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ORIGINAL PAPER

Endophytic to total tumour volume ratio: An added variable to patients with T1b/T2 renal tumours undergoing partial nephrectomy

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Summary ***Introduction: Partial nephrectomy is the standard of care to patients with small renal masses. It is still encouraged to larger tumours whenever feasible. The aim of this study is to look for the endophytic to total tumour volume ratio as an added variable to study the complexity of partial nephrectomy to patients with T1b/ T2 renal tumours.***

Methods: Retrospective data collection of patients that had partial nephrectomy for T1b/T2 renal tumours by a single surgeon was done. Radiological re-assessment for the CT images to measure the endophytic to total tumour volume ratio was done.

Results: The mean age of the patients was 63 years. The study included 25 males and 11 females. All cases were managed by open surgery using retroperitoneal transverse lateral lumbotomy and warm ischemia was used in all patients. The mean tumour volume was 74 cc, the mean endophytic tumour volume was 29 cc. The mean percentage of endophytic to total tumour volume was 42%.

Conclusions: Partial nephrectomy is safe for most of the patients with good performance status, having large renal masses. More complex surgery can be predicted in patients with endophytic to total tumour volume greater than 42%.

KEY WORDS: RCC; Partial nephrectomy; Tumour volume.

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INTRODUCTION

Partial nephrectomy (PN) is currently accepted as the standard of care for most localized kidney cancer. The American society of clinical oncology defines partial nephrectomy as the standard of care for patients with T1a kidney mass (1). American Urology association guidelines (2021) confirm PN to be the preferred treatment for patients with T1a solid/complex cystic renal tumours (2). Canadian urology association guidelines recommend partial nephrectomy for treatment of tumours 2-4 cm in diameter (3). Most recent European guidelines (2022) (4) recommend PN whenever feasible for T1 tumours, raising the bar to tumours up to 7 cm in diameter. Some studies did show the feasibility of PN for T2 renal tumours (5, 6).

Renal scoring systems were emerged and validated over the last 15 years (7, 8). The scoring system may be beneficial to in patients' counselling about complexity of surgery and the anticipated success/ failure rate of PN. In daily practice, PN is attempted as the standard of care for small renal masses, regardless of the tumour's complexity. The aim of this study is to look for the endophytic to total tumour volume ratio as an added variable to study the complexity of partial nephrectomy to patients with T1b/T2 renal tumours.

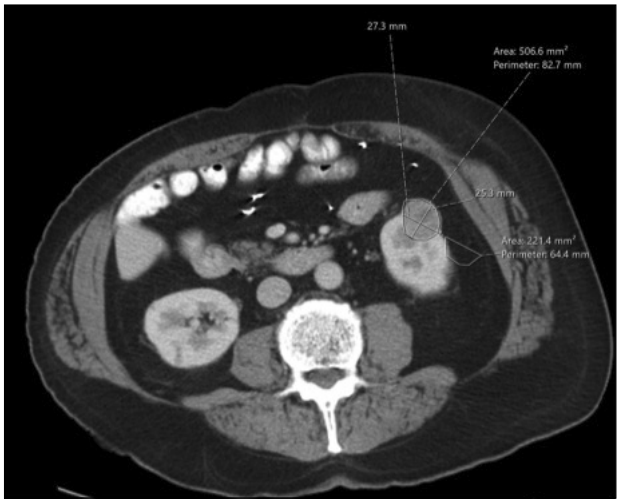
METHODS

Retrospective data collection for patients managed by partial nephrectomy, by a single surgeon (AK) for clinically T1b/T2 renal in 2018-2020. Radiologists were provided with the patients' list for the aim of the study and calculation of the tumour endophytic volume and the percentage of the endophytic volume to the total volume was calculated. The whole tumor volume was calculated by using this equation: Antero-posterior x transverse x craniocaudal dimensions multiplied by 0.52. The area tool was then used to calculate the total tumor as well as to calculate the endophytic tumor component which lies within the kidney. The ratio endophytic to total tumor ratio was calculated by dividing the endophytic component to the whole tumor area. The endophytic component was identified by drawing a line through the tumour to complete the border of the kidney. Figure 1 illustrates the markings.

Institutional ethical approval was obtained. Patients' consent for publishing was obtained as well.

Surgery was always started by full mobilization of the kidney and dissection of the renal pedicle regardless of the tumour location. Tumour was identified. Fat covering the tumour was left intact but margins of the tumour at contact with the kidney was cleared of fat. Fat in this region was always sent separately for pathological analysis. After tumour edges are all clearly seen, monopolar cautery was used on the renal capsule 5-10 mm beyond the tumour edge for marking without cutting deeply into the kidney parenchyma. After that, the vascular clamp was used over the artery and vein and deep cutting with the monopolar

Figure 1.
Calculation of the tumour endophytic volume and the percentage of the endophytic volume to the total volume. The endophytic component was identified by drawing a line through the tumour to complete the border of the kidney.



cautery mixed with mobilizing the wedge having the tumour away with an empty blade handle till tumour with normal parenchymal margin was completely removed. We repair collecting system if encountered. We then use the monopolar cautery spray to cauterize the parenchymal edges before repair. Vicryl 0 was then used to take multiple deep interrupted transverse mattress sutures. Once satisfied, the whole sutures are tied and the vascular clamp is removed. We usually cover the renorrhaphy with a large piece of surgicel leave a drain for 48 hours. The patient was usually discharged on the morning of the third postoperative day.

