



TRENDS IN SURGICAL MANAGEMENT OF RENAL NEOPLASMS: SINGLE CENTER RESULTS IN THE LAST DECADE

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SUMMARY – The majority of renal neoplasms can be treated surgically using open or minimally-invasive approach. Nephron-sparing surgery should be used when possible, regardless to the operative approach. In this retrospective study, we analyzed surgical trends of operative treatment of renal neoplasms in the period from February 2011 until December 2020. There were a total of 1031 procedures, 703 (68.2%) radical nephrectomies (RN) and 328 (31.8%) partial nephrectomies (PN). Laparoscopic approach was used in 211 (20.5%) (111 PN and 100 RN), while open approach was used in 820 (79.5%) (328 PN and 703 RN) cases. There were 12 procedures performed with the use of cardiopulmonary bypass and hypothermic arrest. The median operative time was 161 minutes for open RN and 158 for open PN, 160 for laparoscopic RN, and 162 for laparoscopic PN. The most common pathology was clear cell carcinoma in 693 (67.3%), papillary carcinoma in 115 (11.2%), chromophobe carcinoma in 67 (6.5%), oncocytoma in 46 (4.5%), and angiomyolipoma in 33 (3.2%) patients. Pathologically, pT1 stage was diagnosed in 56.9%, pT2 in 5.8%, pT3 in 22.4% and pT4 in 1.2% of patients. Regional lymphadenectomy was performed in 354 (34.3%) patients, among which lymph nodes were positive in 40 (11.3%) cases. Surgical margins were positive in 27 cases when PN was performed (8.2%). In conclusion, there was an ongoing raising trend in the number of procedures in general, and also in minimally invasive and nephron-sparing surgery in our study.

Key words: *Nephrectomy; Laparoscopy; Renal cancer; Nephron-sparing surgery*

Introduction

Kidney neoplasms account for 2.2% of total neoplasms worldwide¹. Renal cell carcinoma (RCC) accounts for 2% of global cancer incidence and mortality, making it the seventh most common neoplasm¹. It has a male predominance, with a relative risk of 1.7 when compared to women, and with a higher incidence in

developed countries¹. Survival depends on the stage at the time of diagnosis; stage I, localized cancer has 93%, while stage IV has a 12% 5-year survival rate¹. The mortality rate among all cancer deaths is 1.8%, and it remained the same in the last 35 years despite a doubling incidence, most likely due to improvements in diagnostics and treatment¹. Today, most cases are diagnosed incidentally, using ultrasound (US), computed tomography (CT), or magnetic resonance imaging (MRI). RCC has several subtypes, but the most common are clear cell, papillary, and chromophobe carcinoma, which account for 75%, 10%, and 5% of

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all cases, respectively². There are many options for the management of patients with kidney tumors, including surgical and non-surgical approaches. The selection of a proper modality is based on a multidisciplinary and patient-specific approach, bearing in mind patient age, comorbidities, life expectancy, and clinical stage of the disease.

The aim of this study was to analyze long-term trends in surgical management of patients with kidney tumors at the Zagreb University Hospital Center (Zagreb UHC).

Materials and Methods

We retrospectively reviewed data in the Hospital Information System on patients having undergone surgical treatment for renal neoplasms in the period between February 2011 and December 2020. We collected all demographic data, type of nephrectomy (partial or radical), surgical technique (laparoscopic or

open), and pathologic characteristics. All patient and operative data were analyzed and graphically presented using SPSS software (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY, USA). For categorical variables, descriptive statistics were reported as frequencies and percentages, and for continuous variables as median and range.

