

# Preoperative scoring systems used in retroperitoneoscopic partial nephrectomy for T1-T2 renal tumors

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## ABSTRACT

**Introduction.** P.A.D.U.A. (The preoperative aspects and dimensions used for anatomic), R.E.N.A.L. (radius exophytic/endophytic nearness anterior/posterior location) and zonal NePhRO scoring were developed in an effort to predict the intraoperative (warm time ischemia, blood loss) and postoperative complications in patients undergoing partial nephrectomy, with an important role on surgical decision-making (2-4).

**Materials and methods.** Between January 2014 and July 2017, 37 patients(p) underwent retroperitoneoscopic nephro-sparing surgery at our center for clinically localized renal tumor. All patients had a normal contralateral kidney. The selection of patients for nephro-sparing surgery was based on preoperative CT scan, location of the tumor, the individual general health status of the patient and individual surgeon preferences. A chart review was carried out, including age, sex, anatomic preoperative scoring system (P.A.D.U.A., R.E.N.A.L. nephrometry and zonal NePhRO), operative time (skin opening to skin closing), estimated blood loss (EBL), warm ischemia time (WIT), hospital stay.

**Results.** The mean age of patients with partial nephrectomy was 54.3±9.1 years. Mean preoperative serum creatinine level for the patient group was 0.97±0.14 mg/dl. All patients had normal contralateral kidney. Average tumor diameter in this group was 3.6± 0.86 cm. When using P.A.D.U.A. score to predict warm time ischemia p value was of 0.001, even if the mean warm ischemia time is higher in medium risk patients than in high risk patients 24.3 min vs. 23.2 min. R.E.N.A.L. nephrometry score was able to predict the warm ischemia time according to the risk groups (17.6 vs. 23.9 vs. 31 min) with a p value under 0.001. Zonal NePhRO score was statistically correlated with total operative time, blood loss, warm ischemia and renal function decrease, all with a p value < 0.05.

**Conclusion.** P.A.D.U.A. score, R.E.N.A.L. nephrometry score and Zonal NePhRO score have proved to be reliable preoperative tools in order to evaluate surgical complexity and to predict outcomes such as warm time ischemia, blood loss, postoperative estimated GFR and complications rate.

**Keywords:** renal tumors, P.A.D.U.A score, warm ischemia, partial nephrectomy

## INTRODUCTION

The preoperative aspects and dimensions used for anatomic (P.A.D.U.A.), radius exophytic/endophytic nearness anterior/posterior location (R.E.N.A.L.) and zonal NePhRO scoring systems are according to EAU 2017 Guidelines useful preoperative tools in order to provide an

objective evaluation of patients proposed for nephro-sparing surgery, with a great impact on patient counselling and treatment planning (1).

P.A.D.U.A., R.E.N.A.L. and zonal NePhRO scoring were developed in an effort to predict the intraoperative (warm time ischemia, blood loss) and postoperative complications in pa-

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tients undergoing partial nephrectomy, with an important role on surgical decision-making (2-4).

Our objective is to evaluate which of the 3 scoring systems is more accurate in determine the intraoperative features and postoperative outcomes of patients undergoing retroperitoneoscopic nephro-sparing surgery for T1-T2 renal masses.

## MATERIAL AND METHODS

Between January 2014 and July 2017, 37 patients (p) underwent retroperitoneoscopic nephro-sparing surgery at our center for clinically localized renal tumor. All patients had a normal contralateral kidney. The selection of patients for nephro-sparing surgery was based on preoperative CT scan, location of the tumor, the individual general health status of the patient and individual surgeon preferences.

A chart review was carried out, including age, sex, anatomic preoperative scoring system (P.A.D.U.A., R.E.N.A.L. nephrometry and zonal NePhRO), operative time (skin opening to skin closing), estimated blood loss (EBL), warm ischemia time (WIT), hospital stay.

The perioperative complications were carefully graded using the Clavien-Dindo system.

