AUA 2026
Washington, DC
MAY 15-18

039IC - Optimization of Technological Advancements in Ureteroscopy and Related Instrumentation

Sunday, May 17

Faculty

Scott G. Hubosky, MD

Olivier Traxer, MD

Michael Grasso, III, MD

MÉDECINE SORBONNE UNIVERSITÉ

Hôpital Tenon AP-HP

LASER & HIGH FREQUENCY
How High can we go safely ?

May 2026 – AUA
Washington DC

olivier.traxer@aphp.fr @OTRAXER

CONFLICTS

2026 Consultant for

IPG Medical

ROCAMED

KARL STORZ

COLOPLAST

QUANTA System

EMS-HUGEMED-PUSEN (Education)

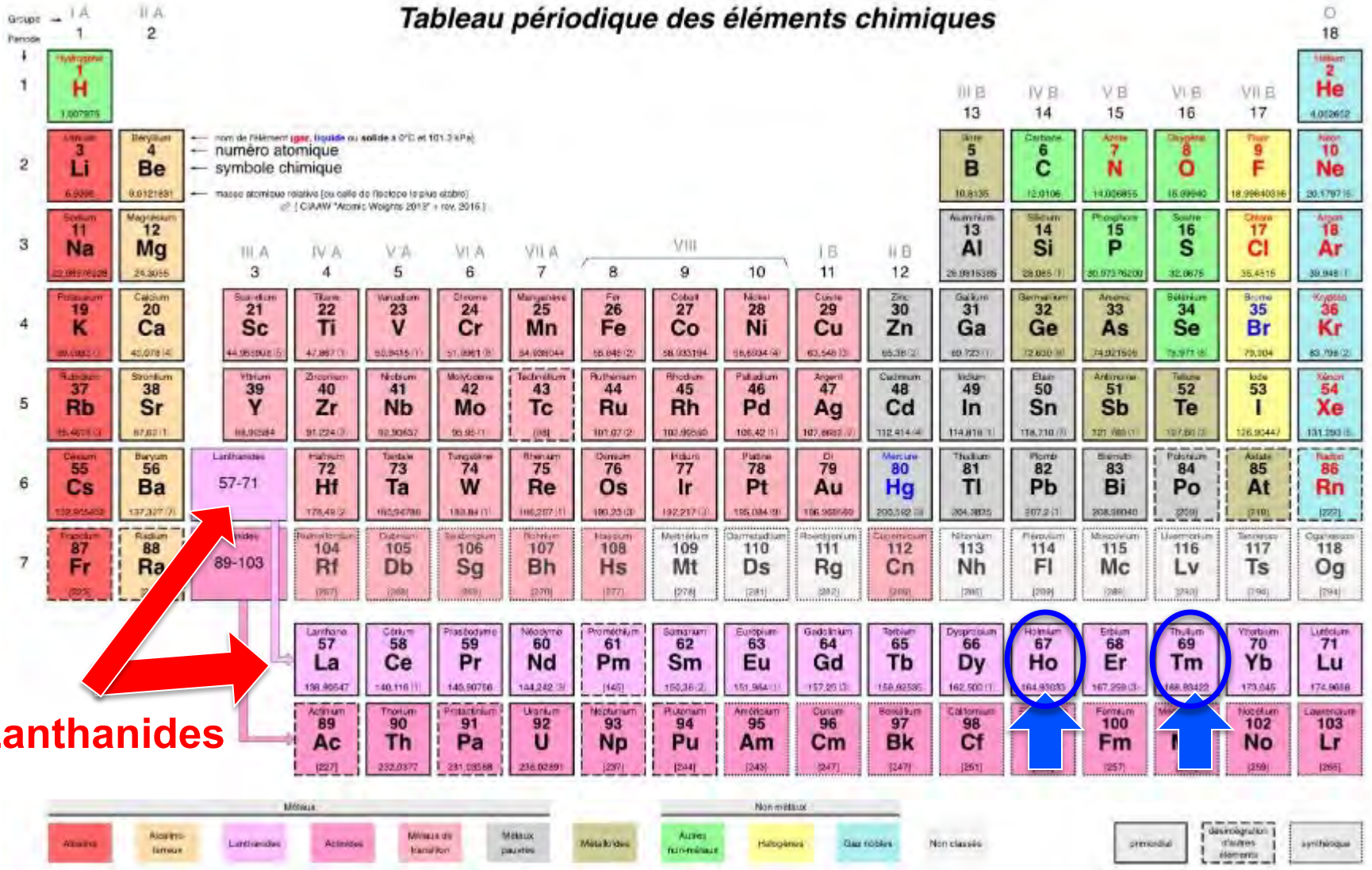
DEFINITION

1879

HOLMIUM-Ho^{67}(***Holmia:*** Stock**holm**)

THULIUM-Tm^{69}(***Thule:*** Scandinavia) 1879 Per Teodor Cleve

DEFINITION



DEFINITION

Ho:YAG

Tm:YAG

TFL

DEFINITION

1960

LASER

[technical arconym]

Light

Amplification by
Stimulated
Emission of
Radiation


Theodore Maiman


Gordon Gould


Dennis Gabor


Nikolaï Bassov


Charles Townes


Alexandre Mikhaïlovit...


Jun'ichi Nishizawa


Arthur Leonard

DEFINITION

1989 „Isner JM : Report of Mose‘s Effect “

Isner JM. Blood. In: Isner JM, Clarke R, eds. “Cardiovascular Laser Therapy.” New York: Raven Press, 1989:39–62.

Results of our investigation demonstrate that the Ho:YAG laser combines the advantages of the CO_2 laser (cutting) and the Nd:YAG laser (hemostasis) and can be used endoscopically in a fluid medium in both a contact and noncontact mode (Table 2). Although the Ho:YAG laser has a strong affinity for water and bl laboratory studies have clearly demonstrate noncontact tissue ablation is possible throu e and blood [11]. The observed tissue defect ieved to result from a vapor cavity formation caused by the delivery of energy in a pulse mode (“Mose’s effect” [12]).

Ventimiglia, J EndoUrol 2019

DEFINITION

PULSED LASER

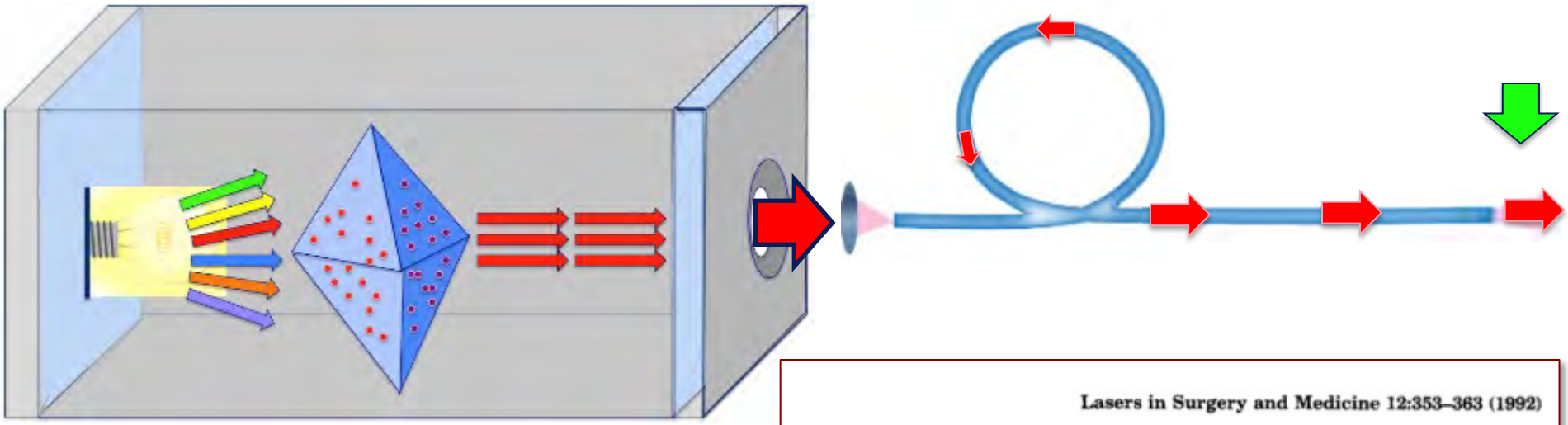
Energy x Freq = Power

J x Hz = Watts

Holmium-YAG & UROLOGY

1992

„Johnson DE : the first report in Urology“



Pulsed Laser

Lasers in Surgery and Medicine 12:353–363 (1992)

Use of the Holmium:YAG Laser in Urology

Douglas E. Johnson, MD, Douglas M. Cromeens, DVM, and Roger E. Price, DVM, PhD

Holmium-YAG & UROLOGY

1992

400 micron fiber with contact and non-contact technique

„Johnson DE : the first report in Urology“

- 10 settings
- Max 15 Watts

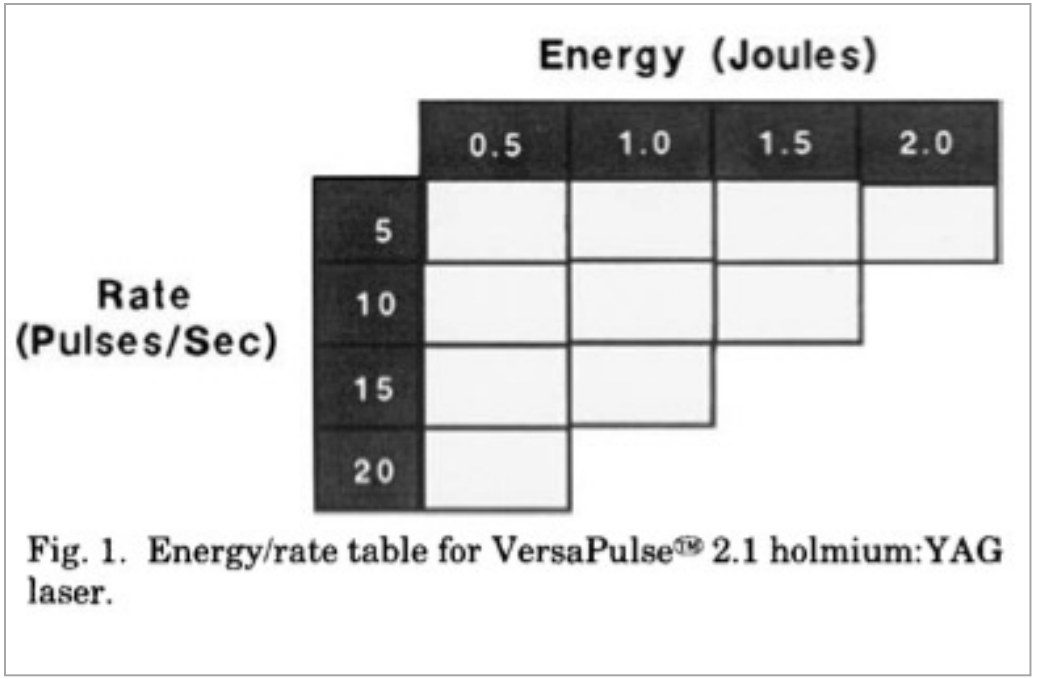


Fig. 1. Energy/rate table for VersaPulse™ 2.1 holmium:YAG laser.

Holmium-YAG & UROLOGY

1992

Lasers in Surgery and Medicine 12:353–363 (1992)

Use of the Holmium:YAG Laser in Urology

Douglas E. Johnson, MD, Douglas M. Cromeens, DVM, and Roger E. Price, DVM, PhD

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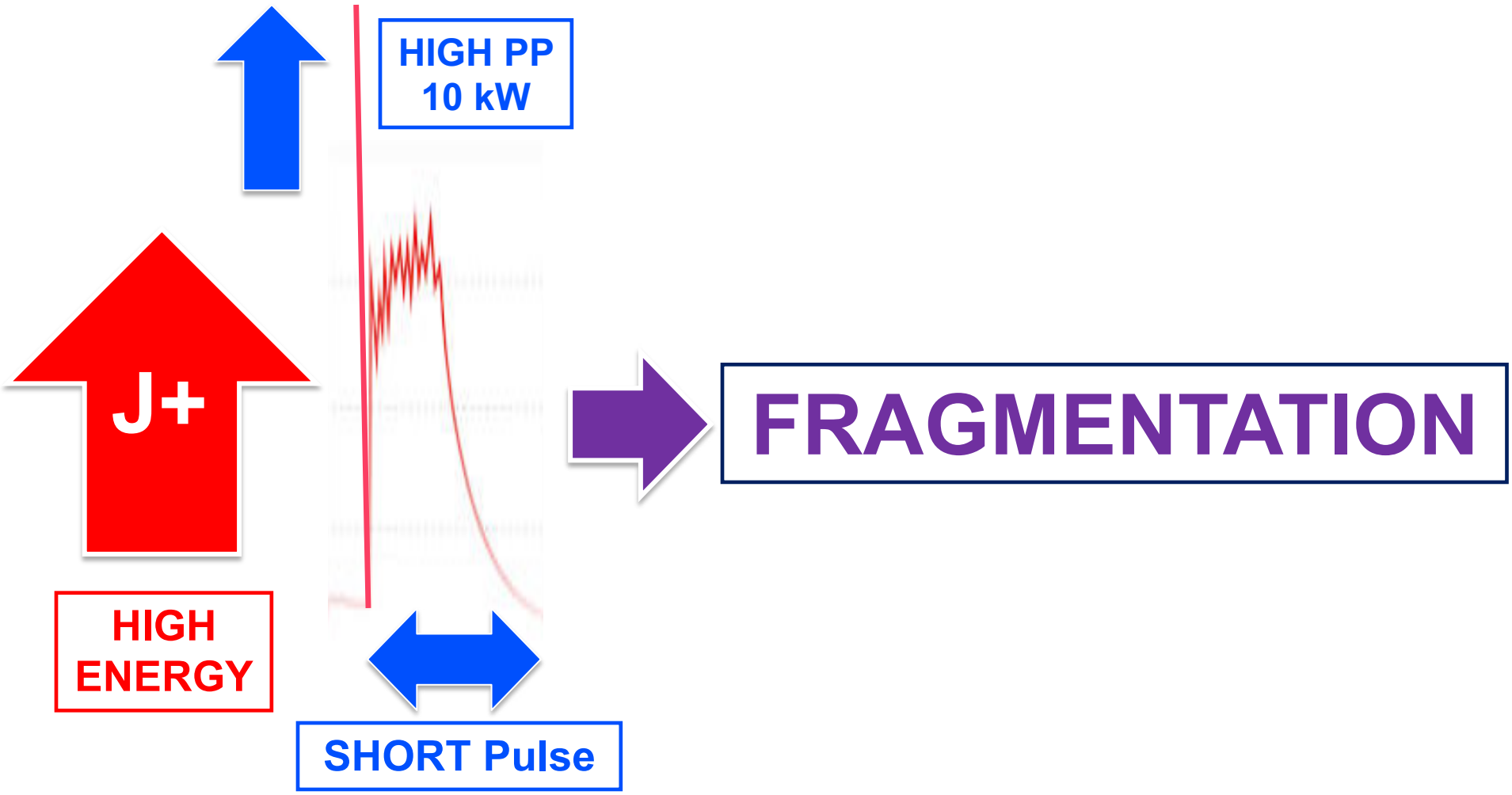
Holmium-YAG & UROLOGY

Pulse

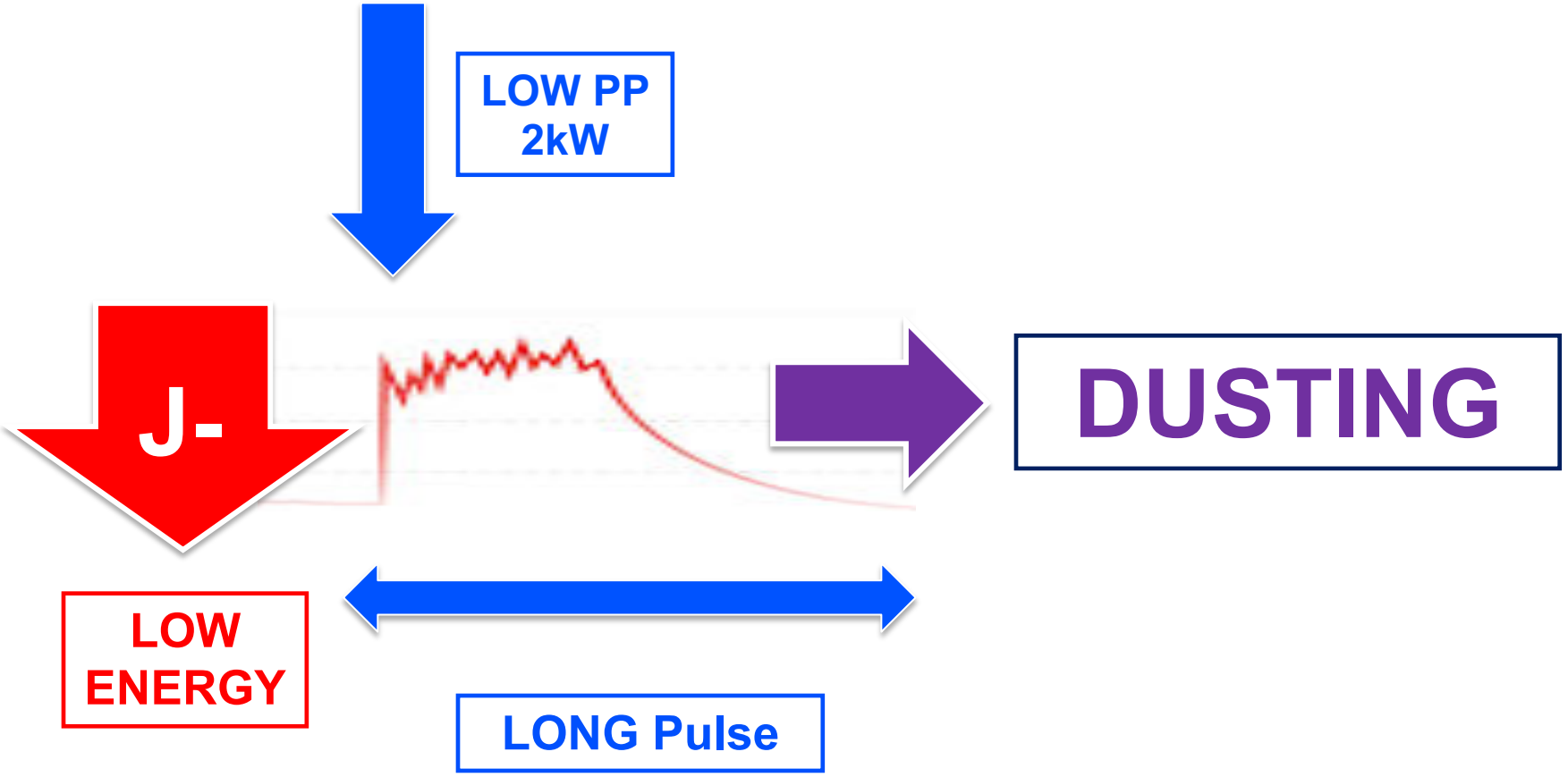
Holmium-YAG & UROLOGY

Pulse Duration & Peak Power

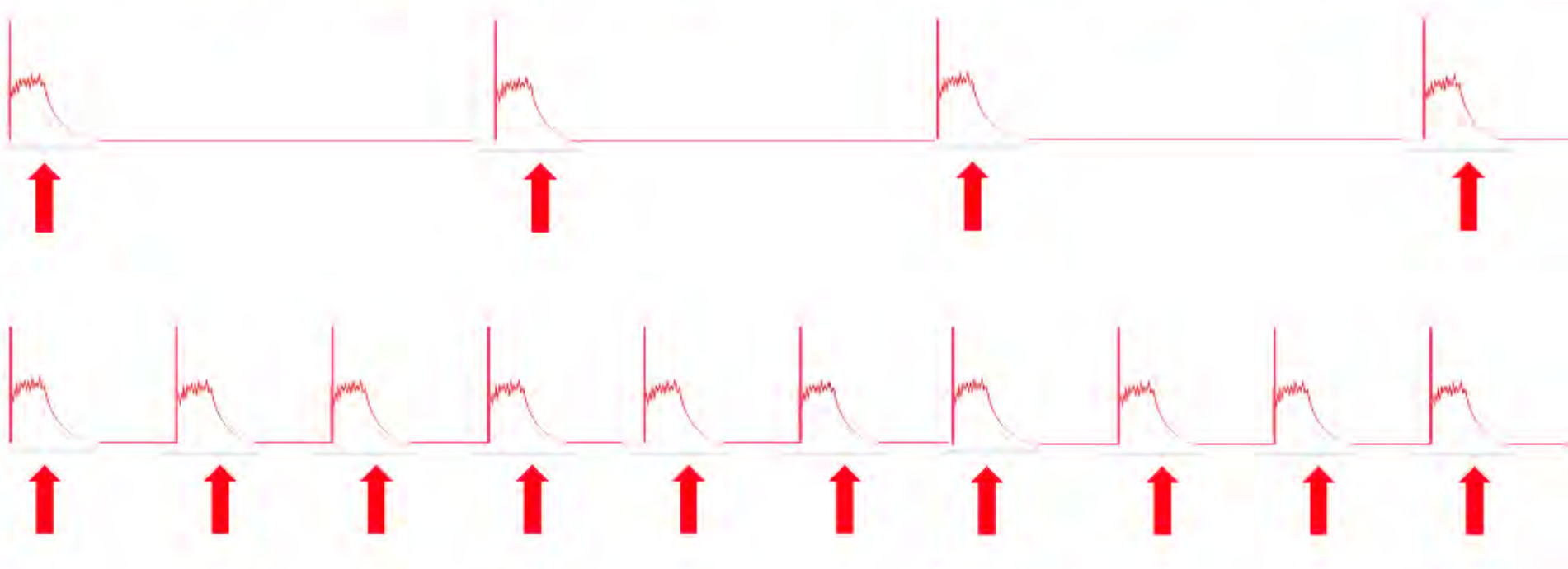


Holmium-YAG & UROLOGY

Pulse Duration & Peak Power



Holmium-YAG & UROLOGY



FREQUENCY (Hz) : High vs **Low**

"the **SPEED !**"

Holmium-YAG & DUSTING

World Journal of Urology
https://doi.org/10.1007/s00345-022-04090-4

ORIGINAL ARTICLE

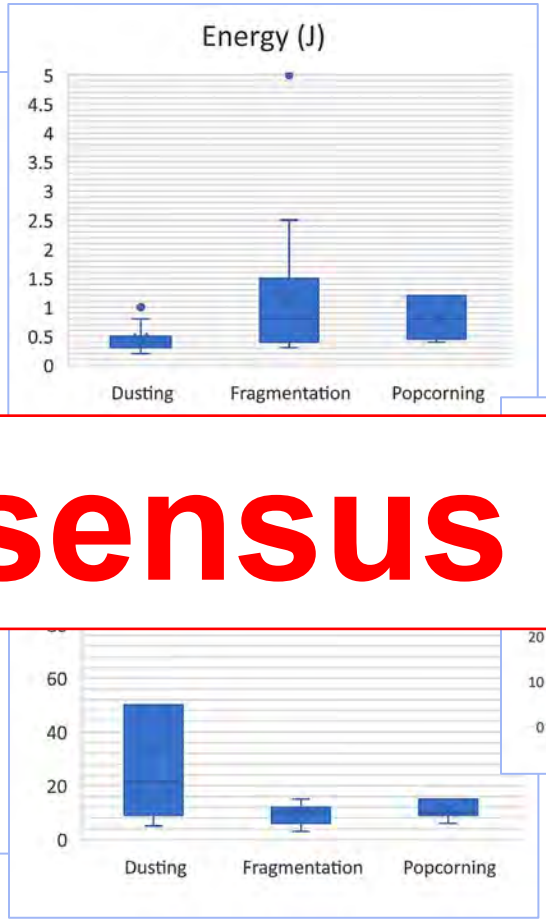
Glossary of pre-settings given by laser companies: no consensus!