Results

There were 1031 procedures performed in the selected period. Radical nephrectomy (RN) was performed in 703 (68.2%) and partial nephrectomy (PN) in 328 (31.8%) procedures (Table 1). The median patient age was 62 (17–88) years. There were 657 (63.7%) men and 374 (36.3%) women. Laparoscopic approach was used in 211 (20.5%) (111 PN and 100 RN), while open approach was used in 820 (79.5%) (328 PN and 703 RN) cases. Trends in the type of surgery and use of surgical technique in the selected period are shown in

Table 1. Type of surgery and surgical technique

Surgical approach	PN n (%)	RN n (%)	Total N (%)
Laparoscopic	111 (10.7)	100 (9.7)	211 (20.5)
Open	217 (21.1)	603 (58.5)	820 (79.5)
Total	328 (31.8)	703 (68.2)	1031 (100)
Histologic type	n (%)		
Clear cell carcinoma	693 (67.3)		
Papillary carcinoma	115 (11.2)		
Chromophobe carcinoma	67 (6.5)		
Oncocytoma	46 (4.5)		
Angiomyolipoma	33 (3.2)		
Other	77 (7.3)		
Pathologic stage (pT)	n (%)		
pT1a	390 (37.8)		
pT1b	197 (19.1)		
pT2a	38 (3.7)		
pT2b	22 (2.1)		
pT3a	160 (15.5)		
pT3b	63 (6.1)		
pT3c	8 (0.8)		
pT4	12 (1.2)		
Undetermined	141 (13.7)		

PN = partial nephrectomy; RN = radical nephrectomy

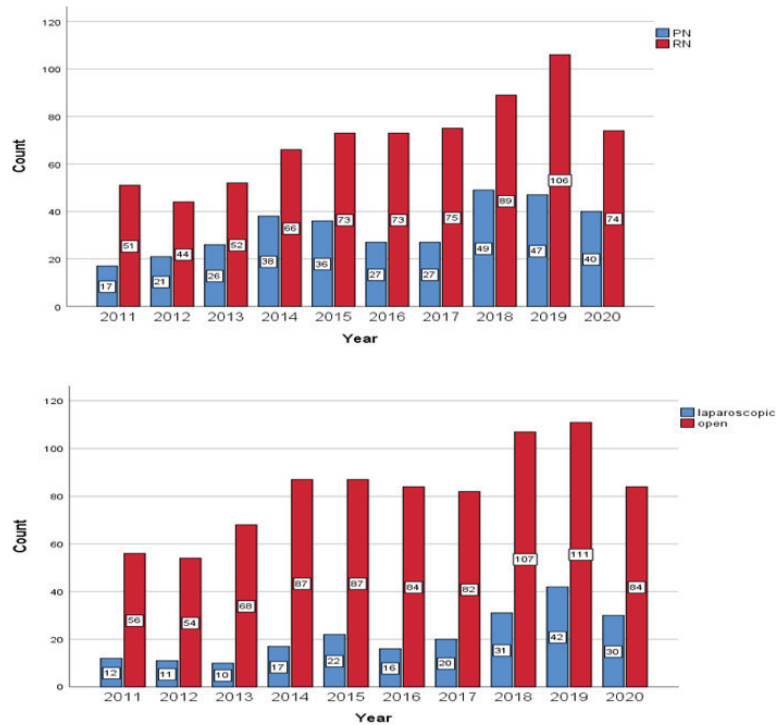


Fig. 1. Number of procedures performed during study period.

PN = partial nephrectomy; RN = radical nephrectomy

Figure 1. The median operative time was 161 minutes for open RN and 158 minutes for open PN, 160 minutes for laparoscopic RN, and 162 minutes for laparoscopic PN. The most common pathology was clear cell carcinoma in 693 (67.3%), papillary carcinoma in 115 (11.2%), chromophobe carcinoma in 67 (6.5%), oncocytoma in 46 (4.5%), and angiomyolipoma in 33 (3.2%) patients. In the remaining 7.3% of cases of other pathology, there were some interesting clinical cases, for example, metastasis of neuroendocrine tumor (NET) into clear cell renal carcinoma. There were three cases of

Bellini duct carcinoma, two cases of perivascular epithelioid cell tumor (PEComa), one case of microphthalmia-associated transcription (MiT) family translocation, and other sporadic cases of rare tumors.

