Laparoscopic partial nephrectomy for renal tumors

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ABSTRACT

Objectives: Increased occurrence of the partial renal resections through a minimally invasive approach (laparoscopic/robotic) as well as the progress achieved in oncological therapy have dramatically improved the long-term results of the patients with malignant renal tumors. This study aims to evaluate the short-term results after laparoscopic partial nephrectomy in renal tumors, performed in a single clinic within 2 years.

Method: Retrospective, observational and partially experimental, non-randomized study on a sample of 38 patients diagnosed with renal neoplasm between January 2021 and January 2023, who underwent laparoscopic nephron sparing surgery. The monitored parameters were: the characteristics of the primary renal tumor (location, size), long-term survival, post-operative mortality (the first 30 days after surgery), complication rate (using the Dindo-Clavien Classification), conversion rate to open surgery, length of the surgical procedure and the time patient spent in hospital .These data were evaluated compared to those in the specialized literature.

Results: A number of 38 patients with renal tumors classified as T1 (<7cm) for whom laparoscopic nephron sparing surgery was performed were enrolled in this study. Long-term survival (12 months postoperatively) was 100%, without relapses in the first 12 months, and with a complication rate of only 7.9%. No case was converted to classical surgery. There is a direct link between the PADUA score and the length of hospital stay.

Conclusion: Although we are a small volume center, the results of the statistical analysis comparable to those obtained in the centers with a large volume, stimulate us to continue on this path of minimally invasive resections for renal malignant pathology.

Keywords : kidney cancer, laparoscopic partial nephrectomy, Clavien- Dindo classification, Padua score

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Introduction

Kidney cancer represents 2-3% of all cancers. Among these, clear cell renal cancer (RCCC) represents the most common histopathological type, with incidence increasing by 2% in the last 2 decades, as a result of advances in imaging [1], [2]. It is characterized as a cancer with poor symptoms in the initial stages, hematuria being the most common symptom. Other frequently manifest symptoms are hypertension, lumbar pain, asthenia or signs of distant dissemination of the disease (30% of patients being in a metastatic stage at the time of diagnosis). Renal cancer is 2 times more common in males and the 7th decade of life represents the period with the highest incidence of cases.[2]

The risk factors identified in the case of RCCC are: smoking, obesity, hypertension, estrogen replacement therapy, performing daily activities in a toxic environment, von Hippel Lindau syndrome and tuberous sclerosis.[27]

Although important progress has been made in the systemic treatment of these patients (the use of monoclonal antibodies such as endothelial growth factor inhibitors – Bevacizumab) [25], surgery remains the therapeutic gold standard for this pathology.[4] Thus, we can choose between the possibility of partial kidney resections for small tumors and total nephrectomies when facing voluminous tumors. Concerning the tactic, things have undergone changes; today, more and more RCCCs benefit from the minimally invasive approach, be it laparoscopic or robotic. [26]

Patients and Methods

The study is retrospective, observational and non-randomized. All patients with T1 renal tumors (38 patients), who underwent laparoscopically surgery with radical intention (nephron sparing surgery) between January 2022 and January 2023 in the Urology Clinical Department of the Prof. Dr. Theodor Burghele Clinical Hospital, were included in the study.

Selection criteria: medical status fit for a surgical procedure, preoperative assessment of radical resectability (R0) of the tumor with significant preservation of the functional remaining renal tissue.

Preoperative assessment of the patients included abdominal and pelvic ultrasound, abdominal and pelvic CT with contrast material/MRI, all patients having a lung X-ray before surgery. In our department we use 3D-CT reconstruction with silicone mold, a procedure that allows a better preoperative grounding of the partial nephrectomy technique, especially in cases of complex renal tumors.

The data were obtained both from the medical files and from the existing surgical protocols recorded in an electronic database that registers patients who had a laparoscopic partial renal resection.

The resections were considered R1 when the anatomical-pathological result showed the existence of a microscopic invasion of the safety margins of the resected specimen and R2 when the invasion was macroscopically evident.

The following data were assessed: age, sex, associated pathology (Arterial Hypertension, Diabetis, Ischemic heart disease), localization of the tumor at the renal level (left/right as well as lower/upper pole/mid-renal part), type of approach (transperitoneal/retroperitoneal), histopathological data of the tumor type, the radicality of the surgical intervention (R0/R1), the complication rate (using the Dindo-Clavien Classification), the conversion rate to open surgery, the length of the surgical procedure, the extent of hospital stay, the degree of renal function impairment tributary to surgical intervention, long-term survival and post-operative mortality.

