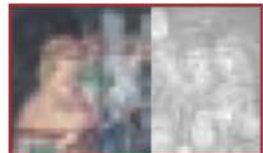
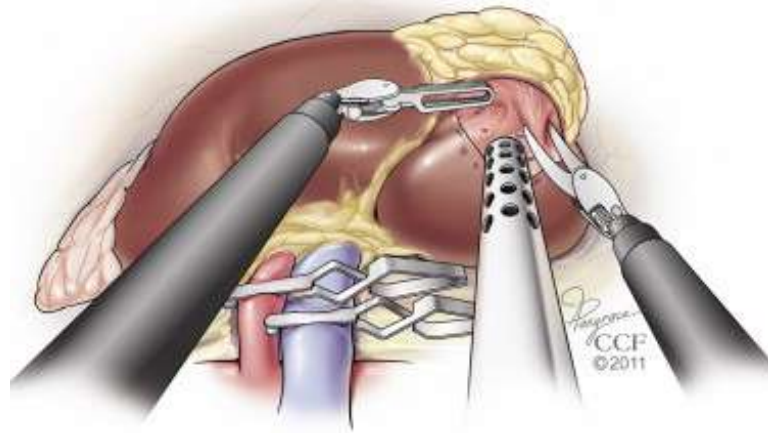


# NEPHRON SPARING ROBOTIC SURGERY



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DI UROLOGIA  
FONDATA NEL 1908



**Sisto Perdonà, MD**

**Director of Urology**

**National Cancer Institute IRCCS**

**Fondazione "G. Pascale" Napoli**

# RCC - A Brief History of Time



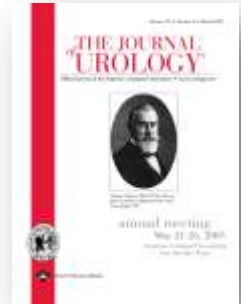
Ziya Kirkaly 2012

## Historical Article

### A HISTORY OF PARTIAL NEPHRECTOMY FOR RENAL TUMORS

HARRY W. HERR\*

*From the Department of Urology, Memorial Sloan-Kettering Cancer Center, New York, New York*



*J Urol 2005 Mar;173(3):705–8.*

**Partial nephrectomy (NSS) has as its aim the preservation of a portion of functioning renal tissue, maintaining the same oncological outcome as the radical nephrectomy (RN).**



## Simple enucleation versus standard partial nephrectomy for clinical T1 renal masses: Perioperative outcomes based on a matched-pair comparison of 396 patients (RECORD project)

N. Longo <sup>a</sup>, A. Minervini <sup>b</sup>, A. Antonelli <sup>c</sup>, G. Bianchi <sup>d</sup>,  
A.M. Bocciardi <sup>e</sup>, S.C. Cunico <sup>c</sup>, C. Fiori <sup>f</sup>, F. Fusco <sup>a,\*</sup>,  
S. Giancane <sup>b</sup>, A. Mari <sup>b</sup>, G. Martorana <sup>g</sup>, V. Mirone <sup>a</sup>,  
G. Morgia <sup>h</sup>, G. Novara <sup>i</sup>, F. Porpiglia <sup>f</sup>, M.R. Raspollini <sup>j</sup>,  
F. Rocco <sup>k</sup>, B. Rovereto <sup>l</sup>, R. Schiavina <sup>g</sup>, S. Serni <sup>b</sup>,  
C. Simeone <sup>c</sup>, P. Verze <sup>a</sup>, A. Volpe <sup>m</sup>, V. Ficarra <sup>i</sup>, M. Carini <sup>b</sup>

# Indications for NSS:

**Elective (localized unilateral renal mass, with contralateral renal functioning)**

**Relative (unilateral localized renal mass with comorbidity such as diabetes, hypertension or renal lithiasis)**

**Absolute (bilateral tumor, multiple, IRC of a moderate/severe grade or tumors of only one kidney).**

**NSS is carried out as enucleoresection or enucleation based upon the preference of the surgeon and beginning with the characteristics of the tumor.**

# Enucleoresection



# Enucleation

## NEPHRON SPARING SURGERY FOR RENAL TUMORS: INDICATIONS, TECHNIQUES AND OUTCOMES

ROBERT G. UZZO\* AND ANDREW C. NOVICK



The partial standard nephrectomy (SPN) which consists of the removal of the tumor with an adequate surgical margin of functioning tissue is still considered the Gold Standard in the treatment of renal tumors.

## DOES THE SIZE OF THE SURGICAL MARGIN IN PARTIAL NEPHRECTOMY FOR RENAL CELL CANCER REALLY MATTER?

SUZETTE E. SUTHERLAND, MARTIN I. RESNICK,\* GREGORY T. MACLENNAN AND HOWARD B. GOLDMAN



Over the past decade some authors have demonstrated that the removed functional parenchyma which surrounds the tumor can **also** be a few millimeters, maintaining an elevated oncological security.

## Is Simple Enucleation a Minimal Partial Nephrectomy Responding to the EAU Guidelines' Recommendations?

Vincenzo Ficarra \*, Antonio Galfano, Stefano Cavalleri

**Simple Enucleation  
semplice (SE) as an  
alternative to partial  
standard nephrectomy  
(SPN)**

**The medium thickness of the removed functioning tissue that surrounds the oscillate neoplasm is from 2.5 mm to 5 mm, and other studies clearly demonstrate that the minimum safety margin is from 0 mm to 1 mm from the tumor's margin.**

**· Summary of the most recent data from the literature: analysis of the mean, minimum, and maximum values of the safety margin of healthy tissue around the tumor during partial nephrectomy**

Study	Cases	Safety margin		Indications
		Mean value, mm	Range, mm	
Piper et al [10]	67	4.5	1-12	A safety margin <1 mm is sufficient.
Sutherland et al [11]	41	2.5	0.5-7	A minimum safety margin (2-5 mm) is sufficient.
Castilla et al [16]	69	3.5	0.5-9.5	The extension of the safety margin is not related to disease progression in patients with negative surgical margins.
Berdjis et al [13]	121	5	1-23	No correlations between safety margins and disease progression/local relapse.
Timsit et al [14]	61	Cortical: 7 Bottom: 2	4-10 0-5	Tumor localization and its more or less intraparenchymatous penetration sometimes render difficult a safety margin of 1 cm.
Li et al [15]	115	Cortical: 4.5 Bottom: 2.2	4-6 0-6	A <5-mm safety margin is sufficient.

