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Introduction

The incidence of renal cell carcinoma (RCC) continues to increase at the same time the aging of the world population increases (1). Today RCC accounts for 3% of adult solid tumors and the highest incidence is between 50 and 70 years of age. In the European Union almost 20,000 RCC patients are estimated to be detected yearly. Obviously the use of the ultrasound and CT scan is responsible for an increased detection of asymptomatic low stage tumors that would not require radical nephrectomy to be cured. Today the majority of newly detected tumors are smaller than 4 cm in size at diagnosis (2).

Small renal tumors have a low metastatic potential and while conservative management like active surveillance and thermal ablation are sometimes proposed, resection of solid renal masses remains the cornerstone when the lesion is suspected to be malignant.

For many decades radical nephrectomy was the gold standard for the treatment of localized renal cell carcinoma, however radical nephrectomy is a risk factor for the development of new onset chronic kidney disease and leads to more cardiovascular events and worse survival (3–4).

Despite the fact that the only randomized trial comparing partial and radical nephrectomy in patients with a normal contralateral kidney for tumors up to 5 cm in diameter did not show an overall survival advantage for partial nephrectomy (5), the European Association of Urology (EAU) guidelines advocate the use of nephron sparing surgery whenever possible in cT1a and b renal tumors (6). In the meantime many reports have emphasized on the efficacy and safety of nephron sparing surgery (7).

Abstract

Background: Nephron sparing surgery has become the standard treatment for small renal masses particularly in Western Europe, but in countries like Kosovo, the experience is much more limited. Our aim is to report our initial experience in managing small renal masses with nephron sparing surgery (NSS).

Materials and Methods: This is a retrospective study of patients who underwent Open Partial Nephrectomy (OPN) at our Clinic of Urology between January 2000 and December 2015.

Results: Of 216 patients with renal tumors, 33 underwent OPN. 11 (33%) were female and 22 (67%) were male. The mean kidney tumor size was 3.2 cm (range 3.1–4.0). The patients median age was 46 years (range 24–61). The indications were elective in 29 cases and relative is 4 cases. There were no intra–operative complications and the post–operative complications were minimal. After a median follow–up of 34 months (range 24–41) there were no local recurrences or late complications.

Discussion: Well recognized modern guidelines on the treatment of small renal masses indicate the use of nephron sparing surgery. Our urological community needs to implement these guidelines and our urologists need to be provided with the necessary education and training and emerging treatment strategy.

Conclusions: Patients with small renal masses that are amenable for a technically and oncologically safe partial nephrectomy, even in presence of a normal contralateral kidney, should undergo nephron sparing surgery. This we showed to be feasible to provide excellent tumor control.

Keywords: ONSS, Open Nephron Sparing Surgery, T1a Renal Tumors
Although open partial nephrectomy is commonly performed worldwide, it is still not widely utilized in our country.

The first nephron sparing surgery for a renal tumor was done by Czerny in 1887 \(^8\). In 1950, Vermooten first suggested that localized RCC could successfully be excised while leaving a surrounding area of normal renal parenchyma on the specimen \(^9\).

Obviously nephron sparing surgery was in the past only performed in imperative situations as chronic renal failure, functional of anatomical solitary kidneys and bilateral tumors, where a radical nephrectomy would make the patient dialysis-dependent. Over the years, with growing expertise in conservative surgery, more and more elective conservative surgeries where done and reports were published about patients with small peripherally located lesions of uncertain malignancy \(^10\).

If all suspicious tumors where to be treated by radical nephrectomy, a significant number of kidneys would be resected that harbor no malignancy but rather benign lesions like angiomiolipoma, oncocytoma, cystic nephroma and complicated cysts \(^11\).

Since the year 2000 we have offered partial nephrectomy to a selected group of our patients with various localized malignant and benign tumors and we report our experience.

**Material and Methods**

This is a retrospective analysis of the files of patients who underwent partial nephrectomy at our clinic of Urology between January 2000 and December 2015. Their records were reviewed and we collected the epidemiologic data about age and gender, preoperative investigations and imaging, the indications for nephron sparing surgery, the pre-, intra- and postoperative data, the histopathology with tumor size and pathological type, histologic grading by the Fuhrman system and the findings during the follow-up concerning local tumor recurrence and metastasis.

Of a total of 126 patients that were treated for kidney masses, 33 underwent open partial nephrectomy; the patients were not randomized and the indication for partial nephrectomy was dependent on the individual surgical urologist who felt that the patient was a good candidate for conservative surgery. Twenty–two males (67%) and 11 females (33%) where included in the analysis with a median age of 46 years, ranging from 24 to 61. Routine laboratory analyses were completely normal in all patients. All tumors were incidentally found on different imaging techniques performed for diverse, not kidney tumor related symptoms. 27 patients were found to have a renal mass on ultrasound, 5 on CT scan and 1 on MRI. The mean tumor diameter was 3.2 cm ranging from 3.1 till 4.0 cm. Nineteen tumors where located in the upper pole, 13 in the lower pole and 1 was interpolar (Figure 1).