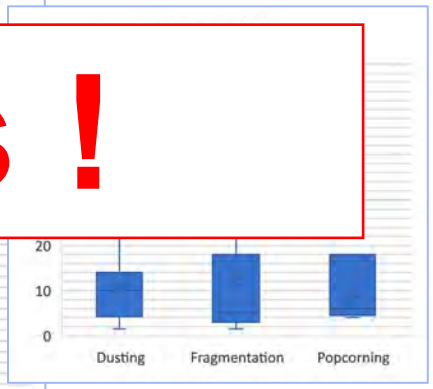
Alba Sierra[1,2] · Mariela Corrales[1,2] · Adrià Piñero[1,2] · Merkourios Kolvatzis[1,2] · Bhaskar Somani[3] · Olivier Traxer[1,2]

Received: 16 February 2022 / Accepted: 30 June 2022

Abstract
Introd
of new
We air
Materi
Manu
directl
Result
35 W
mode
0.4 J (
tion is 0.8 J (0.3–5), 10 (3–15) Hz and 5 (1.5–50) W for energy, frequency, and power, respectively; and for popcorn is 0.8 J (0.4–1.2), 10 Hz (6–15) and 5 W (4–18) for energy, frequency, and power, respectively. Dusting and fragmentation mode of Rocamed MH01 and EMS LaserClast 35 are programmed according to the stone type. Most of these settings do not depend on the size of the fiber being used nor the location and type of stone. For TFL, the pre-sets are divided in bladder stone, dusting, fine dusting, fragmentation, and ureteral stone.
Conclusion There is a huge variability regarding pre-sets offered by companies because there is no consensus. Pre-sets should provide a range to work efficacy and safety.

Keywords Laser · Holmium YAG · Thulium fiber laser · Settings · Kidney calculi · Ureteroscopy · Percutaneous nephrolithotomy





No Consensus !

Pre-Settings

Sierra et al, WJU 2022

Thulium-Fiber & DUSTING

World Journal of Urology
https://doi.org/10.1007/s00345-022-03966-9

ORIGINAL ARTICLE

Check for updates

Thulium fiber laser pre-settings during ureterorenoscopy: Twitter's

No Consensus !

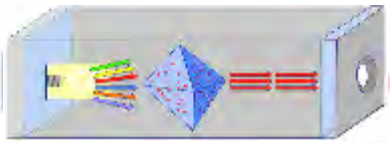
Received: 4 November 2021 / Accepted: 14 February 2022

Pre-Settings

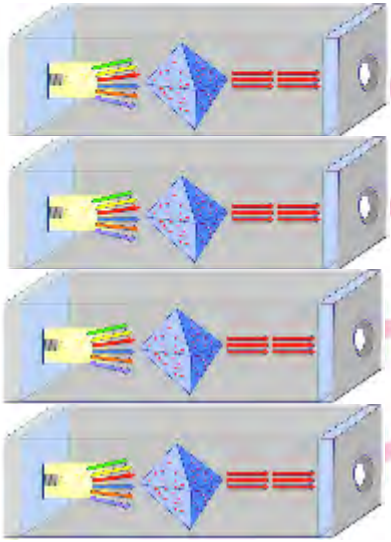
Sierra et al, WJU 2022

Holmium-YAG & UROLOGY

Low or High **Power**



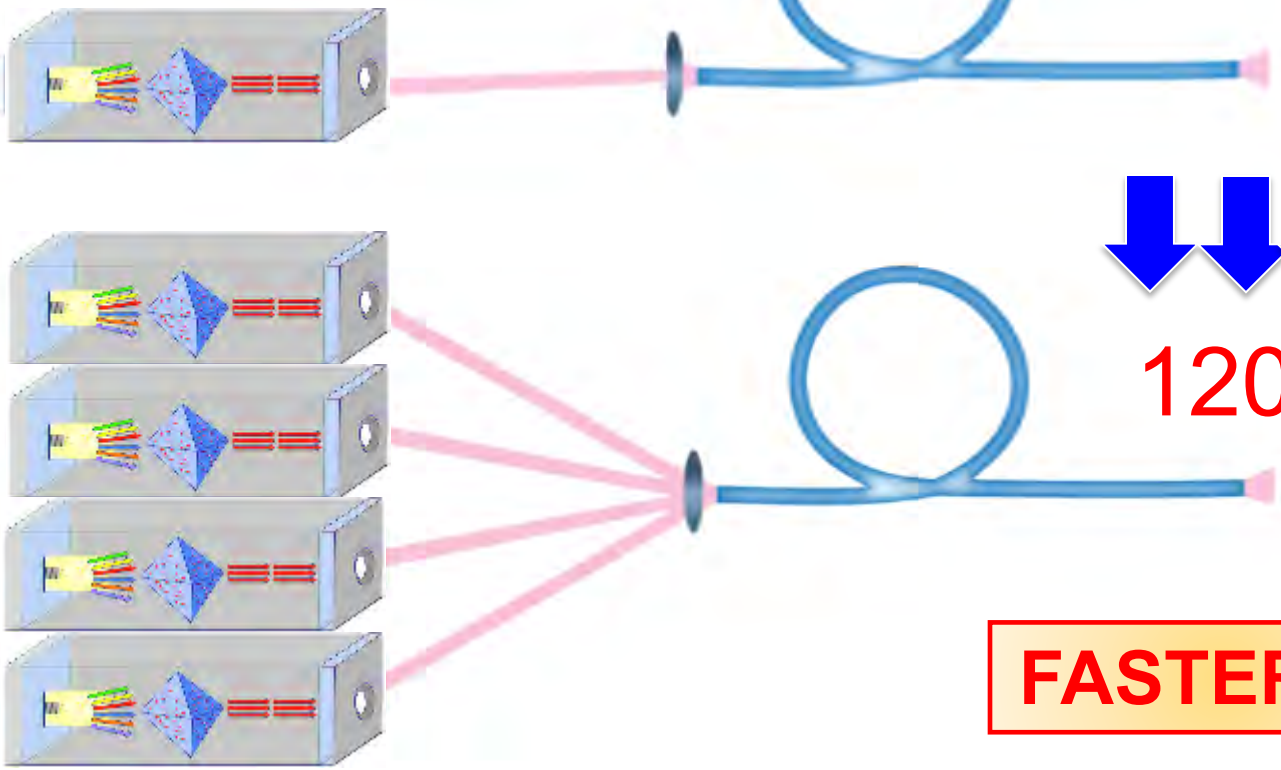
30 W



150 W

Holmium-YAG & UROLOGY

Low or High **Frequency**



20-30 Hz

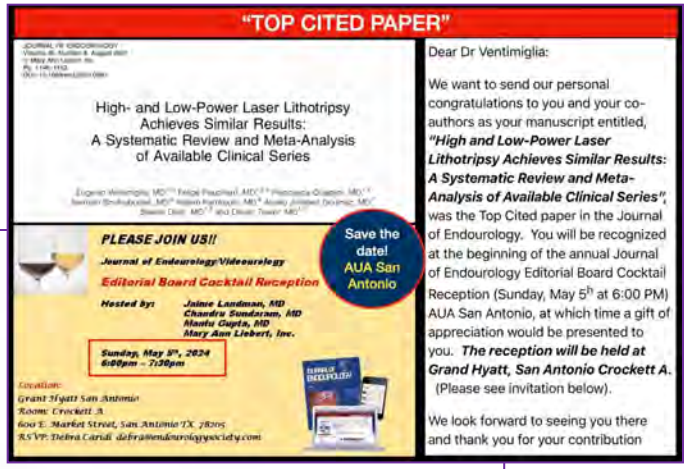
120 Hz

FASTER ??

Holmium-YAG & UROLOGY

2021

2024



JOURNAL OF ENDOUROLOGY
Volume 35, Number 8, August 2021

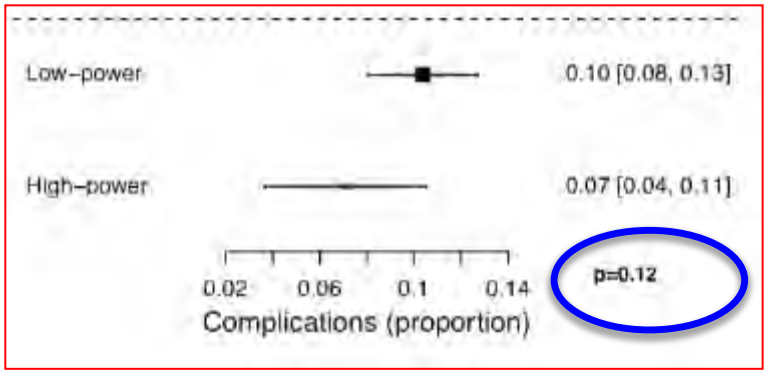
Pp. 1146–1152
DOI: 10.1089/end.2020.0090

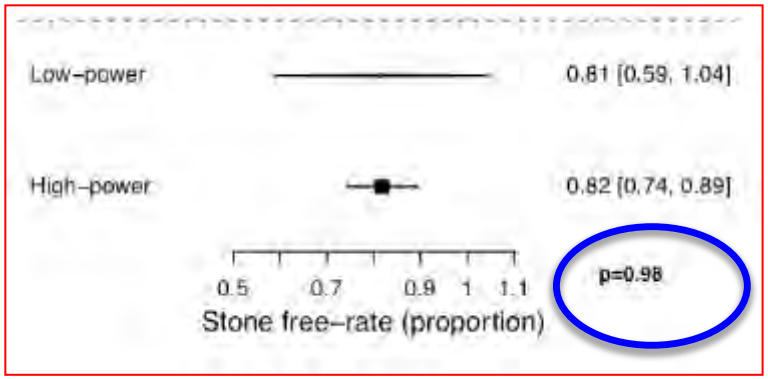
High- and Low-Power Laser Lithotripsy Achieves Similar Results: A Systematic Review and Meta-Analysis of Available Clinical Series

Eugenio Ventimiglia, MD,[1–3] Felipe Pauchard, MD,[1,2,4] Francesca Quadrini, MD,[1,2] Sermsin Sindhubodee, MD,[5] Hatem Kamkoum, MD,[6] Alvaro Jiménez Godínez, MD,[7] Steeve Doizi, MD,[1,2] and Olivier Traxer, MD[1,2]

Holmium-YAG & UROLOGY

RIRS : Low or High Frequency





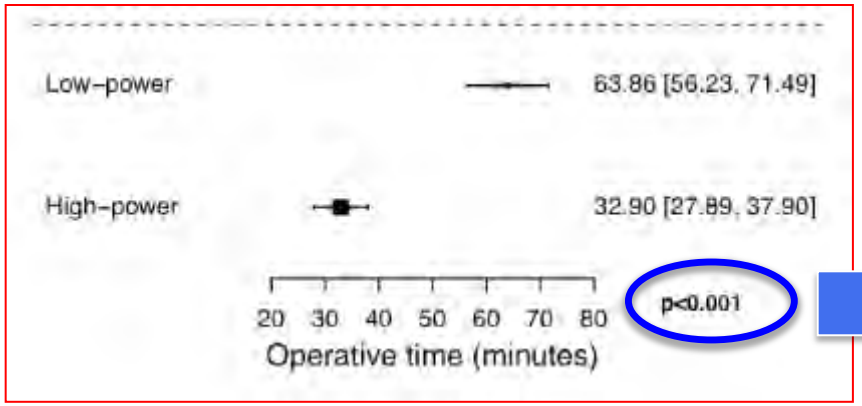


Table 2. Meta-analytic synthesis of baseline characteristics of patients in included studies according to high-power (HP) vs. low-power (LP) laser lithotripsy

	Group	N. of available studies	Pooled estimate (95% CIs)	I^2 (%)	p-value
Age (years)					
mean (95% CIs)	LP	16	50.9 (45.7-56.1)	99,6	
mean (95% CIs)	HP	5	46.4 (42-50.8)	98,5	0,19
Stone size (mm)					
mean (95% CIs)	LP		15.8 (13.6-18)	99,5	
mean (95% CIs)	HP		12.9 (9.6-16.3)	99,2	0,16
Stone volume (mm^3)					
mean (95% CIs)	LP		2604.4 (1457.9-3750.9)	100,0	
mean (95% CIs)	HP		1217.1 (461.2-1972.9)	100,0	0,047
Hounsfield unit density					
mean (95% CIs)	LP		969.8 (914.2-1025.3)	88,4	
mean (95% CIs)	HP		914.1 (787.4-1040.9)	92,6	0,43

HP: high-power, LP: low-power
I^2 statistics represents the estimate for the percentage of variability across studies attributable to heterogeneity beyond chance
P-value according to Wald-type test

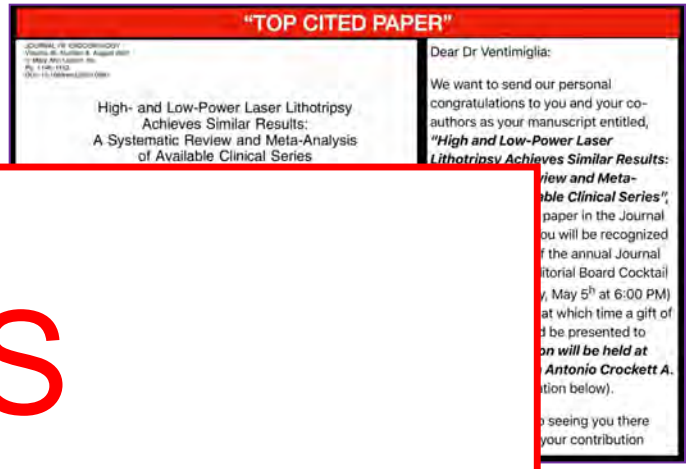
23 Publications

Ventimiglia et al, J EndoUrol 2021

Holmium-YAG & UROLOGY

2021

2024



for RIRS

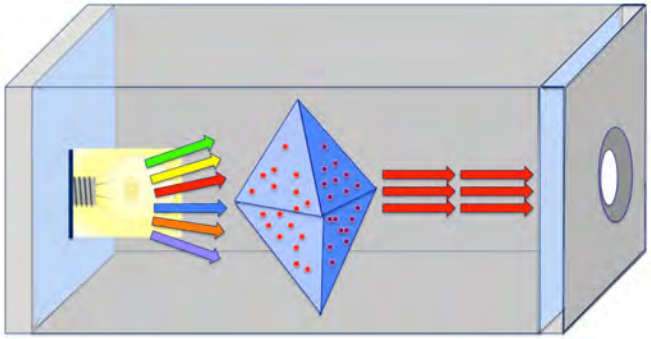
Low vs High Power :

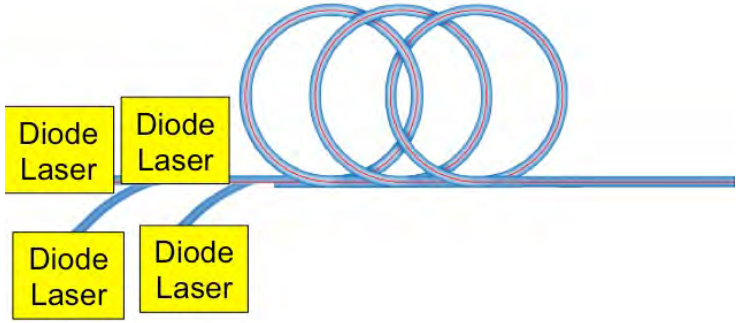
NO DIFFERENCE!

Steeve Doizi, MD,[1,2] and Olivier Traxer, MD[1,2]

Holmium:YAG vs Tm Fiber

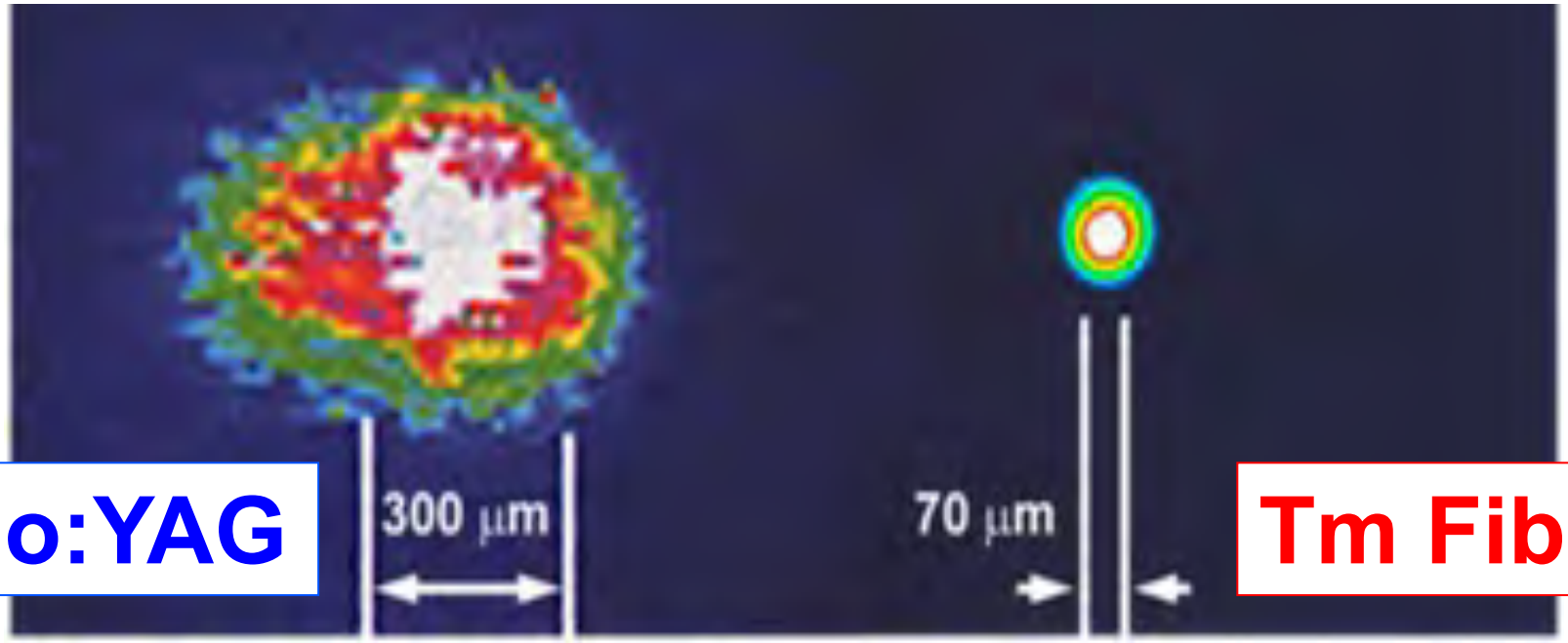
What are the 4 main Differences between Ho:YAG & TmFiber ?





Holmium:YAG vs Tm Fiber

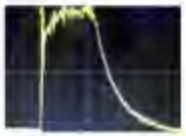
Laser beam profiles at the surgical fiber connector



FIBER SIZE **#1**

16 Times Smaller

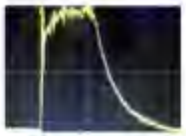
Holmium:YAG vs Tm Fiber

Parameter	Lumenis Pulse 120H (Ho long)	IPG Prototype Super Pulse Tm fiber system (Tm)
Wavelength, nm	2100	1940
Pulsewidth range, ms	0.05 to 0.7 	0.05 to 12 
Pulse Energy, J	0.2 to 6.0 J	0.025 J to 6.0 J
Max Peak Power, W	2000 to 10000	500
Max Average Power, W	120	50
Max repetition rate, Hz	80	2000
Fiber	SlimLine 200 (275 µm core) fiber (Lumenis, Israel)	200 µm core fiber (Low OH Silica/ Silica Fibers - ZLWF, "Z-light", Livani, Latvia)

ENERGY **#2**

10 Times Less for the mini.

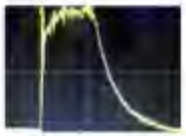
Holmium:YAG vs Tm Fiber

Parameter	Lumenis Pulse 120H (Ho long)	IPG Prototype Super Pulse Tm fiber system (Tm)
Wavelength, nm	2100	1940
Pulsewidth range, ms	0.05 to 0.7 	0.05 to 12 
Pulse Energy, J	0.2 to 6.0 J	0.025 J to 6.0 J
Max Peak Power, W	2000 to 10000	500
Max Average Power, W	120	50
Max repetition rate, Hz	80	2000
Fiber	SlimLine 200 (275 µm core) fiber (Lumenis, Israel)	200 µm core fiber (Low OH Silica/ Silica Fibers - ZLWF, "Z-light", Livani, Latvia)

PEAK POWER **#3**

10 Times Less for the mini.

Holmium:YAG vs Tm Fiber

Parameter	Lumenis Pulse 120H (Ho long)	IPG Prototype Super Pulse Tm fiber system (Tm)
Wavelength, nm	2100	1940
Pulsewidth range, ms	0.05 to 0.7 	0.05 to 12 
Pulse Energy, J	0.2 to 6.0 J	0.025 J to 6.0 J
Max Peak Power, W	2000 to 10000	500
Max Average Power, W	120	50
Max repetition rate, Hz	80	2000
Fiber	SlimLine 200 (275 µm core) fiber (Lumenis, Israel)	200 µm core fiber (Low OH Silica/ Silica Fibers - ZLWF, "Z-light", Livani, Latvia)

FREQUENCY **#4**

25 Times More

Holmium:YAG vs Tm Fiber

Ho:YAG

To do WHAT ???