# EAU Guidelines on Renal Cell Carcinoma: The 2010 Update

Börje Ljungberg<sup>a,\*</sup>, Nigel C. Cowan<sup>b</sup>, Damian C. Hanbury<sup>c</sup>, Milan Hora<sup>d</sup>, Markus A. Kuczyk<sup>e</sup>, Axel S. Merseburger<sup>e</sup>, Jean-Jacques Patard<sup>f</sup>, Peter F.A. Mulders<sup>g</sup>, Ioanel C. Sinescu<sup>h</sup>



As of today no guidelines exist on the optimal thickness of the functioning tissue removed. EAU guidelines recommend the presence of a **minimum** non-neoplastic tissue margin without particular indications.

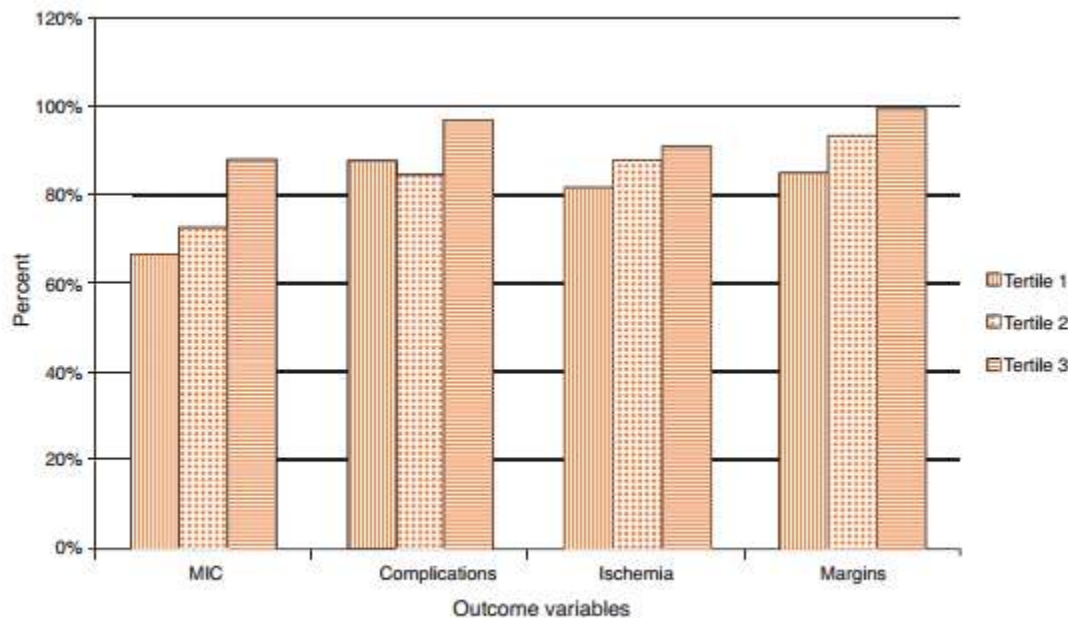


Fig. 1 – Overall margin, ischemia, and complications (MIC) rates by tertile and overall rates of separate outcome variables by tertile.

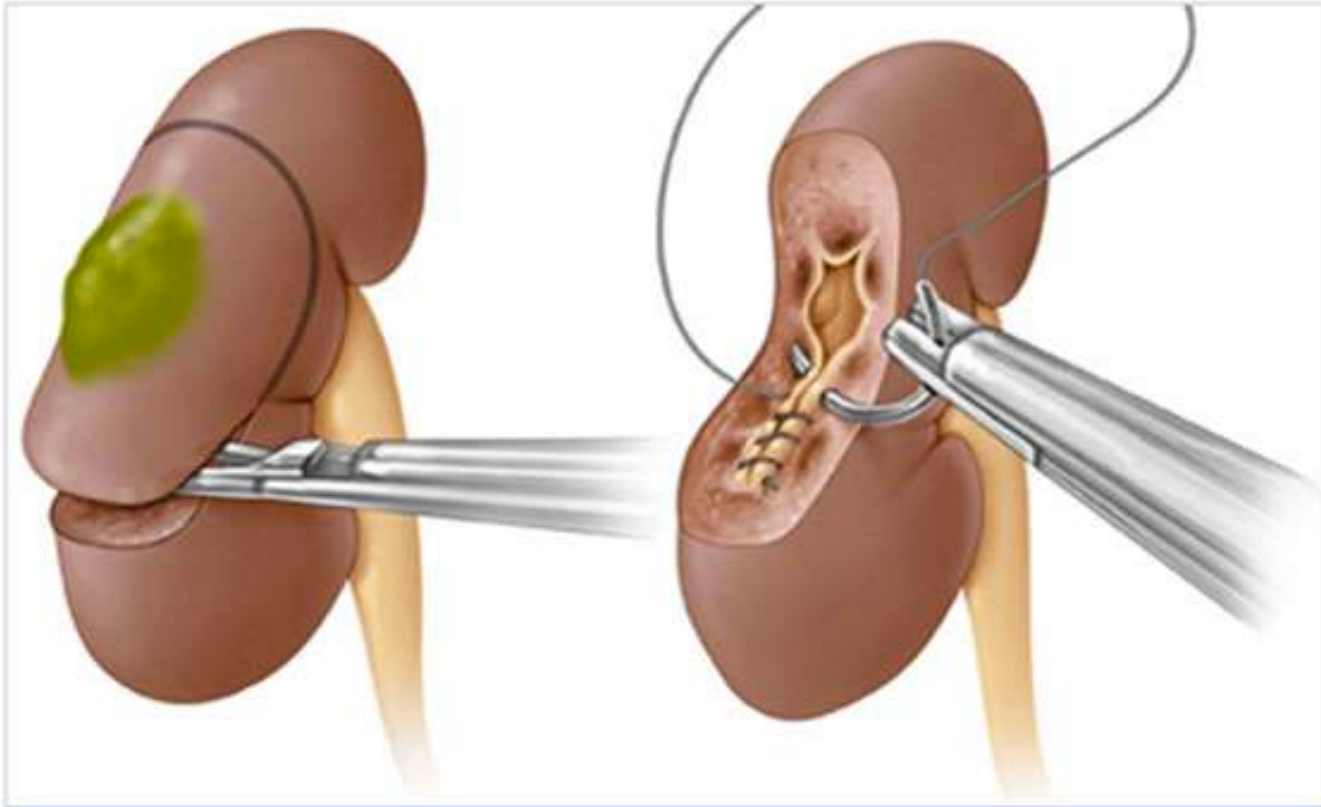
## Platinum Correspondence

Margin, Ischemia, and Complications (MIC) Score in Partial Nephrectomy: A New System for Evaluating Achievement of Optimal Outcomes in Nephron-sparing Surgery

Over the last years data has emerged that demonstrates the positive results of standard enucleation (SE).



