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Original Scientific Paper

HISTOPATHOLOGIC FEATURES OF KIDNEY TUMORS AND COMPARISON OF PATIENTS TREATED WITH RADICAL AND PARTIAL NEPHRECTOMY AT OSIJEK UNIVERSITY HOSPITAL CENTER FROM 2017 UNTIL THE END OF 2021

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SUMMARY – The objective of this study was to present results of kidney tumor treatment at Osijek University Hospital Center over a 5-year period and to compare the outcomes between patients treated with radical nephrectomy (RN) and partial nephrectomy (PN). From November 2016 until the end of 2021, there were 280 consecutive PNs and RNs included in this cross-sectional study. Exclusion criteria were nephrectomies due to non-oncologic reasons and transitional cell carcinoma. There were 229 RNs and 51 PNs, median age of all patients was 62.5 (range 34-84) years. In the RN group, there were 197 renal cell carcinomas (RCC), predominantly clear-cell subtype, while among others there were 8 multilocular cystic renal neoplasms of low malignant potential (MCRNLMP) and 6 oncocytomas and angiomyolipomas each. There were 44 RCCs, 4 oncocytomas, 1 MCRNLMP and 2 cysts removed with PN; median R.E.N.A.L. score was 5. RN group had greater tumor diameters and higher tumor grade, higher postoperative creatinine levels and complications of higher grade. There was no difference in median hospital stay (6 days) and follow-up (20 months). With regard to oncologic safety, preservation of kidney function and lower overall morbidity, PN should be preferred to RN whenever oncologically safe and technically feasible.

Key words: *Kidney neoplasms; Nephrectomy; Renal insufficiency*

Introduction

Kidney tumor (KT) treatment occupies a substantial part of urologic oncology, and renal cell carcinoma (RCC) is the most common solid renal mass that comprises almost 90% of all kidney malignancies[1]. Its peak incidence is in the seventh and eight decade of life[2] and is usually asymptomatic, found incidentally on radiology examinations, most commonly ultrasound and computed tomography (CT) scan. Vasudev *et al*.[3] report that RCCs are diagnosed incidentally in 60% of patients altogether (87% for T1a stage and 36% for stage 3 or 4 tumors). There is only a small proportion of patients diagnosed with RCC because of the presence of 'classic', nowadays almost obsolete symptoms of advanced disease (flank pain, abdominal mass and hematuria)[2]. Men are 1.5 times more likely to be diagnosed with RCC than women[1,2]. While an annual increase of 2% in RCC incidence has recently been observed in developed countries, mortality rates tend to stabilize or decline[4,5].

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Histologically, there are three major types of RCCs, i.e., clear cell RCC (ccRCC), papillary RCC (pRCC type I and II) and chromophobe RCC (chRCC). ccRCC is the most common type and accounts for around 70% of RCCs. It is sporadic for the most part (95%) but can be associated with familial syndromes such as von Hippel-Lindau disease[6]. pRCC is the second most common RCC type and has two distinctive subtypes, with type II having worse prognosis than type I[1]. chRCC encompasses 5%-7% of RCCs and because of the innate nuclear atypia of chRCC, it does not predict prognosis and therefore cannot be graded by the Fuhrman or World Health Organization (WHO)/International Society of Urological Pathology (ISUP) grading systems[1,6,7]. Apart from the three mentioned types, there are numerous other, less represented RCCs and the current 2016 WHO classification includes 14 subtypes[6]. These tumors are classified primarily by morphology and immunohistochemical features. Immunohistochemistry is of utmost importance and has a major impact on treatment decision, particularly in distinguishing between the eosinophilic variant of chRCC and benign oncocytomas[6]. Multilocular cystic renal neoplasm of low malignant potential (MCRNLMP), which can be found in less than 1% of resected KTs, is another RCC subtype, a relatively new term which refers to the former multilocular cystic RCC, but has been renamed because it hardly ever metastasizes or recurs[6,8].