TmFibre

Holmium:YAG vs Tm Fiber

2021

Laboratory Experiments

5-019-02785-9

ORIGINAL ARTICLE

Check for updates

Preclinical comparison of superpulse thulium fiber laser and a holmium:YAG laser for lithotripsy

Viktoria Andreeva[1] · Andrey Vinarov[2] · Ilya Yaroslavsky[3] · Anastasia Kovalenko[1] · Alexander Vybornov[3] · Leonid Rapoport[2] · Dmitry Enikeev[2] · Nikolay Sorokin[2] · Alim Dymov[2] · Dmitry Tsarichenko[2] · Petr Glybochko[2] · Nathaniel

Received: 15

Superiority of Tm-Fiber vs Ho:YAG for stone Ablation : More Dust & Much Faster

Traxer & Corrales, JCM 2021

Holmium:YAG vs Tm Fiber

2022

Clinical Data

available at www.sciencedirect.com
journal homepage: www.europeanurology.com

European Association of Urology

Stone Disease

Thulium Fibre Laser *versus* Holmium:YAG for Ureteroscopic Lithotripsy: Outcomes from a Prospective Randomised Clinical Trial

Øyvind Ulvik[a,b,*], *Mathias Sørstrand Æsøy*[a], *Patrick Juliebø-Jones*[a,b], *Peder Gjengstø*[a], *Christian Beisland*[a,b]

[a] *Department of Urology, Helse Bergen HF, Haukeland University Hospital, Bergen, Norway;* [b] *Department of Clinical Medicine, University of Bergen, Bergen, Norway*

1. Better SFR
2. Faster
3. Less Complication

Definition and locatio				ulium roup	*p* value
No residual fragments ≥					
Overall, % (*n*)				(8)	0.011 [b]
Renal stones, % (*n*)				(5)	0.014
Ureteral stones, % (*n*)					
Zero fragments					
Overall, % (*n*)				(0)	1
Renal stones, % (*n*)				(3)	0.3
Ureteral stones, % (*n*)					

[a] Adjusted for four-category stratification group.

here were no ureteral
e of to adverse events.

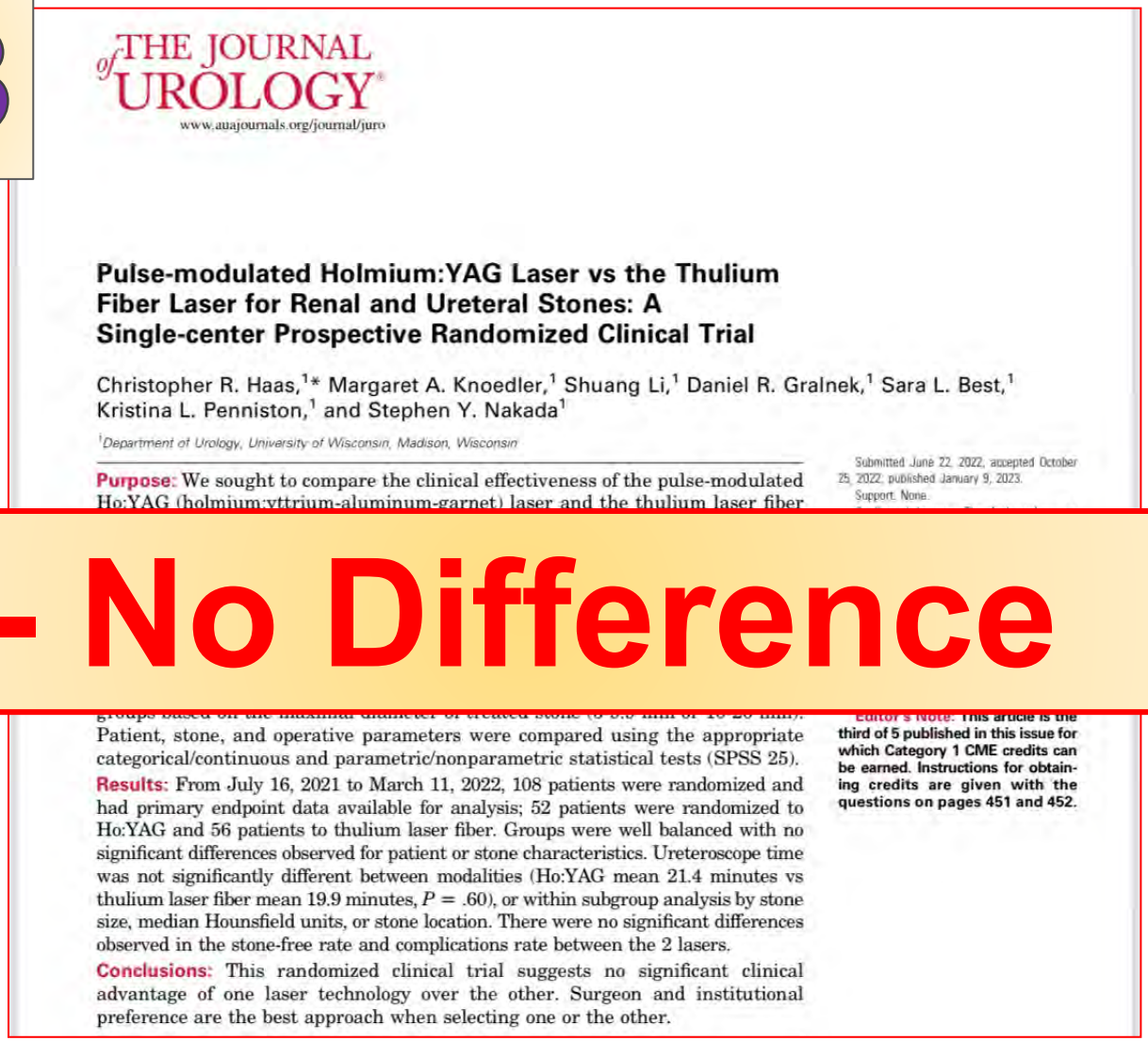
rast leakage on a ret-

[d] Only mucosal abrasion of grade 1 or 2 was registered according to the classification of ureteral wall injuries presented by Traxer and Thomas [15].

Holmium:YAG vs Tm Fiber

2023

Clinical Data



THE JOURNAL of UROLOGY®
www.auajournals.org/journal/juro

Pulse-modulated Holmium:YAG Laser vs the Thulium Fiber Laser for Renal and Ureteral Stones: A Single-center Prospective Randomized Clinical Trial

Christopher R. Haas,[1]* Margaret A. Knoedler,[1] Shuang Li,[1] Daniel R. Gralnek,[1] Sara L. Best,[1] Kristina L. Penniston,[1] and Stephen Y. Nakada[1]

[1]Department of Urology, University of Wisconsin, Madison, Wisconsin

Submitted June 22, 2022; accepted October 25, 2022; published January 9, 2023.
Support: None.

Purpose: We sought to compare the clinical effectiveness of the pulse-modulated Ho:YAG (holmium:yttrium-aluminum-garnet) laser and the thulium laser fiber

groups based on the maximal diameter of treated stone (≤ 9.5 mm or 10-20 mm). Patient, stone, and operative parameters were compared using the appropriate categorical/continuous and parametric/nonparametric statistical tests (SPSS 25).

Results: From July 16, 2021 to March 11, 2022, 108 patients were randomized and had primary endpoint data available for analysis; 52 patients were randomized to Ho:YAG and 56 patients to thulium laser fiber. Groups were well balanced with no significant differences observed for patient or stone characteristics. Ureteroscope time was not significantly different between modalities (Ho:YAG mean 21.4 minutes vs thulium laser fiber mean 19.9 minutes, $P = .60$), or within subgroup analysis by stone size, median Hounsfield units, or stone location. There were no significant differences observed in the stone-free rate and complications rate between the 2 lasers.

Conclusions: This randomized clinical trial suggests no significant clinical advantage of one laser technology over the other. Surgeon and institutional preference are the best approach when selecting one or the other.

Editor's Note: This article is the third of 5 published in this issue for which Category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 451 and 452.

- No Difference

Holmium:YAG vs Tm Fiber

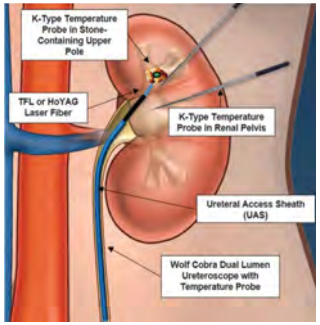
2023

Clinical Data

Comparison of Superpulse Thulium Fiber Laser *vs* Holmium Laser for Ablation of Renal Calculi in an *In Vivo* Porcine Model

Pengbo Jiang, MD,[1] Zhamshid Okhunov, MD,[1] Andrew S. Afyouni, BS,[1] Sohrab Ali, MD,[1] Seyed Hossein Hosseini Sharifi, MD,[1] Rohit Bhatt, BS,[1] Andrew Brevik, MD,[1] Maged Ayad, BS,[1] Krista Larson, BS,[1] Kathryn Osann, MD,[2] Roshan M. Patel, MD,[1] Jaime Landman, MD,[1] and Ralph V. Clayman, MD[1]

- IN VIVO ANIMAL STUDY
- 24 KIDNEYS & Canine CaOx Stone



- TFL : X3 faster & 3X less energy & X1.6 higher SFR

- ABLATION RATE : TFL= 53mm^3/min vs Ho:YAG = 17mm^3/min

- TEMPERATURE : NO DIFFERENCE < 44° C

TFL : 76% < 1mm vs **Ho:YAG :** 17% <1mm

Holmium:YAG vs Tm Fiber

2023

THE JOURNAL of UROLOGY®

Clinical Data

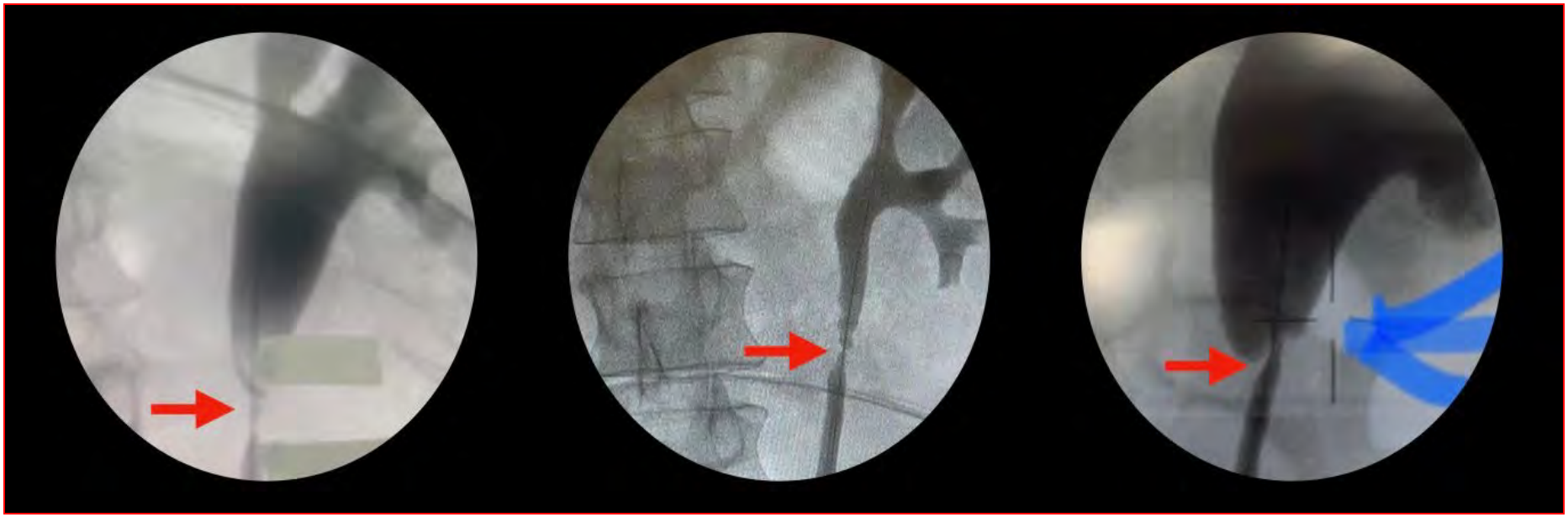
Comparison Between Holmium:YAG Laser with MOSES Technology vs Thulium Fiber Laser Lithotripsy in Retrograde Intrarenal Surgery for Kidney Stones in Adults: A Propensity Score–matched Analysis From the FLEXible Ureteroscopy Outcomes Registry

Daniele Castellani[1]* Khi Yung Fong,[2] Ee Jean Lim,[3] Ben Hall Chew,[4] Thomas Tailly,[5] Esteban Emiliani,[6] Jeremy Yuen-Chun Teoh,[7] Chu Ann Chai,[8] Heng Chin Tiong,[9] William Ong Lay Keat,[10] Yiloren Tanidir,[11] Deepak Ragoori,[12] Andrea Benedetto Galosi,[1] Abhishek Singh,[13] Saeed Bin Hamri,[14] Olivier Traxer,[15] Bhaskar Kumar Somani,[16] and Vineet Gauhar[9]

- BETTER LITHOTRIPSY PERFORMANCE FOR Thulium Fiber Laser

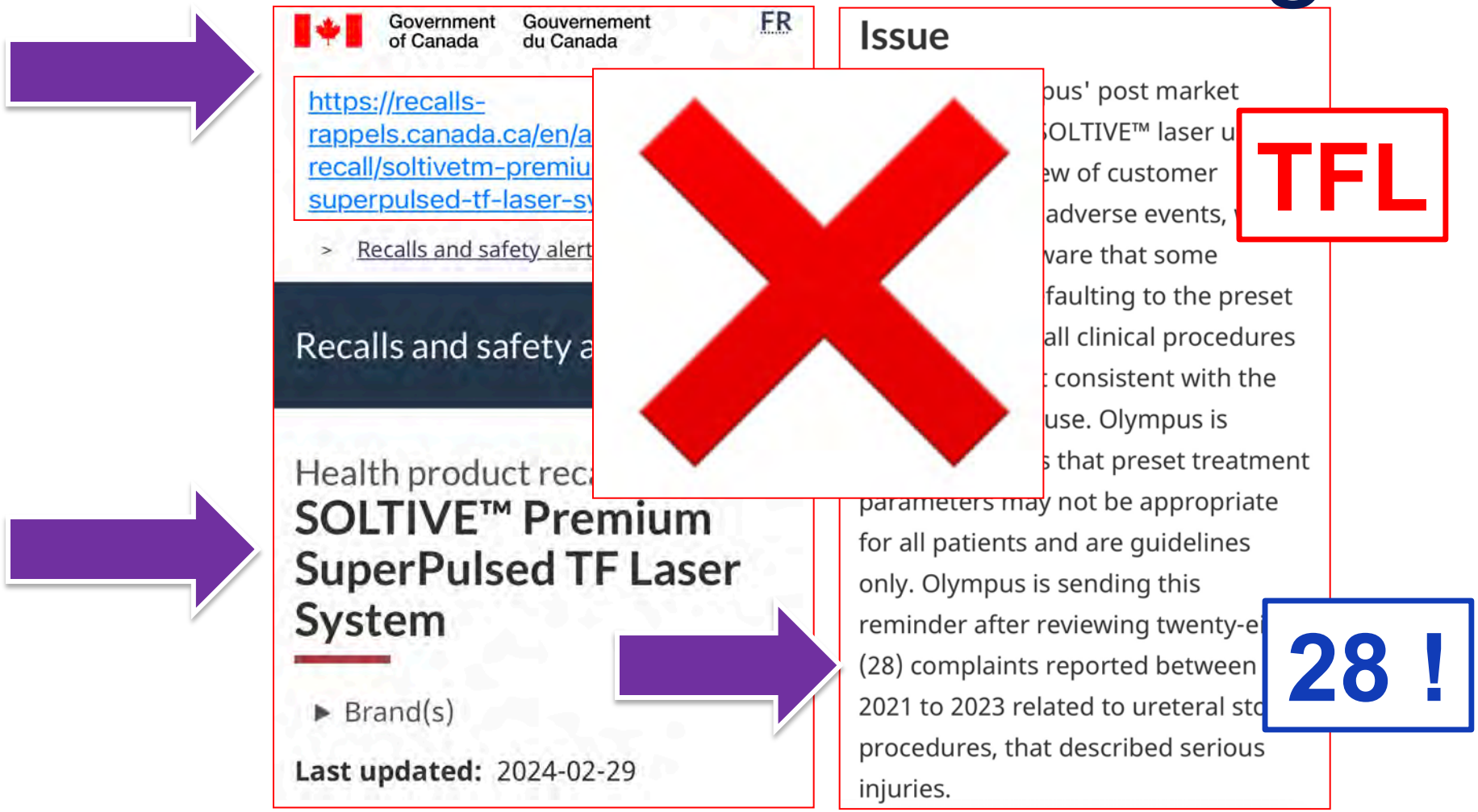
- Stone Free in favor of TFL : **85 versus 56%**

FURS & «Thermal Damage»



Ureteral Stenosis +++

FURS & «Thermal Damage»



Dangerous ?- YES !!!

FURS & «Thermal Damage»

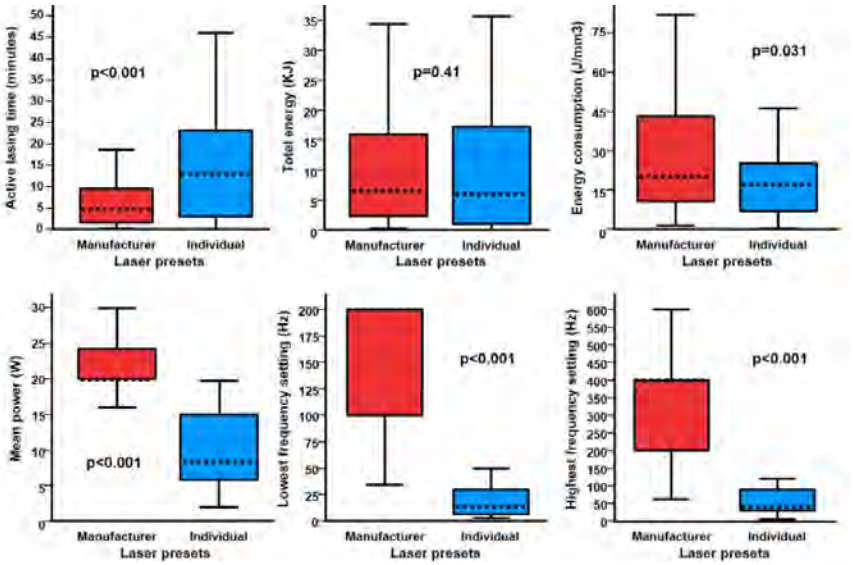
2025

World Journal of Urology (2025) 43:232
https://doi.org/10.1007/s00345-025-05553-0

RESEARCH

High POWER High Frequency Dangerous !

Olivier Traxer[4,5,9,10] · Etienne Xavier Keller[1,4,5,7]



FURS & «Thermal Damage»

“Heat the irrigation” : HOT WATER

Much More Power

Watts !!!