In order to evaluate the damage to the kidney function by the surgical intervention, the patients were distributed according to the glomerular filtration rate (GFR), to one of the 5 groups (G1-G5) according to the classification of chronic kidney disease (CKD) 16, subsequently comparing the pre- and postoperative values of GFR. Thus, patients were assigned to group G1 if GFR≥90mL/min/1.73m2 (normal to high renal function), G2 if GFR= 60-89 mL/min/1.73m2 (mild renal insufficiency), G3a if GFR=45-59mL/min/1.73m2 (mild to moderate renal failure), G3b if GFR=40-44 mL/min/1.73m2 (moderate to severe renal failure), G4 if GFR=15-29 mL/min/1.73m2 (severe renal failure) or G5 if GFR<15 mL/min/1.73m2 (renal failure). At the same time, the impact of the degree of complexity of the

PADUA score was also assessed.
Postoperative mortality was defined as the death of the patient during hospital stay or in the first 30 postoperative days.
Overall survival was defined as the time elapsed from the date of resection to the last follow-up or the date of the patient's death.
The length of hospital stay was defined as the time between the date of admission and the date of discharge. It should be mentioned that the patients are hospitalized one day before the surgical intervention and are supervised 24 hours postoperatively in the intensive care unit.
Follow-up was performed by personal contact with the patient, the patient's family, or the attending oncologist at 3 weeks and 6 months after surgical intervention.
For continuous variables, the Shapiro-Wilk test was used. Whenever the distribution of the variables could be estimated using the Gaussian distribution, the variables were presented using the mean and the standard deviation (SD), otherwise it was presented using the median, the minimum and the maximum of the distribution. Categorical data is presented as proyportions (or absolute and relative frequencies were determined for category variables). Survival was evaluated using the Kaplan-Meier method. The differences related to the length of the surgery depending on the localization of the tumor at the renal level (left/right or upper/lower pole) were examined using the Log-rank test. The sensitivity level α of the study was 0.05, so that p values lower than 0.05 were considered statistically significant.
All patients included in this study provided written permission for further use of their medical data, and the hospital's Ethics Committee approved the stud.

Results

Table 1

	Global (N=38)
Age	
Mediana [Min, Max]	61.0 [42.0, 70.0]
Sex	
F	17 (44.7%)
M	21 (55.3%)
Kidney	
Right	19 (50.0%)
Left	19 (50.0%)
Position	
Medial	11 (28.9%)
Inferior	15 (39.5%)
Superior	12 (31.6%)
Hypertension	
Yes	21 (55.3%)
No	17 (44.7%)
Diabetes	
Yes	4 (10.5%)
No	34 (89.5%)
Cardiac disease	
Da	14 (36.8%)
Nu	24 (63.2%)
PADUA score	
Mediana [Min, Max]	2.00 [1.00,3.00]
Preoperative Hgb	
Medie (SD)	14.6 (1.15)

	Global (N=38)
Preoperative Creatininum	
Medie (SD)	0.926 (0.152)
Approach	
Retro P	6 (15.8%)
Trans P	32 (84.2%)
Tumor Size	
Medie (SD)	25.9 (11.2)
Average time	
Medie (SD)	203 (50.2)
Pathological type	
ANGIOMIOLIPOMA	3 (7.9%)
MUCINOS TUBULAR CARCINOMA	1 (2.6%)
PAPILAR CARCINOMA	2 (5.3%)
CRCC 1	1 (2.6%)
CRCC 2	22 (57.9%)
CRCC 3	6 (15.8%)
O	3 (7.9%)
Surgical margins	
Negative	32 (84,2%)
Pozitive	4(10.5 %)
N/A	2 (5.3%)
Postoperative HGb	
Medie (SD)	12.7 (1.68)
Hgb decrease	

	Global (N=38)
Medie (SD)	1.90 (0.898)
Postoperative Hgb	
Medie (SD)	0.923 (0.248)
Creatinum decrease	
Medie (SD)	-0.00368 (0.201)
Uroculture	
Negative	34 (89.5%)
Pozitive	4 (10.5%)
Dindo-Clavien classification >= 3	
Yes	3 (7.9%)
No	35 (92.1%)
Hospitalization days	
Mediana [Min, Max]	6.00 [4.00, 22.0]

According to the PADUA score, 47% of the patients had T1 renal tumors with a high and medium degree of complexity.

The association of the PADUA score with the length of hospital stay (Spearman correlation index ρ = 0.36 and p value = 0.024) revealed the existence of a statistically significant correlation, so that patients with a high PADUA score also had a longer hospital stay.

Regarding the surgical margins, 4 cases (10.5%) were identified with a positive surgical margin (R1) of the resected specimen. The univariable associations showed the existence of some statistically significant correlations between the presence of positive margins and the young age of the patient as well as the longer duration of the surgical intervention. There were no statistically significant correlations between the positive surgical margins of the resected specimen and the histo-pathological type of the tumor.

Table 2

The Associatioon of Surgical Margins and age Wilcoxon Rank Sum test

Variable	Negative SM, N = 32	Positive SM N = 4	Diferenta (95% CI)[1,2]	p-value[1]
Average age (SD)	60.81 (8.29)	51.60 (8.26)	9.2 (2.7 la 16)	0.008

[1] Welch Two Sample t-test

[2] CI = Interval Confidenta

Table 3

The association of surgical margins and tehnique approach Trans/retroperitoneal

Variable	Negative SM N = 32	Positive SM N = 4	valoare p[1]
Abord, n (%)			1
RP	5 (15)	0 (0)	
TP	27(85)	4 (100)	

[1] Fisher's exact test

Table 4

The association of surgical margins and pathological data RCCvs other types

Variable	Negative SM, N = 32	Positive SM, N = 4	p-value[1]
Tip HP, n (%)			1
Other types	7 (19)	1 (10)	
RCC	25(81)	3 (90)	

[1] Fisher's exact test

Regarding the long-term results (long-term survival and local or distant recurrence rate), the follow-up period was too short (median follow-up of about 12 months) to perform a statistical analysis. However, survival at 12 months is 100% without registering any case of relapse (95% CI = 0.67-1.5).
No complications were reported after the hospital discharge of the patients, nor were there any data on the severe deterioration of renal function.

