Controversies in Endourologic Kidney Stone Management

Davis P. Viprakasit, MD, FACS Clinical Associate Professor

June 21, 2019







Disclosures



Consultant: Olympus Corporation of the Americas





Outline



- Review of controversial topic in regards to:
 - Kidney stone diagnosis and evaluation
 - Surgical treatment of kidney stones
 - Postoperative care of kidney stone patients







Diagnosis and Evaluation:

Optimal Initial Imaging For Stone Diagnosis







What imaging do you use first to assess patients with flank pain concerning for stones?

- 1. Standard CT scan
- 2. Low dose CT scan
- 3. KUB
- 4. Renal ultrasound
- 5. I do not routinely obtain imaging for stone symptoms





What Does the AUA Recommend?

Clinical Effectiveness Protocols for Imaging in the Management of Ureteral Calculous Disease: AUA Technology Assessment



Fulgham et al. J Urol 2013; 189, 1203







Noncontrast CT abdomen / pelvis

- 1st Line Imaging for flank pain / suspected stone
 - Sensitivity (95-98%), Specificity (96-98%) for renal and ureteral stone identification
 - Evaluation of obstruction
 - Alternative diagnosis (10%)
 - Preoperative evaluation / predicts treatment success
 - Stone composition
 - Metabolic activity





Noncontrast CT abdomen / pelvis



Smith-Birdman et al. Arch Intern Med 2009; 169, 2078





Radiation Exposure in the Acute and Short-Term Management of Urolithiasis at 2 Academic Centers

- Review of 108 patients evaluated for symptomatic stone episode
- Evaluated # of stone imaging studies within 1 year of episode
- Mean = 4 studies
- Mean = 1.7 CT scan
- Mean effective dose = 29.7 mSv





Ferrandino et al. J Urol 2009; 181, 668



Risk of Secondary Malignancy



HEALTH RISKS FROM EXPOSURE TO LOW LEVELS OF IONIZING RADIATION BEIR VII PHASE 2

- Biological Effects of Ionizing Radiation Committee (BEIR) evaluated health effects of radiation exposure largely from atomic bomb survivors
- Concluded there is a linear no-threshold dose responsible link between radiation exposure and development of cancer
- Modeling suggests 1/100 people exposed to 100mSv above baseline would develop cancer within their lifetime compared to 42/100 from other causes

https://www.nap.edu/catalog/11340/health-risks-from-exposure-to-low-levels-of-ionizing-radiation







Low Dose Noncontrast CT scan

- Utilizes new CT scanner technology and software
- Adjustments in:
 - » Current (mA) = total number of x-rays
 - » Voltage (kV) = permeability of x-rays
 - » Image quality reference
- Generally defined as total effective dose ≤ 3 mSv





- Meta-analysis of 12 studies including 1529 patients
- Reference standard: Standard dose CT KUB or physical stone demonstration





Low dose CT (2.1-4.5 mSV)

- 1. Different settings required for larger BMI
- 2. Stones <3mm may be missed





Ultra Low dose CT (0.48-1.9 mSV)

Rodger, Roditi, Aboumarzouk. Urol Int. 2018;100(4):375





Utilization of Low Dose CT



Evaluation of Kidney Stones with Reduced-Radiation Dose CT: Progress from 2011-2012 to 2015-2016-Not There Yet1

Three handred four study descriptors for kidney stone CT corresponding to data from X2N facilities that submitted
105:334 kidney stone CT examinations were identified. Be- diaced dese CT examinations accounted for 8040 of 305:334 (7.6%) CT examinations, a 5.6% increase from the 3010 of 40903 (2%) examinations in 2011-2012 (P < .001). Mean
densee interval: 667, 712), decreased from the mean of 746 mGy - rm observed in 2011-2012. Median facility dose- length product varied up to sevenfold, from less than 200 mGy - cm to greater than 1600 mGy - cm.











What about using renal ultrasound?