# Recent past



The ideal indication of NSS in the presence of a contralateral functioning kidney and the presence of a lesion of a small dimension (**<4 cm**) solitary and esofytic, in a patient in good physical condition.

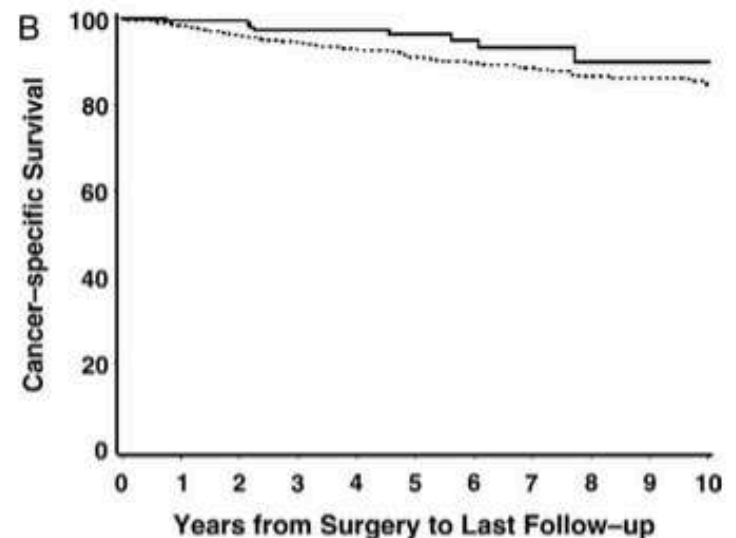
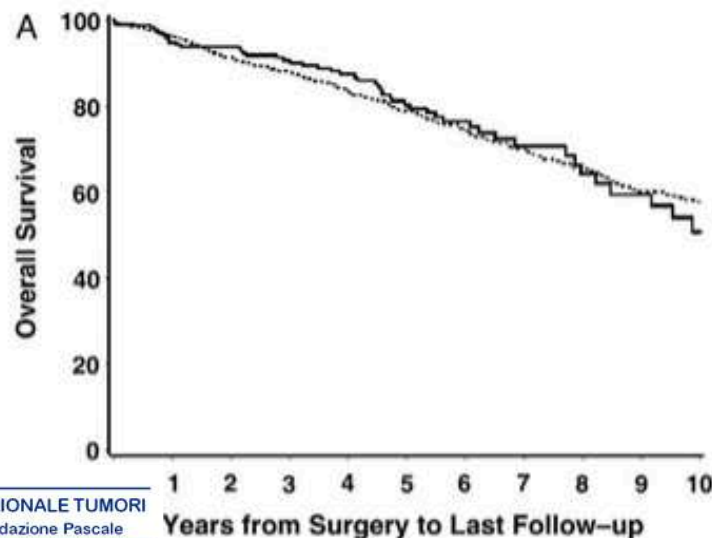
# Present

## Partial Versus Radical Nephrectomy for 4 to 7 cm Renal Cortical Tumors

R. Houston Thompson, Sameer Siddiqui, Christine M. Lohse, Bradley C. Leibovich, Paul Russo and Michael L. Blute\*

*From the Departments of Urology (RHT, SS, BCL, MLB) and Health Sciences Research (CML), Mayo Medical School and Mayo Clinic, Rochester, Minnesota, and Department of Surgery, Urology Service, Memorial Sloan-Kettering Cancer Center (RHT, PR), New York, New York*

For Lesions **larger than 4 cm** the survival rates and absence of recurrence, in patients treated with radical and partial surgery are similar.



# The future... or perhaps already the Present

Conservative surgery for **any lesion** because it is technically do-able and compatible with the technology available and experience level of the surgeon

# The ideal NSS treatment



**1. Oncologic control**

2. Preservazione funzionale

3. Morbidità chirurgica minima

# The ideal NSS treatment



- 1. Oncologic control**
- 2. Functioning preservation**
3. Morbidity chirurgica minima

# The ideal NSS treatment



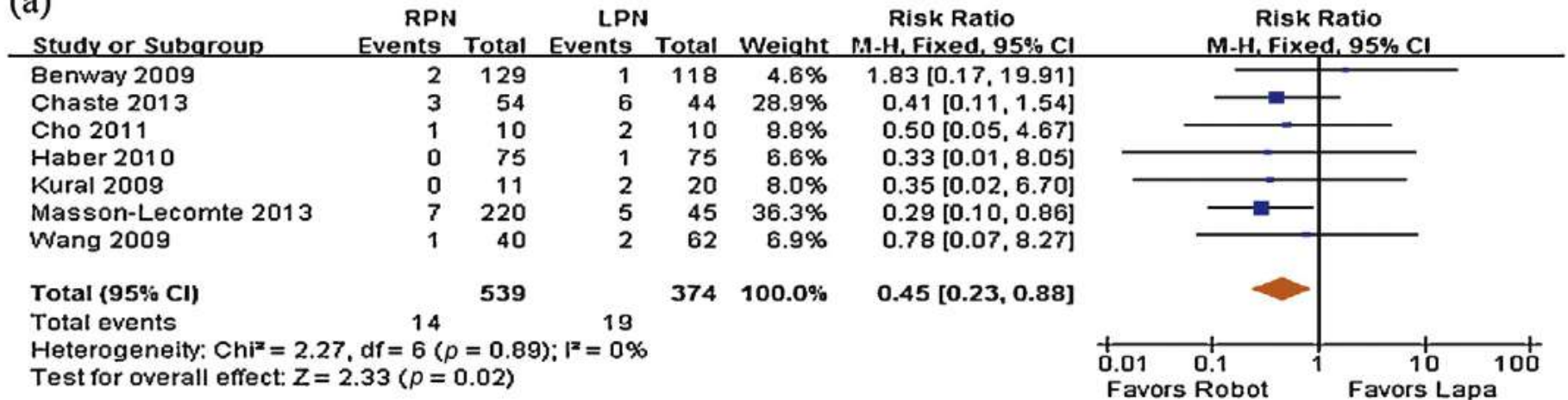
- 1. Oncologic control**
- 2. Functioning preservation**
- 3. Minimum surgical morbidity**

