Laparoscopic nephron-sparing surgery: insights after first 25 cases

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ABSTRACT

Introduction and Objectives. Nephron-sparing surgery (NSS), now indicated fo all cT1 renal tumours and even in selected cases of cT2 tumours, achieves similar oncological, but superior functional outcomes when compared with radical nephrectomy. Laparoscopic partial nephrectomy (PN) has emerged as a minimally invasive alternative to open approach, to decrease the morbidity of procedure. The aim of this study was to analyze the initial experience and outcomes after first 25 cases undergoing laparoscopic nephron-sparing surgery in our department.

Materials and methods. We retrospectively included first 25 consecutive patients who underwent 3D laparoscopic partial nephrectomy in Urology Clinic of Bihor Emergency Clinical County Hospital (Oradea, Romania) between October 2022 and June 2024. We evaluated the preoperative, intraoperative and postoperative data, as well as pathological characteristics of the final specimen.

Results. The median age of the patients was 62 years. The average operative time was 130 minutes. No patient required conversion to open surgery. In five cases an off-clamp technique was successfully used. The median warm ischemia time was 19 minutes. The median size of the tumors was 39 mm. Seventeen patients had clear cell renal cell carcinoma (RCC), three had papillary RCC, two had chromophobe RCC, 2 had oncocytoma and one had angiomyolipoma, respectively. Three cases had positive surgical margins. The median postoperative hospital stay was 4 days. The difference between preoperative and postoperative serum creatinine was not statistically significant.

Conclusions. In conclusion, laparoscopic approach in partial nephrectomy is safe and feasible in our department, with promising oncological and functional results.

Keywords. Enucleoresection, laparoscopic partial nephrectomy, nephron-sparing surgery, renal cell carcinoma, renal tumour.

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Introduction

Renal cell carcinoma (RCC) accounts for 90% of all kidney malignancy and about 3% of all cancers worldwide [1]. Over the past decades, the paradigm related to the diagnosis and treatment of renal tumours significantly evolved [2].

Due to the widespread access of patients to imaging techniques, renal tumours are more commonly detected at smaller dimensions. Reserved in the past for cT1a stage only, the indication for nephron-sparing surgery (NSS) extended in the last years to all cT1 renal tumors, when technically feasible. The goal of NSS is the complete removal of the tumour while preserving as much healthy renal parenchyma as possible, to achieve a minimum loss of renal function without compromise the oncological outcomes. In selected cases, like solitary kidney or bilateral tumors, partial nephrectomy (PN) can be performed even for cT2 renal masses. This type of surgery is technically challenging because it requires the excision of entire tumor by enucleation, enucleoresection or resection with a healthy parenchyma margin, without lasting tumor tissue in place, followed by reconstruction of remaining parenchyma [3,4].

In the setting of advancing surgical techniques and expanding expertise in laparoscopy, laparoscopic nephron-sparing surgery has emerged as a minimally invasive alternative, combining the benefits of tumor excision above mentioned with the advantages of laparoscopy, such as reduced postoperative pain, shorter hospital stays, and quicker recovery.

The aim of this study was to analyze the initial experience and outcomes after first 25 cases undergoing laparoscopic nephron-sparing surgery in our department.

Materials and methods

We retrospectively included first 25 consecutive patients who underwent 3D laparoscopic partial nephrectomy in Urology Clinic of Bihor Emergency Clinical County Hospital (Oradea, Romania) between October 2022 and June 2024.

Our indication for laparoscopic partial nephrectomy was cT1a or cT1b renal tumours where complete resection was considered feasible, after a careful examination of clinical and imaging features of each patient. The cases with increased technical difficulty (complete endophytic tumour, large tumour in solitary kidney) were reserved for open partial nephrectomy.

We chose the standard transperitoneal or retroperitoneal approach depending on the location of the tumour and other characteristics of the case (patient habitus, renal vascular pedicle anatomy).