Renal Ultrasound



- Estimated radiation dose = None
- (Renal) Sensitivity (29-81%), Specificity (82-90%)
- (Ureteral) Sensitivity (11-93%), Specificity (87-100%)
- Effective evaluation for obstruction (hydronephrosis)
- First-line imaging for pediatric / pregnant patient
- Technician dependent
- May have increased sensitivity combined with KUB (58-100%)

Lipkin and Preminger. Urol Clin N Am 2013; 40, 47 Fulgham et al. J Urol 2013; 189, 1203





Ultrasonography versus Computed Tomography for Suspected Nephrolithiasis



- Pragmatic, comparative effectiveness trial of 2759 ED patients with suspected stones
- Patients at high risk for alternative diagnosis excluded
- Additional imaging obtained at discretion of provider
 - 41% of POC US had CT scan
 - 27% of RUS had CT scan
 - 5.1% of CT scan had RUS

US can be used as initial test of renal colic in ED

	Antoliae	Radiation .	Composited	
Determine	10-000	10-001	10.00	-
Printer Televised				
right that designs in the completence of		1.010	194	***
Automatical and a second second	101004	44424	(Final A	-
During and going Managing Standings	Andre .	4144	141-89	
the analyzed a littles	ther.	1844	them .	1.04
St. Officials	a hadott	di lon b	tions .	1.00
Beendary Transman				
Natural and Annual Annua				
Without and	Aug (\$14.118.1)	10048-016	94,811,011,4	
William Loan	Insulation and All	10.04.048	100810104-0	date:
Million and Annual State	101403-0110	115-00x (M-5)	101419-0141	- 6-17
Assessed for surgery				
WHEN YOU	2000.00		118713.46	8.0
\$10x110x	1000.01	4,643.0.0	PARTY IN D	10.0
maindan	\$180 piles	maked (mild	40,819 (010)	1.00

Smith-Bindman et al. N Engl J Med. 2014 Sep 18;371(12):1100





Emergency Department Imaging Modality Effect on Surgical Management of Nephrolithiasis: A Multicenter, Randomized Clinical Trial

- Secondary analysis of 1,666 patients diagnosed with stone in ED
- 14.5% had urology consult in ED
- 30% had follow-up urology consult
- 12% required surgery
 - 26% emergently
 - 74% electively within 90 days with no difference in time to follow-up between imaging types
- Of elective cases, 78% of patients had CT scan prior to surgery
 - Patients with POC US more likely to have CT scan prior to surgery compared to RUS (OR 2.55)



	KD 145	Rationgr 125	101
Na. usefi3 prazedore (%) PNE UPIS ESWI, Start.	5 00 18 00 5 09 3 16	1 01 25 651 7 (15) 7 (15) 7 (15)	1 (2) 27 (34) 8 (22) 8 (23)
Totals Mr. 17 annual and 18 d	25.0730	40 (95)	38.00
LRS Snint	\$ 000 \$ 070	18	2 (4 7.05
Totals	13 (27)	7 (11)	3.01

Metzler et al. J Urol. 2017 Mar;197(3 Pt 1):710





Trends in Imaging Use for the Evaluation and Followup of Kidney Stone Disease: A Single Center Experience



- Retrospective, single institution review of 10,680 stone episodes in 7,659 patients over 6 years
- 76% underwent imaging at index visit (ED, walk in clinic)
- 47% had CT scan at index visit
 - Of 53% without initial CT, 10% had subsequent CT scan within 90 days
- 20% had primary RUS
 - 10% had CT scan during same index visit
 - 10% had CT scan during subsequent 90 days
- Total 90 day imaging costs / radiation exposure higher if CT scan performed at index visit





Accuracy of ultrasonography for renal stone detection and size determination: is it good enough for management decisions?



Retrospective review of 486 stone patients with 552 US / CT pairs ۲

and the second second second second		Toble 3 Stone I	mee woolened	by ultrasonogra	ipte compared w	en cr
table 1 Schollwhy of ultracnog	Sensibility (95% CI), %	Shows size group	Bits on CT*	Size on US*	Difference US - CT*	
sl.mm sl.mm	28 (18-48) 37 (29-48)	0-4 mm 5-20 mm	3-(2-4) 7-(6-4)	# (4-8) 8 (8-12)	4 (2-5) 1 (0-5)	- 00
5-10 mm. 1-28 mm.	64 (35-73) 76 (35-40)	US, albumpt	phy. Non open	l a medar (mir	partic surge). "Mo	

737 808		12.50°%		4105
UL altrainingraphy.	"Non reported a	e moles (mingant) well tist	ik namps) tribi	

- Assuming patients with stones ≤ 4 mm counseled for observation and \geq 5mm would consider alternative intervention:
 - 22% would receive inappropriate counseling due to US based on \bullet discordance with CT





Overall sensitivity 54%

Innovations in Ultrasound Technology in the Management of Kidney Stones

 Improved stone detection through optimizing and standardization of stone twinkling on color doppler





 Improved stone sizing accuracy through measurement of posterior acoustic shadow width



• May be combined in stone specific algorithms to optimize stone imaging

Dai et al. Urol Clin North Am 2019 May;46(2):273





Summary



- Excessive radiation exposure is a concern in stone patients
- Ultrasound can be used as the initial imaging study for suspected stones without significant delay in subsequent care
- CT imaging may still be needed particularly if surgery required
- Low dose CT protocols should be followed when possible
- New refinements in US may improve accuracy with stone imaging







Surgical Treatment:

Optimal Method For Stone Removal During Ureteroscopy







During flexible ureteroscopy, what is your typical approach to stone treatment?