![Figure 1: CT scan showing an upper (A) and a lower (B) pole tumor](image)

The indications for open partial nephrectomy were elective in 29 of the 33 patients included. This means that they had a normal preoperative kidney function, a normal eGFR and serum creatinine and on imaging a normal contralateral kidney. In 4 cases the indication was relative.

All cases were submitted to open surgery with an extra–peritoneal flank incision above the 11th (for upper pole tumors) or 12th rib, ranging from 7 to 15cm related to the patients’ BMI (Figure 2).

![Figure 2: Installation of the patient for lumbotomy](image)
principle was followed of obtaining a 1 cm tumor free margin, early vascular control, proper hemostasis by oversewing small intrarenal vessels, closure of the collecting system when opened and closure of the renal cortex with separate sutures, hemostatic agents were not used (Figure 3).

The perinephric fat was closed over the remnant kidney and a drain inserted in the renal fossa. The wound was closed in 2 layers. Diuretics were administered eventually in the recovery room when there was some hematuria present.

The resected tumor was fixed in buffered neutral Formalin and embedded in paraffin for pathological examination. Tissue sections where cut and stained with haematoxylin and eosine (H&E) (Figure 4).

The histopathological data are given in Table 1.

The follow-up consisted of 3-monthly ultrasound during the first year and at 4-monthly intervals during the second and third year. On top of that a yearly contrast enhanced CT scan was performed. The median follow-up was 34 months (24–41).

Table 1: Histopathological data in 33 partial nephrectomies

<table>
<thead>
<tr>
<th>Tumor side:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• left</td>
<td>19</td>
</tr>
<tr>
<td>• right</td>
<td>14</td>
</tr>
</tbody>
</table>

| Tumor size in cm | 3.2 cm (range 3.1–4.0) |

<table>
<thead>
<tr>
<th>Pathological type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Benign</td>
<td>4</td>
</tr>
<tr>
<td>Angiomyolipoma</td>
<td>1</td>
</tr>
<tr>
<td>Oncocytoma</td>
<td>3</td>
</tr>
<tr>
<td>• Malignant (%)</td>
<td>29 (90.9%)</td>
</tr>
<tr>
<td>Clear cell</td>
<td>24</td>
</tr>
<tr>
<td>Papillary</td>
<td>3</td>
</tr>
<tr>
<td>Chromophobe</td>
<td>2</td>
</tr>
<tr>
<td>• Fuhrman grade</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>19</td>
</tr>
<tr>
<td>II</td>
<td>8</td>
</tr>
<tr>
<td>III</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>0</td>
</tr>
</tbody>
</table>

| Total tumors | 33 |
During the follow-up period there were no postoperative local recurrences and no signs of metastases.

Nineteen patients underwent an upper and 13 a lower polar nephrectomy while the interpolar case was treated with a wedge resection. Injection of Methylene-blue in the collecting system was done 6 times to assure the watertight closure. The operation took as mean 105 minutes (range 95–156), the mean blood loss was 170 ml (range 100–450). The patient stayed in the hospital for 5 days as a mean (4–9), 3 of them presented a wound infection (9%), 2 presented a minimal leakage on pyelography (6%), without clinical implication, and 1 patient presented a postoperative bleeding (3%).

Partial nephrectomy for the treatment of kidney tumors is still underutilized in many parts of the world including in our country. More and more however it has become accepted that partial nephrectomy can achieve oncological cure rates comparable to those of radical nephrectomy.\(^{(6)}\) With the introduction of minimal invasive radical nephrectomy using laparoscopy there was a slight increase of radical nephrectomies performed for small solid renal masses since the low morbidity and obviously excellent oncological tumor control of this laparoscopic approach. Today, if radical nephrectomy is needed laparoscopic radical nephrectomy should be considered, as it has become a recognized standard with a more rapid recovery and obviating all incisional complications of the classic open surgery. Radical nephrectomy should however not be recommended for small renal masses that can be safely resected from a technical and oncological point of view. Training in open, partial nephrectomy should be continued and a more frequent use is recommended.\(^{(12–13)}\)

Surgical resection of renal cell carcinoma remains the treatment of choice in those patients that can have surgery, nevertheless recently partial nephrectomy has been compared to percutaneous ablation for ct1 renal masses and it was shown that both procedures where associated with similar rates of local recurrence. Obviously this retrospective analysis needs to be interpreted with caution because of a likely selection bias.\(^{(14)}\) Even active surveillance has been studied in patients with small renal masses and it seemed that this approach was not associated with a higher rate of metastatic progression compared to extirpative of ablative treatments.\(^{(15)}\) These authors showed that the renal function preservation was equivalent in active surveillance and partial nephrectomy patients, meaning that partial nephrectomy is absolutely able to preserve kidney function in the majority of patients.

