PENN UROLOGY

Penn Medicine
ABRAMSON CANCER CENTER

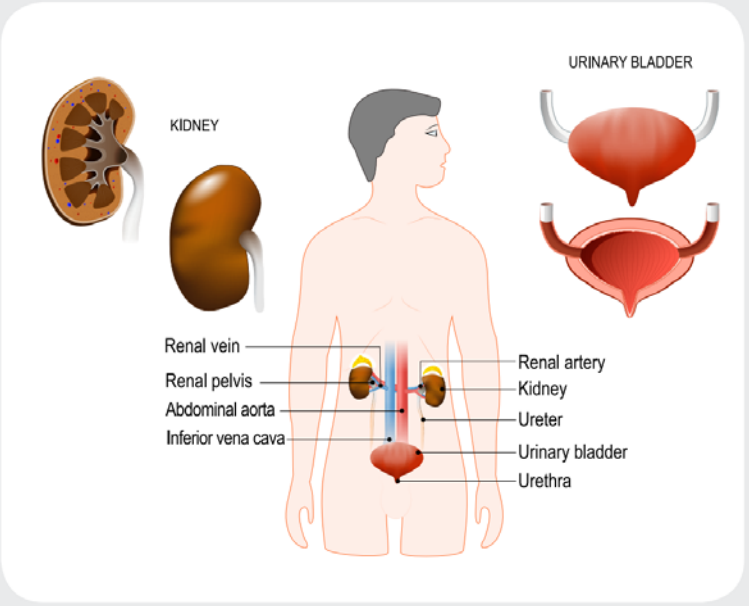
My surgery for kidney cancer

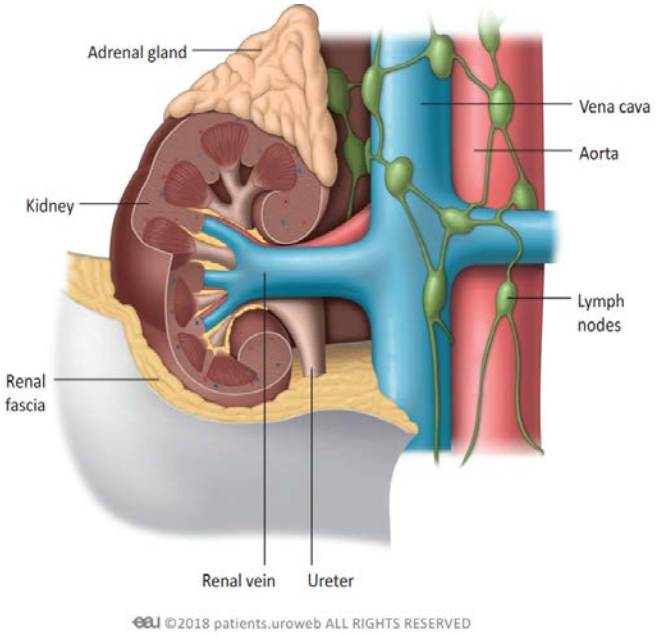
Thomas J. Guzzo, MD, MPH
Chief, Division of Urology
Associate Professor of Surgery (Urology)
University of Pennsylvania Healthy System

Kidneys

Figure 1
The kidneys and urinary system

The kidneys are a pair of organs in the abdomen. The kidneys are the main organs of the urinary system. They filter waste out of blood and make urine. The ureters, bladder, and urethra hold and transport urine before it is released from the body.

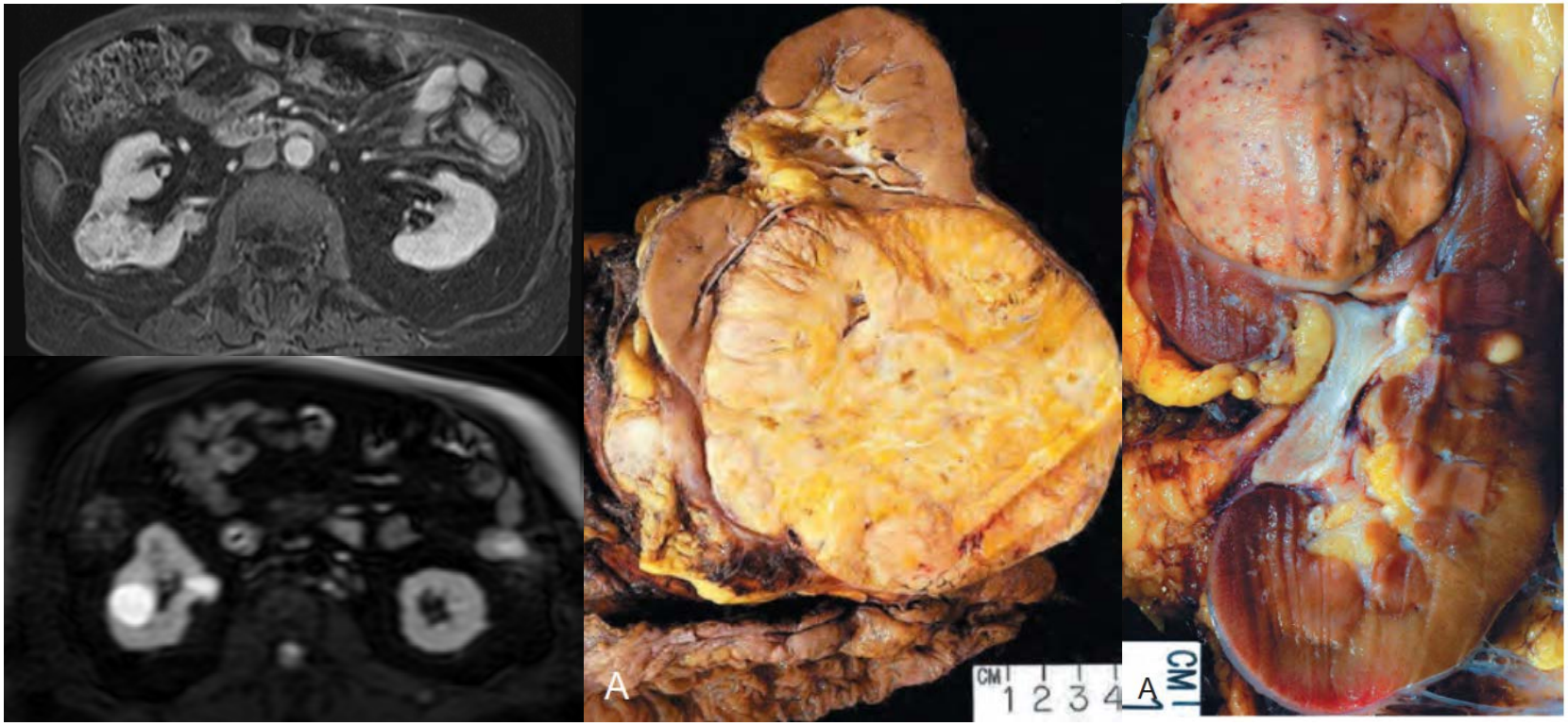




https://www.nccn.org/patients/guidelines/kidney/index.html
https://patients.uroweb.org/kidney-cancer/

PENN UROLOGY

Kidney cancer



Malignant cell growth (a tumor) in the kidneys

Campbell-Walsh urology / editor-in-chief, Alan J. Wein ; editors, Louis R. Kavoussi, Alan W. Partin, Craig A. Peters.—Eleventh edition.

PENN UROLOGY

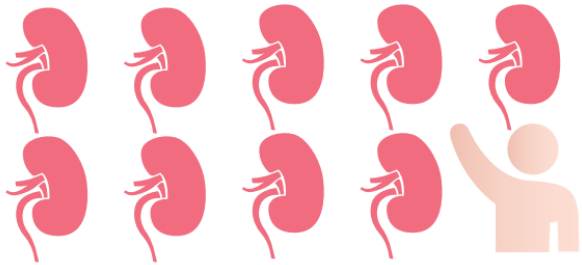
Renal mass vs. kidney cancer vs. renal cell carcinoma (RCC)

- Not all renal masses are cancer, but most of them are (~ 85%)
- Bigger mass = more likely cancer
- Most kidney cancer called RCC

Tumor Size (cm)	No. Benign (%)	No. RCC (%)
0.0–Less than 1.0	37 (46.3)	43 (53.8)
1.0–Less than 2.0	38 (22.4)	132 (77.7)
2.0–Less than 3.0	75 (22.0)	266 (78.0)
3.0–Less than 4.0	71 (19.9)	285 (80.1)
4.0–Less than 5.0	37 (9.9)	336 (90.1)
5.0–Less than 6.0	40 (13.0)	267 (87.0)
6.0–Less than 7.0	11 (4.5)	232 (95.5)
7.0 or Greater	67 (6.3)	998 (93.7)

Percentages indicate the proportion of tumors in each size category that are benign or RCC, respectively.

Renal Cell Carcinoma (RCC)
About 9 out of 10 kidney cancers are RCCs.

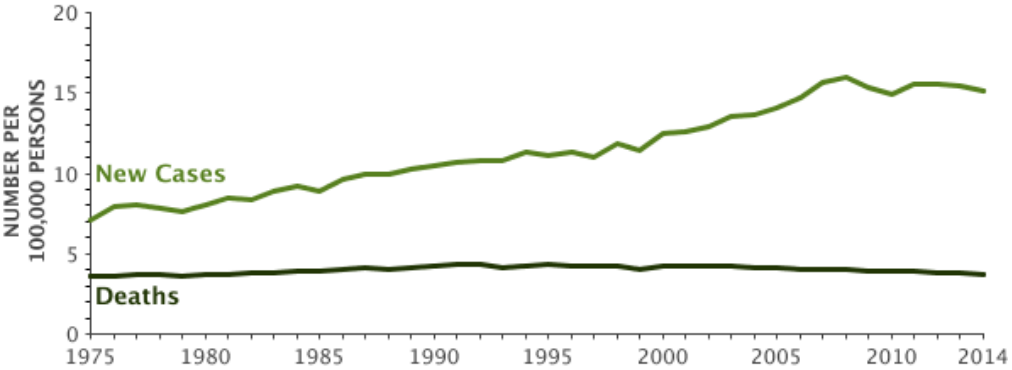


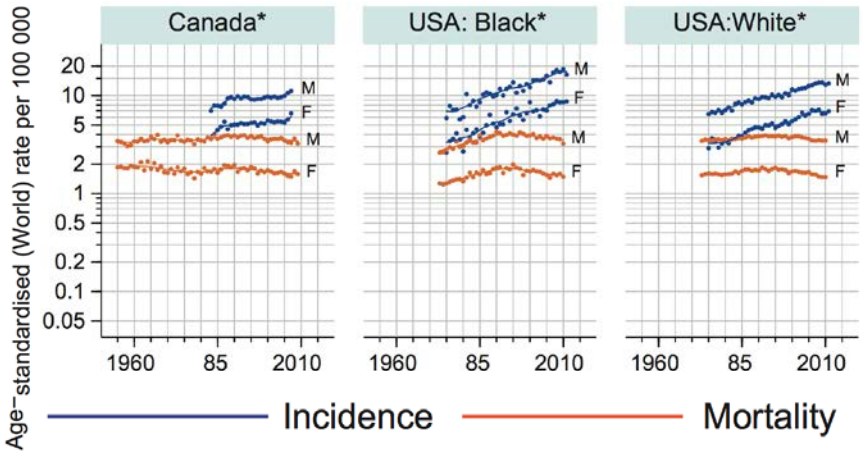
J Urol 2003, 170:2217
https://www.nccn.org/patients/guidelines/kidney/index.html