# A meta-analysis

## Laparoscopic vs. Robot assisted partial nephrectomy

- Meta-analysis of 23 studies, 2240 patients subject to LPN and RAPN
- No differences in complications (Clavien 3-5)  $p=0.78$
- RAPN **minor** conversions to open ( $p=.02$ ), **minor** conversions to radical nephrectomy ( $p=.0006$ ), **lower** ischemia time ( $p=.0005$ ), **minor** variations eGFR ( $p=0.03$ ), and **minor** hospital stay ( $p=0.004$ )

(a)



## COMPLICATIONS OF RADICAL AND PARTIAL NEPHRECTOMY IN A LARGE CONTEMPORARY COHORT

ANDREW J. STEPHENSON,\* A. ARI HAKIMI, MARK E. SNYDER AND PAUL RUSSO†

- **The presence of negative surgical margins is one of the greatest objectives of partial nephrectomy.**
- **In 2-8% of the cases the margins resulted positive.**
- **The presence of positive surgical margins as a risk factor for tumour recurrence is still a much discussed issue, but nonetheless requires closer surveillance.**



Quality of Parenchyma Prior to Surgery (non-modifiable)

↑↑↑  
p<0.001  
↓↓↓

Quantity of Preserved Parenchyma

p<0.001

Ultimate Renal Function

p<0.0001

Significant if > 25min

Warm Ischemia Time

Quality and Quantity Predominate

# Techniques for limiting renal damage.

- **Early Unclamping**
- Selective clamping
- Super-selective clamping
- **Anatomic, zero-ischemia surgery**
- Pre-placed sutures
- LigaSure
- Harmonic scalpel

Thomas et al, J Endourology, 2013; Simone et al, BJU, 2012; Rizkala et al, Urology, 2013; Desai et al, Eur Urol, 2014

# Cold vs. Warm Ischemia

- Temporal and Clinical Parameters:
    - Very close Ischemia interval (<20-25 minutes)
    - Induction of hypothermia
  - Renal function after PN is principally determined by the quantity and the quality of the renal parenchyma preserved
    - The duration of the ischemia is not an independent predictive factor
- The duration of ischemia (>25min) is predictive of AKI but not of GFR in one year

*Lane et al. J Urol 185:421, 2011; Thompson et al. Urology 2012; Zargar et al. J Endourol 2015*

# Factors Determining Renal Function after PN

## *Non-modifiable*

## *Modifiable*

**Quantity** - amount of parenchyma preserved

Ischemia type (warm vs. cold)

**Quality** - pre-operative GFR

Ischemia duration

Age

Tumor size

Tumor Location

***The objective is to preserve as much healthy tissue as possible***

## **Factors Determining Renal Function after PN**

***Non-modifiable***

***Modifiable***

Ischemia type (warm vs. cold)

**Quality - pre-operative GFR**

Ischemia duration

Age

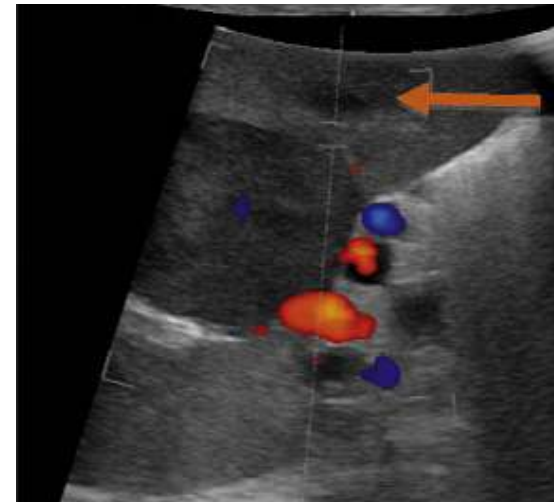
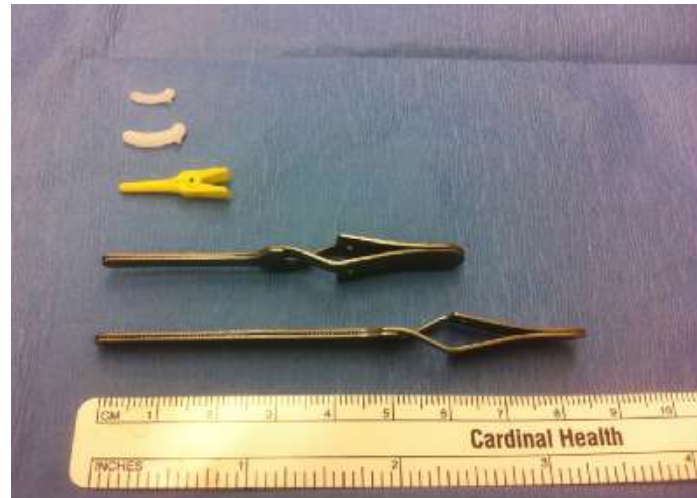
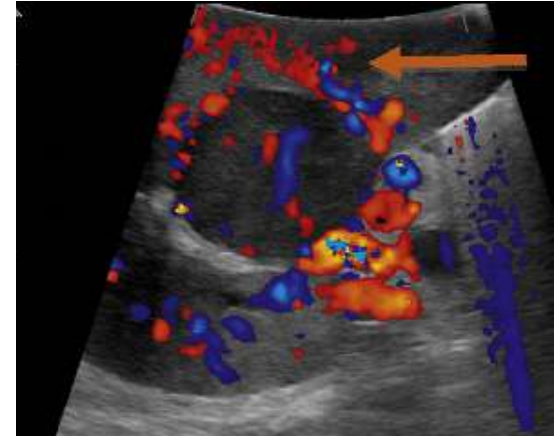
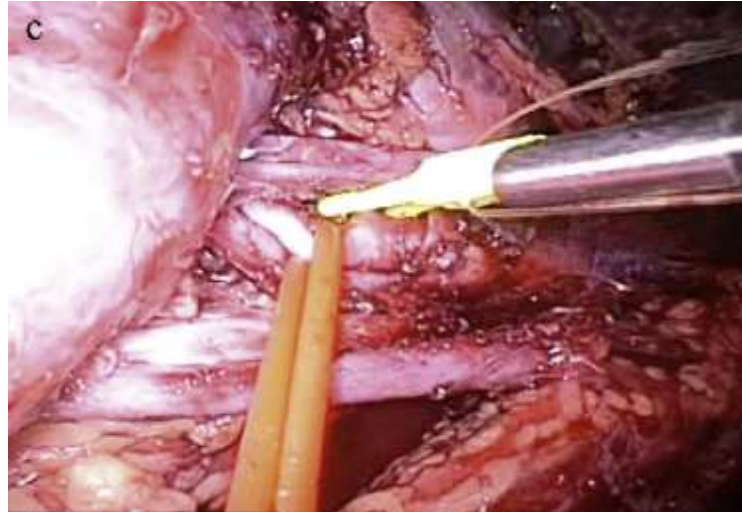
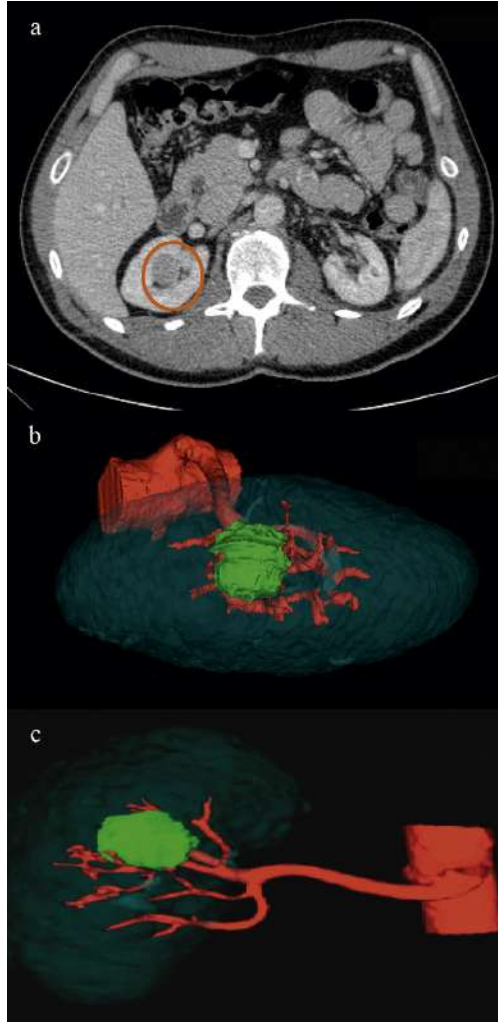
**Quantity - amount of parenchyma preserved**

