

Brief Communication

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# Robot-assisted partial nephrectomy in patients with multiple ipsilateral renal tumors: single-centre experience

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## Abstract

**Aim:** This study aimed to report the perioperative outcomes of off-clamp robot-assisted partial nephrectomy (RAPN) for multiple ipsilateral renal tumours at our Institution.

**Methods:** Data of consecutive patients affected by multiple ipsilateral renal tumours managed by RAPN between September 2018 and June 2023 were retrospectively analysed. Perioperative and post-operative data were collected. Eventual intra- and post-operative complications with or without readmissions (occurred within 30 days) were recorded and classified according to Clavien-Dindo system. Final pathology examination of excised tumours was performed.

**Results:** Twelve patients were included in the analysis. Median tumour size was 34 mm and median R.E.N.A.L. [(R)adius (tumour size as maximal diameter), (E)xophytic/endophytic properties of the tumour, (N)earness of tumour deepest portion to the collecting system or sinus, (A)nterior (a)/posterior (p) descriptor and the (L)ocation relative to the polar line] score was 6. Median console time was 134 min. An off-clamp approach with pure enucleation was possible in 20 out of 28 lesions (71.4%). Median estimated blood loss was 200 mL. No differences were observed in renal function both at discharge and after 30 days, with respect to baseline. No intraoperative complications were recorded. Post-operative complications occurred in two patients, both classified



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as Clavien-Dindo grade 2. Positive surgical margins were reported in one case (4.5%). No local recurrence or metastasis were diagnosed within a median follow-up of six months.

**Conclusion:** Our case series showed the feasibility of off-clamp RAPN in patients with multiple ipsilateral renal tumours in experienced hands. Further studies with larger sample size and longer follow-up are warranted to better define the optimal management strategy in such an uncommon scenario.

**Keywords:** Off-clamp, robot-assisted partial nephrectomy (RAPN), multiple ipsilateral renal tumours

## INTRODUCTION

In recent years, off-clamp robot-assisted partial nephrectomy (RAPN) has known broader diffusion and emerged as a promising technique in the management of complex renal masses<sup>[1-3]</sup>. Several studies have investigated the feasibility and the outcomes of off-clamp RAPN for single renal tumours and found no benefit in terms of renal function<sup>[4,5]</sup>, while there remains a paucity of data regarding its application and outcomes in patients with multiple ipsilateral renal tumours.

The present study analysed a cohort of patients who underwent off-clamp RAPN for multiple ipsilateral renal tumours at our Institution and aimed to report the perioperative outcomes.

## METHODS

### Patients

Data of consecutive patients affected by multiple ipsilateral renal tumours managed by RAPN between September 2018 and June 2023 were retrospectively analysed.

### Surgical technique

All patients underwent Da Vinci Xi RAPN with a transperitoneal approach. A four-arm da Vinci robot was set up with a 30° lens. All the 8-mm robot ports were aligned along the pararectal line. The following robotic instruments were used: ProGrasp forceps, monopolar curved scissors, fenestrated bipolar forceps, and a large needle driver. An assistant 12-mm AirSeal port (Conmed, Largo, FL, USA) was placed in the periumbilical position. In the case of the right-sided procedure, an additional 5-mm port was placed at the level of the xiphoid for managing the liver.

Once a renal tumour was identified, the renal cortex surrounding the lesion was contoured with monopolar energy. The lesion was excised by a combination of sharp and blunt dissection, while pursuing an anatomical enucleation technique whenever feasible as previously described<sup>[6]</sup>. Eventual vessels encountered during the dissection emerging from the resection bed were controlled by either bipolar coagulation or application of re-absorbable clips (i.e., Absolok, Ethicon EndoSurgery, Cincinnati, OH, USA). After resection was completed, renorrhaphy was modulated according to active bleeding (sutureless vs. single-layer vs. double-layer), as previously described by our group<sup>[7]</sup>. Hemostatic agents were eventually employed on the basis of the surgeon's preference.

### Data collection and outcomes measurements

Preoperative variables, including age, sex, body mass index (BMI), Charlson Comorbidity index (CCI), haemoglobin (Hb), estimated glomerular filtration rate (eGFR), number of renal tumours, each lesion tumour size and R.E.N.A.L. [(R)adius (tumour size as maximal diameter), (E)xophytic/endophytic properties of the tumour, (N)earness of tumour deepest portion to the collecting system or sinus, (A)nterior (a)/posterior (p) descriptor and the (L)ocation relative to the polar line] nephrometry score<sup>[8]</sup>, were collected at baseline. eGFR was calculated using the Modification of Diet in Renal Disease equation<sup>[9]</sup>.

Perioperative and post-operative data were collected, including console time, estimated blood loss (EBL), resection and suture technique for each lesion, eventual use of hemostatic agents, length of hospital stay, Hb at discharge, and eGFR at discharge and after 30 days. Eventual intra- and post-operative complications with or without readmissions (occurred within 30 days) were recorded and classified according to the Clavien-Dindo system<sup>[10]</sup>. Final pathology examination of excised tumours was performed to have histology, grading, staging and surgical margin status assigned.