After trocars positioning and medialization of colon (in transperitoneal approach), we identified the ureter and proceeded with cranial dissection along it up to the renal pedicle elements. We always isolated on vessel loop the renal artery. Then, we isolated the renal tumour and adjacent normal parenchyma from surrounding perirenal fat. A vascular bulldog clamp was used for renal artery temporary occlusion (Figure 1), when we started to perform the enucleoresection or resection of tumour (Figure 2). In cases where we found a paucivascular enucleation plane of tumour or when the endophytic part was estimated to be small, we omitted to clamp the renal artery (off-clamp technique). We performed renorrhaphy in 2 layers if it was a deep or large resection bed (unidirectional suture round needle ½ 26 mm USP 3-0 for deep layer and braided polyglycolic acid suture round needle ½ 40 mm USP 1 for the second layer, respectively). Otherwise, we used a single layer of braided polyglycolic acid suture USP 1 (Figure 3). We always put an abdominal drain near the resection bed after declamping and checking the hemostasis.

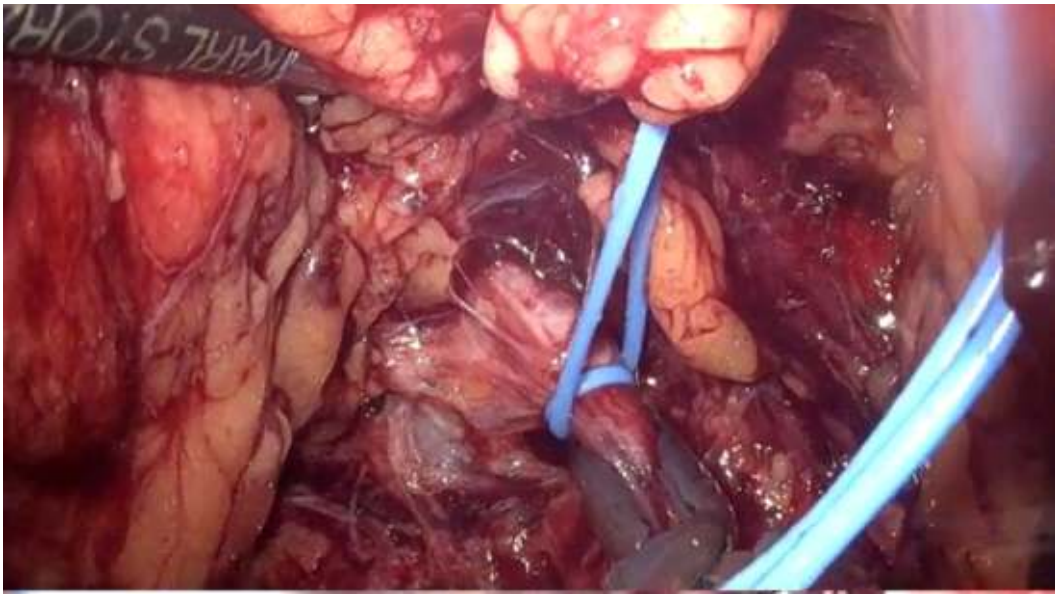


Figure 1. Clamping the renal artery with a vascular bulldog (retroperitoneal approach)