Tumor size

Tumor Location



# “Zero” Ischemia PN: Technical Elements



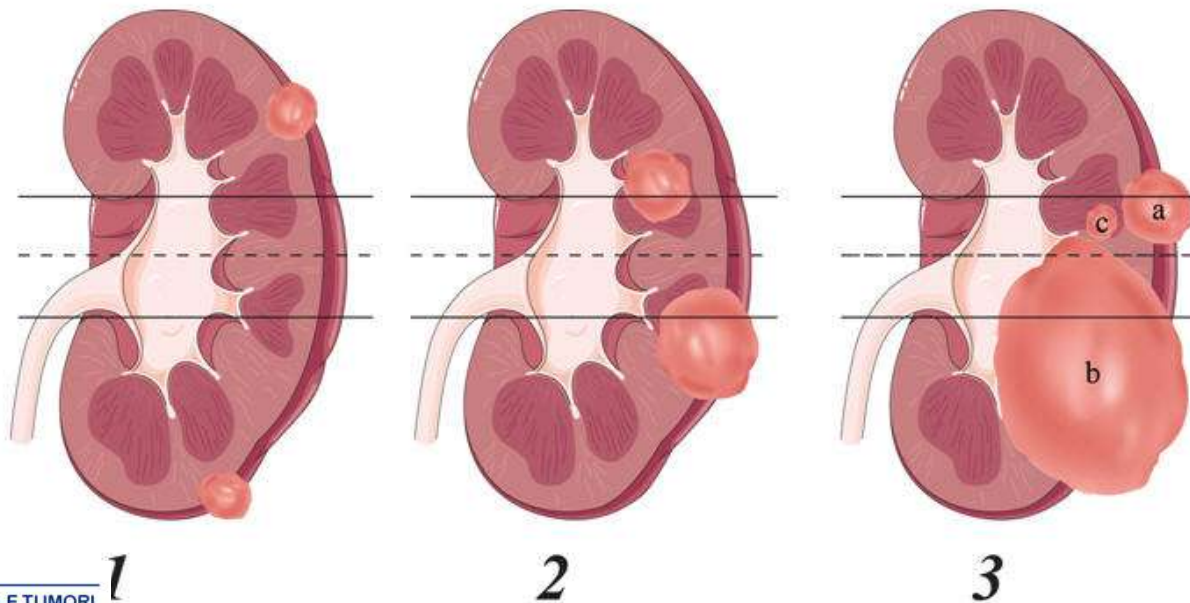
# MORPHOMETRIC CHARACTERISTICS

## R.E.N.A.L. Nephrometry Scoring System

FOX CHASE  
CANCER CENTER



	1pt	2pts	3 pts
<b>(R)adius (maximal diameter in cm)</b>	$\leq 4$	$>4$ but $< 7$	$\geq 7$
<b>(E)xophytic/endophytic properties</b>	$\geq 50\%$	$<50\%$	Entirely endophytic
<b>(N)earness of the tumor to the collecting system or sinus (mm)</b>	$\geq 7$	$>4$ but $<7$	$\leq 4$
<b>(A)nterior/Posterior</b>	No points given. Mass assigned a descriptor of a, p, or x		
<b>(L)ocation relative to the polar lines*</b>	Entirely above the upper or below the lower polar line	Lesion crosses polar line	$>50\%$ of mass is across polar line (a) <u>or</u> mass crosses the axial renal midline (b) <u>or</u> mass is entirely between the polar lines (c)
* suffix "h" assigned if the tumor touches the main renal artery or vein			





<b>RENAL Nephrometry Score</b>	<b>Degree of Case Complexity</b>
10 to 12	HIGH
7 to 9	MEDIUM
4 to 6	LOW