J x Hz = W

FURS & «Thermal Damage»

2015 **2023**

Pseudo-Aneurysm

	Sex	Age (years)	Cormorbidities	Stone size (mm)	Kidney	Location	Laser source	Laser fiber (µm)	Pulse energy (J)	Pulse fequency (Hz)	Total power (W)	Operation time (min)	Days to emboli-zation
Dunner et al. 2017	Male	56	MHVR	10	Left	MP	Ho:YAG	200	N.A.	N.A.	N.A	N.A.	14
Jubber et al. 2018	Female	68	MS NSTEMI	11 4	Left	RP LP	Ho:YAG	200	N.A.	N.A.	N.A	N.A	21
Deng et al. 2022	Male	29	DM	25	Right	RP	Ho:YAG	N.A.	0.8	25	20	60	47
Monteiro et al. 2022	Male	24	-	6 7	Left	UP	TFL	N.A	0.4 2	40 20	16 40	N.A	22
Yin et al. 2022	Male	53	Open bilateral nephrolithotomy	20	Bilateral	N.A	Ho:YAG	N.A	0.8	25	20	N.A	31
Al Barajraji M. et al. 2023	Male	65	HTA, OSA CHD	8	Left	UP	TFL	N.A	0.8 – 1	30	24 – 30	N.A	27
Current cases 2023	Male	40	-	12 8	Left Left	LP MP	TFL	150	1 1	30 30	30 30	75	2

7 cases : 4 Ho:YAG & 3 TmFiber

FURS & «Thermal Damage»

2015 **2023**

Pseudo-Aneurysm

	Sex	Age (years)	Cormorbidities	Stone size (mm)	Kidney	Location	Laser source	Laser fiber (µm)	Pulse energy (J)	Pulse fequency (Hz)	Total power (W)	Operation time (min)	Days to emboli-zation
Dunner et al. 2017	Male	56	MHVR	10	Left	MP	Ho:YAG	200	N.A.	N.A.	N.A	N.A.	14
Jubber et al. 2018	Female	68	MS NSTEMI	11 4	Left	RP LP	Ho:YAG	200	N.A.	N.A.	N.A	N.A	21
Deng et al. 2022	Male	29	DM	25	Right	RP	Ho:YAG	N.A.	0.8	25	20	60	47
Monteiro et al. 2022	Male	24	-	6 7	Left	UP	TFL	N.A	0.4 2	40 20	16 40	N.A	22
Yin et al. 2022	Male	53	Open bilateral nephrolithotomy	20	Bilateral	N.A	Ho:YAG	N.A	0.8	25	20	N.A	31
Al Barajraji M. et al. 2023	Male	65	HTA, OSA CHD	8	Left	UP	TFL	N.A	0.8 – 1	30	24 – 30	N.A	27
Current cases 2023	Male	40	-	12 8	Left Left	LP MP	TFL	150	1 1	30 30	30 30	75	2

Settings : **High Power** because **High Freq.**

FURS & «Thermal Damage»

2015 **2023**

Pseudo-Aneurysm

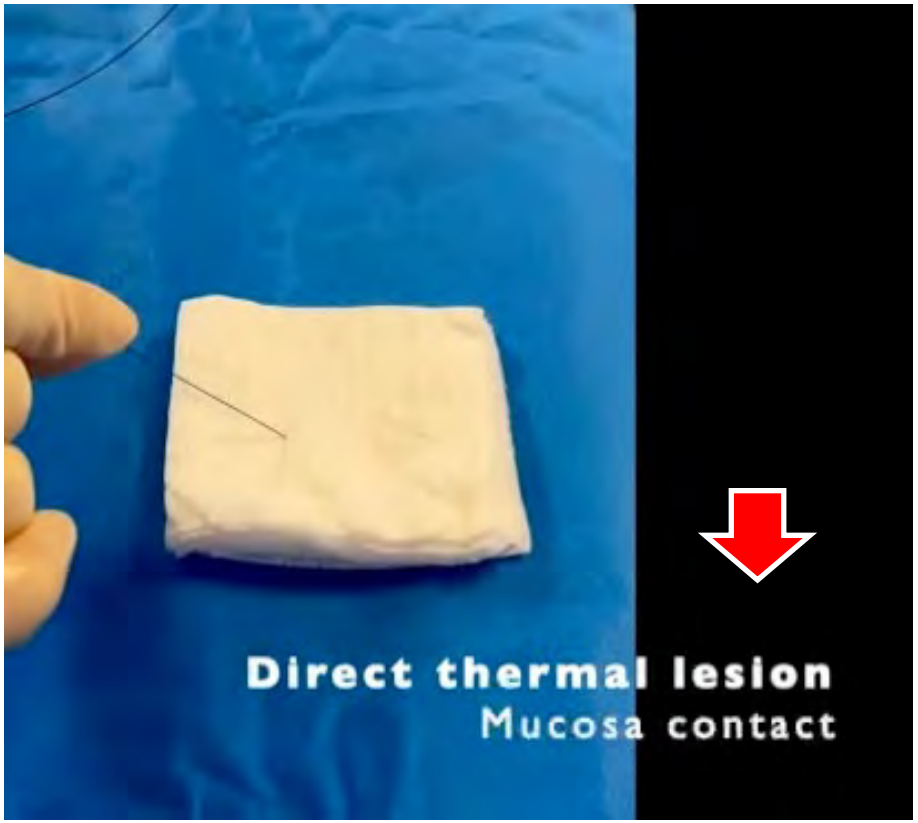
Less than 20 Watts !

	Sex	Age (years)	Cormorbidities	Stone size (mm)	Kidney	Location	Laser source	Laser fiber (µm)	Pulse energy (J)	Pulse fequency (Hz)	Total power (W)	Operation time (min)	Days to emboli-zation
D e 2								00	N.A.	N.A.	N.A	N.A.	14
J e 2								00	N.A.	N.A.	N.A	N.A	21
D e								A.		25	20	60	47
M e 2								A	0	40 20	16 40	N.A	22
Y 2								A		25	20	N.A	31
A B M 2								A	1	30	24 – 30	N.A	27
Current cases 2023	Male	40	-	12 8	Left Left	LP MP	TFL	150		30 30	30 30	75	2

Settings : High Power because High Freq.

FURS & «Thermal Damage»

Pulses away from Stone : Direct Lesion



J x Hz = W

Much More Pulses / second (Hz)!!!

FURS & «Thermal Damage»

2022

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© Mary Ann Liebert, Inc.
Pp. 1599–1606
DOI: 10.1089/end.2022.0216

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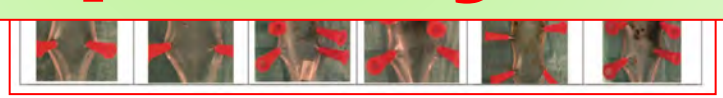
Thermal Injury and Laser Efficiency with Holmium YAG and Thulium Fiber Laser—An *In Vitro* Study

Alba Sierra, MD,[1,2] Mariela Corrales, MD,[1,2] Merkourios Kolvatzis, MD,[1,2] Frederic Panthier, MD,[1,2] Adrià Piñero, MD,[1,2] and Olivier Traxer, MD[1,2]

Less than 10 Watts & LOW frequency <10Hz !



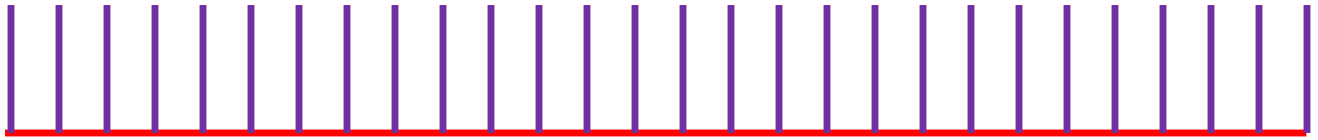
High Frequency is Dangerous for Ureter !

JEndoUrol 2022 Sierra A.

FURS & «Thermal Damage»

2024

C



10W Continous : 1j -10 Hz **100%** activation

B

10W Burst : 1j -20 Hz **50%** activation

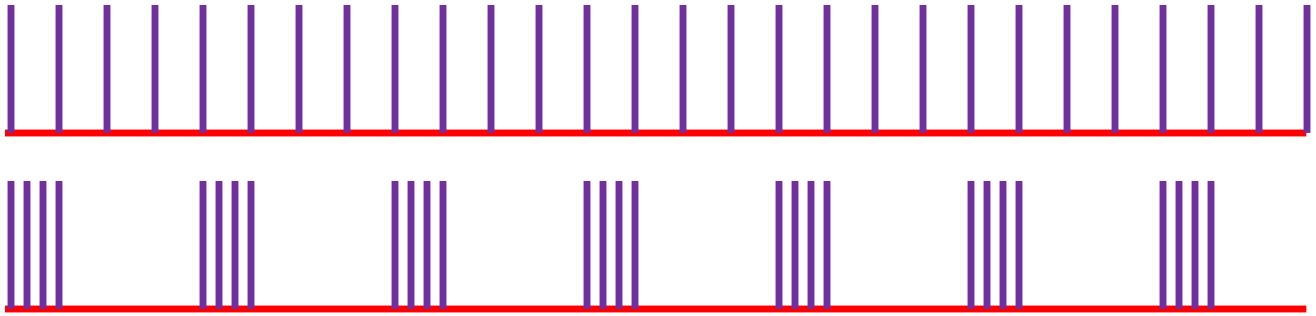
B

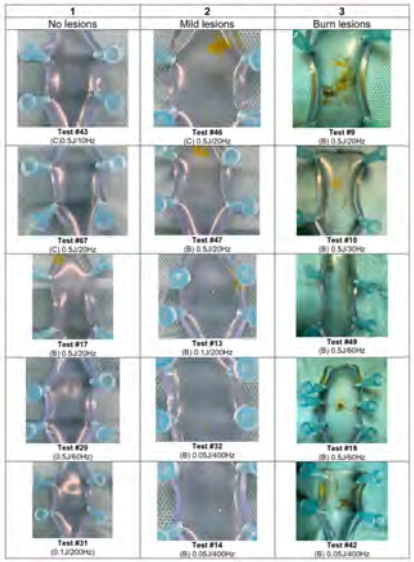
10W Burst : 1J -40 Hz **25%** activation

WJU 2024 Sierra A.

FURS & «Thermal Damage»

2024





	Energy (J)	Frequency (Hz)	Watts (W)	Laser on time (s)	Treatment time (s)	Laser active time (%)	Total delivered energy (KJ)
C	0.5	10	5	300		100	1.5
	0.5	20	10	150		100	1.5
B	0.5	20	10	150	300	50	1.5
	0.5	30	15	100	200	50	1.5
	0.5	60	30	50	100	50	1.5
	0.1	200	20	75	150	50	1.5
	0.05	400	20	75	150	50	1.5

C. Continuous

B. Burst

BURST more Dangerous than **Continous !**

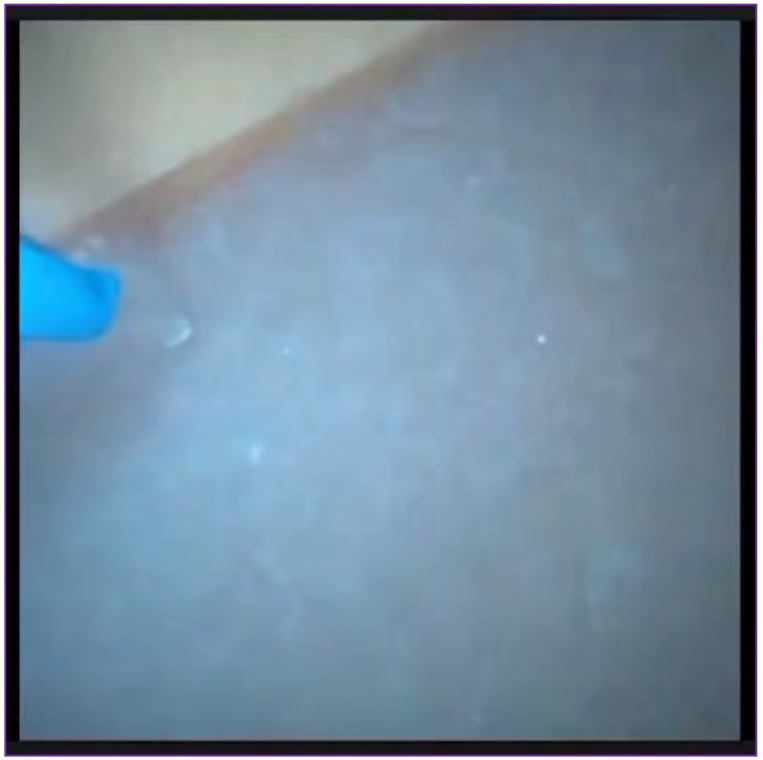
WJU 2024 Sierra A.

The FUTURE

STONE SENSE

In Vitro

OFF ON



ON OFF

Without StoneS. **With StoneS.**

FURS & «Thermal Damage»

2024

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Ureteroscopy and Percutaneous Procedures

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Temperature Measurements During Flexible Ureteroscopic Laser Lithotripsy:

Abstra

Objec
rosco
and re
Mater
(NT)
irrigat
record
Thuli
30 W.

Results: IRT correlated directly to power settings. Each time the power settings were increased, the temperature rose significantly. The increase in average peak temperature was 2.6°C between 5 and 10 W ($p < 0.001$), 3.4°C between 10 and 20 W ($p < 0.001$), and 2.5°C between 20 and 30 W ($p < 0.001$). Temperatures reached 43°C in three patients applying 20 W and in eight patients applying 30 W. The shortest activation-time until threshold was 12 and 28 seconds with 30 and 20 W settings, respectively. When reaching 43°C, temperatures remained above this threshold for an additional 29 seconds on average. There was a significant correlation between IRT and renal APD. For example, when 10 W was applied in the setting of APD ≤20 mm, the recorded temperature was on average 2.3°C higher compared with APD >20 mm, with the same power settings applied, $p < 0.001$.
Conclusion: During FURSL, IRT correlates directly with power settings and is inversely correlated with renal pelvic APD. Using a sheathless approach, power settings ≥20 W should arguably be avoided, especially in the context of a nondilated renal pelvis.
ClinicalTrials: The study was registered on ClinicalTrials.gov (NCT05677425).

Keywords: ureteroscopy, thulium fiber laser, laser lithotripsy, temperature, temperature profiles

Introduction

With an ever-increasing prevalence of kidney stone disease, the number of surgical interventions has increased, and this is especially the case for ureteroscopy.[1,2] When performing surgery, the Hippocratic oath serves as a constant reminder of our responsibilities to cause no harm to patients. However, flexible ureteroscopic laser lithotripsy (FURSL) carries inherent risks for potential complications, such as high intrarenal pressure (IRP).[3,4] As a result of the advent of high-power laser systems, which has been one of several technological advancements, concerns have been

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[2]Department of Clinical Medicine (K1), University of Bergen, Bergen, Norway.

World Journal of Urology (2024) 42:453
https://doi.org/10.1007/s00345-024-05162-3

RESEARCH

Check for updates

Temperature profile during endourological laser activation: introducing the thermal safety distance concept

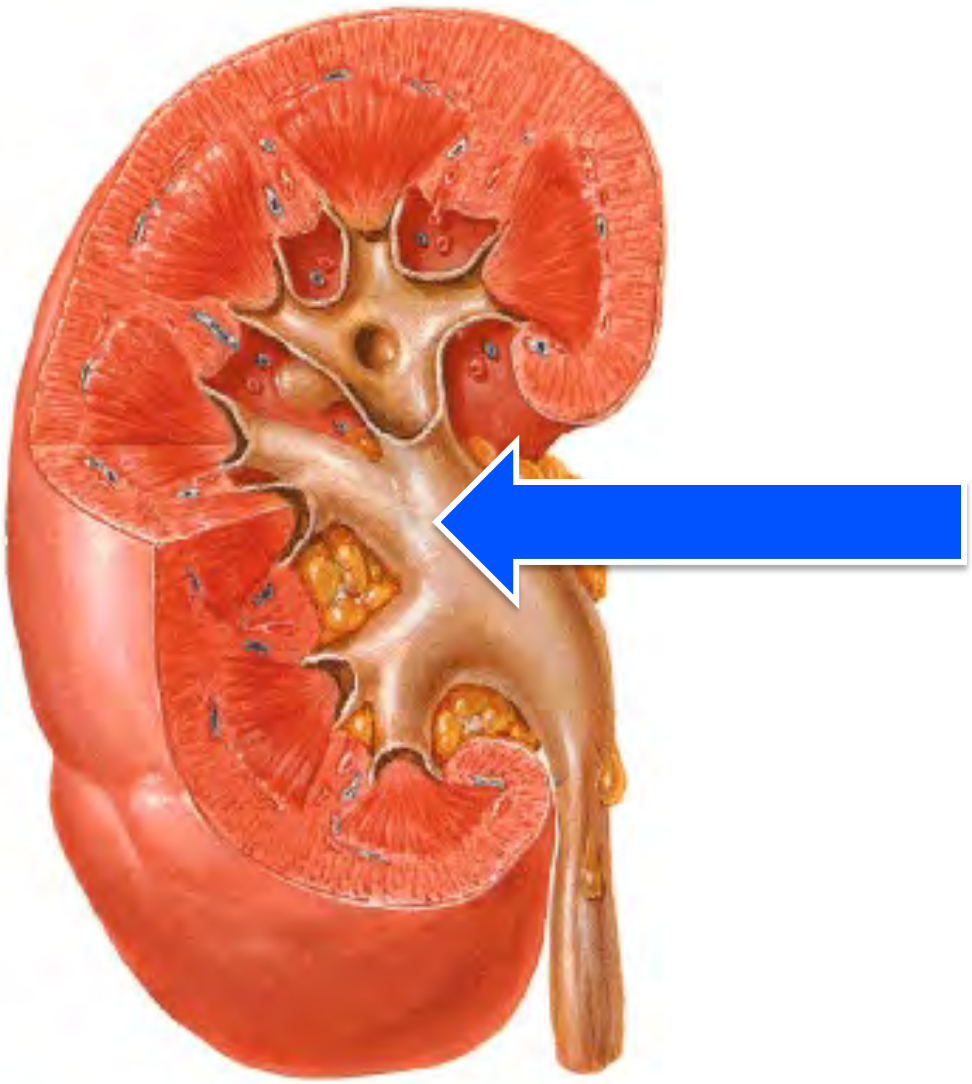
Eugenio Ventimiglia[1,2,3,4] · Daniele Robesti[1,2] · Etienne Xavier Keller[3,4,5] · Christian Corsini[1,2] · Andrea Folcia[1,2] · Margherita Fantin[1,2] · Luigi Candela[6] · Edoardo Pozzi[1,2] · Alba Sierra[3,4,6] · Amelia Pietropaolo[3,7] · Bhaskar K. Somani[7] · Frederic Panthier[4,6] · Felipe Pauchard[4,8] · Ioannis Kartalas Goumas[9] · Luca Villa[1,2] · Francesco Montorsi[1,2] · Olivier Traxer[4,6] · Andrea Salonia[1,2] · Paola Saccomandi[10]

Results A positive correlation was observed between average power and the highest recorded temperature (Spearman's coefficient 0.94, $p < 0.001$). Irrigation was found to reduce the highest recorded temperature, with a maximum average reduction of 9.4 °C at 40 W ($p = 0.002$). A positive correlation existed between average power and safety distance values (Spearman's coefficient 0.86, $p = 0.001$). A thermal dose indicative of tissue damage was observed at 20 W without irrigation (safety distance 0.93±0.11 mm). While at 40 W, irrigation led to slight reduction in mean safety distance (4.47±0.85 vs. 5.22±0.09 mm, $p = 0.08$).
Conclusions Laser settings with an average power greater than 10 W deliver a thermal dose indicative of tissue damage, which increases with higher average power values. According to safety distance values from this study, a maximum of 10 W should be used in the ureter, and a maximum of 20 W should be used in kidney in presence of irrigation.

Kidney: Less than 20 Watts!
Ureter: Less than 10 Watts!

J EndoUrol 2024 Aeso M.
WJU 2024 Ventimiglia E.

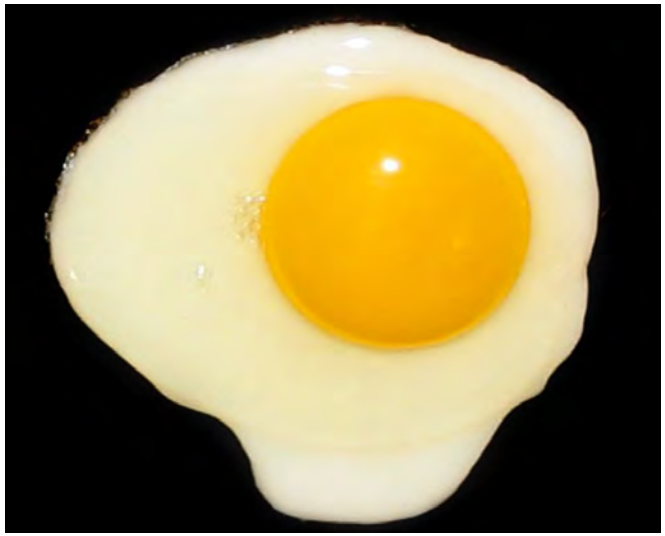
FURS & «Thermal Damage»



ANATOMY

PCS Volume:
10-20 ml

FURS & «Thermal Damage»



T° & PROTEINS

Denaturation : Starting 40°

Coagulation : 60°

Joules & Calories?

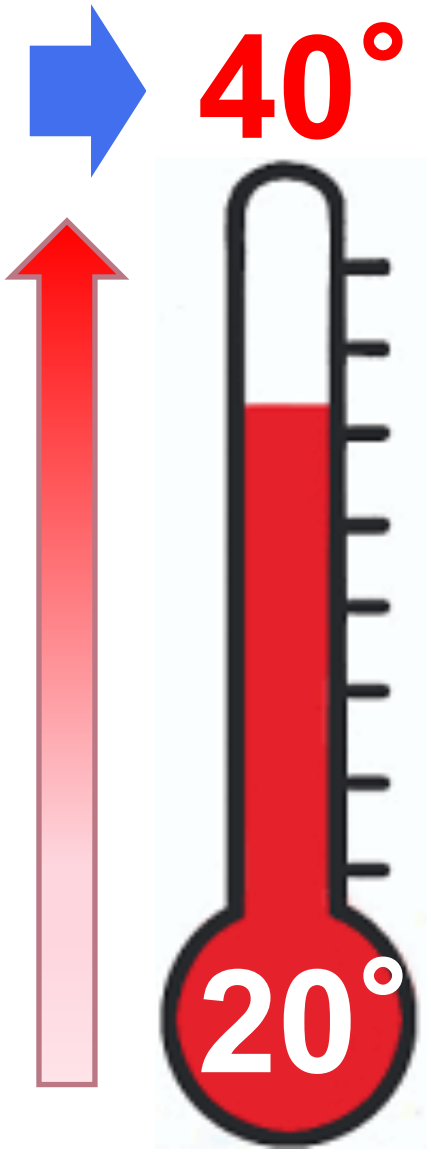
UNITS

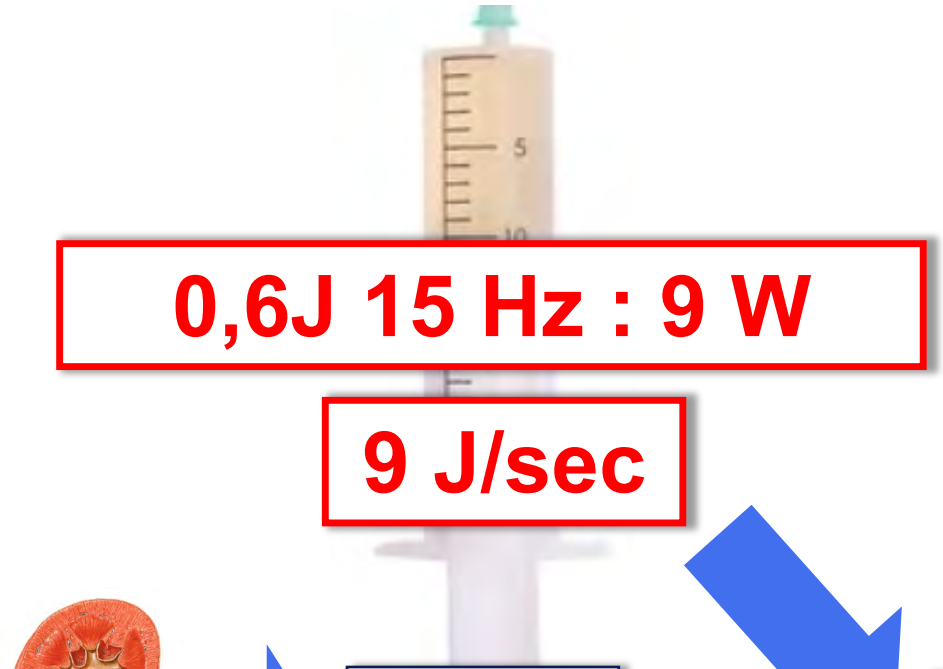
1 Calorie increases

1 ml by 1 degree

1 Calorie = 4,2 J

Joules & Calories?