### Retroperitoneoscopic nephro-sparing surgery technique

For the retroperitoneal approach we used 4 trocars, one 10 mm for the camera at the tip of the 12 rib, and other 3 working trocars (one 10 mm and two 5 mm). After positioning the 4 trocars and creating the retroperitoneal work space, the Gerota fascia was opened and the renal artery was isolated. In order to comply with the oncological rules of the procedure the fat surrounding the tumor was excised. The renal artery was then clamped with a vascular bulldog, without clamping the renal vein, and cold excision of the renal mass using round-tipped scissor was performed.

The specimen was placed in a retrieving bag, which was then removed at the end of the procedure. Interrupted 3.0 Vicryl suture was performed in order to close the collecting system if it was injured. The renal parenchyma defect was closed with 1 Vicryl running suture for 21 patients which was locked at both tail ends with Hem-o-lock clips, and for 16 patients we used 1 V-loc running suture. After the hemostasis was complete the renal artery was unclamped.

The statistical analysis of this paper was done by using chi-square test, the Fischer exact

test and the Mann-Whitney U test for parametric variables. A p value < 0.05 was considered statistically significant.

## RESULTS

The mean age of patients was 54.6±9.6 years. The warm ischemia time was 20.2±6.4 minutes. Complications rate was 34.5%. Both P.A.D.U.A. and R.E.N.A.L. scoring systems are good postoperative predictors, with a higher correlation of P.A.D.U.A. score with changes of glomerular filtration rate (p = 0.033 vs p = 0.046) and higher correlation of R.E.N.A.L. score with warm ischemia time (p = 0.026 vs p = 0.039)

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The mean age of patients with partial nephrectomy was 54.3±9.1 years. Mean preoperative serum creatinine level for the patient group was 0.97±0.14 mg/dl. All patients had normal contralateral kidney. Average tumor diameter in this group was 3.6± 0.86 cm.

The preoperative comparative characteristics of patients are presented in Table 1.

When using the P.A.D.U.A score in order to evaluate the preoperative tumor characteristics and compare it to the intraoperative and postoperative outcomes, we can observe that the operative time increases proportionally from 116.5 minutes in low risk patients to 166.2 minutes in high risk patients, with important statistical significance demonstrated by the p value under 0.001.

Another outcome with a p value of 0.001, was warm time ischemia, even if the mean warm ischemia time is higher in medium risk patients than in high risk patients – 24.3 min vs. 23.2 min.

TABLE 1

		Patients
Patients		37
Mean age (yr) ± SD (range)		54.3± 9.1 (26-72)
Mean preoperative creatinine (mg/dl) ± SD (range)		0.97±0.14 (0.6-1.3)
Mean CT tumor diameter (cm) ± SD (range)		3.6± 0.86 (1.3-6.2)
P.A.D.U.A. score		
	Low (6-7)	20 (54.05%)
	Medium (8-9)	13 (35.13%)
	High (10-14)	4 (10.82%)
R.E.N.A.L. nephrometry		
	Low (4-6)	19 (51.35 %)
	Medium (7-9)	17 (45.94 %)
	High (10-12)	1 (2.71 %)
Zonal NePhRO score		
	Low (4-6)	16 (43.24 %)
	Medium (7-9)	11 (29.72 %)
	High (10-12)	10 (27.04 %)
Mean CT tumor volume (ml) ± SD (range)		28.9 ± 6.3 (16-64)