Having in mind for the most part incidental diagnosis of KTs of lower stage and benign types of KTs such as oncocytoma, which represents 3%-7% of all solid renal masses[1,8], partial nephrectomy (PN) has become a widely accepted and preferred treatment method for small renal masses (T1a and T1b tumors). With the advent of laparoscopic (already a standard) and robot-assisted PNs, treatment morbidity has decreased significantly and the lines between absolute (KT in a solitary kidney, bilateral KTs) and relative PN indications are becoming blurred. For T1 tumors, PN offers equal oncologic outcome as radical nephrectomy (RN), with the advantage of better postoperative preservation of renal function[1], which can result in lower cardiovascular morbidity and better overall survival[9,10]. This was, however, debated to only be true for younger patients and those without significant comorbidity at the time of surgical intervention[11,12]. Notwithstanding the questionable impact on overall survival, PN should be the gold standard for T1 RCCs because of the mentioned kidney function preservation and potential beneficial effect on cardiovascular health, and is therefore strongly recommended by the European Association of Urology (EAU) to be offered to patients with T1 KTs[1].

Different structured, reproducible and quantitative nephrometry scoring systems have been developed to help classify and compare tumors according to their anatomic complexity. One of the most frequently used is the R.E.N.A.L. nephrometry score, which is based on tumor size, endophytic/exophytic position, proximity to collecting system or renal sinus, anterior or posterior localization, and position of the tumor in relation to polar line[13]. A study from Brasil[14] has shown that R.E.N.A.L. score helps predicting the need of RN or conversion from laparoscopic PN to open surgery. R.E.N.A.L. score ≥9 is related to a fourfold higher chance of conversion from PN to RN.

The objective of our study was to present the results of KT treatment at Osijek University Hospital Center over a recent 5-year period and to compare the outcomes, especially postoperative renal function, between patients treated with RN and PN.

Patients and Methods

Patients

This cross-sectional observational study included 273 consecutive patients with renal masses treated at the Department of Urology, Osijek University Hospital Center, Osijek, Croatia, between November 2016 and the end of 2021. The patients had undergone 229 RNs and 51 PNs. The exclusion criteria were nephrectomies due to stone disease, trauma to the kidney, hydronephrosis/shrunken kidneys, chronic infection, polycystic kidney disease, and nephrectomies as part of upper urinary tract urothelial cell carcinoma treatment. Nephrectomies were done openly, almost exclusively *via* retroperitoneal lumbar approach, with only a few selected patients having transabdominal operation due to the greater retroperitoneal mass. The choice of KT treatment (RN or PN) was based primarily on R.E.N.A.L. nephrometry score, intraoperative finding and technical feasibility of PN, which was done whenever possible, but, ultimately, the decision to perform PN was on the surgeons' decision and preference.

Methods

Patient clinical data were retrospectively acquired by reviewing the Hospital Information System and were analyzed for demographic characteristics,

comorbidities, length of hospital stay, surgical complications, pre- and postoperative creatinine level, KT characteristics (side, preoperative nephrometry score for PN, histologic tumor type, stage and grade), other histopathologic factors such as positive margin rate, adjuvant oncologic treatment, and follow-up. Confidentiality of data and privacy of subjects were fully maintained. Tumor stage was assessed with widely used Tumor, Nodes and Metastases (TNM) classification system (8th edition, 2017) and tumor grade with the novel WHO/ISUP grading system introduced in 2012[7,15], both of which are important prognostic factors. Postoperative complications were evaluated with Clavien-Dindo classification of surgical complications as the most commonly used 5-grade system based on the type of therapy needed to correct the complication[16].

Statistical analysis

Statistical analysis was performed using SPSS statistical program (IBM SPSS Statistics for Windows, Version 26.0; IBM Corp., Armonk, NY, USA). Numeric data were reported as median and interquartile range (IQR). Nominal data were shown as absolute and relative frequencies. Normality of distribution was examined by Kolmogorov-Smirnov test. Difference between two independent samples was calculated by Mann-Whitney test, while the paired sample t-test was used for comparing two dependent samples. The χ^2-test and Fisher exact test were used to display difference for categorical data. A two-sided p-value of <0.05 was considered statistically significant.

Results

During the 5-year period, there were 229 RNs and 51 PNs performed in 273 consecutive patients (6 patients had synchronous bilateral KTs and one patient had metachronous KT). Median age of all patients was 62.5 years, with the youngest being 34 and the oldest 84 years. Men were 1.7 times more likely to have a KT. The majority of patients had at least one comorbidity present, generally more than a few, with arterial hypertension being by far the most common comorbidity. Median hospital stay was 6 days and did not differ between RN and PN groups, nor did the average follow-up of 20 months. Clinical characteristics of the study population are shown in Table 1.