0,6J 15 Hz : 9 W

9 J/sec

10 ml

840 J

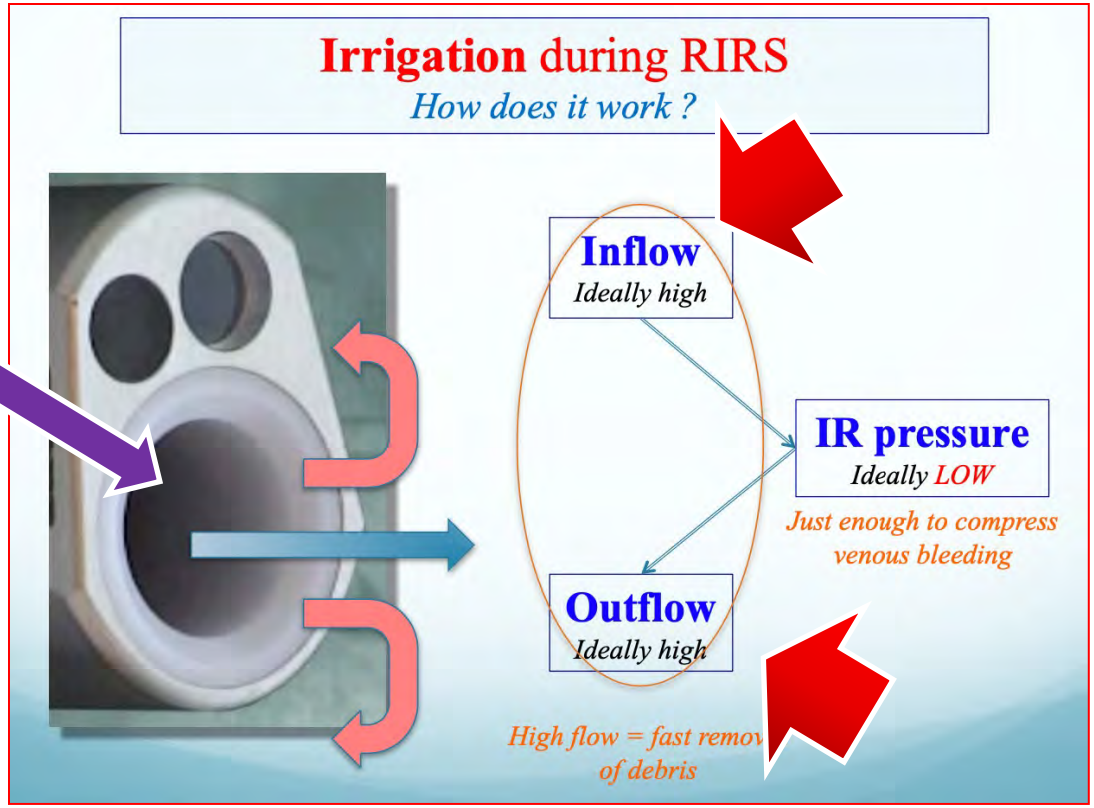
1,5 min

IRRIGATION FLOW

We need a good Irrigation FLOW !...

BUT…

3.6
Ch



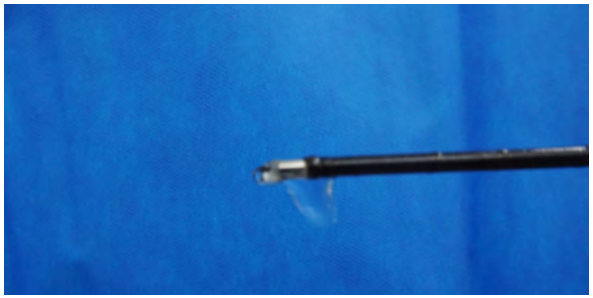
INTRA-Renal PRESSURE

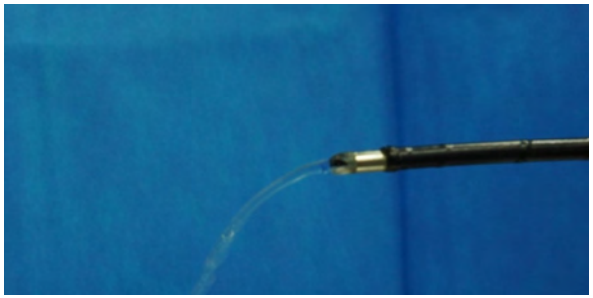
IRRIGATION FLOW

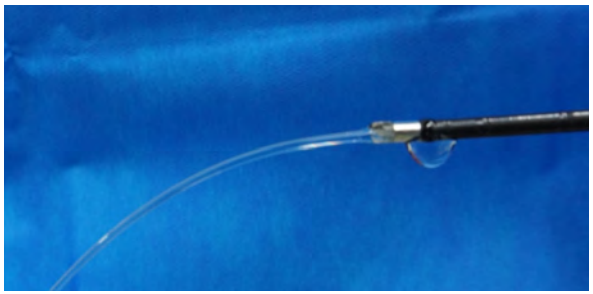
FURS: Working Channel 3,6 Fr

Gravity Bag: 50 cm	Gravity Bag: 100 cm	Gravity Bag: 150 cm
En		n
27		in
20		
150 µm: 17.5 ml/min	150 µm: 25 ml/min	150 µm: 33 ml/min

20 ml/min







IRRIGATION FLOW

FURS: Working Channel 3,6 Fr

European Urology
European Urology 45 (2004) 58–64

Impact on Active Scope Deflection and Irrigation Flow of All End

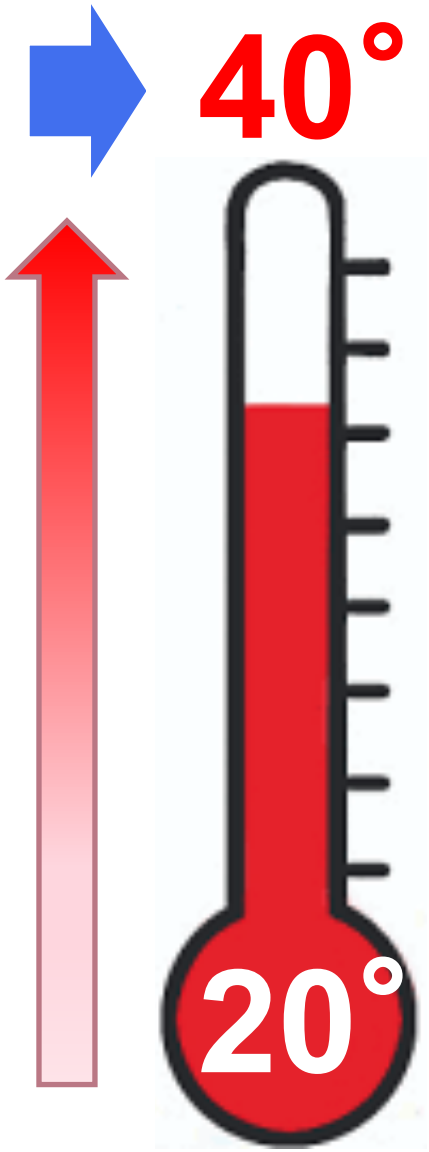
Federico P
Bernard Ga
Department of Ur

Accepted 28 Aug
Published online

20 ml/min

							7325.172
							44 [54]
							0 [0]
							7 [9]
							0 [2]
							4 [6]
							11 [14]
							13 [15]
							0 [2]
							0 [3]
							12 [15]
	Boston Scientific	Graspit™ 3.2F	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
	Boston Scientific	Graspit™ 2.6F	10 [10]	10 [10]	4 [5]	4 [5]	4 [5]	5 [6]
	Boston Scientific	Triceps 3.0F	12 [18]	12 [18]	6 [7]	7 [9]	4 [5]	8 [9]
	Bard	Grasper 2.4F	8 [8]	8 [8]	5 [7]	7 [9]	6 [7]	7 [9]
	Boston Scientific	Stone Cone®	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Probes								
	ACMI/Circon	Laser 200µ	30 [40]	30 [40]	22 [30]	26 [36]	22 [30]	26 [32]
	Lumenis Coherent	Holmium Laser 200µ	26 [36]	26 [36]	20 [28]	22 [29]	20 [25]	24 [29]
	Lumenis Coherent	Holmium Laser 365µ	18 [23]	18 [23]	13 [18]	16 [18]	14 [18]	19 [22]
	EMS Swiss	Lithoclast Maste.	10 [10]	10 [10]	4 [5]	4 [6]	4 [6]	6 [7]
	Storz	EHL 1.6F	18 [26]	18 [26]	16 [24]	16 [24]	16 [18]	16 [24]
	ACMI/Circon	EHL 1.9F	23 [26]	23 [26]	11 [15]	14 [16]	12 [15]	14 [18]
	W o M	Freddy® Laser 273µ	26 [36]	26 [36]	20 [28]	22 [29]	20 [25]	24 [29]
	W o M	Freddy® Laser 420µ	9 [11]	9 [11]	7 [12]	7 [12]	7 [10]	10 [12]

EXAMPLE



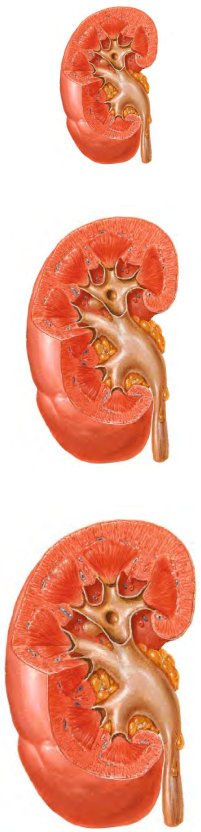
0,6J - 15Hz	90 sec
9 Watts	7 ml/min
0,6J - 30Hz	45 sec
18 Watts	14 ml/min
0,6J - 45Hz	30 sec
24 Watts	21 ml/min
0,6J - 60Hz	22 sec
36 Watts	28 ml/min

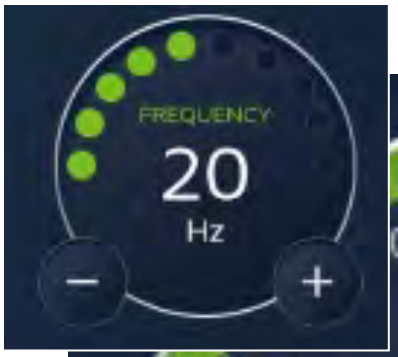
EXAMPLE

0,6J - 15Hz 9 Watts	90 sec 7 ml/min
0,6J - 30Hz 18 Watts	45 sec 14 ml/min
0,6J - 45Hz 24 Watts	30 sec 21 ml/min
0,6J - 60Hz 36 Watts	22 sec 28 ml/min

COMPROMISE


?
20°




FREQUENCY
20
Hz
−
+

0.4
0.3
0.5
0.2
0.6
0.1
0.7
0
0.8
0.5 J
ENERGY
10 W
0
POWER
20

FURS & «Thermal Damage»

2017

JOURNAL OF ENDOUROLOGY
Volume 31, Number 12, December 2017

Pp. 1308–1313
DOI: 10.1089/end.2017.0679

Thermal Response to High-Power Holmium Laser Lithotripsy

Ali H. Aldoukhi, MBBS,[1] Khurshid R. Ghani, MBChB, MS,[1] Timothy L. Hall, PhD,[2] and William W. Roberts, MD[1,2]

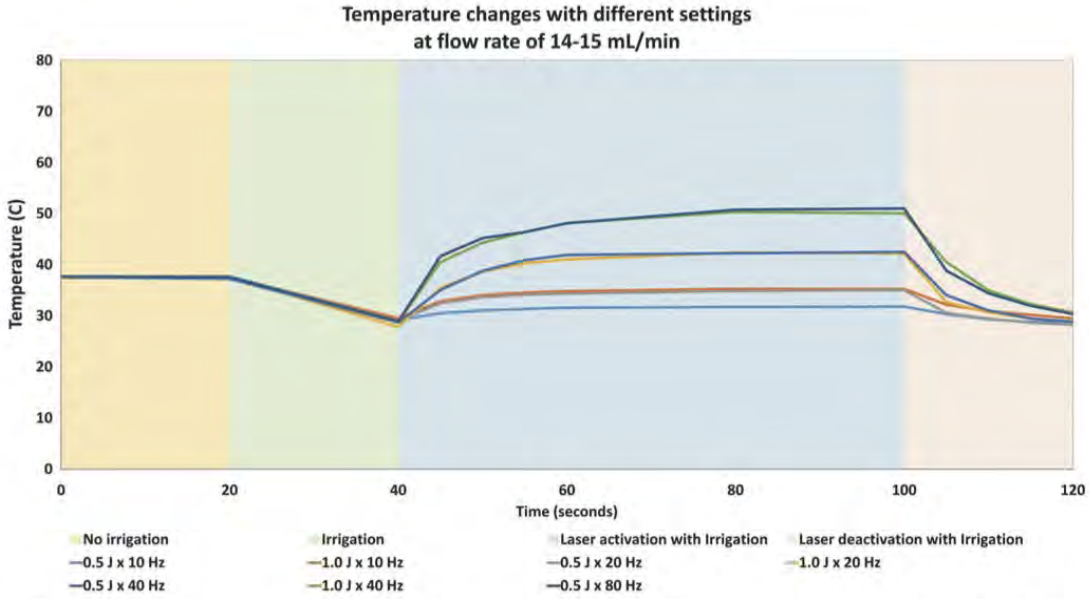


FIG. 2. Temperature changes during holmium laser activation utilizing different settings on a short pulse mode at irrigant flow rate of 14–15 mL/minute.

FURS & «Thermal Damage»

2017

JOURNAL OF ENDOUROLOGY
Volume 31, Number 12, December 2017
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Pp. 1308–1313
DOI: 10.1089/end.2017.0679

TABLE 2. T

FFERENT LA

Setting	38–40 mL/minute, mean °C (SD)
0.5 J × 10 Hz	—
1.0 J × 10 Hz	—
0.5 J × 20 Hz	—
1.0 J × 20 Hz	31.8 (1.5)
0.5 J × 40 Hz	31.7 (1.4)
1.0 J × 40 Hz	38.1 (2.1)
0.5 J × 80 Hz	37.8 (2.1)

Less than 20 Watts !

High Power with Low Irrigation : DANGEROUS

FURS & «Thermal Damage»

2023

doi:10.1111/bju.16218

BJUI
BJU International

Original Article

Exploring optimal settings for safe and effective thulium fibre laser lithotripsy in a kidney model

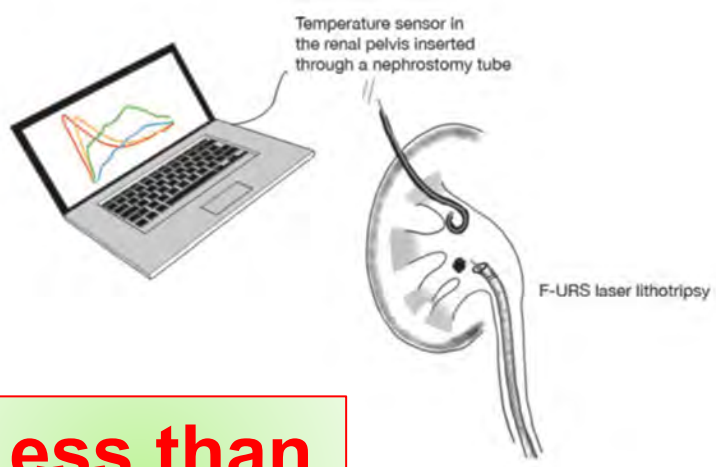
0,8J-12Hz : 9,6W

Conclusions

Our findings suggest that high E_P/low F settings, such as 0.8 J/12 Hz, are optimal for TFL lithotripsy in the treatment of COM stones. These settings demonstrated significantly improved treatment efficiency with reduced residual fragments compared to conventional settings while keeping the thermal dose below the injury threshold. This study highlights the importance of using the high E_P/low F combination with low power settings, which maximizes treatment efficiency and minimizes potential thermal injury. Further studies are warranted to determine the optimal settings for TFL for treating kidney stones with different compositions.

FURS & «Thermal Damage»

2024



Less than 20 Watts !

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Pp. 308–315
DOI: 10.1089/end.2023.0660

Ureteroscopy and Percutaneous Procedures

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Temperature Measurements During Flexible Ureteroscopic Laser Lithotripsy: A Prospective Clinical Trial

Mathias Sørstrand Æsøy, MD,[1,2] Patrick Juliebø-Jones, MD, PhD,[1,2]
Christian Beisland, MD, PhD, Professor,[1,2] and Øyvind Ulvik, MD, PhD, Assoc Professor[1,2]

Abstract

Objective: The primary aim of the study was to explore intrarenal temperatures (IRTs) during flexible ureteroscopic laser lithotripsy (FURSL). The secondary aim was to investigate the correlation between temperatures and renal pelvis anteroposterior diameter (APD).
Materials and Methods: From February 2023 to June 2023, 10 patients with an indwelling nephrostomy tube (NT) undergoing FURSL were enrolled in the study. Sheathless FURSL was performed using gravitational irrigation (23°C) at 60 cm. A sterile K-type thermocouple was inserted through the NT. Temperatures were recorded for 120 seconds with continuous laser activation and for another 60 seconds after deactivation. Thulium fiber laser delivered energy using a 150 μm fiber and incremental power settings of 5, 10, 20, and 30 W. The laser was deactivated whenever the IRT reached 43°C.
Results: IRT correlated directly to power settings. Each time the power settings were increased, the temperature rose significantly. The increase in average peak temperature was 2.6°C between 5 and 10 W ($p < 0.001$), 3.4°C between 10 and 20 W ($p < 0.001$), and 2.5°C between 20 and 30 W ($p < 0.001$). Temperatures reached 43°C in three patients applying 20 W and in eight patients applying 30 W. The shortest activation-time until threshold was 12 and 28 seconds with 30 and 20 W settings, respectively. When reaching 43°C, temperatures remained above this threshold for an additional 29 seconds on average. There was a significant correlation between IRT and renal APD. For example, when 10 W was applied in the setting of APD ≤20 mm, the recorded temperature was on average 2.3°C higher compared with APD >20 mm, with the same power settings applied, $p < 0.001$.
Conclusion: During FURSL, IRT correlates directly with power settings and is inversely correlated with renal pelvic APD. Using a sheathless approach, power settings ≥20 W should arguably be avoided, especially in the context of a nondilated renal pelvis.
ClinicalTrials: The study was registered on ClinicalTrials.gov (NCT05677425).

Keywords: ureteroscopy, thulium fiber laser, laser lithotripsy, temperature, temperature profiles

Introduction

With an ever-increasing prevalence of kidney stone disease, the number of surgical interventions has increased, and this is especially the case for ureteroscopy.[1,2] When performing surgery, the Hippocratic oath serves as a constant reminder of our responsibilities to cause no harm to patients. However, flexible ureteroscopic laser lithotripsy (FURSL) carries inherent risks for potential complications, such as high intrarenal pressure (IRP).[3,4] As a result of the advent of high-power laser systems, which has been one of several technological advancements, concerns have been

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[2]Department of Clinical Medicine (K1), University of Bergen, Bergen, Norway.

FURS & «Thermal Damage»

2024

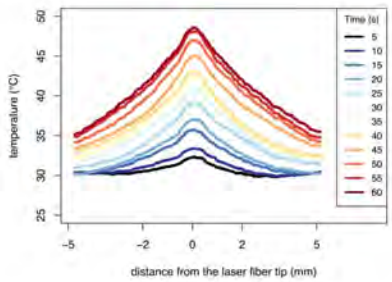

Figure 3

	Safety distance in mm [mean (SD)]
5 W	Irrigation 0 mm; No irrigation 0 mm
10 W	Irrigation 0 mm; No irrigation 0 mm
20 W	Irrigation 0 mm; No irrigation 0.93 (0.11) mm
40 W	Irrigation 4.67 (0.85) mm; No irrigation 5.22 (0.09) mm

Table 1. Highest recorded temperature according to average power and use of irrigation

Average power	No irrigation, mean (SD)	Irrigation, mean (SD)	Temperature reduction	p value
5 W	40.1 (0.4) °C	39.1 (1.21) °C	1.0 °C	0.28
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20 W	56.4 (0.4) °C	50.7 (1.4) °C	5.7 °C	0.02
40 W	72.9 (0.9) °C	63.3 (0.0) °C	9.4 °C	0.002

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https://doi.org/10.1007/s00345-024-05162-3

RESEARCH

Temperature profile during endourological laser activation: introducing the thermal safety distance concept

Eugenio Ventimiglia[1,2,3,4] · Daniele Robesti[1,2] · Etienne Xavier Keller[3,4,5] · Christian Corsini[1,2] · Andrea Folcia[1,2] · Margherita Fantin[1,2] · Luigi Candela[6] · Edoardo Pozzi[1,2] · Alba Sierra[3,4,6] · Amelia Pietropaolo[3,7] · Bhaskar K. Somani[7] · Frederic Panthier[4,6] · Feline Pauchard[4,8] · Ioannis Kartalas Goumas[9] · Luca Villa[1,2] · Francesco Montorsi[1,2] ·

Kidney: Less than 20 Watts!
Ureter: Less than 10 Watts!