PENN UROLOGY

Incidence in United States

- The incidence of kidney cancer has been increasing steadily since the 1970's (USA)
- Due to more prevalent use of axial imaging (CT/MRI)
- Continue to increase over last decade, about 1% per/year (USA)





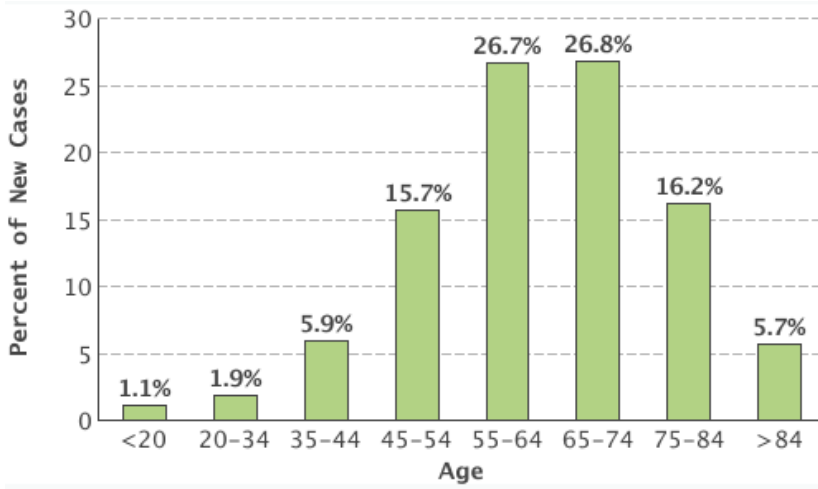
Eur J Cancer Prev 2002; 11: 171
Eur Urol 2015; 67: 519
Urol Clin North Am. 2008; 35(4):581
https://seer.cancer.gov/statfacts/html/kidrp.html

PENN UROLOGY

Kidney cancer demographics, 2019

Estimated New Cases

Males			Females		
Prostate	174,650	20%	Breast	268,600	30%
Lung & bronchus	116,440	13%	Lung & bronchus	111,710	13%
Colon & rectum	78,500	9%	Colon & rectum	67,100	8%
Urinary bladder	61,700	7%	Uterine corpus	61,880	7%
Melanoma of the skin	57,220	7%	Melanoma of the skin	39,260	4%
Kidney & renal pelvis	44,120	5%	Thyroid	37,810	4%
Non-Hodgkin lymphoma	41,090	5%	Non-Hodgkin lymphoma	33,110	4%
Oral cavity & pharynx	38,140	4%	Kidney & renal pelvis	29,700	3%
Leukemia	35,920	4%	Pancreas	26,830	3%
Pancreas	29,940	3%	Leukemia	25,860	3%
All Sites	**870,970**	**100%**	**All Sites**	**891,480**	**100%**



- Male: 6th most common cancer diagnosis
- Female: 7th most common cancer diagnosis
- Male > Female 2:1
- Most frequently diagnosed at age 55-74
- Median age at diagnosis: 64
- About 14,770 people (9,820 men and 4,950 women) will die from this disease

CA Cancer J Clin. 2019 Jan;69(1):7-34
SEER 18 2010-2014

PENN UROLOGY

Kidney cancer diagnosis

- Most kidney cancers are found by chance during imaging tests for other health problems
- Majority asymptomatic
- About 1 in 10 people do experience symptoms like pain in the side of the body, abdominal mass or blood in the urine
- Bone pain or a persistent cough could be signs that the cancer has spread through the body. This is known as metastatic disease

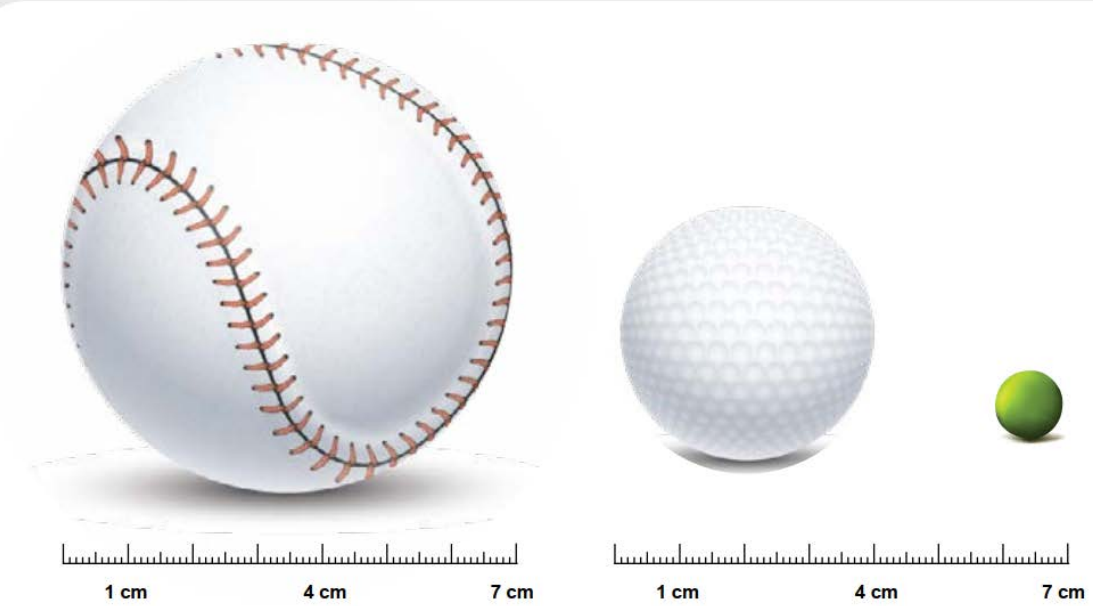
https://patients.uroweb.org/kidney-cancer/

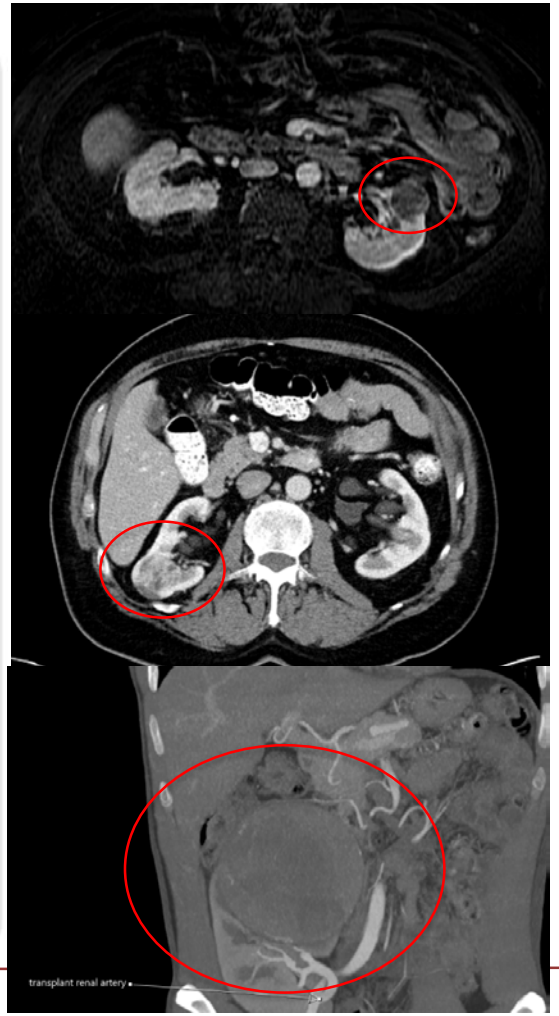
PENN UROLOGY

Size is important

Figure 5
Kidney tumors are measured in centimeters

A baseball is 7 cm, a golf ball is 4 cm, and a pea is 1 cm.

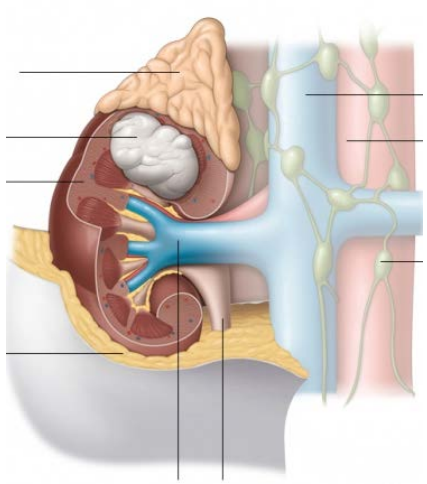




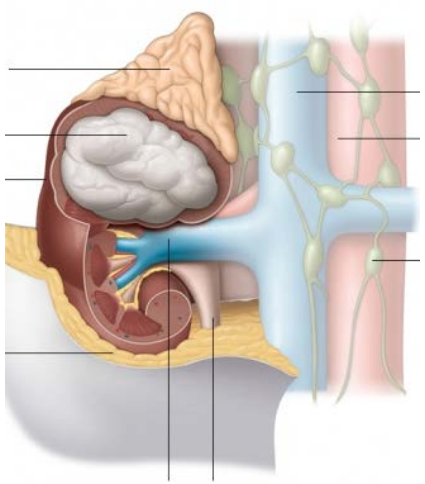
https://www.nccn.org/patients/guidelines/kidney/index.html