Most tumors were adenocarcinomas, with clear-cell predominance among them (201 of 241). Next, there were 10 oncocytomas, which were the most common benign tumors, and 9 MCRNLMPs. Preoperative biopsy was done only 8 times, i.e., 5 times before RN and 3 times before PN. The indications for preoperative biopsy were bilateral KTs (one patient), large renal masses in metastatic setting (three patients), suspicion of kidney metastasis (one patient with two other primary tumors), two hypofunctional contralateral kidneys, and one patient with growing renal lesion, who was previously surveilled because of a small renal mass. None of the biopsied renal masses resulted in focal therapy or follow-up only. The findings of preoperative biopsy were in accordance with definitive pathological assessment. Table 2 lists all the KT types found on definitive histopathologic examination. Considering T-stage, there were 42 T1a, 2 T1b and 1 T2 tumors in the PN group. Tumors in the RN group were mostly T1 (107), followed by T3 tumors (80). Complete TNM staging for both groups is shown in Table 3. Greatest tumor diameter varied between 10 and 170 mm, with RN group having median tumor diameter of 55 mm, while PN group tumors were 30 mm on average ($p<0.00001$). The difference between

Table 1. Clinical characteristics of the study population (N=280)

Characteristic	RN* (n=229)	PN† (n=51)	Total	p
Age (median [IQR‡]) (years)	63 (56-70)	60 (53-68)	62.5 (55.5-70)	0.07§
Male to female (ratio)	144/85 (1.7)	31/20 (1.55)	175/105 (1.67)	0.87‖
Comorbidities present (n)	202	41	243	0.17‖
AH¶ among comorbidities (n)	172	32	204	0.25‖
Hospital stay (median [IQR‡]) (days)	6 (5-8)	6 (6-8)	6 (5-8)	0.77§
Follow-up (median [IQR‡]) (months)	18 (4-36.5)	22 (14-36)	20 (4-36)	0.12§

*RN = radical nephrectomy; †PN = partial nephrectomy; ‡IQR = interquartile range; §Mann-Whitney test; ‖Fisher exact test; ¶AH = arterial hypertension

Table 2. Histopathologic tumor features of the study population (N=280)

Tumor type	RN* (n=229)	PN† (n=51)	Total
Adenocarcinoma	197	44	241
ccRCC‡	168	33	201
pRCC§	14	9	23
chRCC‖	8	2	10
Two/more (hybrid) adenocarcinomas	7		7
MCRNLMP¶	8	1	9
Oncocytoma	6	4	10
Angiomyolipoma	6		6
Sarcoma	3		3
Renal cyst	3	2	5
Collecting (Bellini) duct carcinoma	2		2
Adenoma metanephricum	1		1
Anastomosing hemangioma	1		1
Renal capillary hemangioma	1		1
Neuroendocrine tumor	1		1

*RN = radical nephrectomy; †PN = partial nephrectomy; ‡ccRCC = clear-cell renal cell carcinoma; §pRCC = papillary renal cell carcinoma; ‖chRCC = chromophobe renal cell carcinoma; ¶MCRNLMP = multilocular cystic renal neoplasm of low malignant potential

Table 3. Tumor, Node and Metastases (TNM) staging of malignant RN (n=211) and PN† (n=45) tumors (N=256)*

	RN group n (%)	PN group n (%)	Total n (%)
T1a	53 (25.1)	42 (93.3)	95 (37.1)
T1b	54 (25.6)	2 (4.4)	56 (21.9)
T2a	16 (7.6)	1 (2.3)	17 (6.6)
T2b	4 (1.9)	0	4 (1.6)
T3a	75 (35.5)	0	75 (29.3)
T3b	5 (2.4)	0	5 (1.9)
T4	4 (1.9)	0	4 (1.6)
Nx	180 (85.3)	45 (100)	225 (87.9)
N0	27 (12.8)	0	27 (10.5)
N1	4 (1.9)	0	4 (1.6)
Mx	0	45‡ (100)	45 (17.6)
M0	178 (84.4)	0	178 (69.5)
M1	33 (15.6)	0	33 (12.9)

*RN = radical nephrectomy; †PN = partial nephrectomy; ‡chest computed tomography generally omitted in PN group, chest x-ray negative

the groups was also pronounced for tumor grade, as RN group had more higher grades, as expected: PN tumor grades were G1 and G2 in 91% of cases, while 61.5% of RN cases had those grades.

