Off-Clamp Technique Offers Improved Renal Function Outcomes After Robotic Partial Nephrectomy in Low And Intermediate Complexity Tumors

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Introduction and Objectives: Several arterial clamping techniques have been reported to reduce the deleterious effects of warm ischemia time (WIT) on renal function following partial nephrectomy (PN). Since there is a paucity of comparative data on each technique, the present study compared renal function

and surgical outcomes between selective arterial (SAC), main artery (MAC), and off-clamp (OC) techniques in patients undergoing robotic PN (RPN) with low and intermediate complexity tumors.

Methods: The present study identified 1,145 patients from 4 medical institutions who underwent RPN from January 2008 to June 2015. Patients with two kidneys, a RENAL score < 10, follow up > 3 months, and a tumor not abutting the main renal artery or vein were included for analysis providing 346 (78.3%) MAC, 37 (8.4%) SAC and 59 (13.3%) OC patients. The percentage change in eGFR was compared between groups using an analysis of covariance. Positive surgical margins (PSM), estimated blood loss (EBL), length of stay (LOS), complications and non-neoplastic parenchymal volume (NNPV) removed were also compared.

Results: R.E.N.A.L. score (5.8 vs. 6.9 vs. 6.5, p=.001), tumor size (2.2 cm vs. 2.9 vs. 3.1, p<.001) and median follow-up (15.9 months vs. 6 vs. 14.6, p=.002) differed between OC vs. SAC vs. MAC RPN patients respectively. The percentage reduction in eGFR at 13.9 months was significantly reduced in patients undergoing OC vs. MAC (2.5% vs. -9.9%, p=.001) adjusting for R.E.N.A.L. score, American Society of Anesthesiologists (ASA) score, body mass index (BMI) and baseline eGFR (**Figure 1**). In a multivariable cox proportional hazards model, the risk of CKD upstaging was no different in patients undergoing OC vs SAC or MAC (HR= 0.51, p=.260). Greater EBL (178.0 vs. 117.1, p=.008) was seen in patients undergoing OC vs. MAC RPN. No differences in NNPV removed (p=.586), PSM (p=.849), or complications (p=.693) were found between the approaches.

Conclusions:

This study suggests that there may be a renal function advantage to OC RPN. No difference in NNPV removed between groups suggests that the lack of ischemic damage underlies the renal function benefit of OC RPN. Improved renal function without increased risk of PSM or complications suggests that when technically feasible, off-clamp RPN is a consideration in patients with low and intermediate complexity tumors.
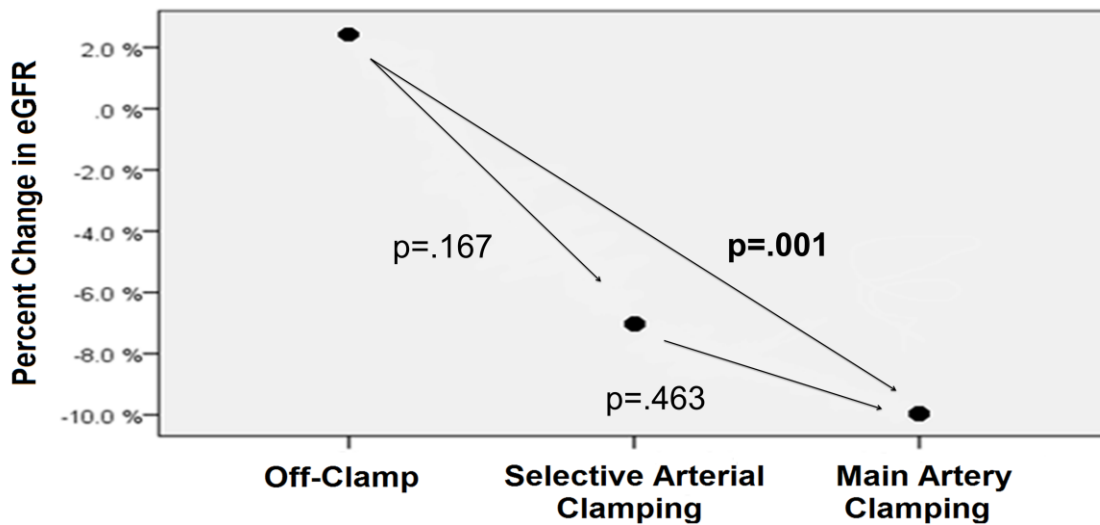

Figure 1. Percent change in eGFR at 13.9 months between clamp techniques adjusting for R.E.N.A.L. Nephrometry score, BMI, ASA and baseline eGFR

Table 1. Clinical Characteristics and Outcomes of Patients who Underwent Off-Clamp, Selective Arterial Clamping and Main Artery Clamping

Characteristic	Off-clamp	Selective Arterial	Main Artery	P Value

		Clamping	Clamping	
Patients	59	37	346	
Age (years)	59.2 (13.1)	57.5 (13.9)	59.8 (12.4)	.569
Male	38 (64.4%)	25 (67.6%)	195 (56.4%)	.253
BMI	30.7 (6.9)	28.9 (6.2)	30.6 (6.5)	.305
ASA score	2.8 (0.6)	2.5 (0.6)	2.6 (0.5)	**.015**
Serum Creatinine (mg/dl)	1.04 (0.59)	0.94 (0.29)	0.98 (0.33)	.397
Baseline eGFR (ml/min/1.73m^2)	83.9 (31.5)	87.8 (21.9)	82.3 (24.6)	.444
RENAL Score	5.8 (1.6)	6.9 (1.4)	6.5 (1.6)	**.001**
NNPV Removed (cm^3)	10.1 (13.8)	13.4 (12.1)	31.5 (120.7)	.586
Tumor Size (cm)	2.1 (1.3)	2.9 (1.1)	3.1 (1.3)	**<.001**
WIT (minutes)	0 (0.0)	14.9 (4.3)	17.3 (7.7)	**<.001**
EBL (ml)	178.0 (227.8)	130.3 (126.5)	117.1 (170.2)	.008
Length of Stay	2.2 (1.9)	1.2 (0.5)	2.2 (2.8)	.085

(days)

PSM	2 (4.5%)	2 (5.4%)	20 (6.6%)	.849
Post-Operative Complications	6 (10.3%)	5 (13.5%)	50 (14.5%)	.693

BMI = body mass index; ASA = American Society of Anesthesiologists; eGFR = estimated glomerular filtration rate; NNPN= Non-Neoplastic Parenchymal Volume; WIT= Warm Ischemia Time; EBL= Estimated Blood Loss; PSM= Positive Surgical Margins.

For categorical variables, chi square tests performed. Frequencies presented with percentages in parenthesis.

For continuous variables, One-way analyses of variance performed. Means presented with standard deviations in parenthesis.