PENN UROLOGY

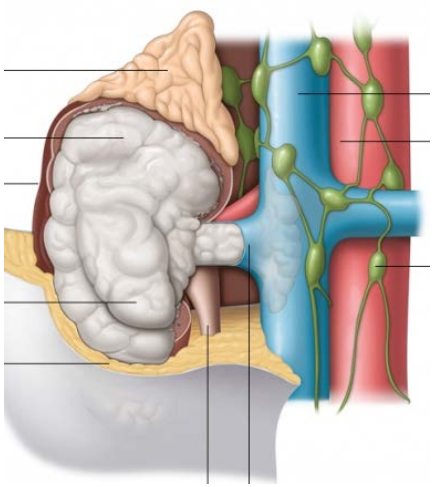
Stages of kidney cancer (TNM staging)



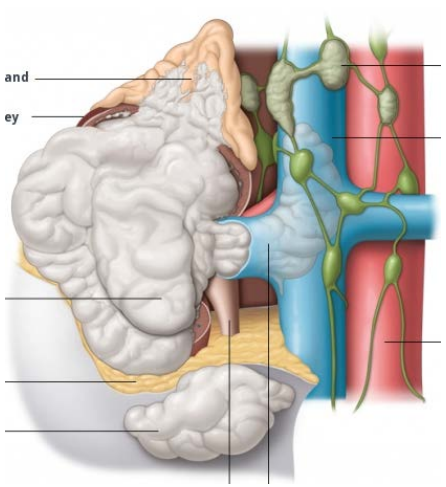
T Stage 1
Tumor ≤7 cm confined to kidney



T Stage 2
Tumor >7 cm confined to kidney



T Stage 3
Spread into renal vein, perirenal fat, or the vena cava

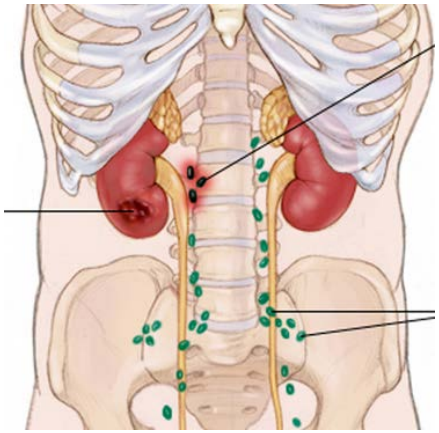


T Stage 4
Spread beyond renal fascia and into the adrenal gland

https://patients.uroweb.org/kidney-cancer/

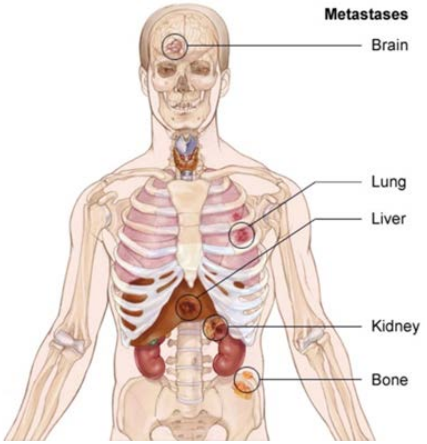
PENN UROLOGY

Stages of kidney cancer (TNM staging)



N0 - No metastasis in lymph node

N1 - Metastasis in regional lymph node



M0 - No distant metastasis

M1 - Distant metastasis

Lung (75%)

Soft tissues (36%)

Bone (20%)

Liver (18%)

Cutaneous sites (8%)

CNS (8%)

https://patients.uroweb.org/kidney-cancer/

PENN UROLOGY

Stages of kidney cancer (TNM staging)

Majority

Stage	Primary tumor (T)	Regional lymph nodes (N)	Distant metastasis (M)
Stage I	**T1** Tumor is 7 cm or smaller and found only in kidney	**N0** There is no cancer in nearby lymph nodes	**M0** Cancer has not spread to other parts of the body
Stage II	**T2** Tumor is larger than 7 cm and found only in the kidney	**N0**	**M0**
Stage III	**T1 or T2**	**N1** There is cancer (metastasis) in nearby lymph nodes	**M0**
	T3 Tumor has grown outside the kidney into major veins and tissues, but not into Gerota's fascia	**N0 or N1**	**M0**
Stage IV	**T4** Tumor has grown beyond Gerota's fascia	**Any N**	**M0**
	Any T	**Any N**	**M1** Cancer has spread to other parts of body (metastasized)

https://www.nccn.org/patients/guidelines/kidney/index.html

PENN UROLOGY

Stage migration

- The greatest increase in incidence has been in small, clinically localized kidney cancers (Stage I [T1N0M0])
- The size of stage I cancers decreases

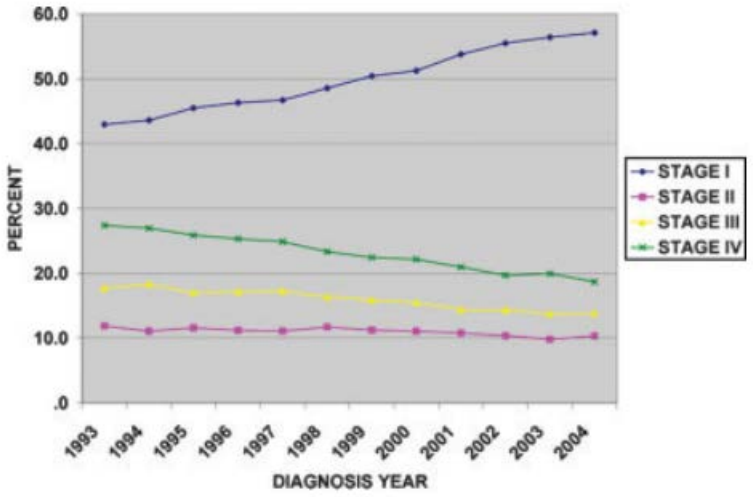
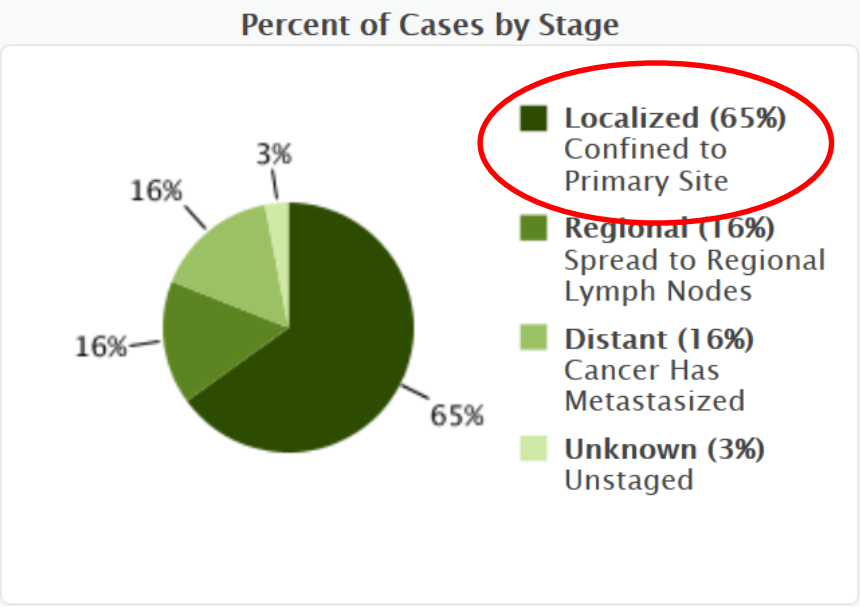


FIGURE 1. Renal cell carcinoma (RCC) stage distribution by diagnosis year.



https://www.nccn.org/patients/guidelines/kidney/index.html

PENN UROLOGY

Survival and cancer stages

TABLE 57-10 Tumor, Node, Metastasis (TNM) Stage and 5-Year Survival for Renal Cell Carcinoma

FINDINGS	ROBSON STAGE	TNM (2002)	TNM (2009)	5-YEAR SURVIVAL (%)
Organ-confined (overall)	I	T1-2N0M0	T1-2N0M0	70-90
≤4.0 cm	I	T1aN0M0	T1aN0M0	90-100
>4.0 cm to 7.0 cm	I	T1bN0M0	T1bN0M0	80-90
>7.0 to 10.0 cm	I	T2N0M0	T2aN0M0	65-80
>10.0 cm	I	T2N0M0	T2bN0M0	50-70
Invasion of perinephric or renal sinus fat	II	T3aN0M0	T3aN0M0	50-70
Invasion of renal vein or branches	IIIA	T3bN0M0	T3aN0M0	40-60
Invasion of IVC below diaphragm	IIIA	T3cN0M0	T3bN0M0	30-50
Invasion of IVC above diaphragm or invasion of IVC wall	IIIA	T3cN0M0	T3cN0M0	20-40
Direct adrenal involvement	II	T3aN0M0	T4N0M0	0-30
Locally advanced (invasion beyond Gerota fascia)	IVA	T4N0M0	T4N0M0	0-20
Lymph node involvement	IIIB	(Any)TN1-2M0	Any)TN1M0	0-20
Systemic metastases	IVB	(Any)T(Any)NM1	(Any)T(Any)NM1	0-10

IVC, inferior vena cava.
Data from Hafez et al, 1999; Leibovich et al, 2005a; Thompson et al, 2005a; Lane and Kattan, 2008; Campbell et al, 2009; Martinez-Salamanca et al, 2011; and Haddad and Rini, 2012.

Campbell-Walsh urology / editor-in-chief, Alan J. Wein ; editors, Louis R. Kavoussi, Alan W. Partin, Craig A. Peters.—Eleventh edition.

PENN UROLOGY

Kidney cancer treatment

- **Surgery**
- Active surveillance
- Thermal ablation
- Targeted therapy
- Immunotherapy
- Clinical trials

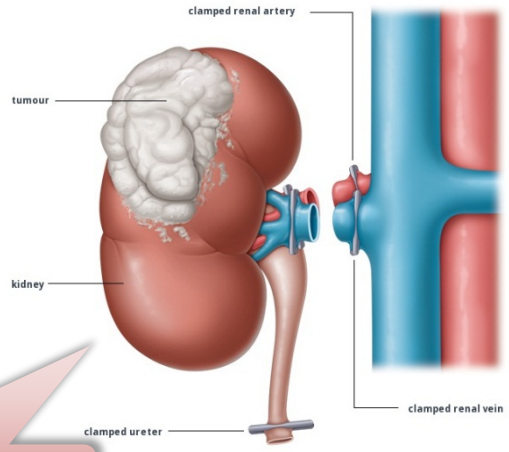
- Cancer stages
- Cancer complexities
- General health
- Your preferences for treatment

Surgery is the main treatment for the majority of kidney cancers, with the goal of removing the tumor and preserving normal kidney function.