Adrenalectomy was performed as part of 66 RNs, the majority of patients having locally advanced (38 T3 tumors) or metastatic disease (18 M1 patients). Positive margin rate was 3.9% for RN group: those

Table 4. Tumor characteristics and complication rate of the study population (N=280)

Characteristic	RN* (n=229)	PN† (n=51)	total	p
Great diameter (median [IQR‡]) (mm)	55 (40-80)	30 (25-36)	45 (35-70)	<0.00001§
Tumor grade‖ (median [IQR‡])	2 (2-3)	2 (1-2)	2 (1-3)	<0.00001§
Clavien-Dindo I+II/higher grade (n)	212/17	48/3	260/20	>0.99¶
Benign tumors, n (%)	18 (7.8)	6 (11.8)	24 (8.6)	0.41¶
Positive margins, n (%)	9 (3.9)	3 (5.9)	12 (4.3)	0.46¶

*RN = radical nephrectomy; †PN = partial nephrectomy; ‡IQR = interquartile range; §Mann-Whitney test; ‖International Society of Urological Pathology (ISUP) grading system; ¶Fisher exact test

Table 5. Postoperative creatinine serum level change after radical nephrectomy (RN, n=229) and after partial nephrectomy (PN, n=51); (N=280)

Group	Preoperative creatinine (median [IQR*]) (μmol/L)	Postoperative creatinine (median [IQR*]) (μmol/L)	p
RN†	82 (69-97)	118 (99-143)	<0.00001‡
PN§	81.5 (70.5-89)	80.5 (69.5-92)	0.5‡

*IQR = interquartile range; †RN = radical nephrectomy; ‡paired-samples t test; §PN = partial nephrectomy

included 2 locally infiltrative sarcomas and 7 advanced stage RCCs, with 6 of them later receiving adjuvant systemic therapy for advanced disease. For PN group positive margins (3 out of 51 cases), no further active treatment was performed, only close surveillance, and they are disease-free after 20-52 months of follow-up. Adjuvant oncologic treatment was indicated in 33 M1 RN patients (32 of them received chemotherapy, while one patient was ultimately unfit for such a treatment). Conventional vascular hilum clamping during PN was done in every fifth patient, with average clamping time of 17 (range 10-20) minutes, while median R.E.N.A.L. score of PN group KTs was 5.

In the PN group, there were two patients that required postoperative JJ stenting due to urine leakage, and one was reoperated due to hemorrhage. All other patients had minor, if any postoperative complications (Clavien-Dindo grade 1 and 2). In the RN group, there were 7 grade 3 complications: one thoracocentesis and 6 reinterventions due to acute abdomen or postoperative hemorrhage. One patient had cardiac arrest during induction of anesthesia and was successfully resuscitated, as was the other patient that had cardiac arrest during the operation. There was no difference in lower grade (Clavien Dindo grade I and II) complications between the two groups (Fisher exact test, p>0.99). However, PN group did not have grade IV or grade V complications, while RN group had 2 and 8 of them, respectively. Of the 8 deaths, 2 were in the early postoperative period and were somewhat unexpected (one having 13 cm abdominal mass with liver metastasis and the other with severe cardiovascular comorbidity), others were after prolonged hospital stay and associated with the nature of the disease (2 locally and systemically advanced sarcomas), decompensated heart failure, pneumonia or COVID-19 infection. Table 4 lists assorted tumor characteristics and complication rate.

Postoperative creatinine serum level increased significantly after RN (median 82 μmol/L *vs.* 118 μmol/L, p<0.00001), while there was no such creatinine level change after PN (Table 5). There were 4 *de novo* patients on chronic hemodialysis program after RN.

Discussion

Here we presented the outcome of 280 consecutive open KT operations (229 RNs and 51 PNs) performed at the Department of Urology, Osijek University Hospital Center from November 2016 until the end of 2021.

Men were 1.7 times more likely to have a KT, 1.8 times more for adenocarcinoma, which is in accordance

with the Croatian National Cancer Registry data for 2019[17] and similar to the GLOBOCAN global cancer statistics for 2020[18,19]. Furthermore, our patient median age of 62.5 years falls within the most common age group (seventh decade) in which kidney cancer appeared in Croatia in 2019[17].