- 1. Dust stone for spontaneous passage
- Fragment stone for active removal 2.
- Combination of dusting and active fragmentation 3.
- 4. I do not typically treat stones with URS





URS Treatment Options of Renal / Ureteral Stones



- Dusting stone small enough for spontaneous passage of tiny stones through urinary tract
- Breaking stone into multiple fragments that can be actively removed using a basket





Stone Dusting

- Typically utilizes laser setting at High frequency / Low energy
- Technique:
 - Painting / Chipping stone from edge towards center
 - Popcorning residual fragments







Aldoukhi, Black, Ghani. Urol Clin North Am 2019; 46(2):193.





Stone Dusting





Aldoukhiet et al. Front Surg 2017 Sept 29; 4:57





Utilization of Dusting Technique



Contemporary Practice Patterns of Flexible Ureteroscopy for Treating Renal Stones: Results of a Worldwide Survey

Survey of the Endourology Society

• 414 respondents (20.7%)

Aplitute laws

Respondence uniformity utilized a holencare lawy for stone fragmentation, and the vast majority worked in centers that owned their own faser (R5.0%). High-power epistemic (2100 W) were attitioned by 41.1%, while lower power (20-30 W) synames were used by 64.2%. The majority of reported their policy and by 64.2%. The majority of reported the filling technique (i.e., low polic energy and high frequency 0.2-0.5 2 × 30-5036z) was used by 0.2% of the

Dauw et al. J Endourol 2015; 29(11):1221





Stone Fragmentation / Extraction

- Typically utilizes laser setting at Higher energy / Low frequency
- Often combined with ureteral access sheath
- Technique:
 - Targets mid-portion of stone to break into halves until sized amenable for basket extraction





Aldoukhi, Black, Ghani. Urol Clin North Am 2019; 46(2):193.





Stone Fragmentation / Extraction









Dusting versus Basketing during Ureteroscopy–Which Technique is More Efficacious? A Prospective Multicenter Trial from the EDGE Research Consortium



- 152 patients with radio-opaque stones
- Mean stone surface area larger in dusting group (96 vs 63mm², p<0.001)
- Basketing procedure longer (67 vs 36 min , p<0.001)
- Ureteral access sheath use: 16% dusting group vs. 100% basketing group
- Stone-free defined as no stone on RUS / KUB at 4-6 weeks postop
- SFR significantly higher in basketing group (74% vs. 58%) on univariate analysis but no difference on multivariate analysis
- No difference in complication rates, readmissions or additional procedures

No clear difference in SFR between techniques

Humphreys et al. J Urol 2018; 199(5):1272







Importance of Minimizing Fragment Size and Residual Stones





Natural History, Complications and Re-Intervention Rates of Asymptomatic Residual Stone Fragments after Ureteroscopy: a Report from the EDGE Research Consortium



- Retrospective review of 232 patients from EDGE Consortium with residual stone after URS (dusting or basketing)
- Mean follow-up: 17 months
- 56% no stone event
- 29% stone event requiring intervention
- 15% stone event not requiring intervention
- Stones > 4mm
 - More likely to grow with time (p<0.001)
 - Associated with more complications (p=0.039)
 - More likely to require intervention (p=0.017)









New Advances in Laser Technology to Minimize Residual Fragments







Moses Platform for Holmium Laser

- Modulates vapor channel / bubble that forms to transmit laser energy to stone
- Holmium absorbed by H₂0
- Delivery of 2nd energy pulse within already formed vapor channel increases energy delivery to stone
- May decrease retropulsion and increase stone ablation



Aldoukhi, Black, Ghani. Urol Clin North Am 2019; 46(2):193.







Moses Platform for Holmium Laser

- In vitro study assessing laser stone ablation efficiency using "hard" and "soft" stones
- Compared Moses technology contact / distance modes to Ho:YAG short / long pulse modes



Winship et al. J Endourol 2018; 32(12):1131.