Overall, pT1 stage was diagnosed in 56.9%, pT2 in 5.8%, pT3 in 22.4% and pT4 in 1.2% of patients (complete pT distribution is shown in Table 1). In the majority of patients with pT1a, PN was performed (57.9% of patients), whereas this percentage was significantly lower in pT1b and higher-stage cases (Fig. 2). When analyzing cases with pT3 stage disease, there

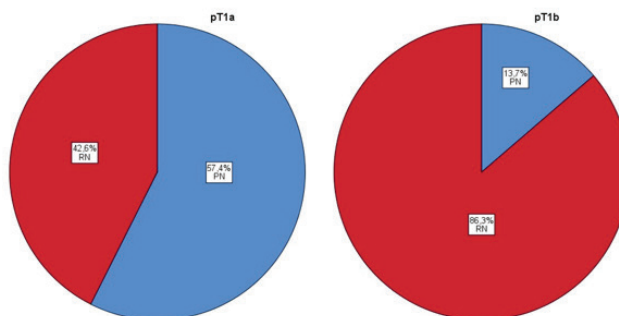


Fig. 2. Descriptive chart of partial nephrectomy (PN) vs. radical nephrectomy (RN) performed in patients with pT1a and pT1b stage over years.

were 160 (69.3%) patients with pT3a, 63 (27.3%) with pT3b and 8 (3.5%) patients with pT3c stage. In collaboration with cardiothoracic surgeons, 12 procedures were performed with the use of cardiopulmonary bypass and hypothermic arrest. Regional lymphadenectomy was performed in 354 (34.3%) patients, among which lymph nodes were positive in 40 (11.3%) cases. Surgical margins were positive in 27 (8.2%) cases when PN was performed. The percentage of positive surgical margins (PSM) was 4.5% in the laparoscopic group *versus* 6.7% in the open group. Compared to two pre-pandemic years (2018 and 2019), the number of cases in 2020 was reduced by 25.5% (2019) and 17.4% (2018), as shown in Figure 1.

Discussion

Surgical treatment is the method of choice for most patients with localized RCC. PN is beneficial for many patients with cT1 disease in terms of comparable overall survival, but also decreased the risk of later cardiovascular events and chronic kidney failure^{3,4}. It can be performed in patients with higher clinical stages, but it requires careful selection and preoperative evaluation. PN has slightly higher complication rates than RN⁵. In comparative studies of open and laparoscopic RN, oncologic results and complication rates were similar, but less morbidity, blood loss, requirement for analgesia, and shorter hospital stay were found for the latter⁶⁻⁹. There was no difference either in progression-free survival and overall survival if laparoscopic PN was performed in experienced centers¹⁰⁻¹². The operative time and warm ischemia time were longer when compared to open PN^{10,11,13}.

In our series, there was an overall increase in surgical procedures performed, with an ongoing trend of increased PN (Fig. 1), which is usually reserved for patients with cT1a-b stage disease (Fig. 2). Our data also show a steady increase in laparoscopic procedures since 2011 (Fig. 2). There was a reduction in the number of overall procedures in 2020, caused by the global coronavirus pandemic. This reduction by 25.49% is comparable to other studies reporting on COVID-19 pandemic reduction of oncologic surgeries¹⁴⁻¹⁶.

In our study, there was no significant prolongation of operative time regarding laparoscopic or open approach both for PN and RN. The most common histopathologic subtype was clear cell renal carcinoma. Most of the patients had pT1 stage disease (66%), but there was also a significant number of pT3 stages

(26%). Distribution of the pathologic T stage is shown in Table 1, and it was comparable to those reported in similar studies¹⁷.

