-operative urine leak was observed in 3 (6.67%) patients in our study population.

The results of this study indicate that age and tumour location may play a significant role in determining the likelihood of post-operative complications in patients who have undergone surgery for renal tumours. To validate these conclusions and to identify additional risk factors for post-operative complications in this group of patients, further investigation is required.

In conclusion, the results of open partial nephrectomy in terms of post-operative complications appear to be no different from those reported in the literature, however, a full picture of complications including delayed complications can only be constructed by long-term follow-up of a larger study population.

Limitations: This study has several limitations, including the use of non-probability sampling which may limit the generalizability of the findings. Additionally, the study was conducted at a single center, which may introduce selection bias. The retrospective nature of data collection may also be subject to information bias. Despite these limitations, this study provides valuable insights into the postoperative complications of open partial nephrectomy with respect to tumour location in a real-world clinical setting.

AUTHORS' CONTRIBUTION

MS: Idea of research topic, data analysis and proofreading. MNJ: Data collection and data analysis. HA: Literature search, study design. RA: Collection of all study material and introduction of the topic. MFT: Data analysis, write-up. EUI: Data interpretation, data collection, proofreading.

REFERENCES

1. O'Connor E, Timm B, Lawrentschuk N, Ischia J. Open partial nephrectomy: current review. Transl Androl Urol. 2020;9(6):3149–59.
2. Hennessey DB, Wei G, Moon D, Kinnear N, Bolton DM, Lawrentschuk N, et al. Strategies for success: a multi-institutional study on robot-assisted partial nephrectomy for complex renal lesions. BJU Int. 2018;121 Suppl 3:40–7.
3. Ljungberg B, Albiges L, Abu-Ghanem Y, Bensalah K, Dabestani S, Fernández-Pello S, et al. European Association of Urology Guidelines on Renal Cell Carcinoma: The 2019 Update. Eur Urol. 2019;75(5):799–810.
4. Campbell SC, Clark PE, Chang SS, Karam JA, Souter L, Uzzo RG. Renal Mass and Localized Renal Cancer: Evaluation, Management, and Follow-Up: AUA Guideline: Part I. J Urol. 2021;206(2):199–208.
5. Saad AM, Gad MM, Al-Husseini MJ, Ruhban IA, Sonbol MB, Ho TH. Trends in Renal-Cell Carcinoma Incidence and Mortality in the United States in the Last 2 Decades: A SEER-Based Study. Clin Genitourin Cancer. 2019;17(1):46-57.e5.
6. Znaor A, Lortet-Tieulent J, Laversanne M, Jemal A, Bray F. International variations and trends in renal cell carcinoma incidence and mortality. Eur Urol. 2015;67(3):519–30.
7. Patel HD, Gupta M, Joice GA, Srivastava A, Alam R, Allaf ME, et al. Clinical Stage Migration and Survival for Renal Cell Carcinoma in the United States. Eur Urol Oncol. 2019;2(4):343–8.
8. Kim JK, Lee H, Oh JJ, Lee S, Hong SK, Lee SE, et al. Comparison of robotic and open partial nephrectomy for highly complex renal tumours (RENAL nephrometry score ≥10). PloS One. 2019;14(1):e0210413.
9. Peyronnet B, Seisen T, Oger E, Vaessen C, Grassano Y, Benoit T, et al. Comparison of 1800 Robotic and Open Partial Nephrectomies for Renal Tumours. Ann Surg Oncol. 2016;23(13):4277–83.
10. Larcher A, Capitanio U, De Naeyer G, Fossati N, D'Hondt F, Muttin F, et al. Is Robot-assisted Surgery Contraindicated in the Case of Partial Nephrectomy for Complex Tumours or Relevant Comorbidities? A Comparative Analysis of Morbidity, Renal Function, and Oncologic Outcomes. Eur Urol Oncol. 2018;1(1):61–8.
11. Ghali F, Elbakry AA, Hamilton ZA, Yim K, Nasseri R, Patel S, et al. Robotic partial nephrectomy for clinical T2a renal mass is associated with improved trifecta outcome compared to open partial nephrectomy: a single surgeon comparative analysis. World J Urol. 2020;38(5):1113–22.
12. Bravi CA, Larcher A, Capitanio U, Mari A, Antonelli A, Artibani W, *et al.* Perioperative Outcomes of Open, Laparoscopic, and Robotic Partial Nephrectomy: A Prospective Multicenter Observational Study (The RECORd 2 Project). Eur Urol Focus. 2021;7(2):390–6.
13. Gabrielson AT, Faisal FA, Pierorazio PM. Management of acute post-operative hemorrhage following partial nephrectomy with renal artery embolization. Urol Case Rep. 2020;32:101252.
14. Seitz M, Schlenker B, Stief C. Acute Postoperative Complications. Emergencies in urology. 2007:364-429.
15. Ciudin A, Huguet J, García-Larrosa A, Musquera M, Alvarez-Vijande JR, José Ribal M, Alcaraz A. Sangrado diferido después de nefrectomía parcial. Manejo mediante embolización selectiva [Delayed bleeding after partial nephrectomy. Management with selective embolization]. Actas Urol Esp. 2011 Nov-Dec;35(10):615-9.
16. Klatte T, Ficarra V, Gratzke C, Kaouk J, Kutikov A, Macchi V, et al. A literature review of renal surgical anatomy and surgical strategies for partial nephrectomy. Eur Urol. 2015;68(6):980–92.
17. Kriegmair MC, Pfalzgraf D, Häcker A, Michel MS. ZIRK-technique: zero ischemia resection in the kidney for high-risk renal masses: perioperative outcome. Urol Int. 2015;95(2):216–22.
18. Ramani AP, Desai MM, Steinberg AP, Ng CS, Abreu SC, Kaouk JH, et al. COMPLICATIONS OF LAPAROSCOPIC PARTIAL NEPHRECTOMY IN 200 CASES. J Urol. 2005;173(1):42–7.
19. Pertia A, Managadze L, Chkhotu A. Nephron-Sparing Surgery for the Treatment of Renal Cell Carcinoma 4 to 7 cm in Size. In: Chen J, editor. Renal Tumour [Internet]. InTechOpen; 2013 [cited 2023 Apr 21]. Available from: http://www.intechopen.com/books/renal-tumour/nephron-sparing-surgery-for-the-treatment-of-renal-cell-carcinoma-4-to-7-cm-in-size
20. Jung S, Min GE, Chung BI, Jeon SH. Risk Factors for Postoperative Hemorrhage After Partial Nephrectomy. Korean J Urol. 2014;55(1):17.
21. Hollingsworth JM, Miller DC, Daignault S, Hollenbeck BK. Rising Incidence of Small Renal Masses: A Need to Reassess Treatment Effect. JNCI J Natl Cancer Inst. 2006;98(18):1331–4.