SD – standard deviation

TABLE 2

	P.A.D.U.A. score			P value
	Low risk	Medium risk	High risk	
Patients	20	13	4	n/a
Operative time (min) ± SD (range)	116.5±22.7 (90-170)	160.7±32.5 (95-230)	166.2±4.7 (160-170)	<0.001
Blood loss (ml) ± SD (range)	178.1±30.3 (150-250)	266.9±161.6 (150-750)	197.5±15.0 (180-210)	0.07
Transfusion rate	0	1 (2.7%)	0	n/a
Warm ischemia time (min) ± SD (range)	18.2±2.94 (14-25)	24.3±5.9 (15-39)	23.2±7.1 (14-31)	0.001
Mean preoperative eGFR (ml/min/1.73 m <sup>2</sup> ) ± SD (range)	81.93±22.23 (44.56-124.91)	81.02±11.2 (61.38-96.56)	77.79±9.56 (66.88-95.72)	n/a
Mean postoperative(48 h) eGFR (ml/min/1.73 m <sup>2</sup> ) ± SD (range)	75.77±18.85 (40.91-108.32)	70.2±16.98 (33.04-90.01)	65.24±8.91 (50.14-84.77)	n/a
Percentage of eGFR decrease after partial nephrectomy (%)	7.51 %	13.35%	16.13 %	0.02
Suture of collecting system	1 (2.7%)	12 (32.4%)	4 (10.8%)	n/a
Hospital stay	4.0±1.16 (3-7)	4.2±1.18(3-7)	5.2±1.5 (4-7)	0.12

The rest of the outcomes evaluated in this study are presented in Table 2.

R.E.N.A.L. nephrometry score was able to predict the warm ischemia time according to the risk groups (17.6 vs. 23.9 vs. 31 min) with a p value under 0.001. The decrease in renal function was directly proportional with the score, with 1.5% in the low risk group, 9.13% and 25.02% in medium and high risk patients. The rest of the features evaluated are listed in Table 3.

Zonal NePhRO score was statistically correlated with total operative time, blood loss, warm ischemia and renal function decrease, all with a p value < 0.05 (Table 4).

All the intraoperative and postoperative complications were recorded and classified according to Clavien-Dindo system. After nephro-sparing surgery by retroperitoneal approach 9 patients (24.3%) developed subcutaneous emphysema and 1 patient (p) (2.7%) required intraoperative blood transfusion. Postoperative complications were represented by urinary fistula in 1 p that required double-J ureteral stenting, 1 p with postoperative bleeding that received blood transfusion, 2 p with urinary tract infection managed with antibiotics and 2 p with Clostridium difficile infection treated with oral antibiotics and i.v. fluids.