Patients with non-metastatic RCC with tumor thrombus in the vena cava present a clinical challenge and require surgical expertise and multidisciplinary approach. Studies have shown that these patients can benefit from surgery, if performed in experienced centers¹⁸. The overall and disease-free 5-year survival has been reported of up to 63% and 55%, respectively, in one study¹⁹. In 12 cases, our patients had pT3b and pT3c stage disease that required collaboration with cardiothoracic surgeons. Nephrectomy and thrombectomy were performed in hypothermic arrest and cardiopulmonary bypass²⁰. Although complex and demanding for the entire team, it is potentially the only curative treatment option for these patients¹⁸.

Positive surgical margins can be found in 2%-8% of PNs with no definitive correlation to the selected surgical approach^{21,22}. In our study, the PSM rate was lower in cases when laparoscopic PN was performed, but this can be explained by the fact that open PN was performed in more complex cases with a higher T stage. The impact of PSM on oncologic outcomes is still controversial. One recent study reports a higher incidence of distant metastasis (11.1% *vs.* 3.5%) and a significantly higher incidence of renal relapses (14.8% *vs.* 3.9%)²³. It suggests that PSM is a predictor of progression-free survival with a higher incidence of local relapse. On the other hand, there are several studies that suggest that PSM does not correlate with a higher risk of metastases and local recurrence^{22,24-26}. In conclusion, there is a risk of overtreatment if RN or re-resection has been performed in patients with PSM, but these patients may require more intensive follow-up.

Whether to perform regional lymphadenectomy in patients with the organ-confined disease is still controversial because it is not associated with improved oncologic outcomes²⁷⁻²⁹. In Zagreb UHC, we do not perform lymphadenectomy routinely in such patients. However, there were 11.3% of cases of lymph node positivity among patients having undergone lymphadenectomy. The usual reasoning for lymphadenectomy was younger patient age, radiological characteristics of tumor and lymph nodes, and intraoperative finding of lymphadenopathy. Our rates of lymph node dissection and positivity are similar to the rates reported elsewhere³⁰.

With the development and more widespread use of radiological imaging (US, multi-slice computed to-

mography, MRI), there are many incidental findings of clinically low-stage tumors in older patients with significant comorbidities. There are several non-surgical approaches in the management of kidney tumors in such patients. Tumors less than 3 cm in size can be managed with one of the ablative techniques^{29,30}. For patients older than 75 years and with tumors smaller than 4 cm, active surveillance can also be a valuable option, except for cases that show significant clinical progression during follow-up³¹⁻³³. In our institution, all patients that are candidates for non-surgical management of kidney tumors are presented to the multidisciplinary team and, if eligible, offered one of the ablative methods³⁴.

In the era of minimally invasive surgery in urology, laparoscopic management is gradually becoming the standard of care. However, open surgery is an important modality for patients with higher-stage disease, especially for those with vena cava involvement. It is important to understand the complexity, limitations, and learning curves of laparoscopic approaches, especially for PN. The clinician should always offer the patient nephron-sparing surgery, if possible, and should not prefer laparoscopic RN over open PN. The non-surgical approach is also an important and valuable modality to consider in selected patients. Further development of minimally invasive and nephron-sparing procedures in the treatment of RCC, including robotics, is expected in our department.