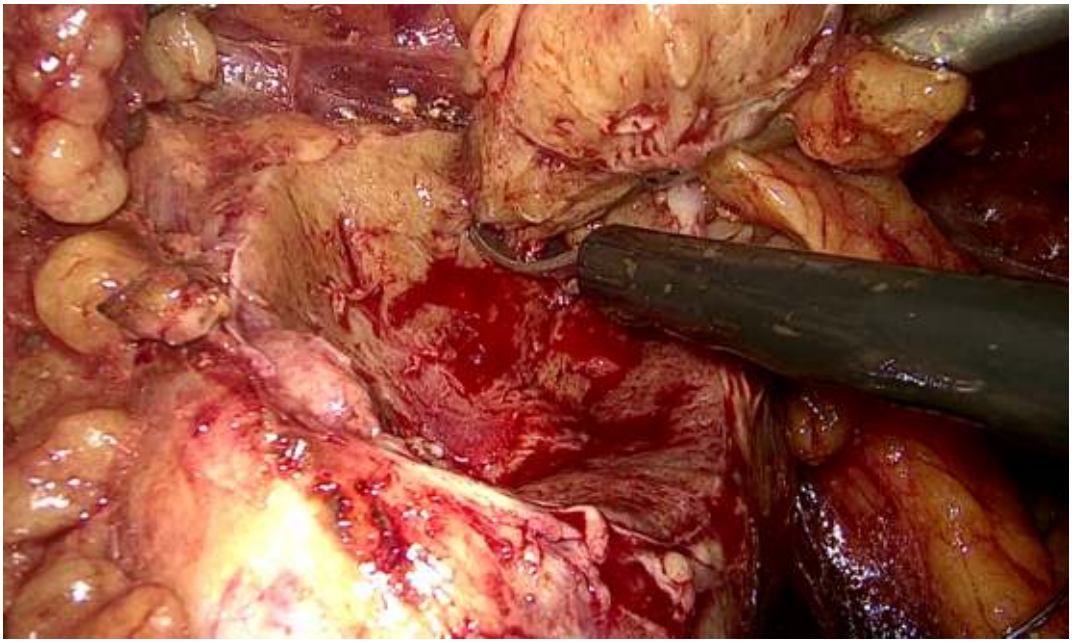


Figure 2. The tumor bed after resection in healthy parenchyma (the tumour can be observed in the upper portion of the image, almost completely detached)

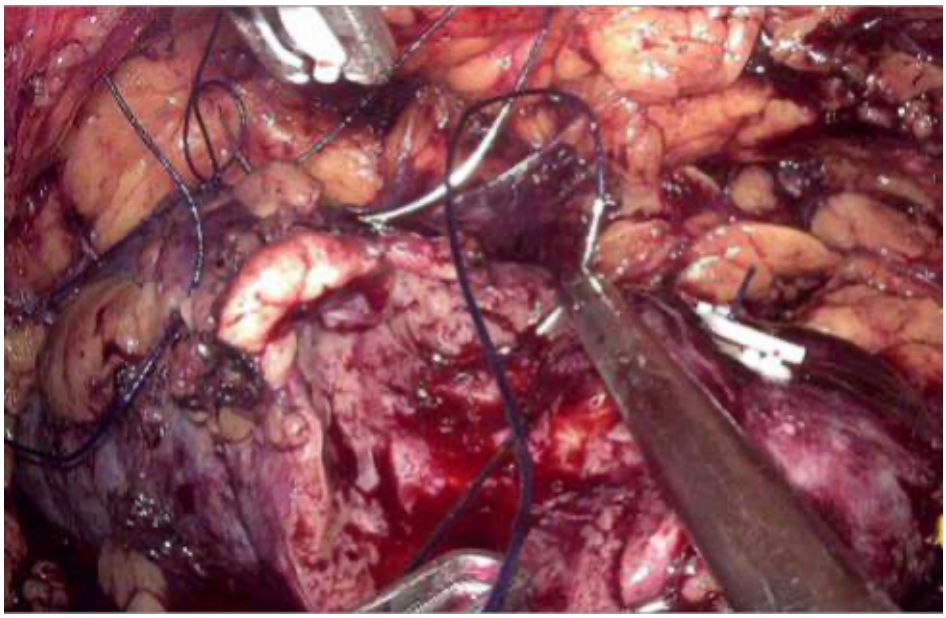


Figure 3. Renorrhaphy using braided polyglycolic acid suture USP 1 blocked with Hem-o-lok in both ends

Data collection

We recorded the following preoperative data: gender, age, body mass index (BMI), laterality of the tumour, specific sectional imaging features (tumour diameter etc.), PADUA (Preoperative Aspects and Dimensions Used for an Anatomical Classification) score, preoperative TNM (Tumour, Nodes, Metastasis) stage, preoperative serum creatinine.

The intraoperative and postoperative characteristics were recorded: total operative time, hilar control, warm ischemia time, estimated blood loss, number of patients who required blood transfusion (and number of transfusions), complexity of renal vascular pedicle, perioperative complications, conversion to open approach, postoperative serum creatinine, postoperative hospital stay.