### Data analysis

Continuous variables were summarised using medians and interquartile ranges (IQR); frequencies and proportions were used to report categorical variables. Data analysis was conducted using the SPSS 21.0 software (IBM, Armonk, NY, USA).

## RESULTS

Twelve patients were included in the analysis. [Table 1](#) shows the distribution of baseline patient characteristics. Based on preoperative CT scan, median tumour size was 34 mm and the median R.E.N.A.L. score was 6. Two patients (16.7% of cases) had a history of partial nephrectomy performed on the contralateral kidney (open approach in one case, pure laparoscopic in the other case). One patient had undergone percutaneous renal mass biopsy and enrolled for a period of active surveillance before partial nephrectomy.

[Table 2](#) summarises the perioperative and post-operative outcomes. Median console time was 134 min. An off-clamp approach with pure enucleation was possible in 20 out of 28 lesions (71.4%). Median EBL was 200 mL. Median Hb showed a 21.5% reduction between baseline and discharge (14.4 vs. 11.3 g/dL), while median eGFR showed an 8.1% reduction during the same time span considered (86 vs. 79 mL/min). No differences were observed in renal function both at discharge and after 30 days (79 and 80 mL/min, respectively), compared to baseline.

No intraoperative complications were recorded. Post-operative complications occurred in two patients (16.7%), both classified as Clavien-Dindo grade 2. Namely, one patient required a blood transfusion on the 2nd post-operative day. The other patient was readmitted two weeks after surgery due to flank pain: CT scan revealed a 7-cm perirenal hematoma without arterial enhancement, which was managed conservatively.

No local recurrence or metastasis was diagnosed within a median follow-up of six months.

## DISCUSSION

Multiple ipsilateral renal tumours are relatively rare, with an incidence ranging from 4.5% to 8%<sup>[11]</sup>. In this specific setting, a nephron-sparing approach is paramount, taking into account the high risk of ipsilateral and/or contralateral recurrence (described in about 5% of cases)<sup>[12,13]</sup>.

RAPN is our preferred approach for managing multiple ipsilateral renal tumours. While most surgeons will agree on the robotic approach in this setting, the management of renal hilum remains open for debate. In 2008, a non-ischemic technique of RAPN for hereditary multiple or small exophytic tumours was first described: in this case series, one patient harboured four ipsilateral renal tumours and was managed by off-clamp RAPN without complications<sup>[14]</sup>. Another retrospective analysis of 12 patients with multiple

**Table 1. Clinical and demographic baseline patients characteristics**

		<b>N = 12</b>
Age (year), median (IQR)		58 (50-69)
Sex, n (%)	Male	9 (75.0)
	Female	3 (25.0)
BMI, median (IQR)		23.4 (21.7-24.6)
CCI, n (%)	0-1	10 (83.3)
	≥ 2	2 (16.7)
Preoperative Hb (g/dL), median (IQR)		14.4 (13.3-16.3)
Preoperative eGFR (mL/min), median (IQR)		86 (74-105)
Renal tumors per patient, n (%)	2	9 (75.0)
	3	2 (16.7)
	4	1 (8.3)
Tumor size (mm), median (IQR)		34 (27-41)
R.E.N.A.L. score, median (IQR)		6 (5-7)
Hilar tumor, n (%)	No	26 (92.8)
	Yes	2 (7.2)

IQR: Interquartile range; BMI: body mass index; CCI: Charlson Comorbidity index; Hb: haemoglobin; eGFR: estimated glomerular filtration rate.

**Table 2. Peri- and post-operative outcomes**

		<b>N = 12</b>
Console time (min), median (IQR)		134 (98-182)
Estimated blood loss (mL), median (IQR)		200 (188-312)
Resection technique, n (%)	Enucleation	20 (71.4)
	Enucleo-resection	7 (25.0)
	Resection	1 (3.6)
Suture technique, n (%)	Sutureless	4 (14.3)
	Single-layer	17 (60.7)
	Double-layer	7 (25.0)
Hemostatic agents, n (%)		18 (64.3)
Intraoperative complications, n (%)		0 (0)
Length of hospital stay (days), median (IQR)		5 (4-6)
Hb at discharge (g/dL), median (IQR)		11.3 (10.5-13.3)
eGFR at discharge (mL/min), median (IQR)		79 (60-105)
eGFR at 30th post-operative day (ml/min), median (IQR)		80 (62-104)
Grade ≥ 2 post-operative complications, n (%)		2 (16.7)
Post-operative readmissions, n (%)		1 (8.3)
Histology, n (%)	Benign	6 (21.4)
	Malignant	22 (78.6)
Positive surgical margins, n (%)		1 (4.5)

IQR: Interquartile range; Hb: haemoglobin; eGFR: estimated glomerular filtration rate.

ipsilateral renal tumours managed by sequential segmental renal artery clamping RAPN showed good renal function preservation at five-months follow-up (-9.3% compared to baseline), without major complications<sup>[15]</sup>. Other recent case series have confirmed the feasibility of off-clamp RAPN for multiple ipsilateral renal tumours<sup>[16,17]</sup>.