References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2018;68(6):394-424. doi: 10.3322/caac.21492.
2. Moch H, Cubilla AL, Humphrey PA, Reuter VE, Ulbright TM. The 2016 WHO Classification of Tumours of the Urinary System and Male Genital Organs – Part A: Renal, Penile, and Testicular Tumours. *Eur Urol.* 2016;70(1):93-105. doi: 10.1016/j.eururo.2016.02.029.
3. Capitanio U, Terrone C, Antonelli A, Minervini A, Volpe A, Furlan M, *et al.* Nephron-sparing techniques independently decrease the risk of cardiovascular events relative to radical nephrectomy in patients with a T1a-T1b renal mass and normal preoperative renal function. *Eur Urol.* 2015;67(4):683-9. doi: 10.1016/j.eururo.2014.09.027.
4. Scosyrev E, Messing EM, Sylvester R, Campbell S, Van Poppel H. Renal function after nephron-sparing surgery *versus* radical nephrectomy: results from EORTC randomized trial 30904. *Eur Urol.* 2014;65(2):372-7. doi: 10.1016/j.eururo.2013.06.044.
5. Van Poppel H, Da Pozzo L, Albrecht W, Matveev V, Bono A, Borkowski A, *et al.* A prospective randomized EORTC intergroup phase 3 study comparing the complications of elective nephron-sparing surgery and radical nephrectomy for low-stage renal cell carcinoma. *Eur Urol.* 2007;51(6):1606-15. doi: 10.1016/j.eururo.2006.11.013.
6. MacLennan S, Imamura M, Lapitan MC, Omar MI, Lam TB, Hilvano-Cabungcal AM, *et al.* Systematic review of perioperative and quality-of-life outcomes following surgical management of localised renal cancer. *Eur Urol.* 2012;62(6):1097-117. doi: 10.1016/j.eururo.2012.07.028.
7. Mir MC, Derweesh I, Porpiglia F, Zargar H, Mottrie A, Autorino R. Partial nephrectomy *versus* radical nephrectomy for clinical T1b and T2 renal tumors: a systematic review and meta-analysis of comparative studies. *Eur Urol.* 2017;71(4):606-17. doi: 10.1016/j.eururo.2016.08.060.
8. Hemal AK, Kumar A, Kumar R, Wadhwa P, Seth A, Gupta NP. Laparoscopic *versus* open radical nephrectomy for large renal tumors: a long-term prospective comparison. *J Urol.* 2007;177(3):862-6. doi: 10.1016/j.juro.2006.10.053.
9. Laird A, Choy KC, Delaney H, Cutress ML, O'Connor KM, Tolley DA, *et al.* Matched pair analysis of laparoscopic *versus* open radical nephrectomy for the treatment of T3 renal cell carcinoma. *World J Urol.* 2015;33(1):25-32. doi: 10.1007/s00345-014-1280-y.
10. Gong EM, Orvieto MA, Zorn KC, Lucioni A, Steinberg GD, Shalhav AL. Comparison of laparoscopic and open partial nephrectomy in clinical T1a renal tumors. *J Endourol.* 2008;22(5):953-7. doi: 10.1089/end.2007.0300.
11. Marszalek M, Meixl H, Polajnar M, Rauchenwald M, Jeschke K, Madersbacher S. Laparoscopic and open partial nephrectomy: a matched-pair comparison of 200 patients. *Eur Urol.* 2009;55(5):1171-8. doi: 10.1016/j.eururo.2009.01.042.
12. Gill IS, Kavoussi LR, Lane BR, Blute ML, Babineau D, Colombo JR Jr, *et al.* Comparison of 1,800 laparoscopic and open partial nephrectomies for single renal tumors. *J Urol.* 2007;178(1):41-6. doi: 10.1016/j.juro.2007.03.038.
13. Lane BR, Gill IS. 7-year oncological outcomes after laparoscopic and open partial nephrectomy. *J Urol.* 2010;183(2):473-9. doi: 10.1016/j.juro.2009.10.023.
14. Dell'Oglio P, Cacciamani GE, Muttin F, Mirabella G, Secco S, Roscigno M, *et al.* Applicability of COVID-19 pandemic recommendations for urology practice: data from three major Italian hot spots (BreBeMi). *Eur Urol Open Sci.* 2021;26:1-9. doi: 10.1016/j.euro.2021.01.012.
15. Guerrieri R, Rovati L. Impact of the COVID-19 pandemic on urologic oncology surgery: implications for moving forward. *J Clin Med.* 2022 Jan;11(1):171. Published online 2021 Dec 29. doi: 10.3390/jcm11010171.
16. Oderda M, Roupert M, Marra G, Merseburger AS, Oderda G, Falcone M, *et al.* The impact of COVID-19 outbreak on uro-oncological practice across Europe: which burden of activity are we facing ahead? *Eur Urol.* 2020;78(1):124-6. doi: 10.1016/j.eururo.2020.04.036.
17. Junejo NN, Alkhateeb SS, Alrumayyan MF, Alkhatib KY, Alzahrani HM, Alotaibi MF, *et al.* Trends in the surgical management of renal cell carcinoma in a contemporary tertiary care setting. *Urol Ann.* 2021;13(2):111-8. doi: 10.4103/ua.ua_151_20.