We also included in analysis the pathological characteristics of surgical specimen: pathological subtype, pathological pT, pathological ISUP / Fuhrman grade, tumour size, surgical margins status.

Statistical analysis

We used Microsoft Excel and IBM SPSS Statistics 19 to evaluate the characteristics of the study group. For quantitative variables, data normality was verified by using the Shapiro-Wilk test.

To compare two quantitative variables with non-parametric distribution, we used Mann-Whitney U test.

All the patients gave their informed consent for participation in this study.

Results

Our initial experience in laparoscopic partial nephrectomy comprised 25 cases, 14 males and 11 females, with a median age of 62 years and median BMI of 32 kg/m2, respectively. A comprehensive descriptive analysis of preoperative characteristics of the patients is presented in Table 1.

Regarding the preoperative diagnosis based on sectional imaging, one patient had angiomyolipoma, four patients had Bosniak IV cysts and solid renal mass suspicious for malignancy was encountered in 20 cases, respectively. No patient

had enlarged retroperitoneal lymph nodes (cN1) or distant metastasis (cM1) on preoperative imaging studies. The median tumour diameter was 39 mm (range: 25-65 mm), 16 cases having cT1a stage and 12 cT1b, respectively. Eight cases had a low PADUA score (6-7), 12 had an intermediate and five had a high PADUA score, respectively.

Table 1. Preoperative characteristics of the study group

Variable, measurement unit		Value
Males / females, number (%)		14 / 11
Median age, years (range)		62 (41-77)
Median BMI, kg/m^2 (range)		32 (23-36)
Laterality of tumour, right / left, number (%)		11 / 14
Median tumour diameter, mm (range)		39 (25-65)
Median PADUA score, number (range)		8 (6-12)
cT staging (benign cases excluded), number (%)	cT1a	16
	cT1b	8
Median preoperative serum creatinine, mg/dL (range)		0.9 (0.5-2.1)

The intraoperative and postoperative data are listed in Table 2. We chose a transperitoneal approach in 20 cases (80%) and retroperitoneal approach in 5 cases (20%), respectively. The average operative time was 120 minutes (range: 80-150 minutes). No patient required conversion to open surgery. In five cases an off-clamp technique was successfully used. The median warm ischemia time was 19 minutes (range: 11-24 minutes).

The median blood loss was 200 mL (range: 50-600 mL), all cases of intraoperative bleeding were successfully managed by using sutures, clips and hemostatic materials. Only one patient necessitated perioperative blood transfusion. In one case, the ureter was partially sectioned incidentally. We intraoperatively put an internal ureteral JJ stent and we performed a laparoscopic T-T uretero-ureteral anastomosis, with favorable outcomes after 6 weeks when we removed the JJ stent. In other two cases, urine leak externalized through drain tube (Clavien-Dindo IIIb), successfully managed by maintaining the urethrovesical Foley catheter 5-7 days and placing an internal ureteral JJ stent that was removed after 6-8 weeks.

Serum creatinine had a postoperative median of 1.1 mg/dL compared with the preoperative value of 0.9 mg/dL, the difference having no statistical significance ($p>0.05$). The median postoperative hospital stay was 4 days.

Table 2. Intra- and postoperative data of the study group

Variable, measurement unit		Value
Median total operative time, minutes (range)		130 (80-150)
Type of approach, number (%)	Transperitoneal	20 (80)
	Retroperitoneal	5 (20)
Hilar control, number (%)	Off-clamp	4
	On-clamp	21
Median warm ischemia time, minutes (range)		19 (11-24)
Median estimated blood loss, mL (range)		200 (50-600)
Blood transfusions, number		1
Conversion to open surgery, number		0
Median postoperative serum creatinine, mg/dL (range)		1.1 (0.8-2.3)
Median postoperative hospital stay, days (range)		4 (3-7)

We summarized data from the pathological reports in Table 3. One case was confirmed to be angiomyolipoma and two other cases were oncocytoma. The main pathological subtype was clear cell RCC (ccRCC) – 17 cases. Three patients had papillary RCC (pRCC), and other two had chromophobe RCC (chRCC). One case was upstaged to pT3a from pT1b, but the surgical margins were negative. Positive surgical margins (R1) were found in 3 cases (12%).