The most common pathologic finding in our cases was RCC, as expected, with 86% representation overall and 94% among malignant KTs, which is in line with previously published data[7]. Clear-cell predominance (201 ccRCCs out of 241 RCCs) was obvious and in the upper bound of expected proportion. Oncocytomas (10 cases) and angiomyolipoma (6 cases) were the leading benign tumors, with benign lesions altogether comprising 8.6% of resected KTs (7.8% for RNs and 11.8% for PNs), which is somewhat less than expected ~15% proportion of benign renal masses[20]. A rather interesting finding in our study was the 3.2% prevalence of MCRNLMP, which is usually expected to be found in less than 1% of resected renal tumors[6,8].

The subject of RN *versus* PN has been thoroughly evaluated in countless previous studies and meta-analyses[21-24]. Themes such as overall- and cancer-specific survival, as well as oncologic outcome altogether, complication rate, postoperative renal function, positive margin rate, length of hospital stay and intraoperative blood loss have been compared between the two techniques for open, laparoscopic and robot-assisted procedures[25-33]. Based primarily on surgical experience and availability of surgical tools, PN can be done with any of the three mentioned modalities[1].

Uzzo *et al.*[25] previously compared the length of hospital stay in patients undergoing PN *versus* RN for small solitary RCCs and there was no significant interaction between the type of surgery and hospital stay or hospital costs. More recently, Lesage *et al.*[26] analyzed perioperative outcome and health-related quality of life in patients undergoing open PN and RN, and found no difference in hospital costs and length of stay either. In our study, median hospital stay was 6 days and did not differ between RN and PN groups. There were previous efforts to introduce laparoscopy at our Department, but unfortunately, at least for now, we are not able to perform laparoscopic nephrectomies. In a systemic review and meta-analysis of surgical, oncologic, and functional outcomes of laparoscopic *versus* open PNs[27], the authors concluded that there was no statistical difference in terms of operation time, intraoperative complications, recurrence, cancer-specific and disease-free survival, and renal function. However, the laparoscopic group had shorter length of hospital stay and lower transfusion and complication rate, higher positive surgical margin rate, higher overall survival, and less increased serum creatinine. Needless to say that robot-assisted PN, with its single overnight stay manner (median stay of 2 days, IQR 1-2 days)[28] represents a barely achievable goal. There are efforts made to implement laparoscopy into our practice, which would presumably relate to shorter hospital stay for RNs and PNs.

The positive margin rate in our study was 4.3% altogether. There were more positive margins in the PN group (3/51; 5.9%) than in the RN group (8/229; 3.9%), which was statistically nonsignificant (Table 5). That is in line with previously estimated PN positive surgical margin rate of 2%-8% of PNs, which is higher than expected for RNs[33]. RN in case of positive margin status after PN is not recommended since it can result in over-treatment (local recurrences for positive margins in 16% *vs.* 3% for negative margins)[34]. Our three patients with positive margins after PN are closely followed up and no adjuvant treatment has been indicated so far. They are without signs of local or distant relapse after median follow-up of 22 months. Almost all of our RN positive margins were T3 tumors (one T2b and one T4) and had median diameter of 130 mm (ranging from 65 to 160 mm). Subsequently, 75% of them received oncologic treatment due to metastases that were present at the time of cytoreductive nephrectomy (one patient developed liver metastasis later).

Concurrent ipsilateral adrenalectomy used to be essential and imperative during RN, not just as originally described by Robson in 1963[35], but also later, in case of upper pole tumor without evidence for local tumor extension or metastasis. It was quite recently[36, 37] shown that in the case of no radiological or intraoperative signs of adrenal involvement, the likelihood of metastases is very low. Routine concurrent ipsilateral adrenalectomy is therefore not recommended during RN since it has no survival advantage in the absence of clinically evident adrenal involvement[1]. In our study, adrenalectomy was performed as part of 66 RNs (28.8%), but the majority of those patients ultimately had locally advanced T3 tumors (38 patients) or metastatic disease (18 patients). Nevertheless, the tendency of experienced

surgeons towards ipsilateral adrenalectomy for larger or more locally advanced RCCs remains inherent.