18. Lardas M, Stewart F, Scrimgeour D, Hofmann F, Marconi L, Dabestani S, *et al.* Systematic review of surgical management of nonmetastatic renal cell carcinoma with vena caval thrombus. *Eur Urol.* 2016;70(2):265-80. doi: 10.1016/j.eururo.2015.11.034.
19. Kulkarni J, Jadhav Y, Valsangkar RS. IVC thrombectomy in renal cell carcinoma – analysis of outcome data of 100 patients and review of literature. *Indian J Surg Oncol.* 2012;3(2):107-13. doi: 10.1007/s13193-011-0114-2.
20. Hudolin T, Ferencak V, Penezić L, Zekulić T, Kuliš T, Marić M, *et al.* Multidisciplinary surgical treatment of clear-cell renal carcinoma with inferior vena cava tumor thrombus level III and IV: our experience during the past decade. *Lib Oncol.* 2020;48(2-3):68-72. doi: <https://doi.org/10.20471/LO.2020.48.02-03.12>.
21. Choi JE, You JH, Kim DK, Rha KH, Lee SH. Comparison of perioperative outcomes between robotic and laparoscopic partial nephrectomy: a systematic review and meta-analysis. *Eur Urol.* 2015;67(5):891-901. doi:10.1016/j.eururo.2014.12.028.
22. Kim SP, Abouassaly R. Treatment of patients with positive margins after partial nephrectomy. *J Urol.* 2016;196(2):301-2. doi: 10.1016/j.juro.2016.05.078.
23. Tellini R, Antonelli A, Tardanico R, Fisogni S, Vecchia A, Furlan MC, *et al.* Positive surgical margins predict progression-free survival after nephron-sparing surgery for renal cell carcinoma: results from a single center cohort of 459 cases with a minimum follow-up of 5 years. *Clin Genitourin Cancer.* 2019;17(1):e26-e31. doi: 10.1016/j.clgc.2018.08.004.
24. Bensalah K, Pantuck AJ, Rioux-Leclercq N, Thuret R, Montorsi F, Karakiewicz PI, *et al.* Positive surgical margin appears to have negligible impact on survival of renal cell carcinomas treated by nephron-sparing surgery. *Eur Urol.* 2010;57(3):466-71. doi: 10.1016/j.eururo.2009.03.048.
25. López-Coste M, Bonet X, Pérez-Reggeti J, Etcheverry B, Vigués F. Oncological outcomes and prognostic factors after nephron-sparing surgery in renal cell carcinoma. *Int Urol Nephrol.* 2016;48(5):681-6. doi: 10.1007/s11255-016-1217-z.
26. Antic T, Taxy JB. Partial nephrectomy for renal tumors: lack of correlation between margin status and local recurrence. *Am J Clin Pathol.* 2015;143(5):645-51. doi: 10.1309/ajcp71klz8js-jqrg.
27. Bekema HJ, MacLennan S, Imamura M, Lam TB, Stewart F, Scott N, *et al.* Systematic review of adrenalectomy and lymph node dissection in locally advanced renal cell carcinoma. *Eur Urol.* 2013;64(5):799-810. doi: 10.1016/j.eururo.2013.04.033.
28. Gershman B, Thompson RH, Boorjian SA, Larcher A, Capitanio U, Montorsi F, *et al.* Radical nephrectomy with or without lymph node dissection for high risk nonmetastatic renal cell carcinoma: a multi-institutional analysis. *J Urol.* 2018;199(5):1143-8. doi: 10.1016/j.juro.2017.11.114.
29. Whitson JM, Harris CR, Reese AC, Meng MV. Lymphadenectomy improves survival of patients with renal cell carcinoma and nodal metastases. *J Urol.* 2011;185(5):1615-20. doi: 10.1016/j.juro.2010.12.053.
30. Marchioni M, Bandini M. The impact of lymph node dissection and positive lymph nodes on cancer-specific mortality in contemporary pT(2-3) non-metastatic renal cell carcinoma treated with radical nephrectomy. *BJU Int.* 2018;121(3):383-92. doi: 10.1111/bju.14024.
31. Lane BR, Abouassaly R, Gao T, Weight CJ, Hernandez AV, Larson BT, *et al.* Active treatment of localized renal tumors may not impact overall survival in patients aged 75 years or older. *Cancer.* 2010;116(13):3119-26. doi: 10.1002/cncr.25184.
32. Hollingsworth JM, Miller DC, Daignault S, Hollenbeck BK. Five-year survival after surgical treatment for kidney cancer: a population-based competing risk analysis. *Cancer.* 2007;109(9):1763-8. doi: 10.1002/cncr.22600.
33. Smaldone MC, Kutikov A, Egleston BL, Canter DJ, Viterbo R, Chen DY, *et al.* Small renal masses progressing to metastases under active surveillance: a systematic review and pooled analysis. *Cancer.* 2012;118(4):997-1006. doi: 10.1002/cncr.26369.
34. Alduk AM, Knežević N, Penezić L, Kuliš T, Goluža E, Sjekavica I, *et al.* Liječenje malih tumora bubrega ablacijskim metodama. *Lijec Vjesn.* 2021;143(1-2):1-5. (in Croatian), doi: <https://doi.org/10.26800/LV-143-1-2-1>.