Methods We developed an in-vitro experimental setup employing a glass pipette and laser activation under various intra-operative parameters, such as power and presence of irrigation. A thermal camera was used to monitor both temporal and spatial temperature changes during uninterrupted 60-second laser activation. We computed the thermal dose according to Sapareto and Dewey's formula at different distances from the laser fiber tip, in order to determine a safety distance.

Results A positive correlation was observed between average power and the highest recorded temperature (Spearman's coefficient 0.94, $p<0.001$). Irrigation was found to reduce the highest recorded temperature, with a maximum average reduction of 9.4 °C at 40 W ($p=0.002$). A positive correlation existed between average power and safety distance values (Spearman's coefficient 0.86, $p=0.001$). A thermal dose indicative of tissue damage was observed at 20 W without irrigation (safety distance 0.93±0.11 mm). While at 40 W, irrigation led to slight reduction in mean safety distance (4.47±0.85 vs. 5.22±0.09 mm, $p=0.08$).

Conclusions Laser settings with an average power greater than 10 W deliver a thermal dose indicative of tissue damage, which increases with higher average power values. According to safety distance values from this study, a maximum of 10 W should be used in the ureter, and a maximum of 20 W should be used in kidney in presence of irrigation.

WJU 2024 Ventimiglia E.

FURS & «Thermal Damage»

To SUMMARIZE

If PCS : 10-15 ml

With Irrigation less than 20ml/min

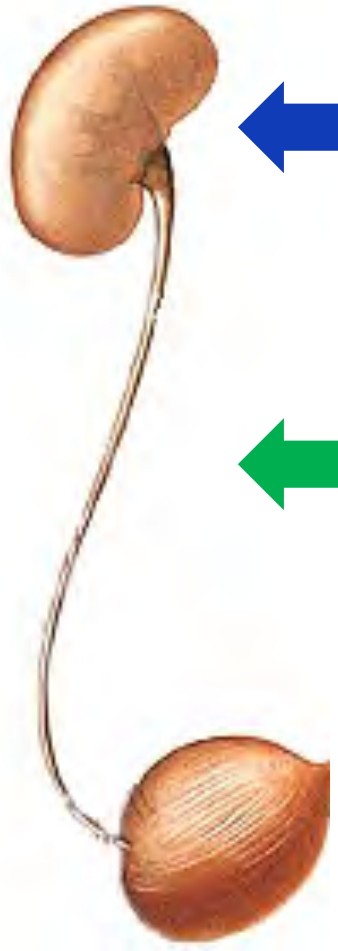
& to respect Temp° less than 40° C
with IRP less than 40 mmHg

LESS than 20 W /Kidney

10 W / Ureter

FURS & «Thermal Damage»

THM #2: ADJUST LASER SETTINGS



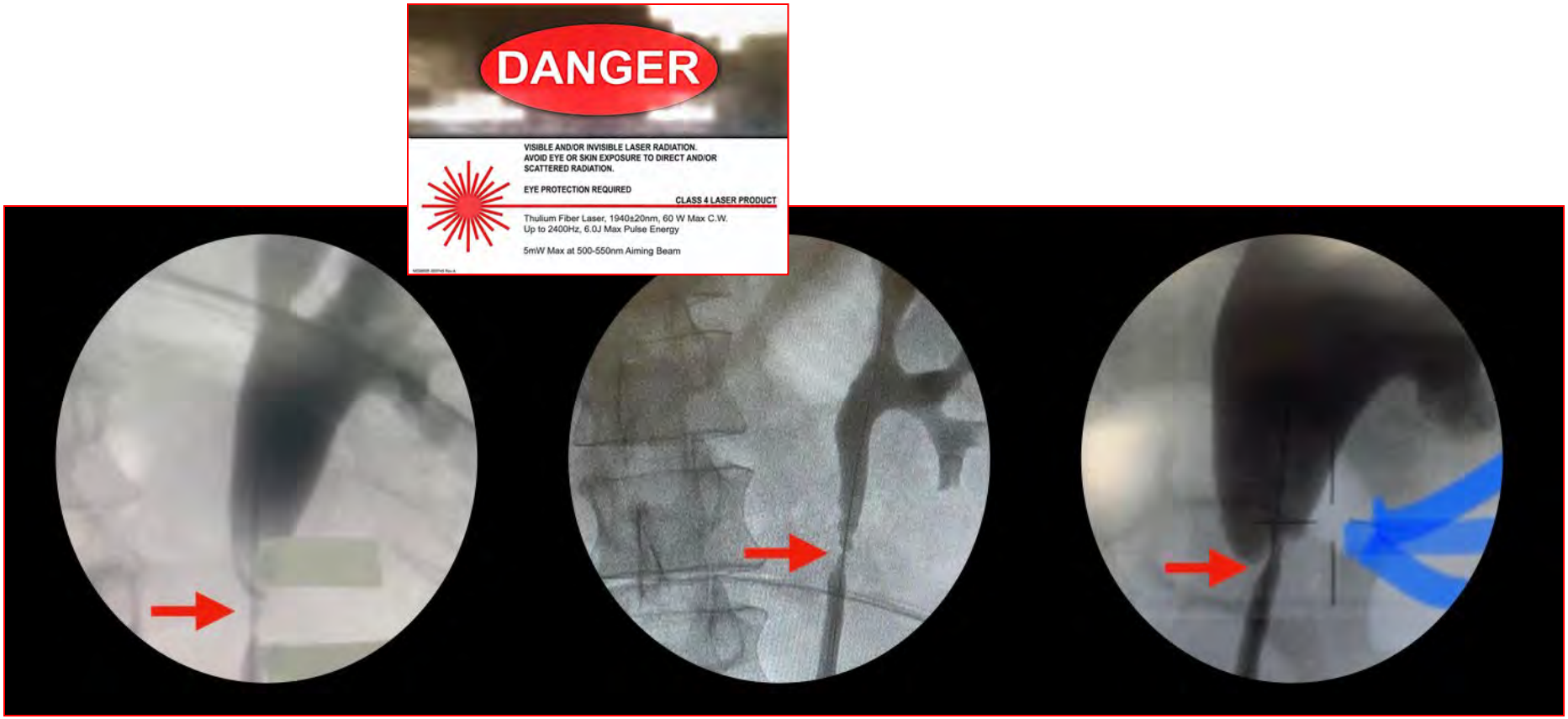
20 W

10 W

AND

Low Frequency (<10 Hz)

FURS & «Thermal Damage»



Ureteral Stenosis +++

FURS & «Thermal Damage»

2022

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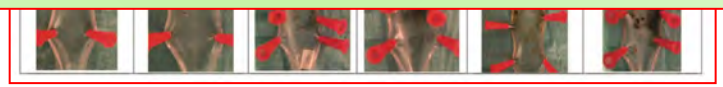
Thermal Injury and Laser Efficiency with Holmium YAG and Thulium Fiber Laser—An *In Vitro* Study

Alba Sierra, MD,[1,2] Mariela Corrales, MD,[1,2] Merkourios Kolvatzis, MD,[1,2] Frederic Panthier, MD,[1,2] Adrià Piñero, MD,[1,2] and Olivier Traxer, MD[1,2]

Less than 10 Watts & LOW frequency <10Hz !

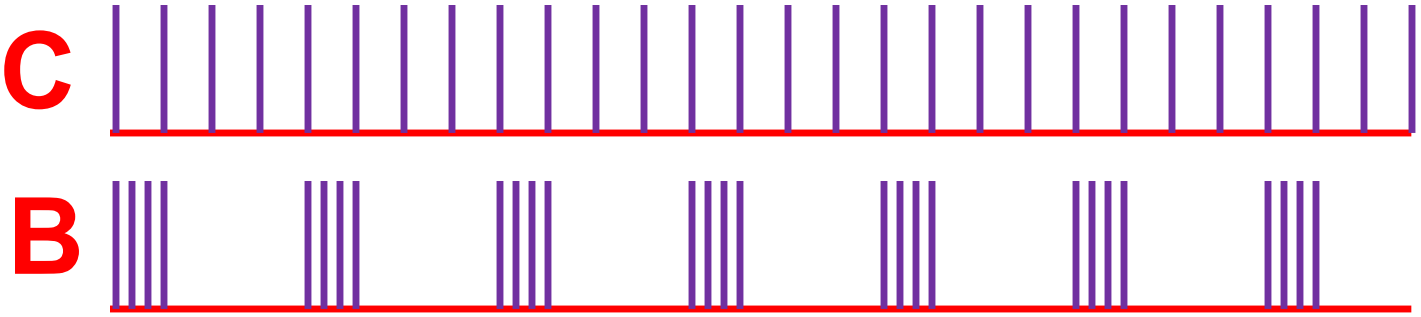


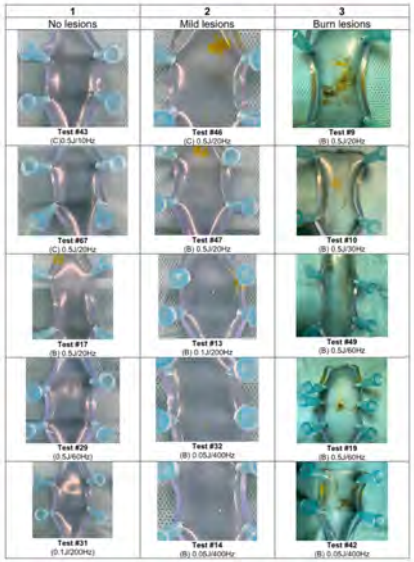
High Frequency is Dangerous for Ureter !

JEndoUrol 2022 Sierra A.

FURS & «Thermal Damage»

2024





	Energy (J)	Frequency (Hz)	Watts (W)	Laser on time (s)	Treatment time (s)	Laser active time (%)	Total delivered energy (KJ)
C	0.5	10	5	300		100	1.5
	0.5	20	10	150		100	1.5
B	0.5	20	10	150	300	50	1.5
	0.5	30	15	100	200	50	1.5
	0.5	60	30	50	100	50	1.5
	0.1	200	20	75	150	50	1.5
	0.05	400	20	75	150	50	1.5

C. Continuous

B. Burst

BURST more Dangerous than **Continous !**

WJU 2024 Sierra A.

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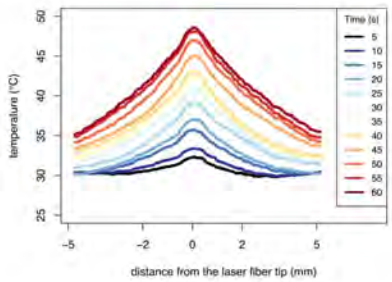
2024



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WJU 2024 Ventimiglia E.

FURS & «Thermal Damage»

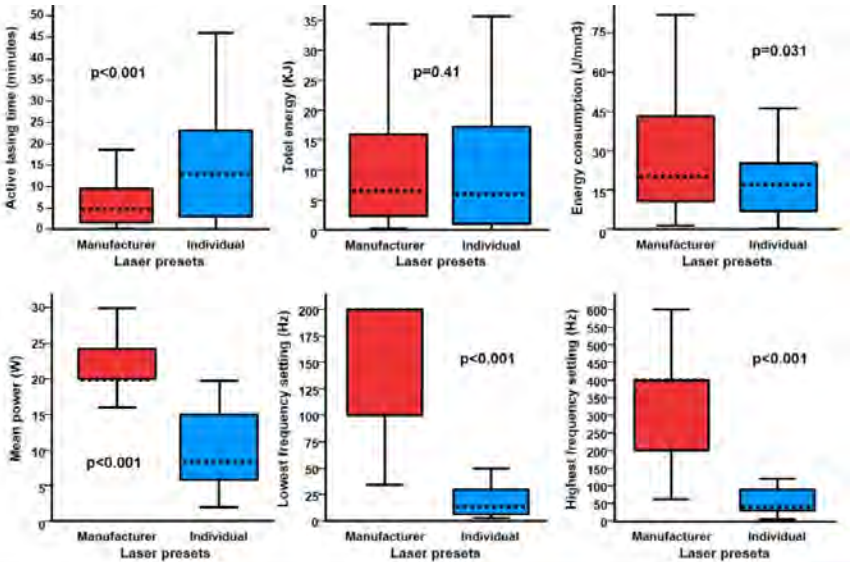
2025

World Journal of Urology (2025) 43:232
https://doi.org/10.1007/s00345-025-05553-0

RESEARCH

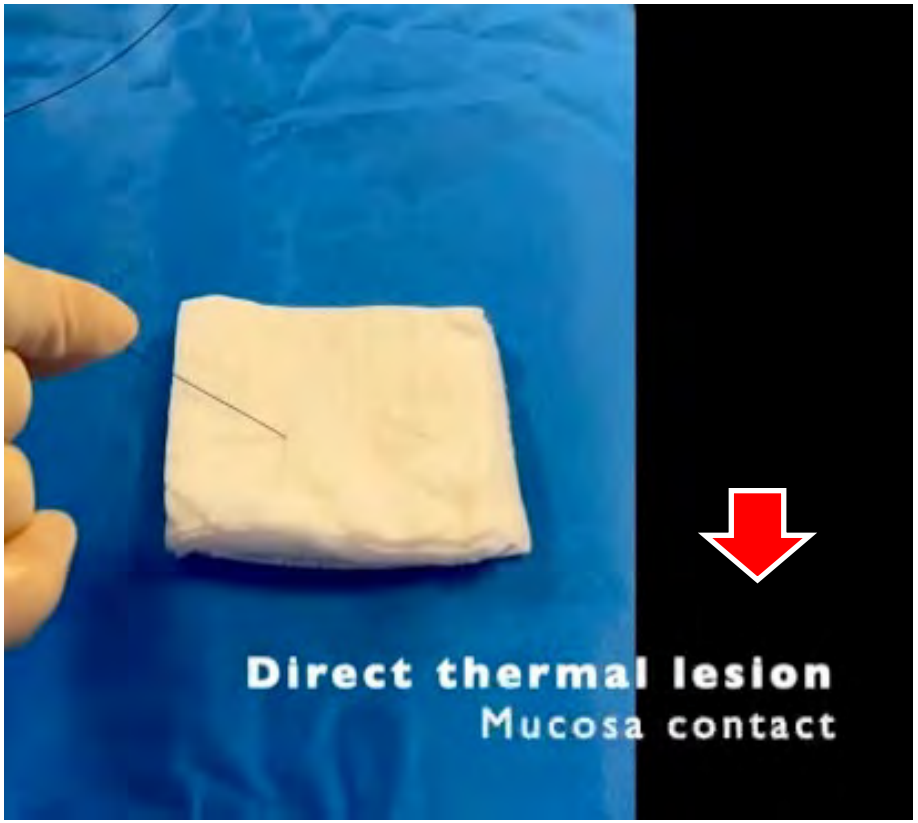
High POWER High Frequency Dangerous !

Olivier Traxer[4,5,9,10] · Etienne Xavier Keller[1,4,5,7]



FURS & «Thermal Damage»

Pulses away from Stone : Direct Lesion



J x Hz = W

Much More Pulses / second (Hz)!!!

STONE SENSE : CONCEPT

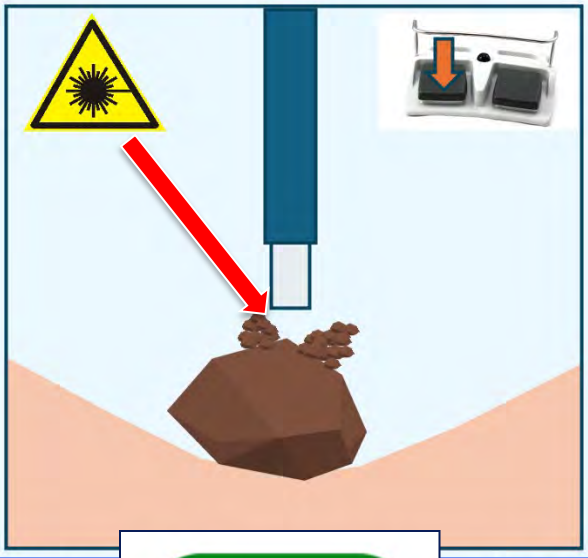
Wavelength: 1.94 µm
Max power: 2 - 120 W
Pulse energy: 0.025 - 8 J

IPG PHOTONICS®

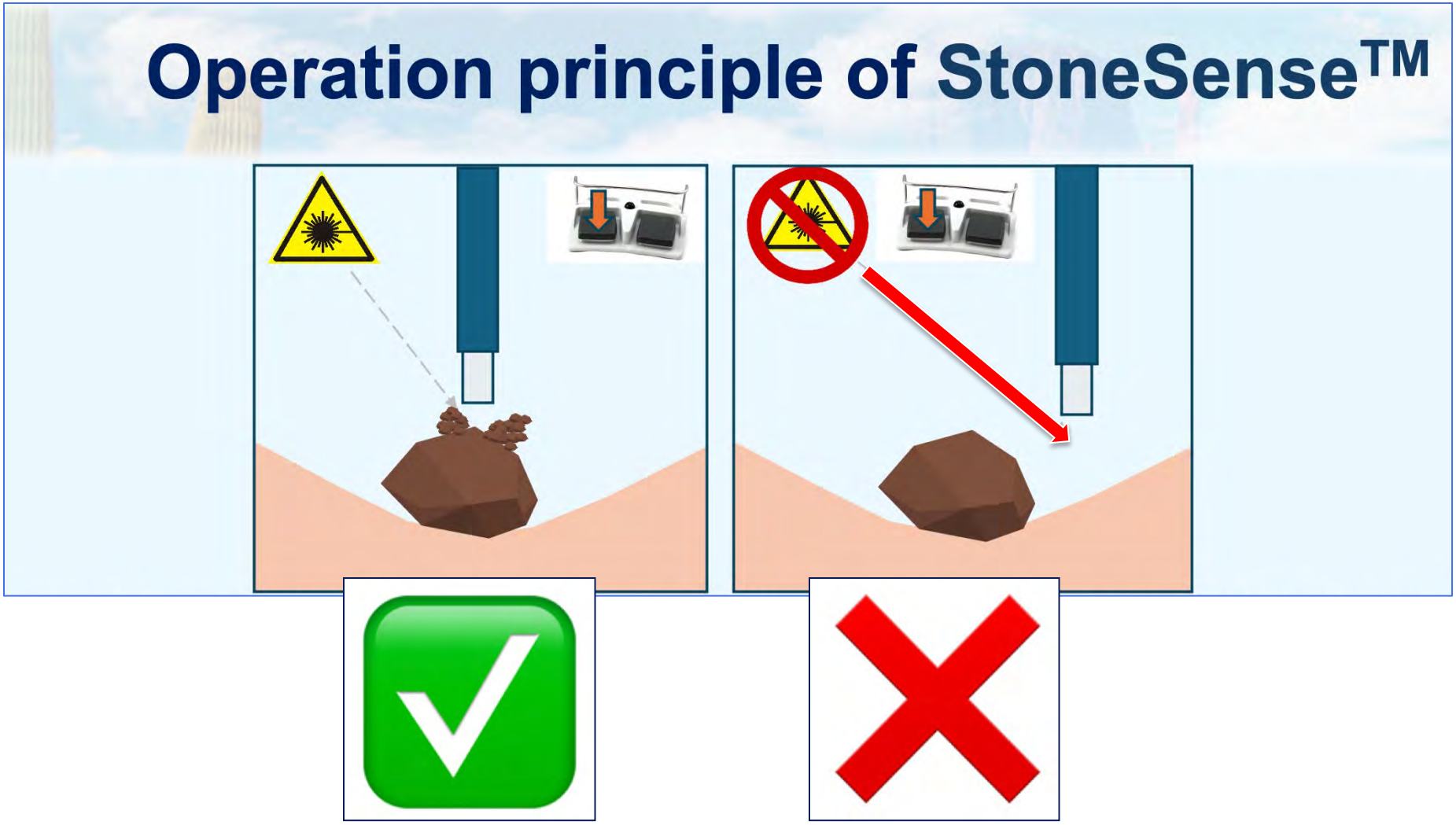
UROLASE MAX
IPG Medical,
Marlborough, MA
USA