Renal function preservation is the main reason for broadening the indications for PN. In the past few decades, there has been an increasing proportion of PNs among all renal surgeries (about 30% in 2005)[38] and rising. PN should be performed whenever technically feasible, while also retaining the oncologic outcome that is not inferior to the one after RN. In a systematic review and meta-analysis of comparative studies of PN *versus* RN for cT1b and cT2 tumors[22], the authors confirmed better postoperative renal function after PN (higher postoperative estimated glomerular filtration rate and lower likelihood of postoperative onset of chronic kidney disease), with lower likelihood of tumor recurrence, cancer-specific and all-cause mortality (taking into account that RN group had a higher rate of malignant histology present). Moreover, Sun *et al.*[39] found a non-cancer-related survival benefit associated with PN for T1a RCC. In our study, there was no change of postoperative creatinine in the PN group, while postoperative creatinine serum level increased significantly after RN [preoperative median (IQR) of 82 μmol/L (69-97) *vs*. postoperative 118 μmol/L (99-143); p<0.00001] (Table 5). One patient was already on chronic hemodialysis program at the time of his RN. Four other patients ended up on dialysis after their RN, one because of the nonfunctional contralateral kidney and three preoperatively had a solitary kidney. PN was unfortunately not an option in those patients, since one patient had multilocular KTs and three others had tumors with diameter ranging from 80 to 93 mm. Preserving residual renal function with PN means lowering the cardiovascular risk and future cardiovascular morbidity[40-44], the results which were reprised with cohort studies and a systematic review[45-48]. However, in a recent retrospective cohort study, despite reduced estimated glomerular filtration rate in the RN group, cardiovascular events and dialysis were not significantly different between the groups[40]. Having all that in mind, one must lower treatment morbidity as much as possible, while also trying to preserve residual renal function, but without jeopardizing patient oncologic outcome.

During 51 PNs, the renal vascular hilum was clamped in just 10 cases (median clamping time 17 minutes). The majority of the procedures were performed without any clamping, while some were done by applying elastic clamp pressure on kidney parenchyma just below the tumor. 'Classic' PN utilizes renal artery clamping during tumor resection to avoid or lower the intraoperative blood loss and to maintain visibility, especially during laparoscopy and robot-assisted procedures. Vascular hilum clamping can cause, especially during prolonged time, ischemia and reperfusion injury, which then counteracts the efforts made to preserve renal function with PN in the first place[49-51]. While the positive impact of non-clamping on renal function has already been shown[49], randomized trials are needed to confirm such an effect.

The proportion of PNs in the total number of performed KT nephrectomies here was 18.2%. Recent UK data[52] showed an increasing trend towards minimally invasive procedures from 2008 to 2017, with nephron-sparing rates increasing from 8.9% to 24.8%. While a shift to robot-assisted surgery in the UK might have contributed significantly to such a trend, there is apparent room for improvement for us, even though comparison with previous five to ten years would be welcomed (authors' personal perception of an increasing proportion of PNs). The need to broaden the indications for PNs becomes more noticeable with data on 25% of RNs having T1a stage (Table 3). Median R.E.N.A.L. score for that subset of patients was 7 (range 4-10). One can argue that indeed the size of the tumor is not the only thing taken into account when deciding on the treatment modality and that the surgeon's preference or intraoperative decision also plays a role. In a survey among American Urological Association members, Breau *et al.*[53] found that tumor size, depth and location were associated with preference for RN instead of PN and that the fellowship trained urologists and urologists at academic hospitals were yet less likely to choose RN. With intentions to implement laparoscopy into our practice, it would be interesting to see whether it will translate into more PNs in the future.

Another topic of interest is a question of preoperative biopsy and, accordingly, the proportion of benign KTs among renal masses managed with RN. Stage down-migration of KTs emphasizes that question even more since benign KTs are more prevalent among small masses[20]. Preoperative histopathology discrimination could improve decision making process and, ultimately, patient management[20]. As mentioned earlier, 8.6% of our resected tumors were benign, 7.8% for RNs, while preoperative biopsy was done in only 8 cases, i.e., 5 times before RN and 3 times before PN. Biopsy results

did not have much impact on definitive management decision as none of the biopsied renal masses resulted in focal therapy (it was not available at our institution during that time) or follow-up only. The indications for preoperative biopsy were mostly large renal masses in metastatic setting and hypofunctional contralateral kidneys.