Table 3. Pathological data of the study group

Variable, measurement unit		Value
Pathological diagnosis, number (%)	ccRCC	17
	pRCC	3
	chRCC	2
	Angiomyolipoma	1
	Oncocytoma	2
Pathological T stage for RCC cases, number (%)	pT1a	14
	pT1b	7
	pT3a	1
Positive surgical margins, number (%)		3 (12)

Discussions

Since first laparoscopic PN was described by Winfield et al in 1993, the technology evolved, as well as knowledge about surgical approaches, thus the adoption of technique has increased among urologist in the last decades [6,7]. The present study was designed to focus on our initial experience in laparoscopic partial nephrectomy, comparing our technique and outcomes with existing studies.

Partial nephrectomy in cT1 tumours proved to have similar oncological outcomes, but better postoperative renal function and quality of life, when compared with radical nephrectomy [3]. Laparoscopic approach minimizes the morbidity of procedure and speed up the postoperative recovery of patients. Although several initial publications reported increased warm ischemia time and postoperative complications, nowadays there are no limitations for laparoscopic approach in PN, even for challenging and complex cases [7]. In our initial experience, we chose for laparoscopic PN only cases with lower dimensions of the tumour, up to 7 cm. Most of the cases also had a low or intermediate PADUA score, but a significant percentage had high PADUA score (5 cases, 20%). The nephrometry scores, including PADUA, evaluate the risk of postoperative complications, but they don't evaluate the feasibility of NSS itself [8]. Despite the high PADUA score for five tumours, we considered suitable for laparoscopic PN.

We have expertise both in transperitoneal and retroperitoneal approach, but we had a preference for the transperitoneal one for cases which hadn't clear advantages for one or another approach. Transperitoneal approach is preferred by most of the surgeons, especially in the beginning of their experience due to large working space and familiar anatomy [5,9,10,11].

Hilum control during minimal invasive PN is another much-debated subject. Renal artery clamping minimizes blood loss from tumour bed that allows for a clear surgical field and for a correct excision plane. However, there are concerns regarding the negative impact of every minute of ischemia on renal function. Although initial results regarding off-clamp technique in minimal invasive surgery showed higher rate of positive margins and significantly increased blood losses, the last evidence in the literature emphasize that there are no statistical differences in positive surgical margins rate, surgical complications and global or split postoperative renal function, when compared with on-clamp approach. The off-clamp technique is a safe and feasible in experienced hands [12,13]. In our study, we used off-clamp approach for tumours where the enucleation plane was easily found and the bleeding was acceptable or when the endophytic part of the tumour was appreciated to be small.

In the on-clamp cases, we didn't surpass the upper limit of warm ischemia time which is considered to be 25 minutes [14]. We didn't have blood losses and blood transfusion rate higher than reported in the literature and no patient didn't have postoperative bleeding complications.

Positive surgical margins are encountered in 1-6% of PN cases, irrespective of surgical approach [3]. The positive surgical margins rates and other oncological outcomes were similar for laparoscopic and open PN in systematic reviews and meta-analysis [15,16]. This rate is slightly higher in our study, but we expect to be lower in the next cases. All three cases with R1 were encountered in the first 15 cases, when we were on a steep learning curve.
Other authors report that in early experience in laparoscopic PN it is expected to have difficulties related to identifying the correct resection plane, maintaining the integrity of tumour capsule, performing an adequate reconstruction of renal parenchyma, that can also explain the intra- and postoperative complications in our patients [17].

As we expected, serum creatinine didn't increase significantly after laparoscopic PN in our experience, confirming the good preservation of renal function.

The main limitations of present study are the retrospective method of data collection, the small dimensions of the study group and the absence of a comparative group. We expect that our sample size will increase as we aim to perform laparoscopic PN in more complex and challenging cases.

.Conclusions

In conclusion, we demonstrated that laparoscopic PN is safe and feasible, the early outcomes being promising, and we opened the way to perform more complex and challenging cases by laparoscopic approach.

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