# PREOPERATIVE PLANNING

- **Patient evaluation**
  - BMI Characteristics, sex, PS
  - Clinical stage
  - ASA score
- **Neoplasia evaluation**
  - Dimensions, location, endofytic development and proximity with the collector system and vessels pre-operatively evaluated with CT or MRI imaging (RENAL nephrometry score)

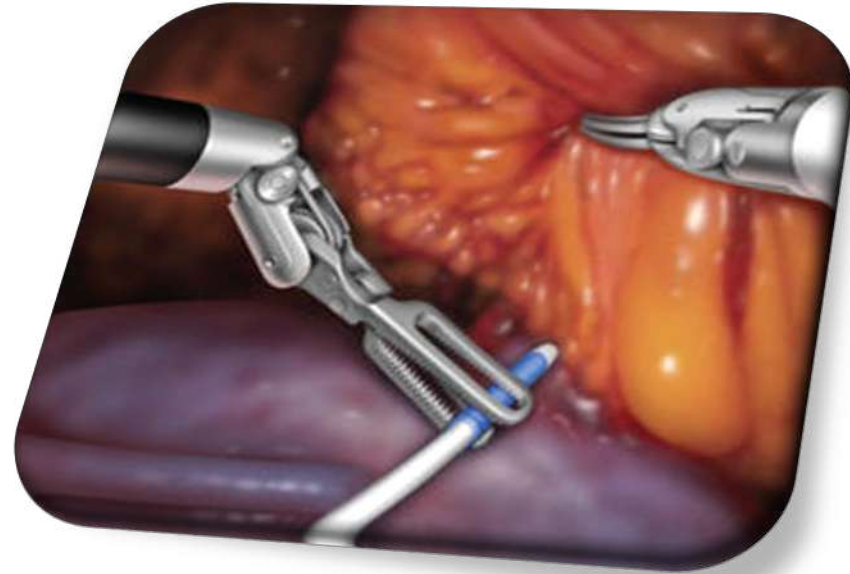


# ROBOTIC INSTRUMENTS

- **with Vinci Si**
- **configuration 3-arm**
- **Instruments**
  - **30° down scope**
  - **Maryland bipolar o PK forceps**
  - **Hot Shears monopolar curved scissors**
  - **Large needle driver**

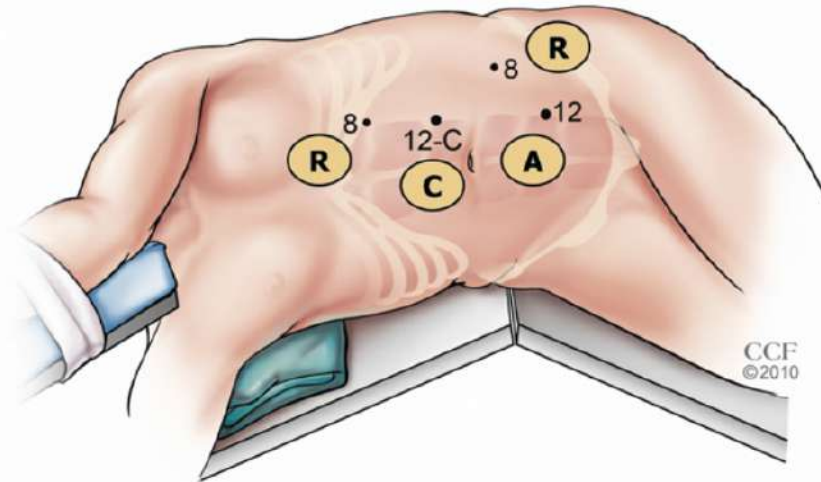
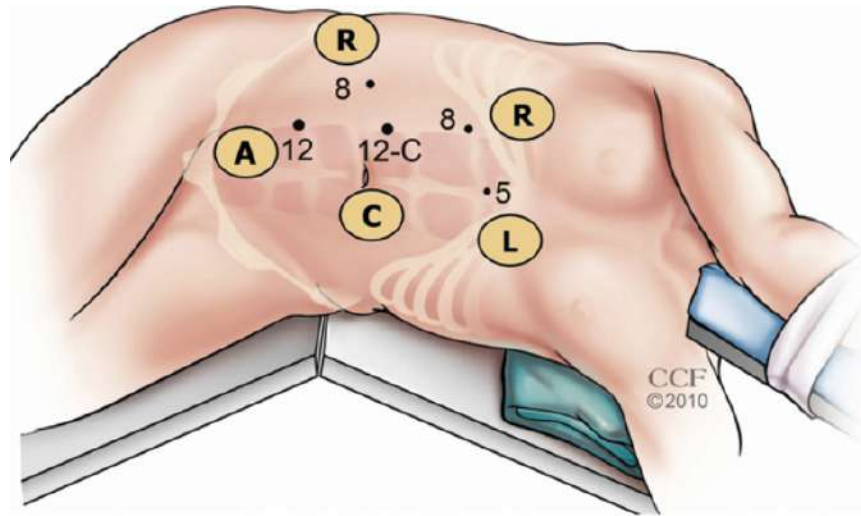


# Additional Instruments



# Configuration

(trans peritoneal approach)