Table 5 Evaluation,comparative laparoscopic partial nephrectomy study to find out the group differences

Authors	Patients Nr	Tummor size (cm)	Operative time	Positive SM %	Hospitalization days	Complication rate
Gill et al[16]	771	2.7	201	1.6	3.3	18.6
Culoar et al [17]	30	2,7	205	2	3	43
Permpongkosol et al [18]	85	2,4	225	2.3	3.3	6
Springer et al [19]	170	2,8	145	1.2	4.5	4.1
Marszalek et al [20]	100	2,8	85	4	5	24
Case study	38	2,6	203	10.5	6	7.9

Discussions

Renal cancer represents 2-3% of all cancers and currently we observe a 2% increase in incidence, compared to the last 2 decades.
Within the multimodal treatment that this pathology benefits from, surgery (total/partial nephrectomy) holds the central place, being considered the therapeutic gold standard and the only one able to offer a chance of cure to such patients [22],[4]

Indications for partial nephrectomy have expanded from the imperative setting to elective partial nephrectomy in the presence of a contralateral normal kidney. Nowadays this operation represents the treatment of choice for T(<7cm) renal tumors (TNM). Go et al. highlighted the existence of a link between reduced glomerular filtration rate (GFR) and increased risk of death, higher frequency of cardiovascular events and longer duration of hospitalization, these findings showing the clinical importance of chronic renal failure [9]. Population-based studies have tilted the balance, in the case of renal intervention, from radical nephrectomy to nephron-sparing open surgery (NSS), based on an adequate selection of patients [10]. Indications also include cases of hereditary renal cell carcinoma (RCC) such as: von Hippel-Lindau syndrome, hereditary papillary RCC and Birt-Hogg-Dubé

syndrome where postoperatively there is an increased risk of additional renal lesions. The goal of this conservative oncological surgery consists in: obtaining negative surgical margins, minimal loss of renal function and lack of perioperative complications (Hung et al [10].

Three decades ago, in 1991, Ralph Clayman performed the first laparoscopic nephrectomy through a transperitoneal approach for a renal tumor (oncocytoma). It was followed in 1993 by the first laparoscopic partial nephrectomy reported by Howard Winfield and in 2001 by the first robotic assisted laparoscopic nephrectomy (Bertrand Guillonneau). [28]The first Romanian national communications of urological laparoscopic surgery appeared in 1996, in the Centers of Cluj and Bucharest (St John Hospital in Bucharest and Cluj Napoca County Hospital - Surgery Clinic III).[3]
Laparoscopic partial nephrectomy (LPN) for renal tumors is considered to have comparable results, in terms of oncological and surgical principles, to those obtained by traditional open nephron-sparing surgery (NSS).[11] At the same time, studies have shown that this technique is viable, with similar oncological effectiveness and superior renal functional outcomes compared to laparoscopic radical nephrectomy (LRN).

The main advantages of LPN include: shorter hospital stay, reduced postoperative analgesic consumption, less blood loss, superior cosmetic results and nephron preservation. [24]

The long learning curve (>35 procedures in some studies) represents the major disadvantage of laparoscopic partial nephrectomy, in addition to the longer duration of the surgical intervention compared to the classical resection. However, these inconveniences can be improved by the existence of centers with a large volume of such surgical interventions (>100 procedures), hence reducing the time required to reach the learning curve. Also, continuous training, in centers dedicated to training in minimally invasive surgery, improves the surgeon's skills, which can be seen by reducing the time required to perform such a procedure. [11] Table5

Although initially reserved for small exophytic tumors (T <7 cm), several studies withstand, through the presented results, that LPN can represent a safe alternative, even in the presence of renal tumors classified as T2 - T3, if it is technically achievable [23]
To quantify the technically feasible term, preoperatively, tools that analyze the complexity of the tumor mass are used: the R.E.N.A.L. score. [6], PADUA score [7] and C-Index [8]. Simultaneously, the use of virtual, three-dimensional models (3DVM) can be helpful in planning the surgical strategy in patients with renal tumors [9].

Taking into account that minimally invasive surgery techniques have continued to evolve with the introduction and advances in robotic surgery, leading to a decrease in technical barriers inherent to laparoscopy, we expect that in the future renal tumor resections will be more and more frequently performed minimally invasive, even in the case of complex tumors.

Conclusion

Although we are a center with a small volume of patients undergoing surgery for renal oncological disease, the results of the statistical analysis comparable to those obtained in the centers with a large volume, stimulate us to continue on this path of minimally invasive resections in the case of renal malignant pathology.

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