Sažetak

TRENDOVI KIRURŠKOG LIJEČENJA BUBREŽNIH NOVOTVORINA: REZULTATI JEDNOG CENTRA U POSLJEDNJEM DESETLJEĆU

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Većina bubrežnih neoplazma može se liječiti kirurški primjenjujući otvoreni ili minimalno invazivni pristup. Parcijalna nefrektomija (PN) treba biti učinjena, kada je moguće, bez obzira na kirurški pristup. U ovoj retrospektivnoj studiji analizirali smo kirurške trendove u operativnom liječenju bubrežnih neoplazma u razdoblju od veljače 2011. do prosinca 2020. godine. Ukupno je učinjen 1031 zahvat, 703 (68,2%) radikalne nefrektomije (RN) i 211 (20,5%) PN. Učinjeno je 211 (20,5%) laparoskopskih (111 PN i 100 RN) i 820 (79,5%) otvorenih (328 PN i 703 RN) operacija. Dvanaest operacija je zahtijevalo upotrebu hipotermičkog aresta i kardiopulmonalnog premoštenja. Medijan trajanja operacije je bio 161 minutu za otvorenu RN, 158 za otvorenu PN, 160 minuta za laparoskopsku RN i 162 minute za laparoskopsku PN. Najčešća patologija je bila svjetlostanični karcinom u 693 (67,3%), papilarni karcinom u 115 (11,2%), kromofobni karcinom u 67 (6,5%), onkocitom u 46 (4,5%) i angiomiolipom u 33 (3,2%) slučaja. Patološki, stadij pT1 dijagnosticiran je u 56,9%, pT2 u 5,8%, pT3 u 22,4% i pT4 u 1,2% bolesnika. Regionalna limfadenektomija je učinjena u 354 (34,3%) bolesnika, među kojima su limfni čvorovi bili pozitivni u 40 (11,3%) slučajeva. Kirurški rubovi su bili pozitivni u 27 (8,2%) slučajeva nakon PN. Zaključno, vidljiv je trend porasta ukupnog broja zahvata, a također i porast broja minimalno invazivnih i za bubrežne poštednih zahvata.

Ključne riječi: *Nefrektomija; Laparoskopija; Rak bubrega; Kirurgija poštedna za bubrež*