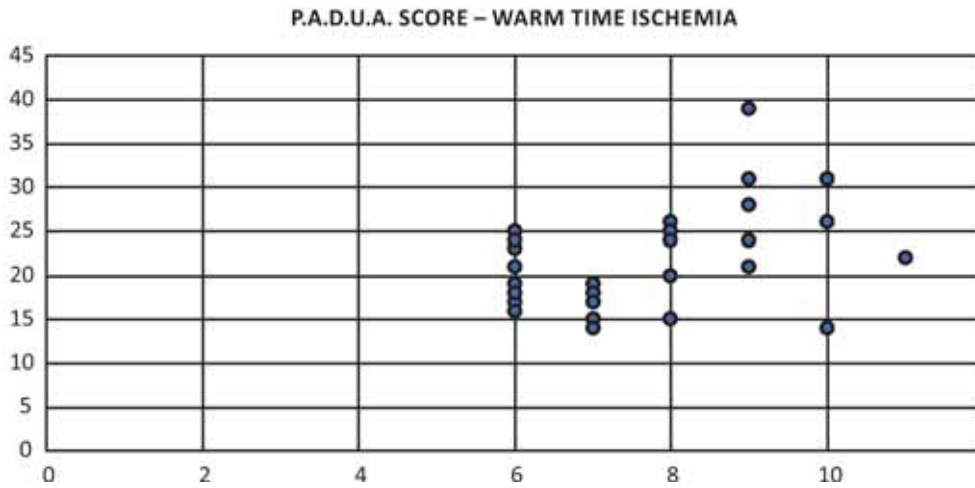


FIGURE 1. Warm time ischemia compared with P.A.D.U.A. score

TABLE 3

	R.E.N.A.L. nephrometry score			P value
	Low risk	Medium risk	High risk	
Patients	19	17	1	n/a
Operative time (min) ± SD (range)	118.4±21.7 (90-170)	164.4±33.4 (120-230)	160	0.02
Blood loss (ml) ± SD (range)	171.1±24.9 (150-230)	257.6±140.5 (170-750)	190	0.04
Transfusion rate	0	1 (2.7%)	0	n/a
Warm ischemia time (min) ± SD (range)	17.6±2.7 (14-25)	23.9±5.5 (14-39)	31	<0.001
Mean preoperative eGFR (ml/min/1.73 m <sup>2</sup> ) ± SD (range)	78.49 ± 8.44 (44.56-104.45)	80.22 ± 21.45 (0.7-1.3)	66.88	n/a
Mean postoperative (48 h) eGFR (ml/min/1.73 m <sup>2</sup> ) ± SD (range)	77.31±16.23 (40.91-108.32)	72.89±23.91 (33.04-106.67)	50.14	n/a
Percentage of eGFR decrease after partial nephrectomy (%)	1.5 %	9.13 %	25.02 %	0.006
Suture of collecting system	0	16 (43.2 %)	1 (2.7%)	n/a
Hospital stay	3.9± 1.11(3-7)	4.2± 1.14 (3-7)	7	0.04

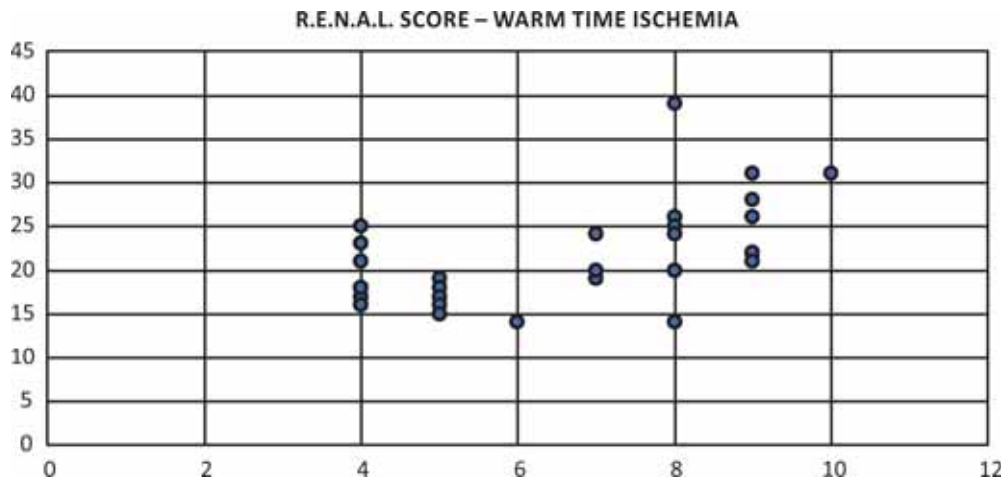


FIGURE 2. Warm time ischemia compared with R.E.N.A.L. score

TABLE 4

	Zonal NePhRO score			P value
	Low risk	Medium risk	High risk	
Patients	16	11	10	n/a
Operative time (min) ± SD (range)	128.1±24.8 (90-170)	131.3±29.7 (90-170)	171.0±25.1 (140-230)	<0.001
Blood loss (ml) ± SD (range)	181.8±29.9 (150-250)	180.0±34.6 (140-250)	293.0±175.7 (170-750)	0.009
Transfusion rate	0	0	1 (2.7%)	n/a
Warm ischemia time (min) ±SD (range)	18.5±3.3 (14-25)	19.3±3.9 (14-26)	26.5±5.9 (20-39)	<0.001
Mean preoperative eGFR (ml/min/1.73 m <sup>2</sup> ) ± SD (range)	90.57±19.51 (56.45-124.91)	70.28±11.47 (44.56-95.72)	78.08±13.45 (0.8-96.56)	n/a
Mean postoperative (48 h) eGFR (ml/min/1.73 m <sup>2</sup> ) ± SD (range)	88.06±18.45 (62.41-108.32)	66.09±8.33 (40.91-84.77)	63.24±19.54 (33.04-96.56)	n/a
Percentage of eGFR decrease after partial nephrectomy (%)	2.77 %	5.96 %	19.00 %	0.002
Suture of collecting system	2 (12.5%)	5 (45.4%)	10 (100%)	n/a
Hospital stay	4.1±1.2 (3-7)	3.7±1.13 (3-7)	4.7±1.26 (3-7)	0.11