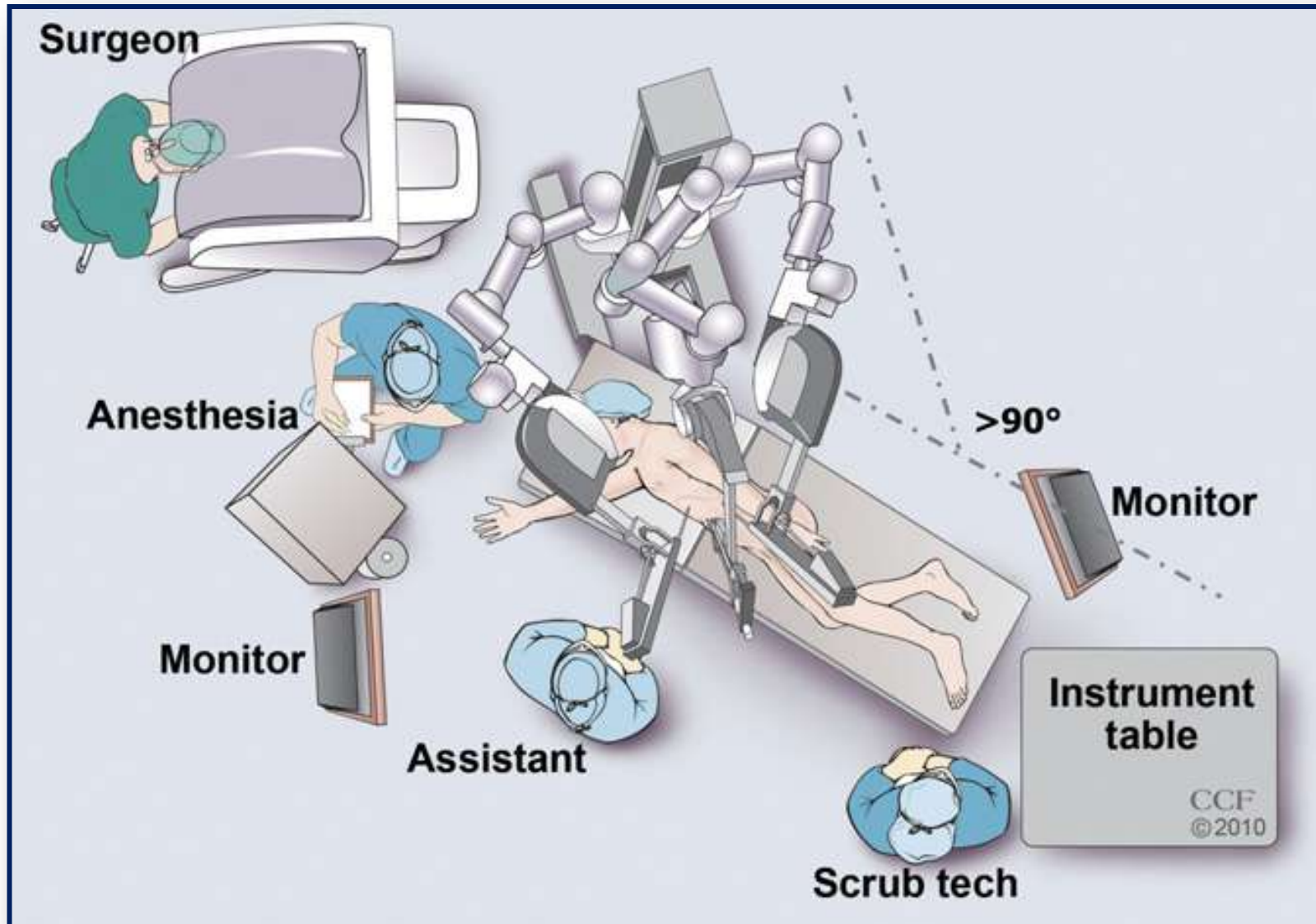


# Trocar configuration: Variations on a theme

- Vary according to the seat of the neoplasm with the scope of optimizing the work angles.
- **Upper neoplasm pole:** entry port shifted 1-2-cm upward
- **Posterior Neoplasm:** entry port shifted medial to allow easy access to the posterior face of the kidney after the medial rotation.
- **Obese Patients:** entry port laterally shifted
- A trocar-assistant 5-mm between optic and the robot's right arm can optimize an assistant help in the field.



# Robot docking



# A multicentre matched-pair analysis comparing robot-assisted versus open partial nephrectomy

Vincenzo Ficarra<sup>1</sup>, Andrea Minervini<sup>2</sup>, Alessandro Antonelli<sup>3</sup>, Sam Bhayani<sup>4</sup>, Giorgio Guazzoni<sup>5</sup>, Nicola Longo<sup>6</sup>, Giuseppe Martorana<sup>7</sup>, Giuseppe Morgia<sup>8</sup>, Alexander Mottrie<sup>9</sup>, James Porter<sup>10</sup>, Claudio Simeone<sup>3</sup>, Gianni Vittori<sup>2</sup>, Filiberto Zattoni<sup>11</sup> and Marco Carini<sup>2</sup>

Intraoperative variable	RAPN N = 200	OPN N = 200	P
Artery clamping, n (%)	180 (90)	138 (69)	<0.001
Median (IQR; range) WIT, min	18 (14–23; 5–51)	15 (11–19; 4–34)	<0.001
N (%):			
WIT >20 min	61 (30.5)	21 (10.5)	<0.001
WIT >25 min	31 (15.5)	8 (4)	0.002
WIT >30 min	10 (5)	2 (1)	0.06
Median (IQR) EBL, mL	100 (50–150)	150 (100–300)	<0.001
Median (IQR) operating time, min	120 (90–157)	127 (96–166)	0.19
Intraoperative complications, n (%)	1 (0.5)	3 (1.5)	0.31
Median (IQR) length of stay (including day of surgery), days	6 (5–6)	7 (6–8)	0.014
n/N (%):			
Postoperative overall complications	28/200 (14)	43/200 (21.5)	0.027
Clavien severity grade:			
1–2	19 (9.5)	34 (17)	0.030
3	8 (4)	7 (3.5)	0.34
4	1 (0.5)	2 (1)	–
Transfusion rate	21/200 (10.5)	20/200 (10)	0.78

## Conclusion

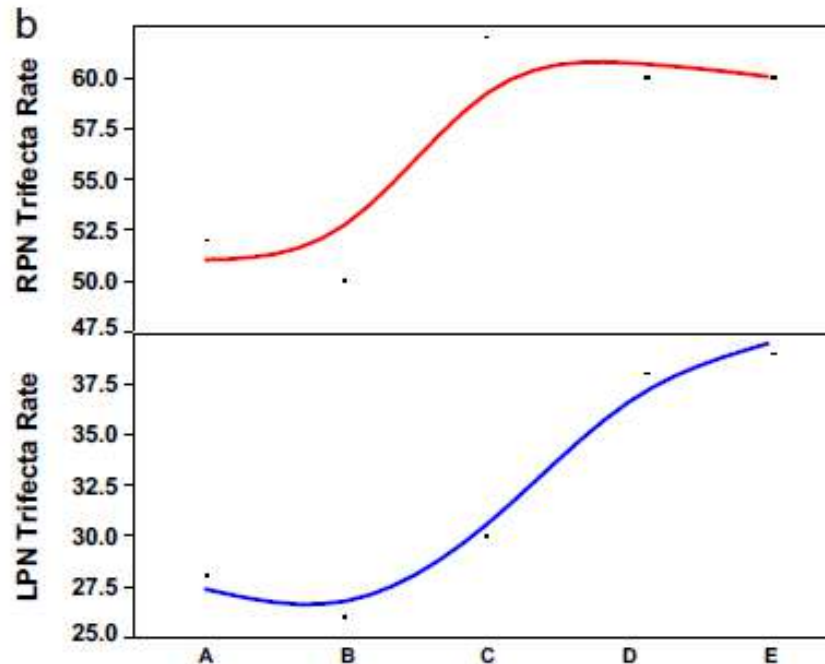
RAPN can achieve equivalent perioperative, early oncological and functional outcomes as OPN. Moreover, RAPN is a less invasive approach, offering a lower risk of bleeding and postoperative complications than OPN.