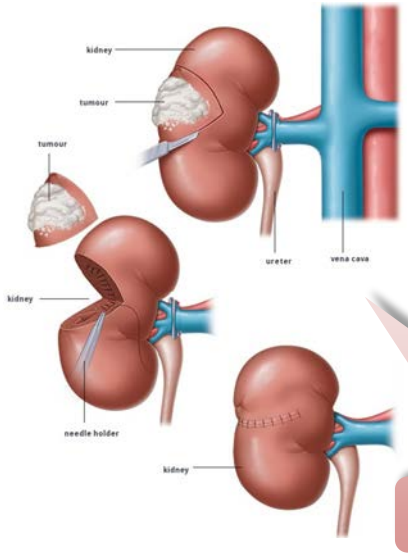
PENN UROLOGY

Surgical treatment

Stage	Surgery	Approach	Recommendations
T1	Nephron-sparing surgery	Open	Recommended standard
		Laparoscopic/Robotic	Optional in experienced centres
	Radical nephrectomy		In patients not suitable for nephron-sparing surgery
T2	Radical nephrectomy	Laparoscopic/Robotic	Recommended standard
	Nephron-sparing surgery		Recommended in selected patients in experienced centres
T3, T4	Radical nephrectomy	Open	Recommended standard for most patients
		Laparoscopic/Robotic	Feasible in selected patients



Radical nephrectomy

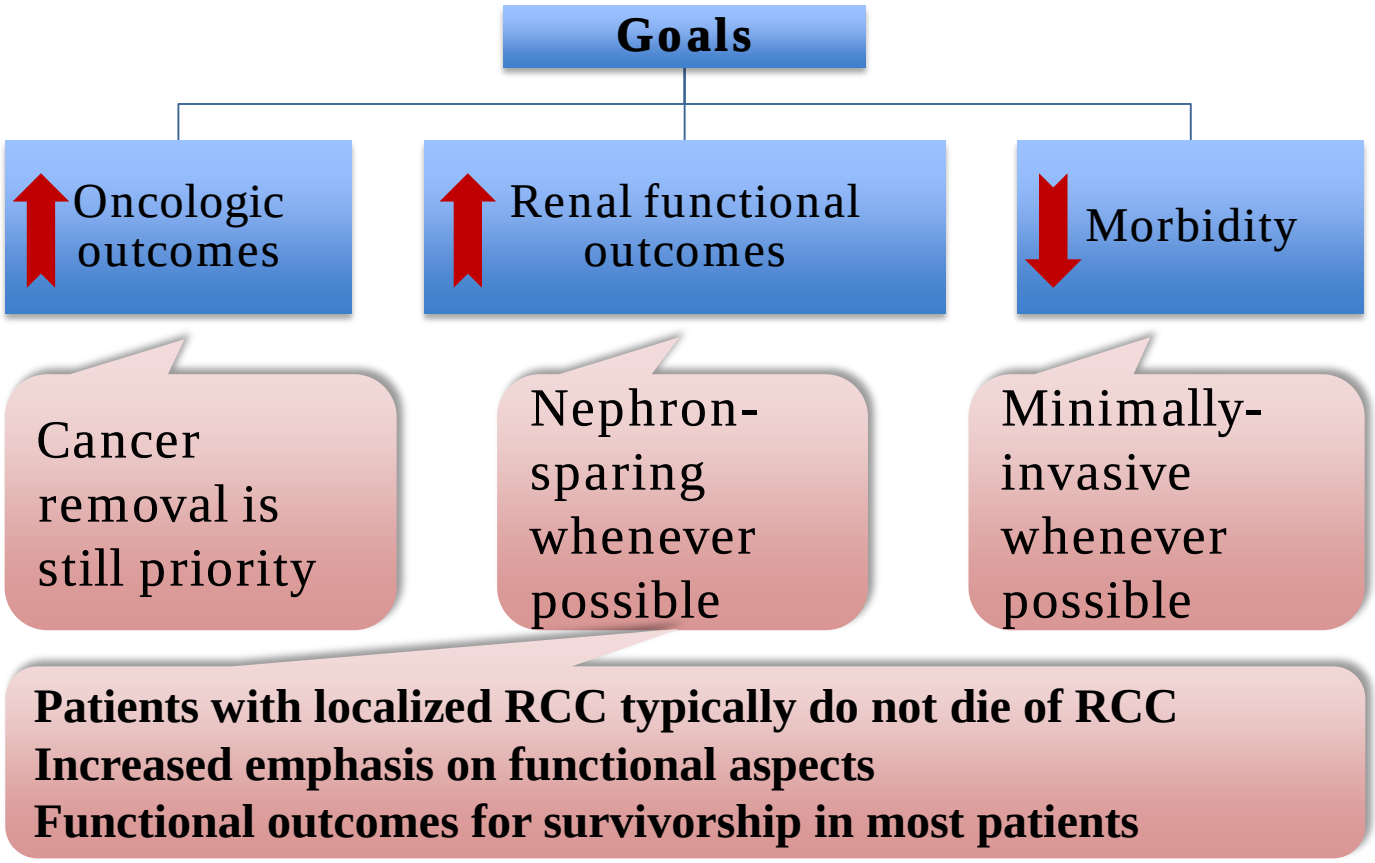


Partial nephrectomy

https://patients.uroweb.org
EAU guidelines, RCC

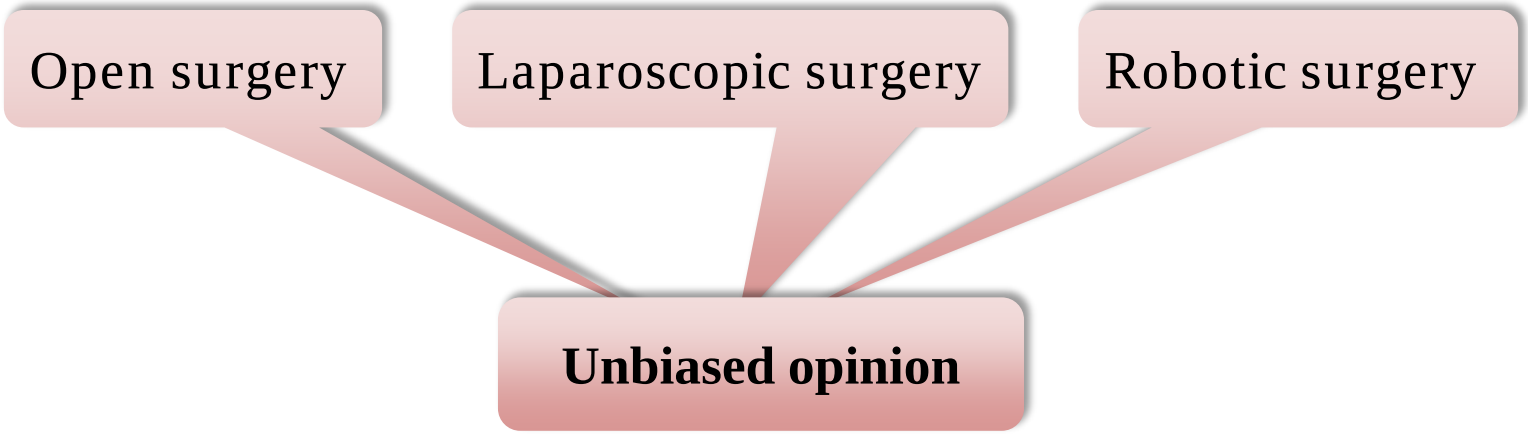
PENN UROLOGY

My surgery for kidney cancer



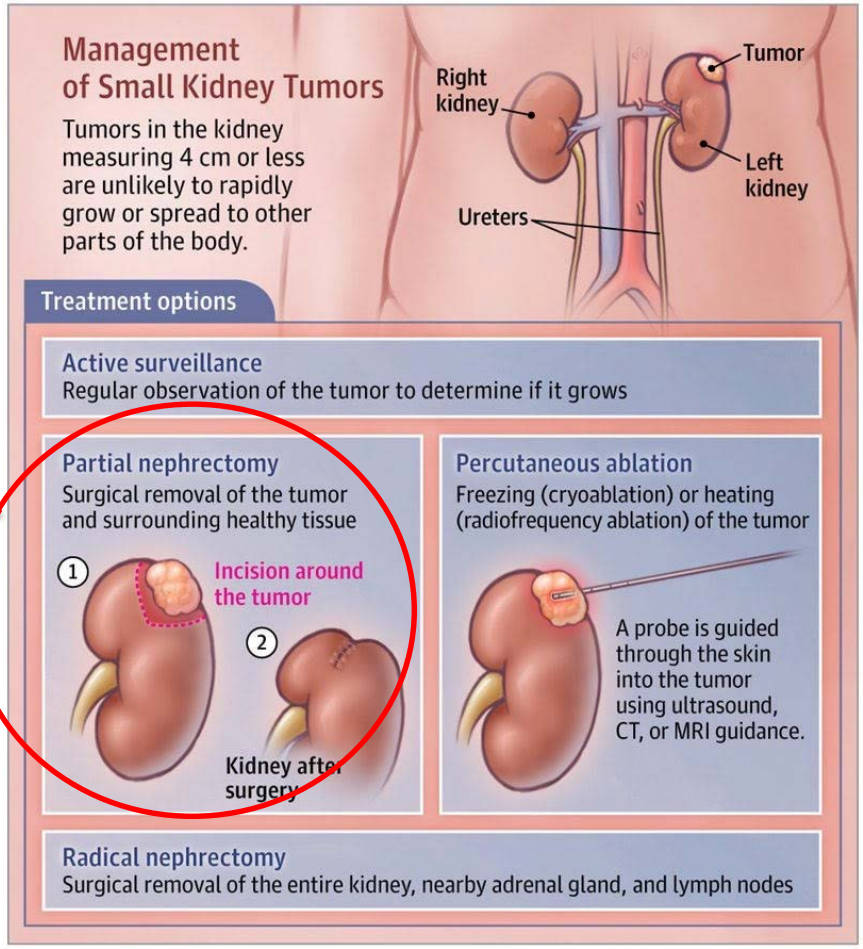
My experiences

- Medical School: Temple University School of Medicine
- Residency (Urology): Hospital of the University of Pennsylvania
- Fellowship (Urologic Oncology): Johns Hopkins Hospital
- Faculty at Penn Medicine since 2009
- Focusing on surgical treatment, especially minimally-invasive surgery for kidney, prostate, bladder, testicular and other urologic cancers