Thulium Fiber Laser





- Not same technology as Thulium:YAG laser for prostate
- Energy generated by chemically doped small laser fiber and transferred to stone through another fiber
- Higher H20 absorption
- Can be coupled to smaller diameter laser fiber
- Can be used at very high pulse frequencies

Traxer and Keller. World J Urol 2019 Feb 6. doi: 10.1007/s00345-019-02654-5





Thulium Fiber Laser





In vitro comparison showed faster ablation / less retropulsion

Andreeva et al. World J Urol 2019 May 4. doi: 10.1007/s00345-019-02785-9





Summary



- Stone dusting vs. fragmentation / basketing are comparable methods for stone treatment during ureteroscopy
- Regardless of technique, goal is to minimize residual stone fragments
- New laser advances may improve treatment efficiency and potentially outcomes







Postoperative Care:

Optimal Pain Management After Stone Surgery







What pain med regimen do you typically prescribe after URS for stones?

- 1. NSAIDS
- 2. Acetaminophen
- 3. Tramadol
- 4. Oral Narcotics
- 5. Other medication
- 6. I do not prescribe medication for pain







A CONTRACTOR OF MORE TO CONTRACTOR

Figure 3. National Drug Overdose Deaths Involving Any Opioid, Number Among All Ages, by Gender, 1999-2017



Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2017 on CDC WONDER Online Database, released December, 2018

Cicero et al. JAMA Psych. 2014 Jul; 71(7):821







KIDNEY STORES AND RISK OF NARCOTIC USE

• Retrospective review of NHANES surveys between 2007-2014



 History of stones independently associated with opioid use (OR 1.27, p=0.006) when adjusting for age, gender, smoking status, number of healthcare visits in past year, and comorbid conditions

Shoag et al. J Urol. 2019 May;201(4S):e171





RISK OF PROLONGED OPIOID USE AMONG OPIOID-NAÏVE FATIENTS FOLLOWING UROLOGIC STONE SURGERY



- Review of MarketScan claims data between 2009-2015
- 50,249 opioid naïve patients who underwent SWL, URS, PCNL and filled perioperative narcotic script identified
 - 8.1% patients continued to fill narcotic script between 90-180 days after surgery
 - Prolonged use significantly associated with:
 - Greater perioperative total oral morphine equivalent prescribed
 - History of pain / mental health disorders
 - Substance / alcohol / tobacco use





How to address this issue?







POST-OPERATIVE OPIOID PRESCRIBING IN UROLOGY: ARE WE CONTRIBUTING TO THE MATIONAL CRISIS?

- Prospective assessment of patients at UNC undergoing 10 different types of urologic surgery
- Postoperative pain medication regimen queried
- Patients surveyed at 2 weeks postop regarding postoperative opioid usage, storage and disposal habits
- Overall, 70% of respondents had unused meds

Urologic Surgeries
Stent placement
Ureteroscopy
Cysto / TUR
Perc Nephrolithotomy
Penile / Urethral
Scrotal / Testis
Lap Nephrectomy
Prostatectomy
Cystectomy
Major Oncology

Hacker et al. J Urol. 2018 May;199(4S):e1093







POST-OPERATIVE OPIOID PRESCRIBING IN UROLOGY: ARE WE CONTRIBUTING TO THE NATIONAL CRISIS?





47 URS patients received 792 opioid tablets

Hacker et al. J Urol. 2018 May;199(4S):e1093







POST-OPERATIVE OPIOID PRESCRIBING IN UROLOGY, ARE WE CONTRIBUTING TO THE NATIONAL CRISIS?





Of 792 opioid tablets, 498 pills unused

 Only 34% reported receiving counseling on proper storage and disposal of meds







POST-OPERATIVE OPIOID PRESCRIBING IN UROLOGY: ARE WE CONTRIBUTING TO THE NATIONAL CRISIS?



- Adherence to Protocol
 - 88% for URS
 - 97% for PCNL
- No observed difference in post-op calls for narcotics or patient satisfaction with pain management scores

Hacker et al. J Urol. 2018 May;199(4S):e1093







How about eliminating postoperative opioid use altogether?