When discussing histopathologic outcomes of robotic PNs and RNs for renal masses, Nandanan *et al.*[54] found benign histology altogether in 18% of cases and only 3% were managed with RN, while none of the patients underwent preoperative tumor biopsy. Using the Mayo Clinic Nephrectomy Registry, Kaushik *et al.*[55] retrospectively identified 442 patients with unilateral sporadic benign renal masses referred to a tertiary care facility, and among them there were 206 treated with RN. Weight *et al.*[56] retrospectively evaluated 2608 clinical T1 KTs treated with PN and RN between 1999 and 2006, and 19% were benign, with one-fifth of them treated with RN. The underuse of preoperative KT biopsy in urology is quite noticeable, used only by 8% of urologists[53], mostly for historical reasons of possible needle track seeding, but also due to concerns of biopsy inaccuracy and assumed minimal impact on clinical management decision[57]. Tumor histology uncertainty is best illustrated with oncocytomas where tumor biopsy was accurate in only 64.6% of cases and the remainder of the tumors were chRCC (18.7%), other RCCs (12.5%) and other benign lesions (4.2%)[58]. Immunohistochemistry is here especially important as it helps distinguish between the eosinophilic variant of chRCC and oncocytomas[6]. On the other hand, Wang *et al.*[59] report on high accuracy and safety of image-guided core needle biopsy in T1a tumors, where 90.9% were sufficient for diagnosis and out of 34 ultimately operated patients, final histopathologic correspondence was 100%. As for needle track tumor seeding, in a systematic literature review from 1997 until 2015, Patel *et al.*[60] concluded that no tumor seeding was reported in any modern renal mass biopsy series for localized disease. To minimize the risk of seeding, core biopsies with a coaxial technique should be used[1,61], except for cystic KTs without a solid pattern (i.e., < grade IV Bosniak cysts)[1,62]. While the tumor biopsy tract seeding case reports still exist[63] and are not just anecdotal, percutaneous KT biopsies are increasingly being used to avoid unnecessary surgery for benign lesions, to select patients for surveillance, and to obtain histology before ablative or primary systemic treatment[1,62].

In conclusion, we here reported the histopathologic characteristics and outcome of 280 consecutive KT operations over a recent 5-year period and reaffirmed the existing evidence for better postoperative renal function after PN than after RN. Having the preservation of residual renal function and lowering of future cardiovascular morbidity in mind, one should opt for PN more often, even at the expense of more surgical complications. Future efforts should be made to increase the number of preoperative KT biopsies, especially for small renal masses, and thus lower the proportion of benign KTs being removed with RN.

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Sažetak

PATOHISTOLOŠKA OBILJEŽJA TUMORA BUBREGA I USPOREDBA BOLESNIKA LIJEČENIH RADIKALNOM I PARCIJALNOM NEFREKTOMIJOM U KLINIČKOM BOLNIČKOM CENTRU OSIJEK OD 2017. DO KRAJA 2021. GODINE

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Cilj istraživanja bio je prikazati liječenje tumora bubrega (TB) u Kliničkom bolničkom centru Osijek u nedavnom petogodišnjem razdoblju te usporediti ishode liječenja nakon radikalne (RN) i parcijalne nefrektomije (PN). U ovo presječno istraživanje uključeni su bolesnici s TB-om liječeni PN-om i RN-om od studenog 2016. do kraja 2021. godine. Isključni kriteriji su bile nefrektomije zbog ne-onkoloških razloga i karcinom prijelaznog epitela. Učinjeno je 229 RN-a i 51 PN, prosječna dob svih ispitanika iznosila je 62,5 (raspon 34-84) godina. U skupini RN-a bilo je 197 adenokarcinoma bubrega, pretežito svijetlostaničnog tipa, dok se među ostalim tumorima nalazilo 8 multilokularnih cističnih bubrežnih neoplazma niskog malignog potencijala (MCBNNMP) te po 6 onkocitoma i angiomiolipoma. PN-om odstranjeno je 44 adenokarcinoma, 4 onkocitoma, 1 MCBNNMP te 2 ciste, a prosječni nefrometrijski zbroj R.E.N.A.L. iznosio je 5. Najveći promjer i gradus tumora očekivano su bili veći u RN-u. Nadalje, nakon RN-a zabilježen je značajan poslijeoperacijski porast razine kreatinina i komplikacije većeg Clavien-Dindo gradusa u odnosu na PN, dok razlike u trajanju hospitalizacije nije bilo (medijan 6 dana). Prosječno praćenje bolesnika iznosilo je 20 mjeseci. S obzirom na onkološku sigurnost, očuvanje bubrežne funkcije i smanjenje ukupnog pobola u liječenju TB-a prednost treba dati PN-u kadgod je to onkološki sigurno i tehnički izvedivo.

Ključne riječi: *Tumori bubrega; Nefrektomija; Bubrežna insuficijencija*