Small kidney tumors

Robot-assisted partial nephrectomy



JAMA. 2019 Apr 23;321(16):1622-1623

PENN UROLOGY

Robot-assisted partial nephrectomy (RAPN)

Systematic Review and Meta-analysis of Comparative Studies Reporting Perioperative Outcomes of Robot-Assisted Partial Nephrectomy Versus Open Partial Nephrectomy

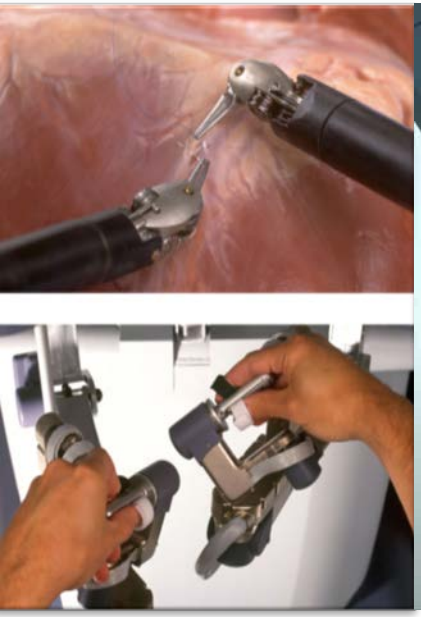
Leilei Xia, MD,[1] Xianjin Wang, MD,[2] Tianyuan Xu, MD,[2] and Thomas J. Guzzo, MD, MPH[1]

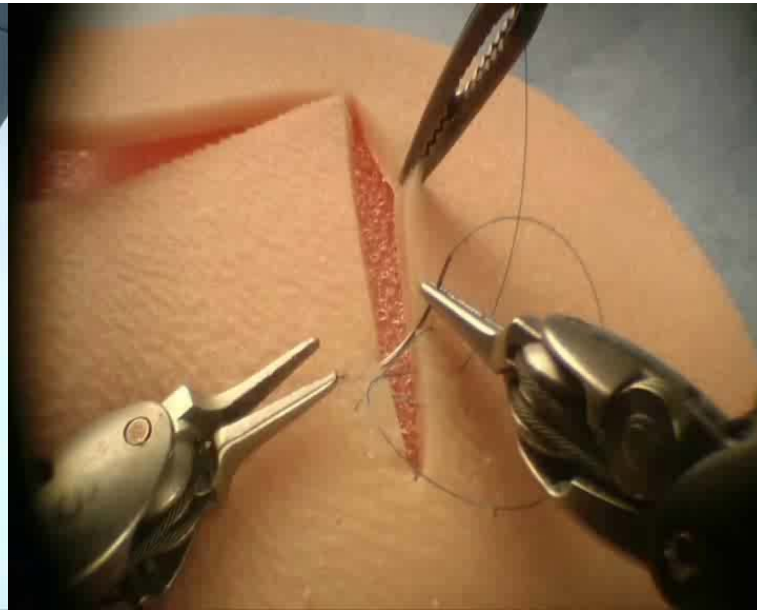
- Equivalent oncologic and functional outcomes
- Less blood loss
- Fewer complications
- Reduced pain and discomfort
- Shorter hospitalization
- Faster recovery time and return to normal activities
- Smaller incisions, resulting in reduced risk of infection
- Better cosmetic appearance

https://www.uchealth.com/services/robotic-surgery/patient-information/benefits/
J Endourol. 2017 Sep;31(9):893-909

PENN UROLOGY

What are the advantages





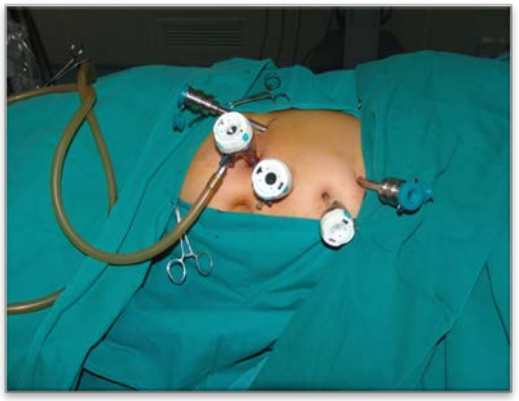
- Immersive high-definition 3-D visualization
- Enhanced dexterity, fully articulating instruments
- Greater precision, intuitive computer-enhanced motion control

Surgeons can perform delicate and complex procedures that may have been difficult or impossible with other methods, such as partial nephrectomy

https://www.intuitive.com

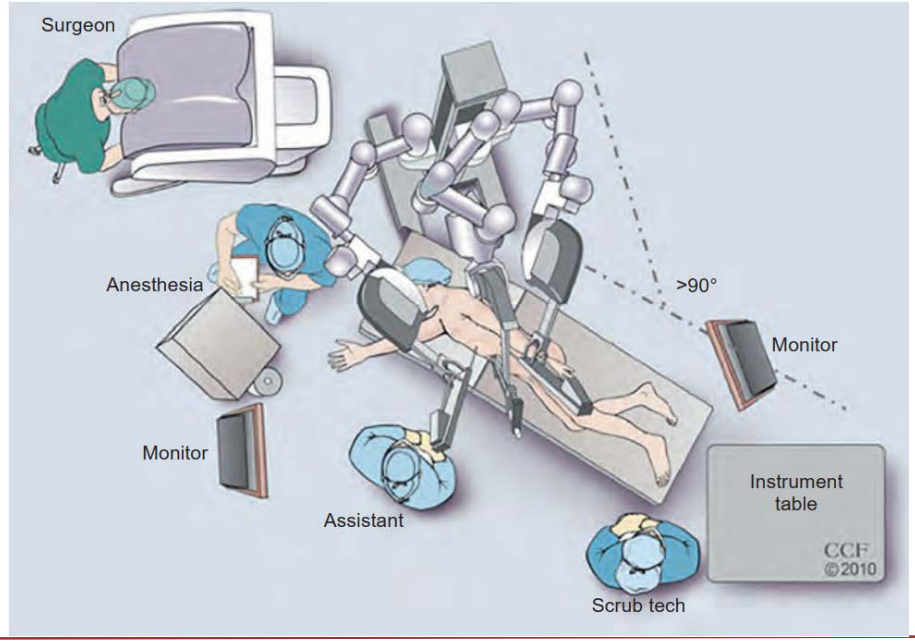
PENN UROLOGY

How it is done



When performing robotic surgery using the da Vinci Surgical System:

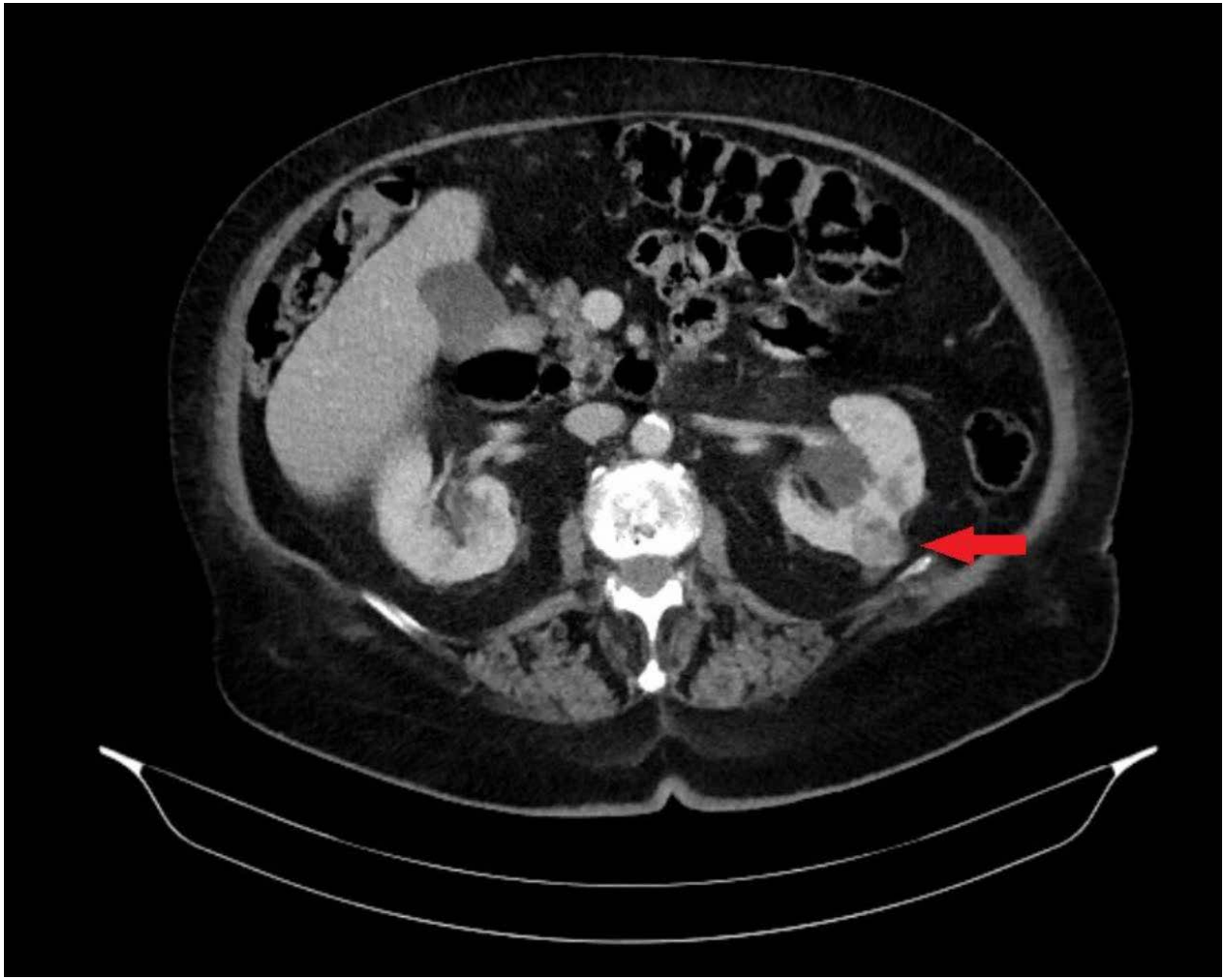
- The surgeon works from a computer console in the operating room, controlling miniaturized instruments mounted on three robotic arms to make tiny incisions in the patient.
- The surgeon looks through a 3-D camera attached to a fourth robotic arm, which magnifies the surgical site.
- The surgeon's hand, wrist and finger movements are transmitted through the computer console to the instruments attached to the robot's arms. The mimicked movements have the same range of motion as the surgeon allowing maximum control.
- The surgical team supervises the robot at the patient's bedside.