Results

Thirty-six patients were identified fulfilling our criteria. The mean age of the patients was 63 years. The study included 25 males and 11 females. All cases were managed by open surgery using retroperitoneal transverse lateral lumbotomy (9). Warm ischemia was applied to all cases, clamping both the renal artery and the vein. The mean ischemic time was 9 minutes. No case required intra or postoperative blood transfusion. No case was changed to radical nephrectomy.

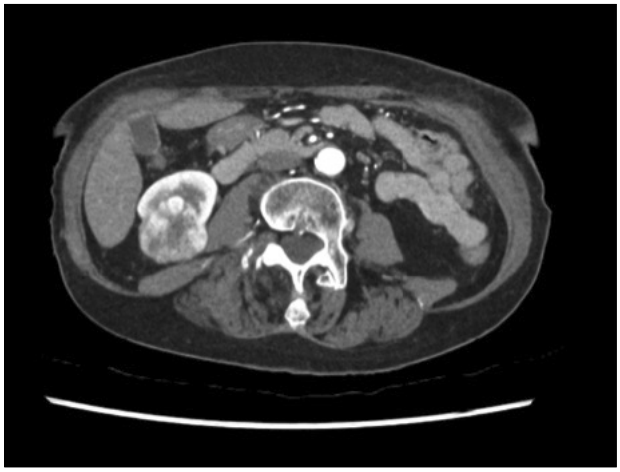
Thirty-two cases had solid tumour and 4 had Bosniak 3/4 renal cysts. The mean tumour diameter was 5.5 cm, ranging from 4.2 to 10 cm. The mean tumour volume was 74 cc, the mean endophytic tumour volume was 29 cc. The mean percentage of endophytic to total tumour volume was 42%.

Endophytic to total tumour volume of > 42% was found to be associated with longer mean operative time (90 minutes versus 50 minutes. P 0.01) and more mean blood loss (200 *versus* 50 ml. P 0.02).

Renal cell carcinoma (RCC) was the pathological diagnosis of all patients, but one case had *angiomyolipoma* (AML). Fortunately, positive surgical margin was only seen in the patient having AML. Pathological T3 was identified in 5 patients. Over a median follow up of 3 years, disease and recurrence free survival was 100%.

Figure 2 shows a case with a tumour diameter of 4.2 cm involving the right lower renal pole. The endophytic to total tumour volume was 39%. The case was successfully managed by PN, under warm ischemic time of 10 minutes. Single patient had significant hematuria and drop in Hgb few weeks after surgery. Pseudoaneurysm was identified and clamping by the interventional radiology team was safely done. That patient had endophytic to total tumour volume of 79%.

Figure 2.
Figure shows a case with a tumour diameter of 4.2 cm involving the right lower renal pole. The endophytic to total tumour volume was 39%.



Discussion

In patients with adequate performance status, PN should be always attempted. All guidelines agree on that for T1a tumours, and some guidelines and many publications extend the recommendation to T1b/ T2 tumours. Scoring systems were introduced and validated to help the decision making and patients' counselling.

Efforts were ongoing to identify adding parameters to predict the success of PN. *Sciorio et al.* (2020) identified MIC (surgical margin, ischemic time, and complications) as a parameter that could mark the success of the surgery. In their study. Low MIC was correlated to high PADUA score and large tumour diameter (10).

Tumour volume and specifically the endophytic tumour volume was not widely studied. *Tiwari et al.* (11) studied 87 patients that underwent PN for T1a renal mass and found a positive correlation between the endophytic tumour volume and nephrometry score.

Mohammadi et al. (12) published a case report for a successful PN to 17 cm renal mass. While they did not measure the tumour volume in their study, the CT images they published clearly showed very low ratio of endophytic to total tumour volume.

To our knowledge, this is the first study looking for the percentage of endophytic to total tumour volume in patients that underwent PN for T1b/T2 renal masses. In our hands, PN was safe for such large renal tumours in

medically fit patients. We must disclose that this study did not include patients with similar or smaller tumour mass that we elected to do radical nephrectomy because of their poor performance status that we felt PN may be an added risk to them. In our experience, the patients' performance status and comorbidities were the main factors we consider when offering partial versus radical nephrectomy. While all cases that had PN for large renal masses were successful, cases that had larger endophytic to total tumour volume had significantly longer operative time and blood loss.

Conclusions

Partial nephrectomy is a safe treatment option that should be attempted in most of the patients with good performance status regardless of the tumour size. Endophytic to total tumour volume is an added parameter to consider for surgical planning. Endophytic to total tumour volume ratio of greater than 0.42 was associated with longer operative time and more blood loss in patients with T1b/T2 tumours undergoing partial nephrectomy.

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