# RAPN: The era of the TRIFECTA

## Comparative Outcomes and Assessment of Trifecta in 500 Robotic and Laparoscopic Partial Nephrectomy Cases: A Single Surgeon Experience

Ali Khalifeh, Riccardo Autorino, Shahab P. Hillyer, Humberto Laydner, Remi Eyraud, Kamol Panumatrassamee, Jean-Alexandre Long and Jihad H. Kaouk\*,†





## Platinum Correspondence

**Margin, Ischemia, and Complications (MIC) Score in Partial Nephrectomy: A New System for Evaluating Achievement of Optimal Outcomes in Nephron-sparing Surgery**

The objective of the NSS is obtained when:

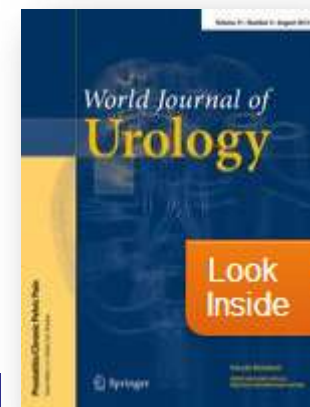
***1) WIT is low***

***2) Surgical margins are negative***

***3) No evidence of further complications***

## Validation of the preoperative aspects and dimensions used for an anatomical (PADUA) score in a robot-assisted partial nephrectomy series

Alexander Mottrie · Peter Schatteman ·  
Peter De Wil · Bart De Troyer · Giacomo Novara ·  
Vincenzo Ficarra



# Independent Predictors of WIT >20 min.

**Surgical  
Experience**

**Anatomic  
tumor  
characteristics**

**pathological  
tumor  
characteristics**

# Every minute counts!.....

available at [www.sciencedirect.com](http://www.sciencedirect.com)  
journal homepage: [www.europeanurology.com](http://www.europeanurology.com)



European Association of Urology



## Platinum Priority – Kidney Cancer

Editorial by Antonio Alcaraz on pp. 346–348 of this issue

## Every Minute Counts When the Renal Hilum Is Clamped During Partial Nephrectomy

R. Houston Thompson<sup>a,\*</sup>, Brian R. Lane<sup>b,1</sup>, Christine M. Lohse<sup>a</sup>, Bradley C. Leibovich<sup>a</sup>,  
Amr Fergany<sup>b</sup>, Igor Frank<sup>a</sup>, Inderbir S. Gill<sup>c</sup>, Michael L. Blute<sup>a</sup>, Steven C. Campbell<sup>b</sup>

<sup>a</sup> Mayo Medical School and Mayo Clinic, Rochester, MN, USA

<sup>b</sup> Glickman Urological Institute; Cleveland Clinic Foundation, Cleveland, OH, USA

<sup>c</sup> Keck School of Medicine, University of Southern California, Los Angeles, CA, USA

### Article info

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#### Keywords:

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Kidney neoplasms  
Postoperative complications  
Nephrectomy

### Abstract

**Background:** The safe duration of warm ischemia during partial nephrectomy remains controversial.

**Objective:** Our aim was to evaluate the short- and long-term renal effects of warm ischemia in patients with a solitary kidney.

**Design, setting, and participants:** Using the Cleveland Clinic and Mayo Clinic databases we identified 362 patients with a solitary kidney who underwent open ( $n = 319$ ) or laparoscopic ( $n = 43$ ) partial nephrectomy using warm ischemia with hilar clamping.

**Measurements:** Associations of warm ischemia time with renal function were evaluated using logistic or Cox regression models first as a continuous variable and then in 5-min increments.

# .....or maybe not?

J Urol. 2011 Aug;186(2):405-10. doi: 10.1016/j.juro.2011.03.154. Epub 2011 Jun 15.

## **Effect of parenchymal volume preservation on kidney function after partial nephrectomy.**

Simmons MN<sup>1</sup>, Fergany AF, Campbell SC.

**CONCLUSIONS:** These data support the notion that preoperative nephron endowment and the percent of functional volume preservation are the primary determinants of the long-term functional outcome after partial nephrectomy in patients with normal preoperative kidney function who have ischemia time within acceptable limits.

J Urol. 2012 May;187(5):1667-73. doi: 10.1016/j.juro.2011.12.068. Epub 2012 Mar 15.

## **Functional recovery after partial nephrectomy: effects of volume loss and ischemic injury.**

Simmons MN<sup>1</sup>, Hillver SP, Lee BH, Fergany AF, Kaouk J, Campbell SC.

**CONCLUSIONS:** In this cohort volume loss and not ischemia time was the primary determinant of ultimate renal function after partial nephrectomy. Technical modifications aimed at minimizing volume loss during partial nephrectomy while still achieving negative margins may result in improved functional outcomes.

J Urol. 2013 May;189(5):1638-42. doi: 10.1016/j.juro.2012.11.042. Epub 2012 Nov 13.

## **Association between warm ischemia time and renal parenchymal atrophy after partial nephrectomy.**

Simmons MN<sup>1</sup>, Lieser GC, Fergany AF, Kaouk J, Campbell SC.

**CONCLUSIONS:** In most patients with warm ischemia time less than 40 minutes the incidence of parenchymal atrophy was minimal, suggesting that the kidney volume decrease after partial nephrectomy was predominantly resection related. Kidney volume decrease after partial nephrectomy in patients with warm ischemia time greater than 40 minutes appeared to be due to a combination of resection related and atrophy related changes.

# Conclusions

**RAPN is by now widely standardized and is increasingly being adapted by reference centers**

**Absolutely replicates the principles of the actual gold standard (partial open nephrectomy)**

**Consents to expand the indications of LPN with potentially better outcomes**

**RAPN is inevitably destined to become a new gold standard for a minimally invasive partial nephrectomy wherever robotic technology is available.**