22. Van Poppel H, Becker F, Cadeddu JA, Gill IS, Janetschek G, Jewett MAS, *et al.* Treatment of localised renal cell carcinoma. Eur Urol. 2011;60(4):662–72.
23. Uzzo RG, Novick AC. Nephron sparing surgery for renal tumours: indications, techniques and outcomes. J Urol. 2001;166(1):6–18.
24. Van Poppel H, Da Pozzo L, Albrecht W, Matveev V, Bono A, Borkowski A, *et al.* A prospective, randomised EORTC intergroup phase 3 study comparing the oncologic outcome of elective nephron-sparing surgery and radical nephrectomy for low-stage renal cell carcinoma. Eur Urol. 2011;59(4):543–52.
25. Van Poppel H, Da Pozzo L, Albrecht W, Matveev V, Bono A, Borkowski A, et al. A prospective randomized EORTC intergroup phase 3 study comparing the complications of elective nephron-sparing surgery and radical nephrectomy for low-stage renal cell carcinoma. Eur Urol. 2007;51(6):1606–15.
26. Montag S, Rais-Bahrami S, Seideman CA, Rastinehad AR, Vira MA, Kavoussi LR, et al. Delayed haemorrhage after laparoscopic partial nephrectomy: frequency and angiographic findings. BJU Int. 2011;107(9):1460–6.
27. Gill IS, Kavoussi LR, Lane BR, Blute ML, Babineau D, Colombo JR, et al. Comparison of 1,800 laparoscopic and open partial nephrectomies for single renal tumours. J Urol. 2007;178(1):41–6.
28. Nadu A, Kleinmann N, Laufer M, Dotan Z, Winkler H, Ramon J. Laparoscopic partial nephrectomy for central tumours: analysis of perioperative outcomes and complications. J Urol. 2009;181(1):42–7; discussion 47.
29. Van Poppel H, Bamelis B, Oyen R, Baert L. Partial nephrectomy for renal cell carcinoma can achieve long-term tumour control. J Urol. 1998;160(3 Pt 1):674–8.
30. Meeks JJ, Zhao LC, Navai N, Perry KT, Nadler RB, Smith ND. Risk factors and management of urine leaks after partial nephrectomy. J Urol. 2008;180(6):2375-8.
31. Peyton CC, Hajiran A, Morgan K, Azizi M, Tang D, Chipollini J, Gilbert SM, Poch M, Sexton WJ, Spiess PE. Urinary leak following partial nephrectomy: a contemporary review of 975 cases. Canadian J Uro. 2020;27(1):10118-24.

Submitted: July 18, 2023	*Revised: August 6, 2023*	*Accepted: August 19, 2023*

Address for Correspondence:

Muhammad Nasir Jamil, Department of Urology, Ayub Medical College, Abbottabad-Pakistan
Cell: +92 322 948 7696
Email: drnaserjamel@gmail.com