STONE SENSE : CONCEPT

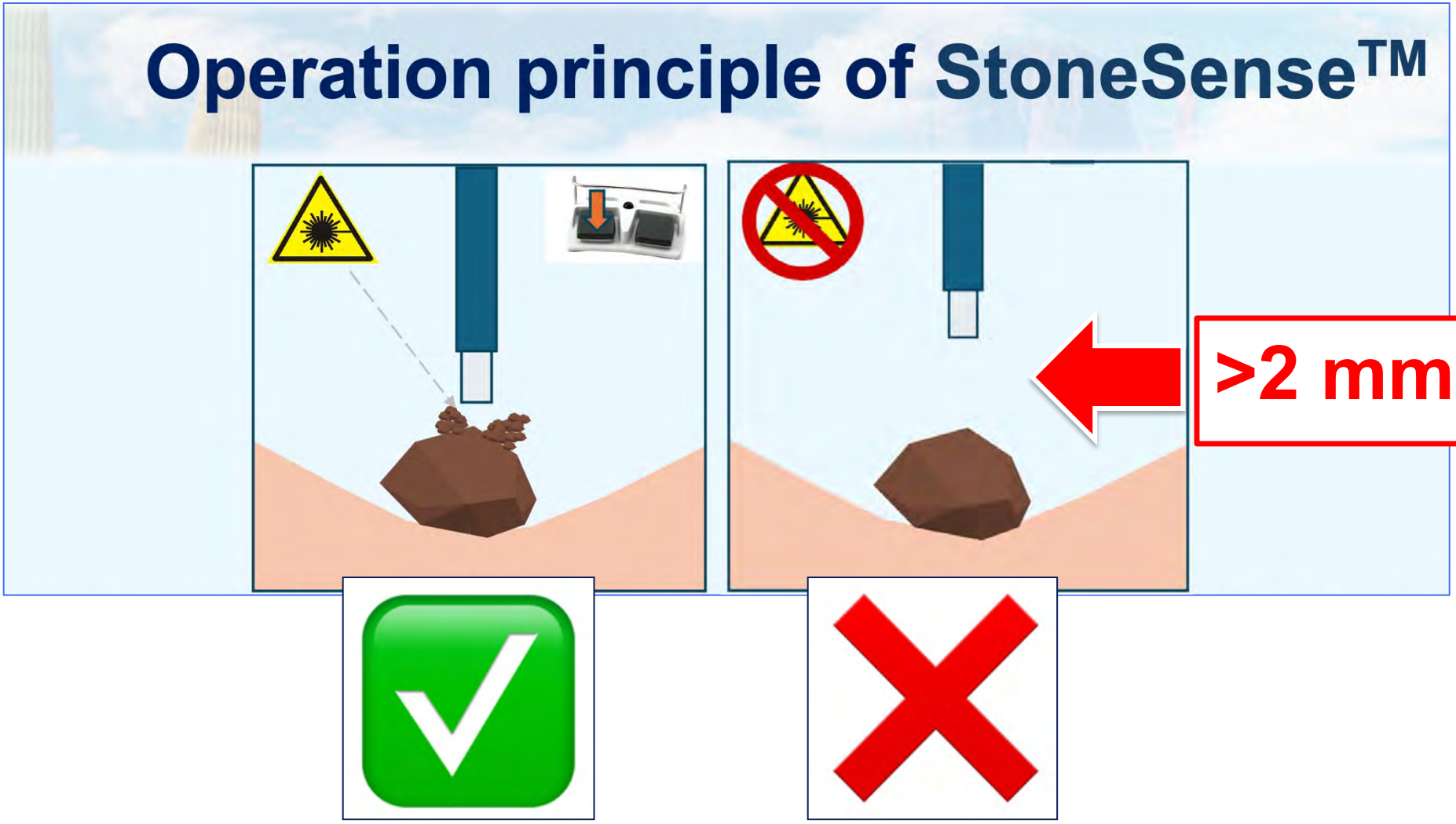
Operation principle of StoneSense™



STONE SENSE : CONCEPT

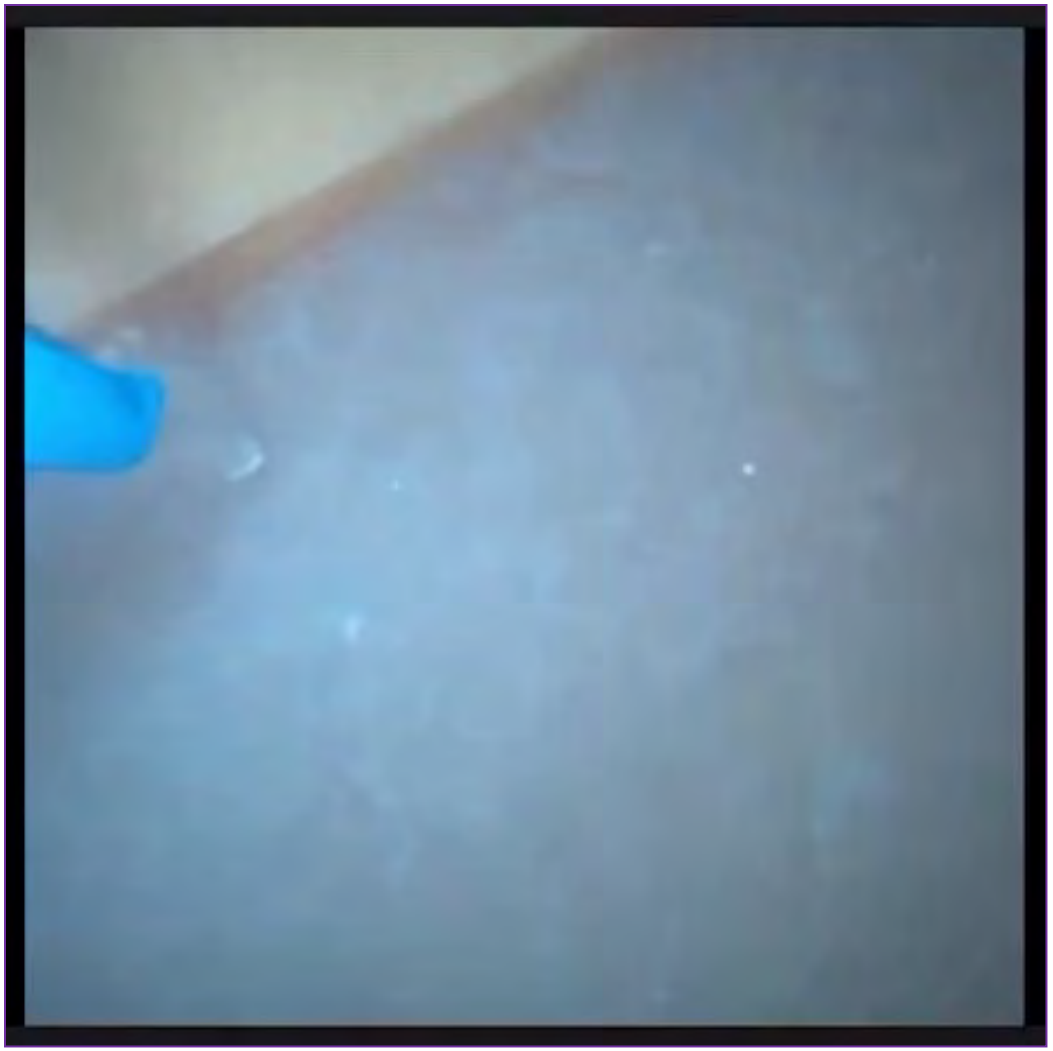


STONE SENSE : CONCEPT



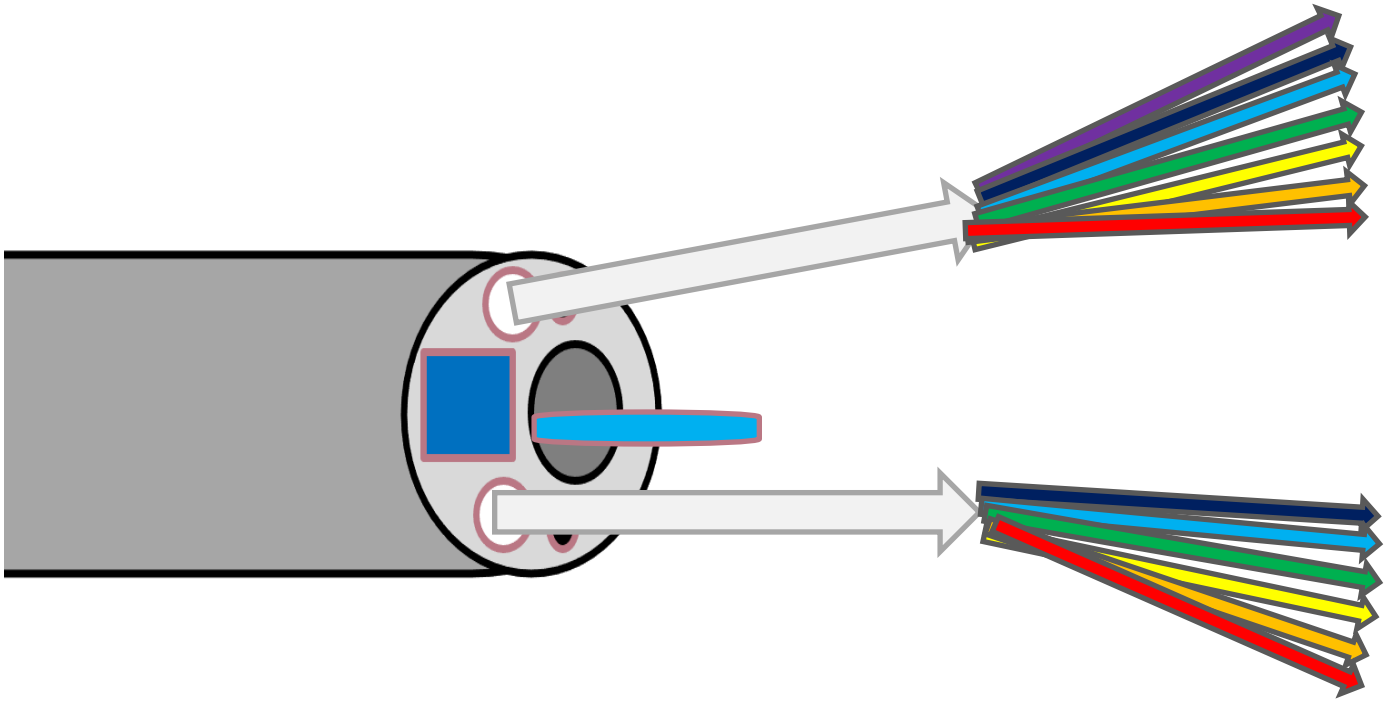
STONE SENSE : CONCEPT

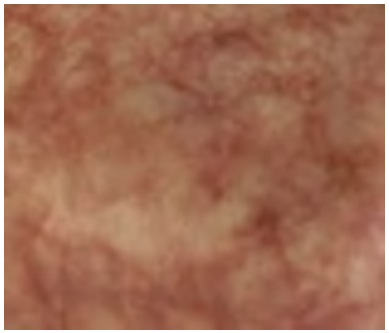
AI Integrated to LASER



Determine in real time whether the distal fiber tip is in contact or quasi-contact with stone

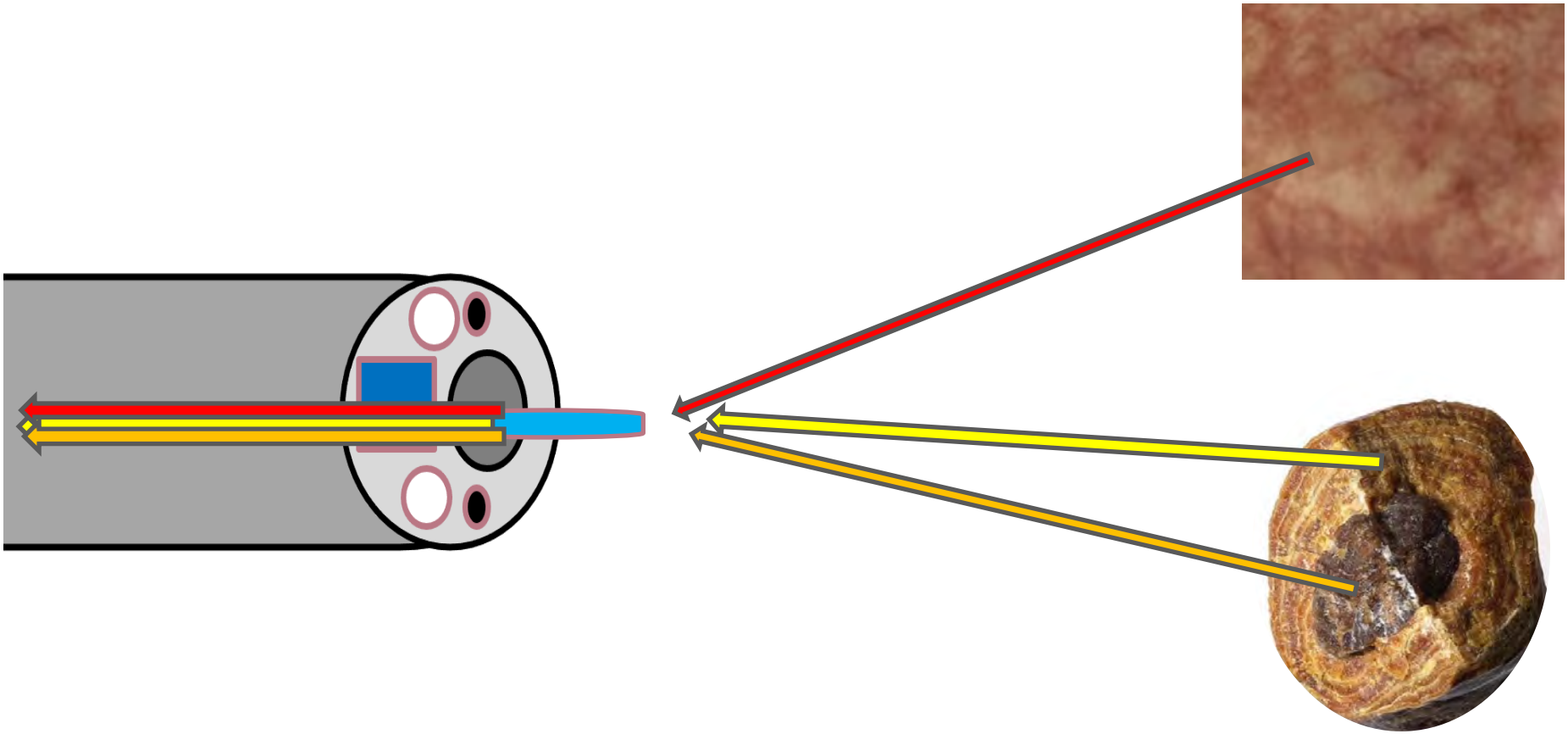
STONE SENSE : CONCEPT





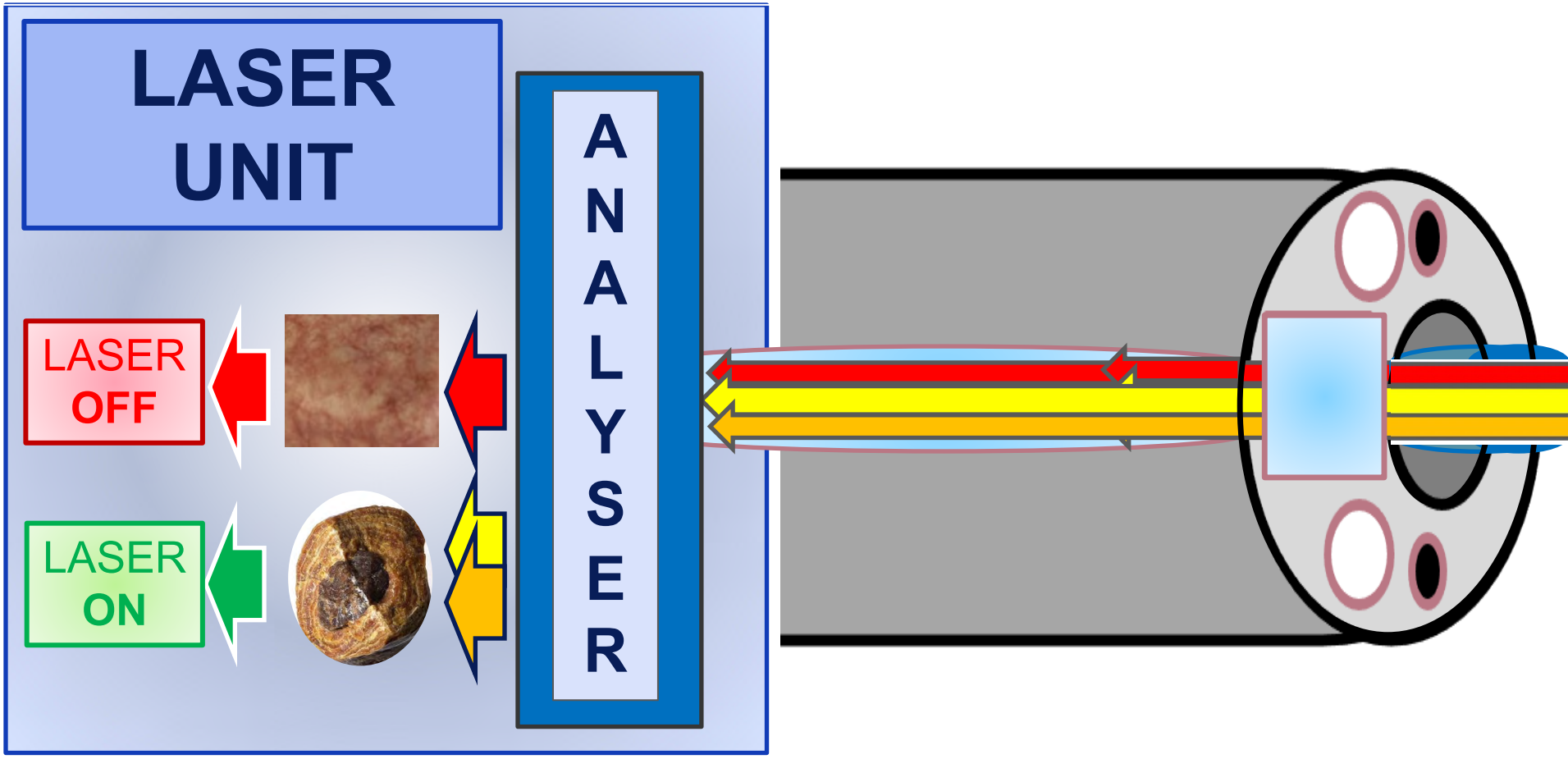
LIGHT ILLUMINATION

STONE SENSE : CONCEPT



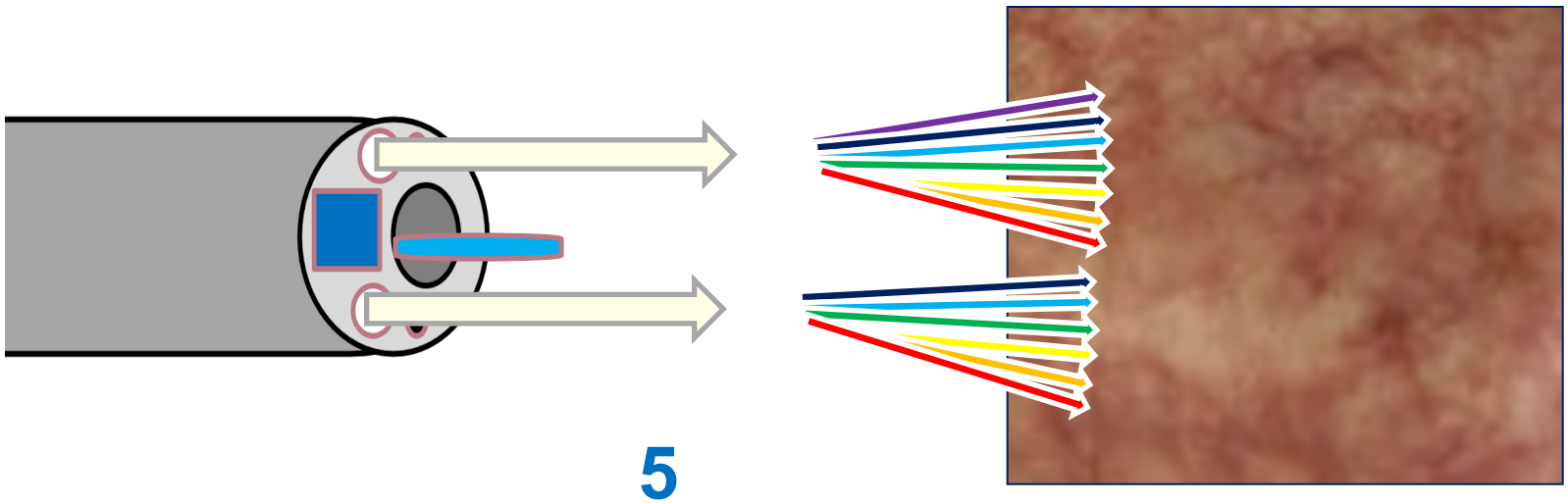
LIGHT REFLECTION

STONE SENSE : CONCEPT



LIGHT TRANSMISSION

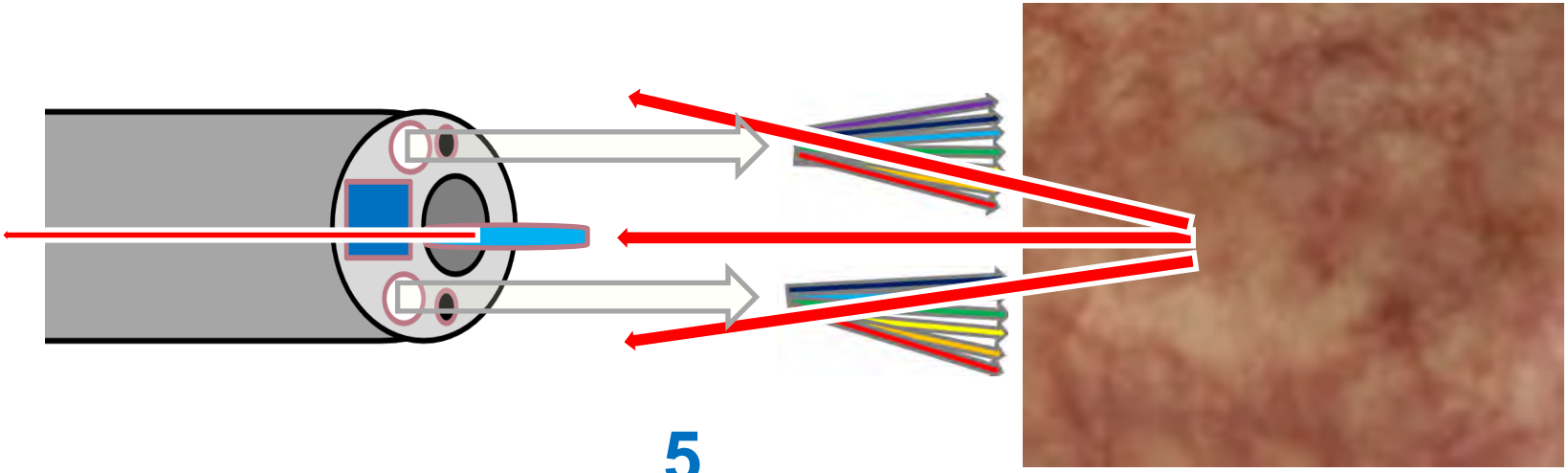
STONE SENSE : CONCEPT



5
SECONDS

Teaching the System : Tissue identification

STONE SENSE : CONCEPT



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SECONDS

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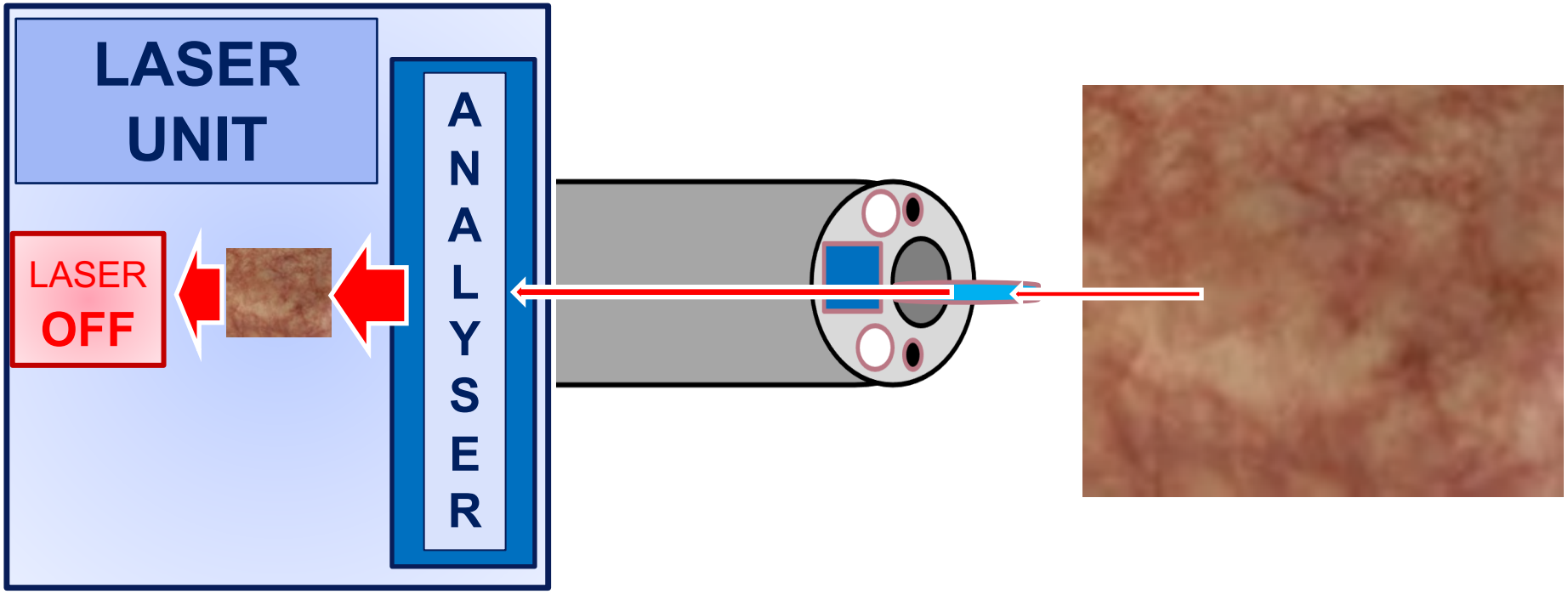
STONE SENSE : CONCEPT