The clamping of renal pedicle has been described as an independent predictor of immediate and early renal function impairment after partial nephrectomy<sup>[18]</sup>. This led to the development of the off-clamp RAPN<sup>[19]</sup>. However, randomised clinical trials comparing on-clamp *vs.* off-clamp RAPN have shown minimal impact of ischaemia on functional recovery. On the other hand, the two techniques demonstrated similar blood loss and complication rates<sup>[20-22]</sup>.

On these bases, the question arises spontaneously: in light of the aforementioned results, why an off-clamp approach should be adopted? We herein provide some considerations. First, the cited results concern procedures performed for single renal tumours, with limited ischemia intervals (averaging 15-20 min).

The lack of trials specific of the setting of multiple ipsilateral tumours prevents us from drawing definitive conclusions on which is the more appropriate approach. Overall, our institutional experience led us to opt for an off-clamp technique whenever possible. While the benefit from this approach can be debated in the setting of bilateral kidney, normal renal function, and single localised tumour, we believe that the off-clamp approach is a good indication in the management of multiple ipsilateral tumours.

Given the consistent experience matured also in the setting of pure laparoscopy<sup>[23,24]</sup>, our philosophy is even more extreme in this setting. Beyond the off-clamp approach, we believe that an “off-renal-hilum-dissection” approach is key here. As such, if the avoidance of the 30-40 min of ischemia may not translate into any clinically relevant advantage in terms of renal function, we believe that leaving the hilum not dissected is a plus. This is particularly important given the non-negligible risk of re-doing partial nephrectomy in patients with multiple ipsilateral tumours, who, in many cases, live in the context of genetic syndromes. Some reports about re-doing partial nephrectomy have underlined this is a technically demanding procedure due to adhesions both at the level of the previously dissected hilum and at the level of the Gerota’s fascia<sup>[25]</sup>.

When performing off-clamp RAPN, another important point is to pair it with an anatomical tumour excision<sup>[7]</sup>. Recent literature has shown that the amount of healthy parenchyma preserved during the procedure is a major predictive factor for post-operative renal function recovery, both during tumour excision and renorrhaphy<sup>[6,26,27]</sup>. Accordingly, most of the tumour lesions in this case series were managed by a pure enucleation (71%) followed by a single-layer sliding-clip renorrhaphy (61%): this approach is essential in the multiple ipsilateral tumours, in order to perform a “true” nephron-sparing surgery<sup>[28]</sup>.

Our results were comparable with those reported in literature. In a recent retrospective multicentre study on 61 patients affected by multiple ipsilateral tumours, RAPN (regardless of vascular hilar management) showed an overall post-operative complication rate of 23% (2 cases Clavien-Dindo grade > 2), and positive surgical margins rate of 6.5%<sup>[16]</sup>. In another single-centre retrospective study on 50 patients affected by multiple ipsilateral tumours, after a propensity score matching based on age, CCI, tumour size and nephrometric score *vs.* patients with a single tumour undergoing RAPN, no statistically significant difference was found in terms of eGFR (-6.4% in the multiple tumours group) or post-operative complications Clavien-Dindo grade  $\geq$  2 (10.2% in the multiple tumours group)<sup>[17]</sup>.

We acknowledge the limitations of the study. First, the retrospective nature of the study, and the lack of a control group; Second, the limited sample size. Last, the short-term follow-up prevents us from any meaningful conclusion in terms of durability of oncological and functional outcomes.

Nevertheless, we believe that even a single-centre experience on a small cohort of patients can add useful data to a literature that inevitably suffers from the rarity of such condition. We believe our results seem encouraging, highlighting a small impact on early renal functional outcomes from the modifications suggested with respect to a “conventional” technique for RAPN.

In conclusion, our case series showed the feasibility of off-clamp RAPN in patients with multiple ipsilateral renal tumours in experienced hands. Further studies with larger sample size and longer follow-up are warranted to better define the optimal management strategy in such an uncommon scenario.

## DECLARATIONS

### Author contributions

Study concept and design: Carilli M, Bertolo R, Bove P

Data acquisition: Carilli M, Vittori M, Iacovelli V, Antonucci M, Signoretti M, Maiorino F, Petta F

Data analysis: Carilli M, Bertolo R

Drafting of manuscript: Carilli M, Bertolo R, Vittori M

Critical revision of the manuscript: Carilli M, Bertolo R, Vittori M, Iacovelli V, Antonucci M, Signoretti M, Maiorino F, Petta F, Bove P

### Conflict of interest

All authors declared that there are no conflicts of interest.

### Availability of data and materials

Not applicable.

### Financial support and sponsorship

None.

### Ethical approval and consent to participate

This study was approved by the institutional research ethical committee (STS CE Lazio 1/Oss-552) and all related procedures were conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all patients.

### Consent for publication

Not applicable.

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