Campbell-Walsh urology / editor-in-chief, Alan J. Wein ; editors, Louis R. Kavoussi, Alan W. Partin, Craig A. Peters.—Eleventh edition.

PENN UROLOGY

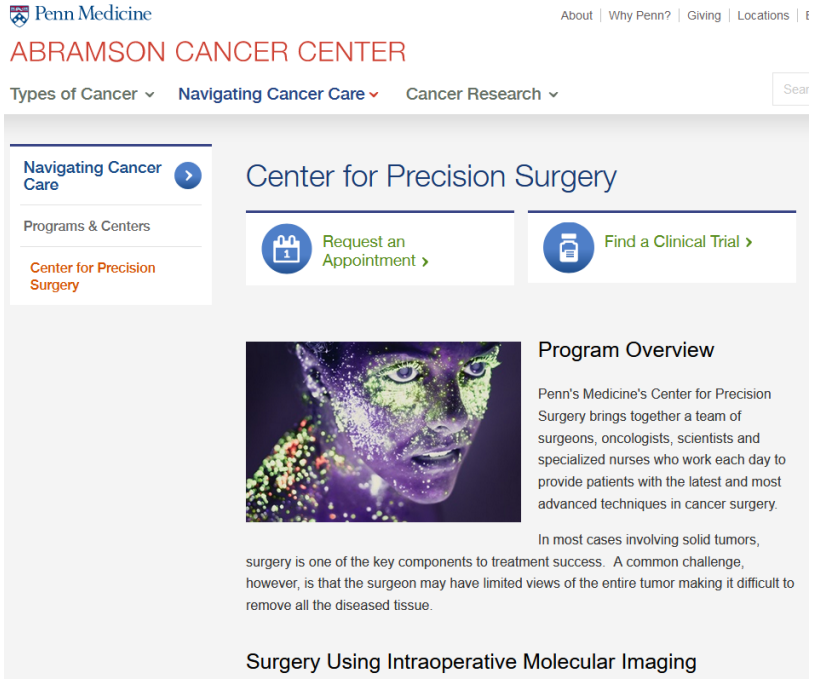
Robot-assisted partial nephrectomy

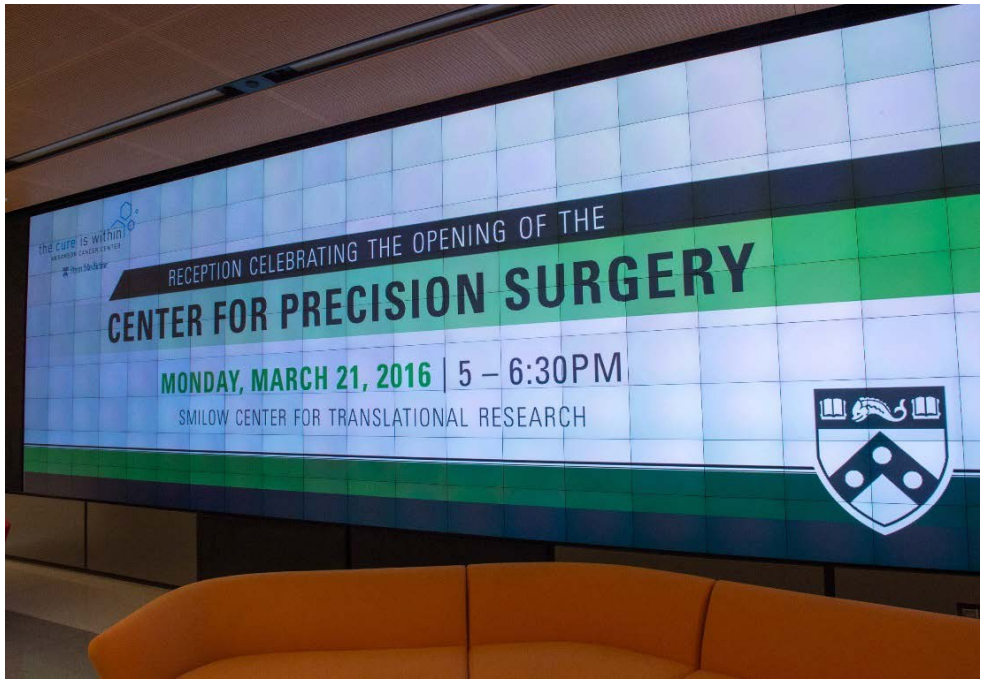


No cancer recurrence since 2016

PENN UROLOGY

Intraoperative imaging at Penn





- **<u>Mission Statement:</u>** To improve the cancer care of surgery patients through intraoperative molecular imaging techniques

- 13 Surgeons (Thoracic, Urology, Neurosurgery, Surg Onc, Breast, ENT, Gyn Onc), 2 Staff PhDs, 10+ Active Clinical Trials , Over 500 patients enrolled

PENN UROLOGY

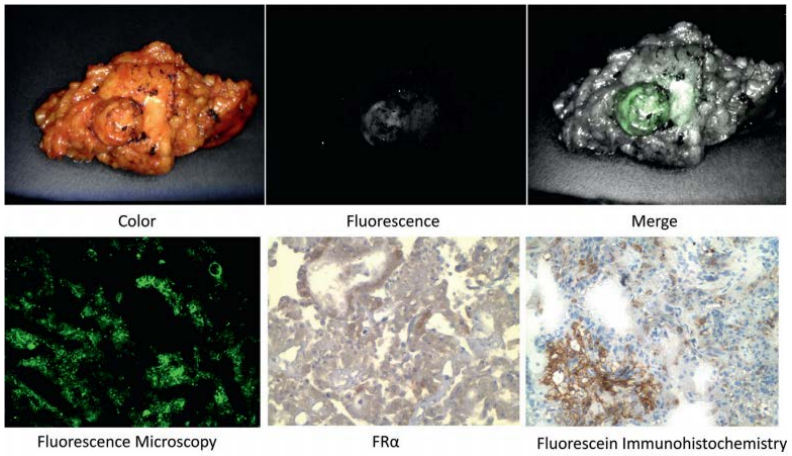
Intraoperative imaging at Penn

Investigative Urology

Intraoperative Molecular Diagnostic Imaging Can Identify Renal Cell Carcinoma

Thomas J. Guzzo,* Jack Jiang, Jane Keating, Elizabeth DeJesus, Ryan Judy, Shuming Nie, Philip Low, Priti Lal and Sunil Singhal

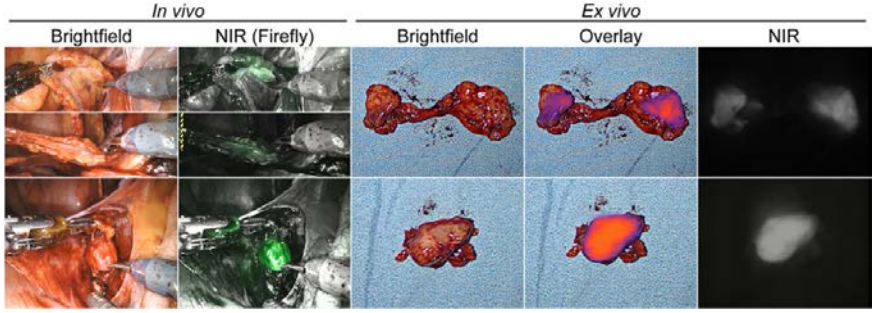
From the Departments of Surgery (TJG, JJ, JK, ED, RJ, SS) and Pathology (PL), Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, Departments of Biomedical Engineering and Chemistry, Emory University (SN), Atlanta, Georgia, and Department of Chemistry (PL), Purdue University, West Lafayette, Indiana



Oncology

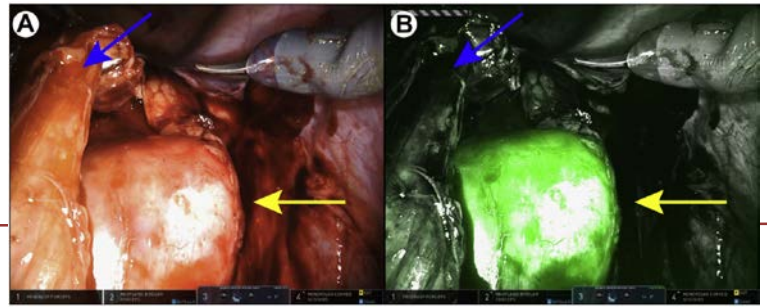
Near-infrared Intraoperative Molecular Imaging Can Identify Metastatic Lymph Nodes in Prostate Cancer

Leilei Xia, Ryan Zeh, Jack Mizelle, Andrew Newton, Jarrod Predina, Shuming Nie, Sunil Singhal, and Thomas J. Guzzo



Intraoperative Molecular Imaging for Post-Chemotherapy Robot-Assisted Laparoscopic Resection of Seminoma Metastasis: A Case Report

Leilei Xia,[1,2] Ollin G. Venegas,[2,3] Jarrod D. Predina,[2,3] Sunil Singhal,[2,3] Thomas J. Guzzo[1,2]



J Urol. 2016 Mar;195(3):748-55
Clin Genitourin Cancer. 2017 Feb;15(1):e61-e64
Urology. 2017 Aug;106:133-138.