NEPHRO SCORE – WARM TIME ISCHEMIA

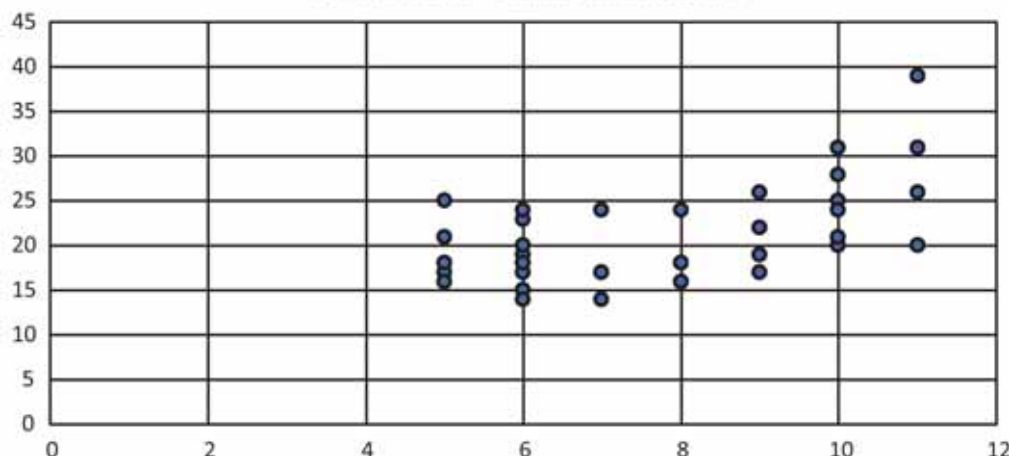


FIGURE 3. Warm time ischemia compared with NePhRO score

Complication rate was 51.1%, mostly grade I and II. Only 2 p (5.4%) presented grade III complications, and were evaluated preoperatively as medium and high risk according to all 3 scoring systems.

### DISCUSSION

All patients in the study benefit from nephro-sparing surgery form renal mases and were evaluated before the surgery using 3 different scoring systems: P.A.D.U.A., R.E.N.A.L. nephrometry and zonal NePhRO.

Warm time ischemia represent the most important aspect of nephro-sparing surgery with

great influence over the postoperative renal function. R.E.N.A.L. score and NePhRO score were able to predict more accurate the time of ischemia with a p value <0.001. When comparing the 2 scoring systems in terms of ischemia, the value ranges from 17.6 min vs 18.5 min in low risk, to 23.9 min vs 19.3 min in medium risk and 31 vs 26.5 min in high risk tumoral characteristics. P.A.D.U.A. score has a p value 0.001, but in terms of mean warm time ischemia wasn't able to differentiate between medium and high risk group.

The results are comparable with those previously reported in different series of patients undergoing partial nephrectomy (4-8).