Still partial nephrectomy will be the treatment of choice for small renal masses that are supposed to be renal cell carcinoma. Technically one could debate the type of incision used. Most authors favor a lumbotomy above the 12th or 11th rib over a laparotomy, that is still a possible approach in patients with bilateral tumors. The disadvantages of the lumbotomy approach are well documented with intercostal nerve palsy and paralysis of the oblique muscles with bulging and neuralgic pain. Some authors advocated the use of mini flank incisions above the 12th rib, but in our patients we preferred a larger incision, eventually dictated by our limited but gradually increasing experience.\(^{(16)}\) The disadvantages of the flank incision are obviously circumvented by the use of laparoscopic approaches when these are possible. Indeed the selection of treatment approach depends on the experience of the surgeon and his staff. While open partial nephrectomy will remain the golden standard, one notices an increased use of laparoscopic partial nephrectomy (LPN), eventually robot assisted (RPN), the latter further decreasing the complications of the procedure. While the oncological results were comparable in the laparoscopic versus the open partial nephrectomy group, there were initially more complications linked to the laparoscopic approach.\(^{(17)}\) More recent reports would indicate an advantage for laparoscopy and certainly for robot assisted laparoscopic partial nephrectomy when it comes to complications, section margins and quality of life.\(^{(18)}\) Partial nephrectomy has been used for T1b and T2 renal tumors, and also in anatomically complex renal masses both with open surgery and with minimal invasive techniques in expert centers. Open partial nephrectomy still seems to be in use because of the longer warm ischemia time needed for minimal invasive techniques.\(^{(19–20–21)}\) In the end for more complex tumors treatment decisions require share decision—making regarding the trade-offs between radical nephrectomy and nephron sparing procedures via open or minimal invasive surgery.\(^{(22)}\)

From a technical point of view, once the Gerota’s fascia and the perinephric fat has been opened and the kidney cortex has been reached a complete mobilization of the kidney out of the fat is needed. In some patients toxic fat can make this stage of the procedure more difficult, a difficulty that can also occur in laparoscopic surgery and be the reason of conversion to radical nephrectomy in some cases. The renal hilus needs to be prepared so that one is able to control bleeding by eventually clamping the artery or the artery and vein when deemed necessary.\(^{(23)}\) On should carefully look for multi-focality, certainly in patients with papillary renal cell carcinoma type 1 that often are multifocal and bilateral, but also in patients with genetic syndromes like Von Hippel–Lindau where multifocal clear cell renal cell carcinoma occurs, or in patients with Birth–Hogg–Dubé syndrome with multifocal chromophob carcinomas.
When hilar clamping is planned, the pre-clamping use of mannitol has been debated, it was recently shown that there was no advantage in using mannitol (24).

One of our major concerns during nephron sparing surgery was focused on careful preparation of the tumor area and resection with a 1cm healthy margin around the tumor. Frozen section was not performed. In the literature the 1cm margin has been left behind and instead of polar nephrectomies and wedge resections, more and more surgeons advocate the use of enucleo–resections with just a few millimeters of healthy parenchyma or even pure enucleation. A large multi–center study, where pure enucleation has been used since many years (25), has shown that the overall survival rates were the same and that eventual local recurrences can be rescued when they occur (26). We have not performed frozen sections because we had a large margin of healthy tissue surrounding the tumor. In case of a pure enucleation relying on the pseudocapsule, that is not always present (see Figure 5), frozen section still might be useful and indicate a more extensive resection during the primary surgery. In our series, with a more extensive resection within healthy parenchyma no local recurrence has been seen after tumor excision, while by some authors a local recurrence rate was reported to vary between 0 and 7.3% (27). On the other hand it was shown that when a positive margin is diagnosed on definitive pathology only 1 out of 4 patients will in the long–term recur locally and need a second treatment. This means that 3 out of 4 margin–positive patients never present with recurrence and to not deserve immediate second measures but a more close imaging follow–up (28).

Since it was clearly shown that the decline in renal function after partial nephrectomy is most related to the loss of nephrons (29) we will need to reconsider our resection technique in order to minimize an unnecessary nephron loss by resection of a wide healthy margin.

After the careful polar nephrectomy or wedge resection we took care of proper hemostasis of the resected surface and meticulous closure of the renal cortex and this has obviously translated in good long–term outcomes. Other reports indeed have shown intra–operative and post–operative bleeding, even necessitating secondary nephrectomy (30). Postoperative bleeding is best treated with interventional radiology (super–selective embolization) when available. Re–operation for bleeding will indeed often lead to total nephrectomy (31).

We have carefully repaired the pelvi–calyceal system when this was opened and have not used double J or single J catheters. When the parenchyma can be closed above the reconstructed urinary tract, there is obviously no need for stenting.

Conclusions

Nephron sparing surgery has emerged as the optimal surgical approach for T1a and in experienced hands for T1b kidney tumors. Probably one of the most important factors is the skill and the quality of the surgeon and this, much more than the surgical approach, be it open or pure laparoscopic or robot assisted laparoscopic. Our results and those of so many larger series discussed here suggest that appropriate patient selection and surgical technical skills are important factors to obtain good functional and oncological long–term outcomes. Through the new technological advancement, OPN has given way to LPN and RPN. Although not currently the gold standard for partial nephrectomy, robotic surgery continues to emerge as the future modality treatment that might result in better functional and oncological outcomes, even compared to open surgery.

Conflict of interests

All authors have no commercial relations or other associations, actual or potential, that might create a conflict of interests in connection with the submitted paper. The authors declare that there is no conflict of interests regarding the publication of this paper.

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