PENN UROLOGY

Intraoperative imaging in RAPN

Curr Urol Rep (2015) 16: 20
DOI 10.1007/s11934-015-0495-9

NEW IMAGING TECHNIQUES (A RASTINEHAD AND S RAIS-BAHRAMI, SECTION EDITORS)

Near-Infrared Fluorescence Imaging with Intraoperative Administration of Indocyanine Green for Robotic Partial Nephrectomy

Marc A. Bjurlin · Tyler R. McClintock · Michael D. Stifelman

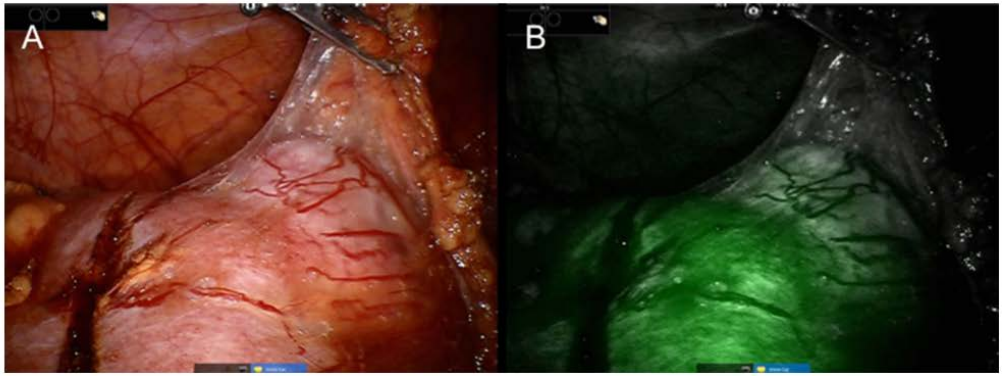


Fig 1 NIRF imaging with ICG to facilitate optimization of renal tumor localization. Renal mass seen under white light (**a**) and under NIRF imaging with ICG demonstrating a hypofluorescent tumor adjacent to bright green normal renal parenchyma (**b**)

Indocyanine green (ICG)

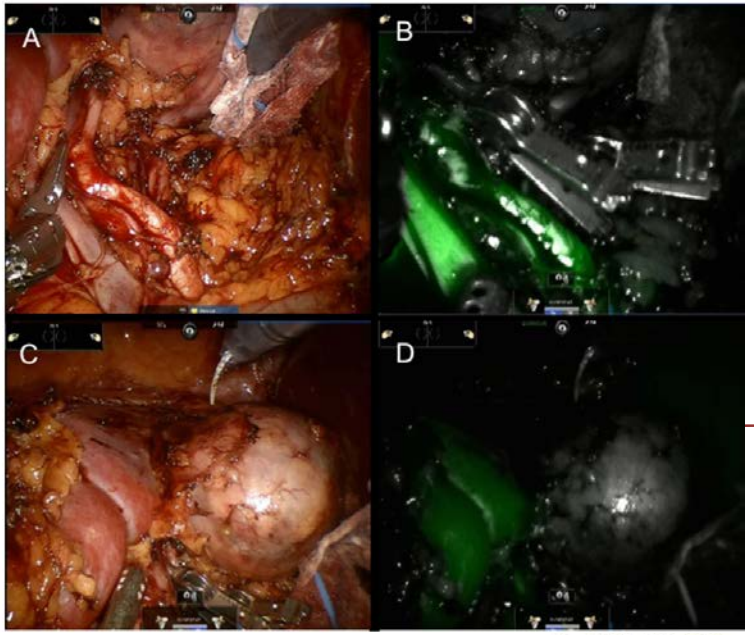
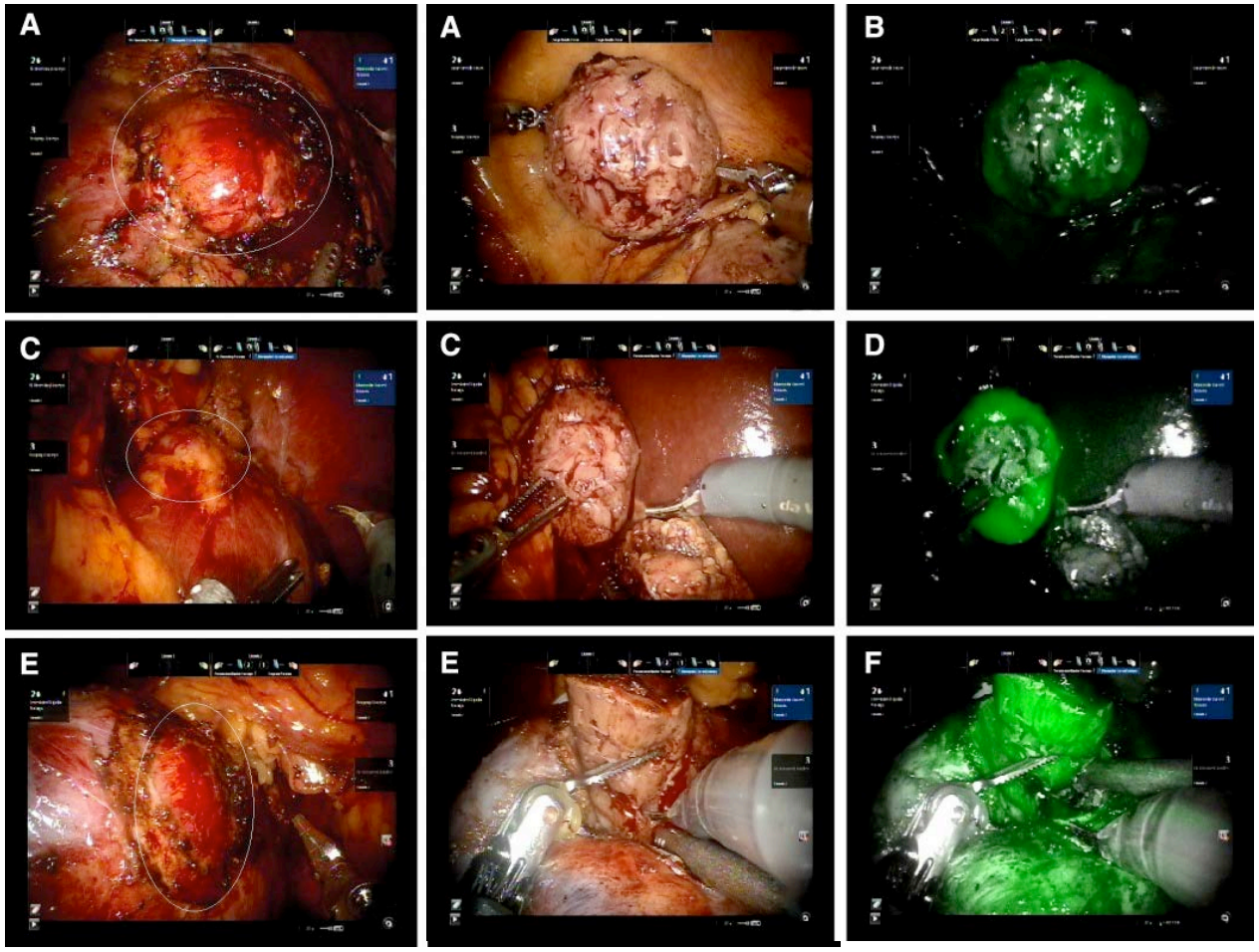


Fig 2 NIRF imaging with ICG to facilitate selective arterial clamping. Dissection of the secondary, tertiary, or quaternary level arterial branches (**a**), selective arterial clamping with mini bulldog clamps seen under NIRF imaging with ICG (bright fluorescent green vessels) (**b**), renal tumor seen under white light (**c**), and NIRF imaging with ICG (hypofluorescent renal tumor confirming ischemia with perfused bright green normal renal parenchyma) (**d**)

Intraoperative imaging in RAPN



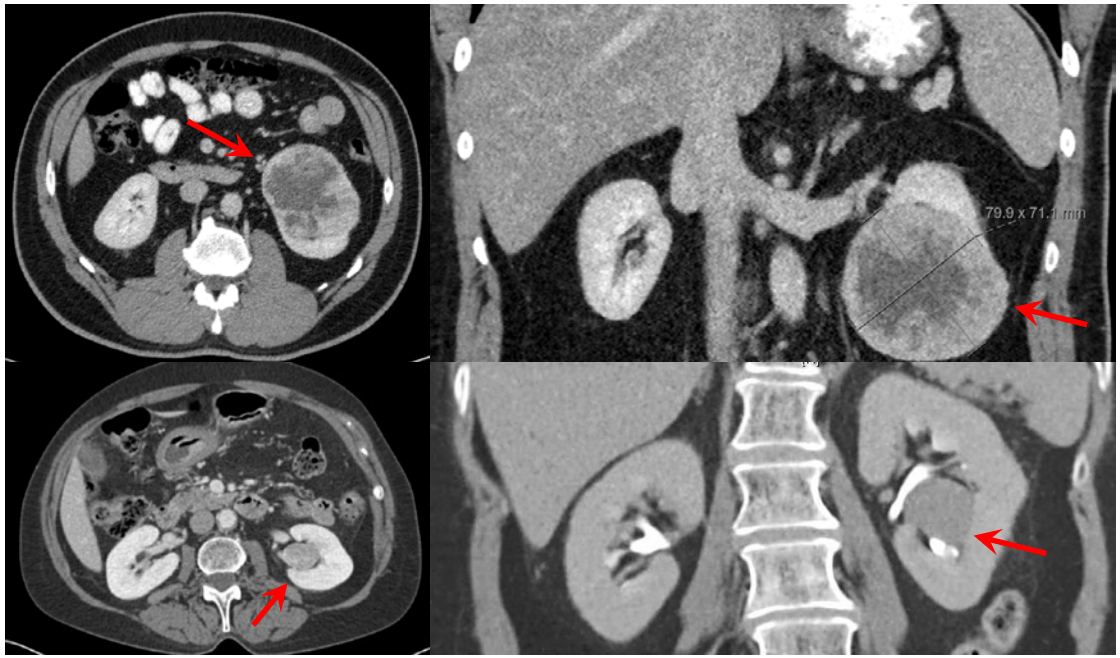
Folate receptor targeted dye OTL38

J Endourol Case Rep. 2016 Nov 1;2(1):189-197

PENN UROLOGY

Laparoscopic/robotic radical nephrectomy

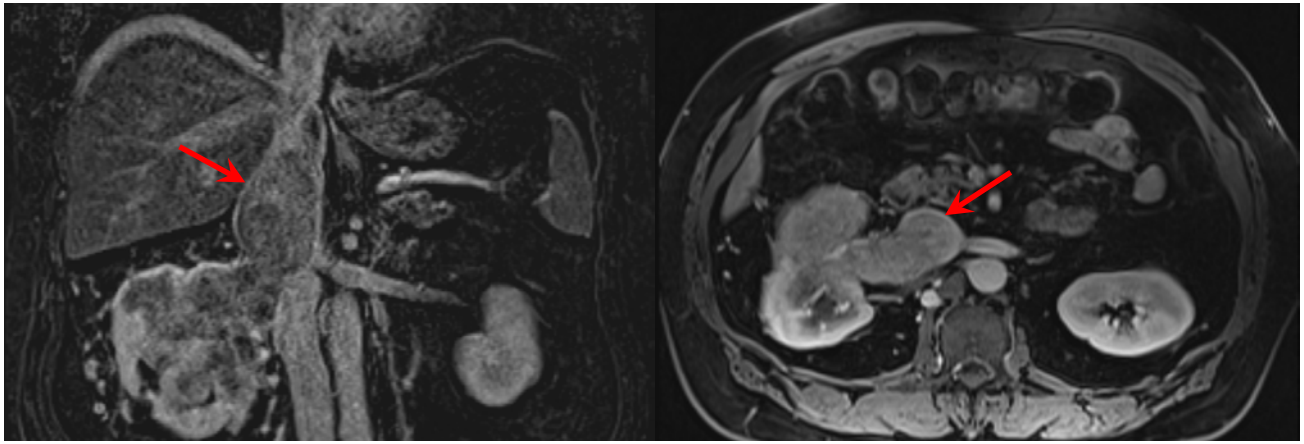
- Mostly for large (>7 cm) and/or endophytic tumors that partial nephrectomy would be oncologically unsafe but can still be done in a minimally invasive manner
- Robot is better than conventional laparoscopy