TABLE 5

Complications	Low risk			Medium risk			High risk		
	P.A.D.U.A	R.E.N.A.L	NePhRO	P.A.D.U.A	R.E.N.A.L	NePhRO	P.A.D.U.A	R.E.N.A.L	NePhRO
Subcutaneous emphysema	3 (8.1 %)	2 (5.4%)	3 (8.1 %)	5 (13.5%)	7 (18.9%)	3 (8.1 %)	1 (2.7%)	0	3 (8.1 %)
Intraoperative bleeding requiring transfusion	0	0	0	1 (2.7%)	1 (2.7%)	0	0	0	1 (2.7%)
Clostridium difficile infection	1 (2.7%)	1 (2.7%)	1 (2.7%)	0	0	0	1 (2.7%)	1 (2.7%)	1 (2.7%)
Urinary tract infection	0	0	0	2 (5.4%)	2 (5.4%)	2 (5.4%)	0	0	0
Urinary fistula	0	0	0	1 (2.7%)	2 (5.4%)	1 (2.7%)	1 (2.7%)	0	1 (2.7%)
Postoperative bleeding requiring transfusion	0	0	0	1 (2.7%)	1 (2.7%)	0	1 (2.7%)	1 (2.7%)	2 (5.4%)
Hematoma	0	0	0	1 (2.7%)	1 (2.7%)	0	0	0	1 (2.7%)
Total	4 (10.8 %)	3 (8.1 %)	4 (10.8 %)	11 (29.7%)	14 (37.8 %)	6 (16.2%)	4 (10.8 %)	2 (5.4%)	9 (24.3%)

TABLE 6

Clavien-Dindo Classification	Low risk			Medium risk			High risk		
	P.A.D.U.A	R.E.N.A.L	NePhRO	P.A.D.U.A	R.E.N.A.L	NePhRO	P.A.D.U.A	R.E.N.A.L	NePhRO
Grade I	3 (8.1 %)	2 (5.4%)	3 (8.1 %)	5 (13.5%)	7 (18.9%)	3 (8.1 %)	1 (2.7%)	0	3 (8.1 %)
Grade II	1 (2.7%)	1 (2.7%)	1 (2.7%)	5 (13.5%)	5 (13.5%)	2 (5.4%)	2 (5.4%)	2 (5.4%)	5 (13.5%)
Grade III	0	0	0	1 (2.7%)	2 (5.4%)	1 (2.7%)	1 (2.7%)	0	1 (2.7%)
Grade IV	0	0	0	0	0	0	0	0	0
Grade V	0	0	0	0	0	0	0	0	0
Total	4 (10.8 %)	3 (8.1 %)	4 (10.8 %)	11 (29.7%)	14 (37.8 %)	6 (16.2%)	4 (10.8 %)	2 (5.4%)	9 (24.3%)

Another important aspect of nephro-sparing surgery is glomerular filtration rate (GFR) after the procedure. We have estimate the GFR using the Modification of Diet in Renal Disease (MDRD) Study equation which provides unbiased and reasonably accurate estimates across a wide range of subgroups (9), with serum creatinine determined 1 day prior the procedure and 48 hours after the surgery.

Zonal NePhRO score realised the strongest statistic correlation with decrease of estimated GFR, with a p value of 0.002, meanwhile P.A.D.U.A. and R.E.N.A.L. score realised a p value of 0.006, respectively 0.02.

R.E.N.A.L. scoring system was the only to have statistic relevance in terms of hospital stay with a p value of 0.04.

All 3 scoring systems were able to predict the occurrence of complications after surgery, with statistic significance in Clavien-Dindo grade III

group, with a p value <0.005, comparable with data reported by Hakky el al. (4).

The limitations of our study are the lack of long term postoperative evaluation and the reduce number of cases over time, since LPN is practice in our department from January 2014.

### CONCLUSION

P.A.D.U.A. score, R.E.N.A.L. nephrometry score and Zonal NePhRO score have proved to be reliable preoperative tools in order to evaluate surgical complexity and to predict outcomes such as warm time ischemia, blood loss, postoperative estimated GFR and complications rate.

This scoring systems are not ideal leaving a good field of research in order to find a more objective formula that can exclude subjective features such as surgeon experience, for a more accurate result.



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