A Retrospective Review Demonstrating the Feasibility of Discharging Patients Without Opioids After Ureteroscopy and Ureteral Stent Placement



- Retrospective review of non-opioid protocol in selected patients
- Unanticipated phone calls, ED visits and need for opioid refills evaluated

Engeneral -	Transmitter (a construction of the
Annual of Street	A Treat Rat - Mercanita de de care - Mercanita de la seconte - Mercanita	Rentering Ameriphics Academic for a list Mile Andre Academic registration phones are Appendix anong 18, 999, a 1999 Appendix anong 18, 999, a 1999 Ameri a 1999 Ameri a 1999
Annual and a second second	1	MARCOLOUM - Stationage-instantions formulate - Million contrag mythe framius formulate - Materials and an advanced
The second secon		Evaluation of the spectration - contrast to product a local sector. In - contrast to product a local sector. - contrast to product a local sector. - contrast to product a local sector. - contrast to product a local sector.

Sobel et al. J Endourol. 2018 Nov;32(11):1044



A Retrospective Review Demonstrating the Feasibility of Discharging Patients Without Opioids After Uneteroscopy and Ureteral Stent Placement





Sobel et al. J Endourol. 2018 Nov;32(11):1044





UPDATE ON INITIAL EXPERIENCE WITH NARCOTIC FREE URETEROSCOPY (NF-URS)



- Retrospective review of patients without contraindication / allergy to NSAIDS receiving postop diclofenac instead of narcotics
- Matched to prior patients receiving standard postop narcotics



- Equivalent of 2500 hydrocodone tablets avoided
- No narcotic naïve patient prior to surgery in NF-URS group required narcotic script compared to 4 of 20 in S-URS group



ENHANCED RECOVERY AFTER SURGERY PROTOCOL FOR URETERDSCOPY: A PROSPECTIVE COMPARATIVE STUDY EVALUATING A NO OPIDIO VERSUS STANDARD PROTOCOL



- Prospective assessment of standardized ERAS pathway for anesthetic care and postop management of URS patients
- Urinary symptoms, pain and PROMIS surveys scores assessed before and after surgery
- Unanticipated phone calls, ED visits and need for opioid refills queried using TN CSMD





ENHANCED RECOVERY AFTER SURGERY PROTOCOL FOR URETERDSCOPY: A PROSPECTIVE COMPARATIVE STUDY EVALUATING A NO OPIDID VERSUS STANDARD PROTOCOL



- Peri-op Protocol
 - Patient counseled multiple times regarding no opioid plan
 - Gabapentin, Acetaminophen, B&O supp and Ketorolac given
 - Narcotic free intraoperative anesthesia per protocol
 - Written postop scripts for acetaminophen, ibuprofen, oxybutynin, tamsulosin given
- Postop Escalation protocol if patients calls
 - 1st confirm patient is taking postop meds as written
 - If pain > 4/10 severity, initiate escalation
 - Tramadol 50 mg q 4-6 hrs prn, sig. 12 tablets











Courtesy of N Miller, MD







Total # pts n=80	Postoperative Outcomes : Multivariable Analysis ¹	Pre-ERAS n=28	ERAS n=52	
No difference		N (%)		p-value
between the	Total Opioid Prescription Dose (Mean MME)	60.1 (41)	7.7 (26)	<0.01*
aroups in	Patients Discharged with Opioid	26 (93)	0 (0)	<0.01* ²
demographic	Total Discharge Rx (Mean MME)	57.9 (39.8)	0 (0)	<0.01*
data	Postop Opioid Refill (VUMC)	1 (3.6)	3 (5.8)	0.5
	Postop Opioid Rx (non-VUMC)	0 (0)	2 (3.8)	0.16 ²
	Postop Calls for Pain	7 (25)	10 (19)	0.9
	Postop Acute Encounters for Pain	0 (0)	2 (4)	0.46 ²

¹Controlling for Age, Sex, Preoperative PROMIS 3a T score

²Univariate analysis – too few events for multivariable regression



-

-

Courtesy of N Miller, MD



ENHANCED RECOVERY AFTER SURGERY PROTOCOL FOR URETERDSCOPY: A PROSPECTIVE COMPARATIVE STUDY EVALUATING A NO OPIDID VERSUS STANDARD PROTOCOL





Minimally important difference in **PROMIS** pain intensity and interference scores is 4-6 points to be clinically significant

Courtesy of N Miller, MD



UNC

SCHOOL OF MEDICINE



Summary



- Current kidney stone treatment contributes to the opioid epidemic
- Minimizing narcotics exposure is key
- Patient education and understanding regarding realistic expectations with pain management with stone treatment important
- No or minimal narcotic protocols possible with ureteroscopy without clear negative patient effects





🎔 @dviprakasit

davis_viprakasit@med.unc.edu