PENN UROLOGY

Open radical nephrectomy with or without thrombectomy

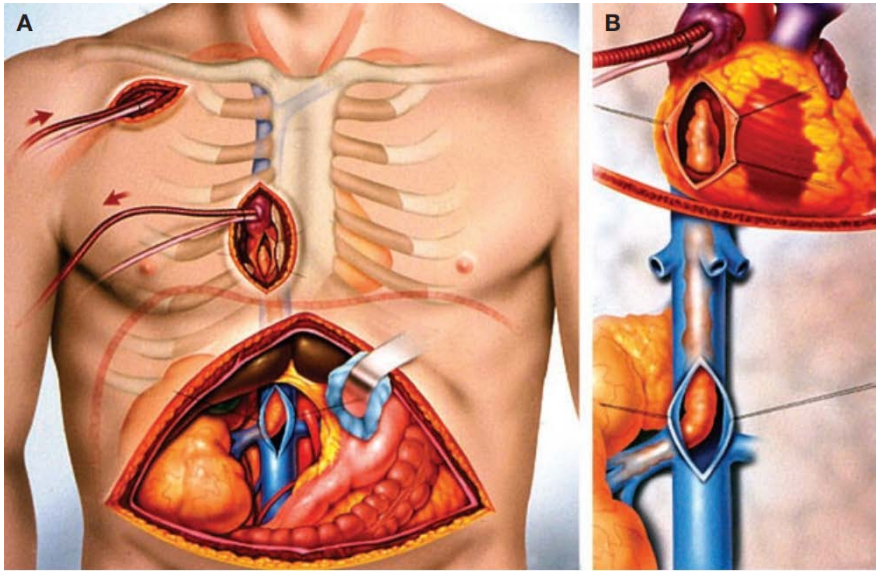
- For very large tumors with or without tumor thrombus in renal vein or inferior vena cava (IVC)
- Cancer control is priority, complete resection of the tumor and thrombectomy allow for the best chance of cure
- Sometimes involves other surgical teams
- High volume institution for RCC IVC thrombectomy



Multidisciplinary surgical team

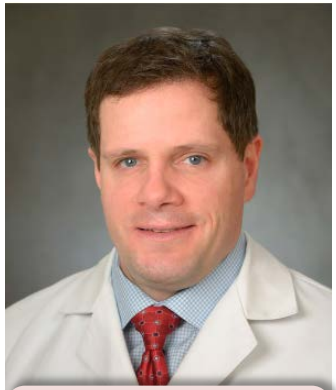
Surgical Oncology

Urologic Oncology



Anesthesiology and Critical Care

Cardiac Surgery



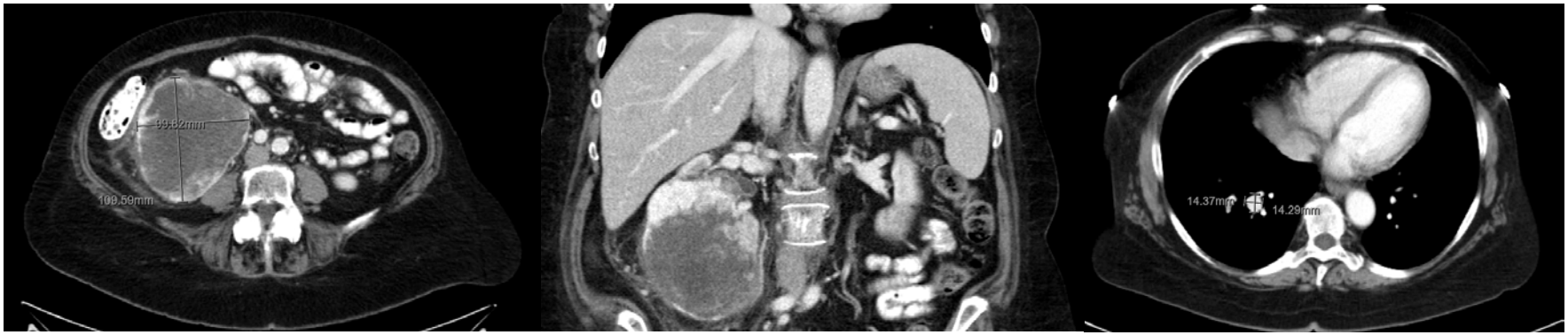
Vascular Surgery

Nature Clinical Practice Urology volume 5, pages35–46 (2008)

PENN UROLOGY

Cytoreductive nephrectomy

- Established management options for selected individuals with metastatic renal cell cancer (mRCC)
- Careful patient selection with multidisciplinary input is essential



JAMA Oncol. 2019 Feb 1;5(2):171-172

PENN UROLOGY

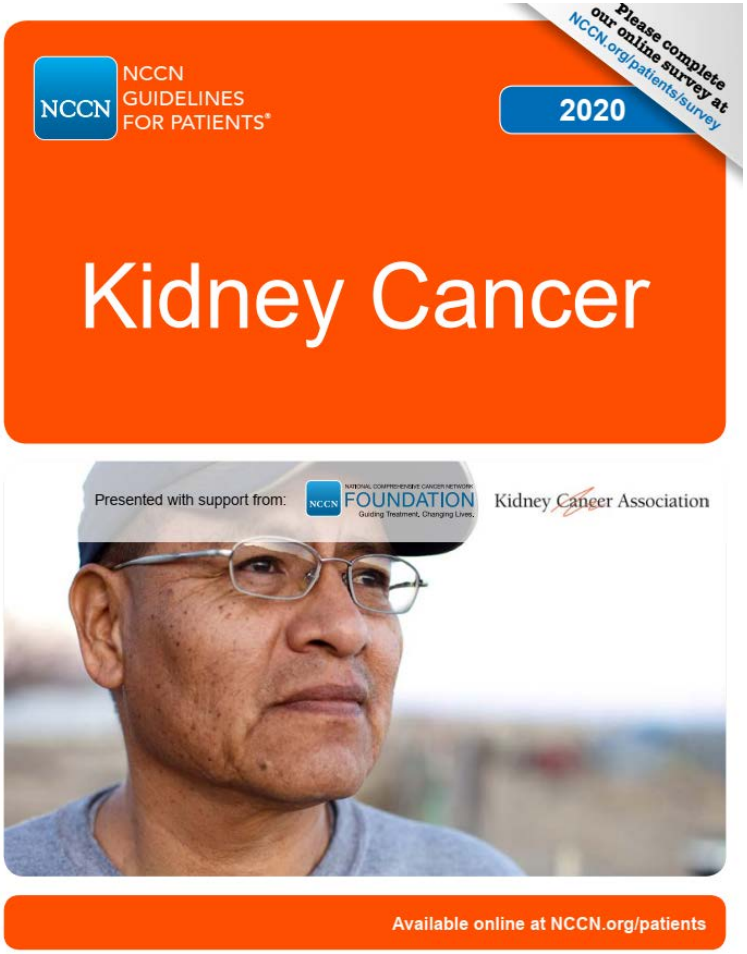
My surgery for kidney cancer

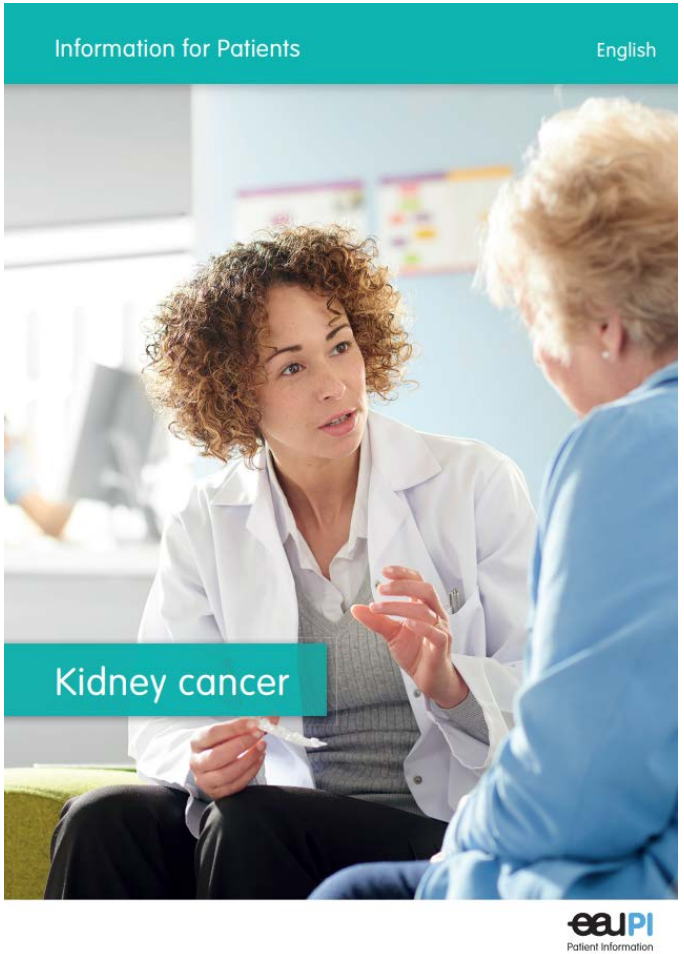
- Surgery is the main treatment for the majority of kidney cancers
- Most small kidney tumors/cancers can be surgically treated with robot-assisted partial nephrectomy
- Some larger tumors/cancers can still be done through minimally invasive approach, either partial nephrectomy or radical nephrectomy
- Open radical nephrectomy with or without thrombectomy are reserved for very large/complex cancers, multidisciplinary surgical team is often needed
- Cytoreductive nephrectomy is still recommended for certain patients

https://patients.uroweb.org/kidney-cancer/

PENN UROLOGY

Recommendations and References





https://www.nccn.org/patients/guidelines/kidney/index.html
https://patients.uroweb.org/kidney-cancer/

PENN UROLOGY

Thank you

Hospital of the University of Pennsylvania

Perelman Center for Advanced Medicine

PENN UROLOGY