Teaching the System : Tissue Identification

STONE SENSE : CONCEPT

AI Integrated to LASER

IPG PHOTONICS

Without StoneS. **With StoneS.**

Determine in real time whether the distal fiber tip is in contact or quasi-contact with stone

STONE SENSE : CONCEPT

AI Integrated to LASER

IPG PHOTONICS

OFF ON

OFF ON

Without StoneS. **With StoneS.**

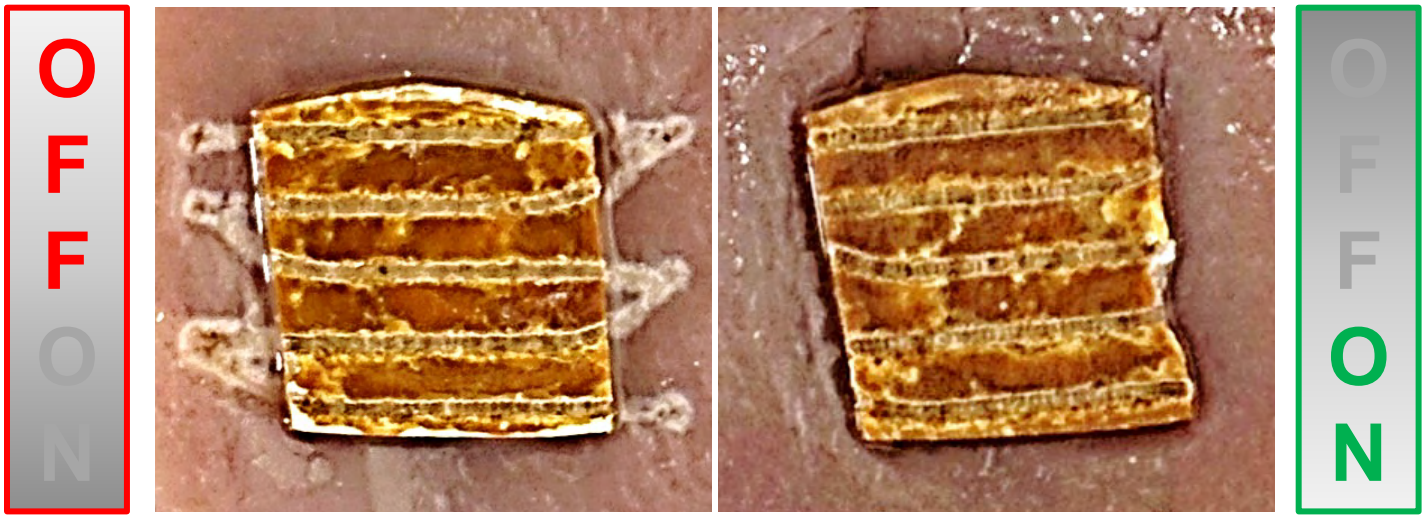
Determine in real time whether the distal fiber tip is in contact or quasi-contact with stone

STONE SENSE : CONCEPT

StoneSense™ module: Ex Vivo experiment

Laser setting: 0.5 J x 20 Hz = 10 W, Fiber movement speed = 5 mm/s

RESULTS POST LASER Treatment



Without StoneS. **With StoneS.**

Determine in real time whether the distal fiber tip is in contact or quasi-contact with stone

STONE SENSE : CONCEPT

Ex Vivo Experiment

In Ex Vivo phase, human stones (uric acid, COM, brushite, cystine) were embedded into soft tissue (porcine kidney). Distal end of a single-use flexible ureteroscope with surgical fiber (Ø 200 µm) was mounted on a 2D-motorized stage and moved over both the stone and the soft tissue with speeds of 2 and 5 mm/s, respectively. Each cut was repeated 5 times.

Stone type	Uric Acid		COM		Brushite		Cystine	
	2 mm/s	5 mm/s	2 mm/s	5 mm/s	2 mm/s	5 mm/s	2 mm/s	5 mm/s
Sensitivity, %	100	100	100	100	100	100	100	100
Specificity, %	98	98	97	97	95	95	98	98

STONE SENSE : CONCEPT

Sampe view
after treatment

Soft tissue
damage

Sample view
after treatment

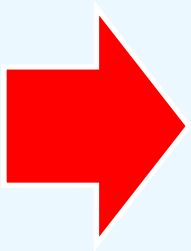
40 times Faster !

HUMAN Reaction : 150 to 250 msec
STONE SENSE Reaction : 2 to 6 msec

STONE SENSE : CONCEPT

Live animal experiment

In GLP-compliant live animal study, the same StoneSense™ -equipped TFL system was used on two animals (female Yorkshire pigs). The animals were anesthetized, and 5 types of human stones (uric acid, COM, struvite, brushite, cystine) were introduced surgically into the bladder, ureter and kidney, followed by laser treatment using a 7.5 Fr flexible ureteroscope with 200 µm fiber. The laser settings were 0.1 J x 100 Hz and 1 J x 5 Hz, respectively. Specificity and sensitivity of the technique were computed. All stones were successfully ablated and collateral damage to the mucosal tissue was assessed as none to minimal. SSM technology has demonstrated specificity and sensitivity higher than 85% (Table 2).



Pig identification	Stone type	Stone site	Specificity, %	Sensitivity, %
1	Uric acid	Bladder	98	100
1	COM	Left kidney	100	100
1	Struvite	Left ureter	99	99
1	Brushite	Right kidney	95	99
1	Cystine	Right ureter	86	90
2	Uric acid	Bladder	100	96
2	COM	Left ureter	97	98
2	Struvite	Left kidney	95	99
2	Brushite	Right ureter	85	100
2	Cystine	Right kidney	100	100

STONE SENSE : CONCEPT

Conclusion

Automatic recognition of target object with StoneSense™ technology in broad range of laser parameters **(5 –100 Hz, 0.025 – 6 J)** and speeds of fiber movement **(2-5 mm/s)** was demonstrated Ex Vivo and in animal models for 5 types of human stones (uric acid, COM, struvite, brushite, cystine). Using StoneSense™ technology can reduce the probability of accidental damage of mucosa during laser lithotripsy without negatively affecting the efficacy of the procedure

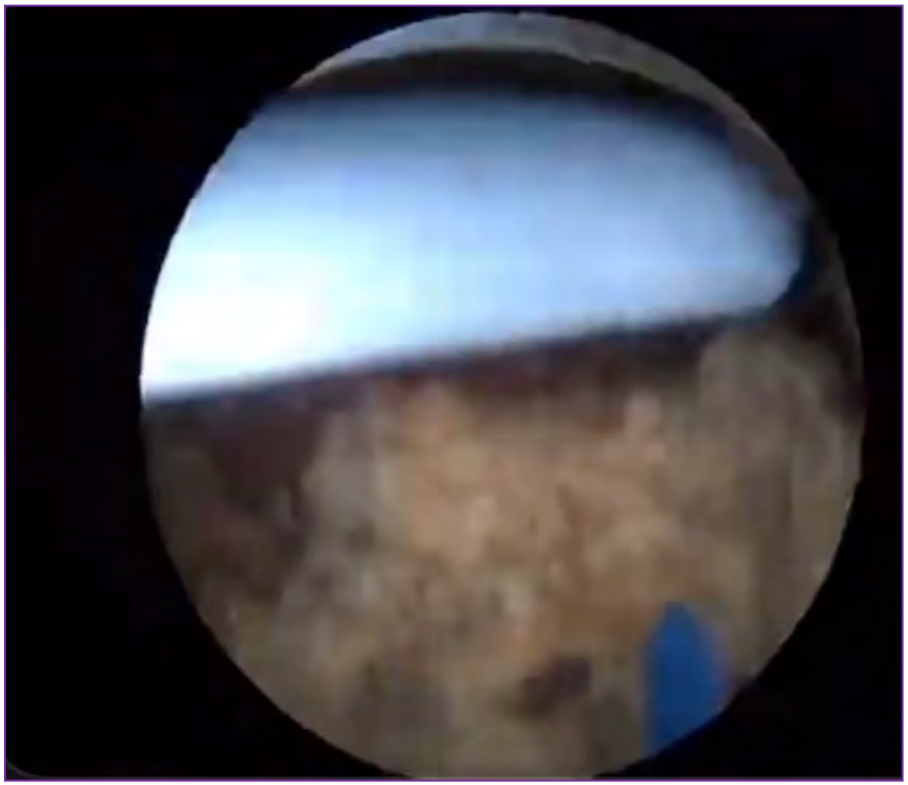
STONE SENSE : CONCEPT

IPG PHOTONICS®

STONE SENSE

In Vivo

OFF ON



OFF ON

Courtesy Pr A. MARTOV (Moscow)

THANK YOU FOR YOUR ATTENTION

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Jefferson
Philadelphia University + Thomas Jefferson University

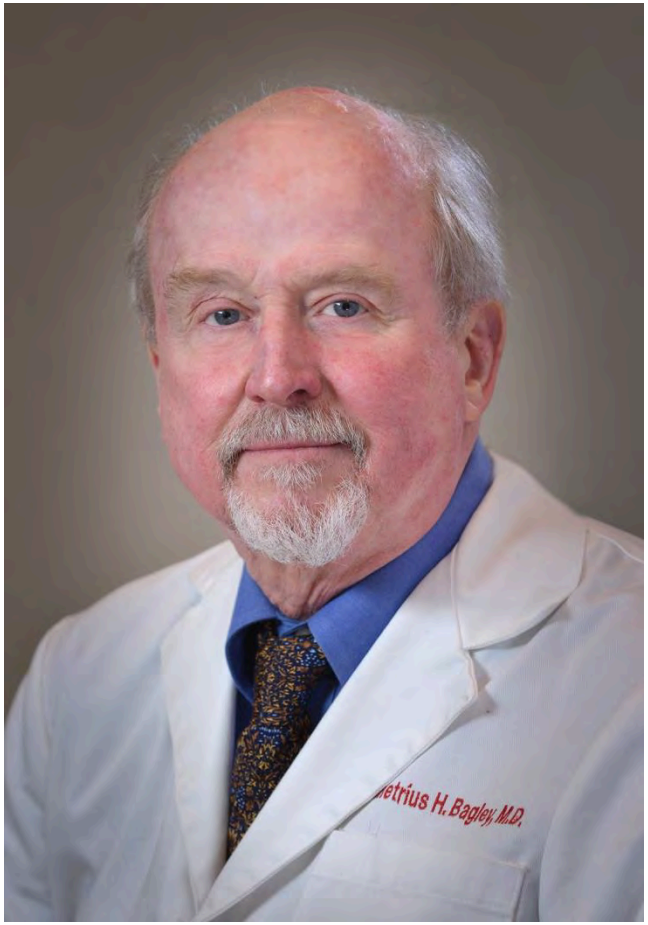
Maximizing Technological Advances in Ureteroscopy to Minimize Complications

Scott G. Hubosky, MD

The Demetrius H. Bagley Jr., MD Professor of Urology
Director of Endourology
Vice Chair of Quality and Safety
Thomas Jefferson University Hospital
Philadelphia, PA, USA

Demetrius H. Bagley, Jr. MD

Aug. 21, 1945 - Jan. 17, 2022



- > 400 manuscripts in the peer reviewed literature
- 11 textbooks
- Member American Association of Genitourinary Surgeons
- Lifetime Achievement Awards
  - AUA 2014
  - Endourology Society 2010
- Valentine Award
  NY Academy of Medicine 2012
- Thomas Jefferson Inter-Professional Education Award
- Trainees:
  - > 60 Urology residents
  - > 15 Endourology Fellows

Contemporary Surgical Trends in the Management of Upper Tract Calculi

Daniel T. Oberlin, Andrew S. Flum, Laurie Bachrach, Richard S. Matulewicz and Sarah C. Flury*

From the Department of Urology, Northwestern Memorial Hospital, Chicago, Illinois

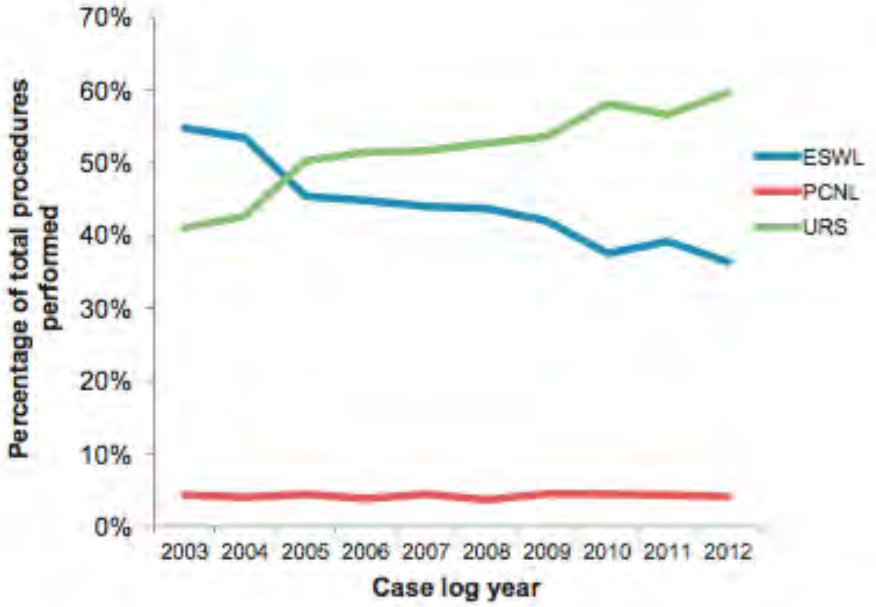
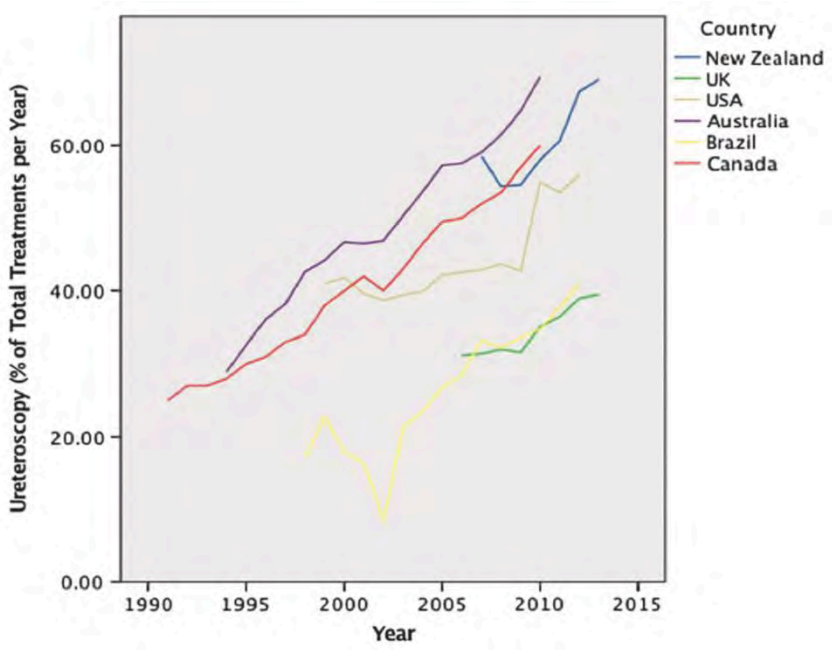


Figure 1. Change in stone treatment modality with time of all certifying urologists. *ESWL*, extracorporeal SWL.

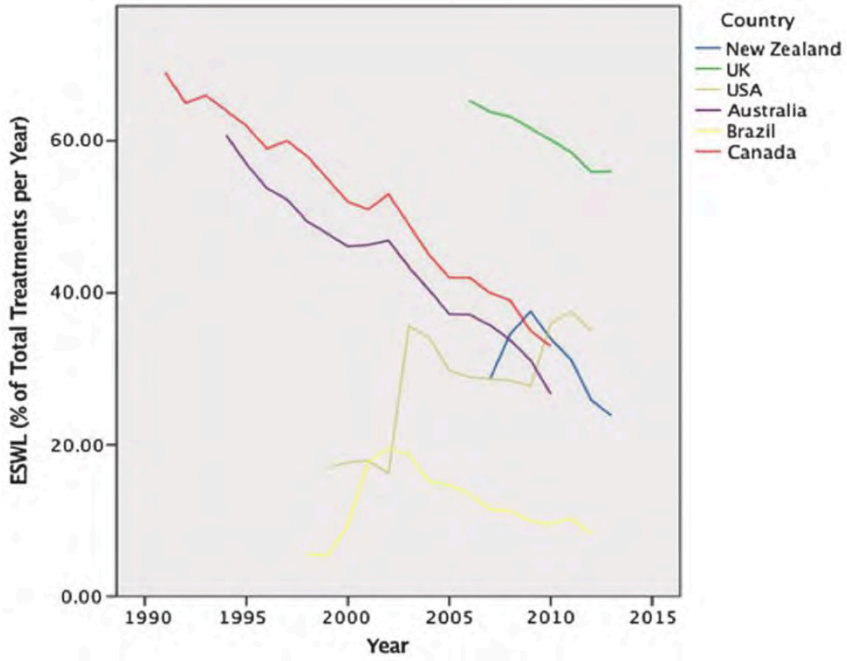
Oberlin et al. J Urol 2015 (193) 880-4

Upper Urinary Tract Stones: Treatment Trends

Ureteroscopy



ESWL



Geraghty et al. J Endourol. 2017 (31) 547-56

Durable Trend: **More Ureteroscopy**

URETEROSCOPY

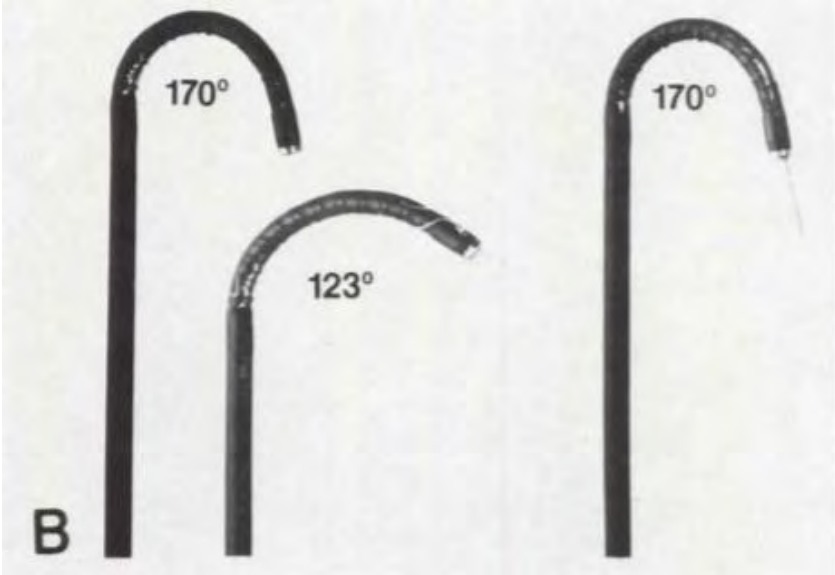
e 2. Percent of patients receiving ureteroscopy from 2011 to 2019. (Color version available online.)

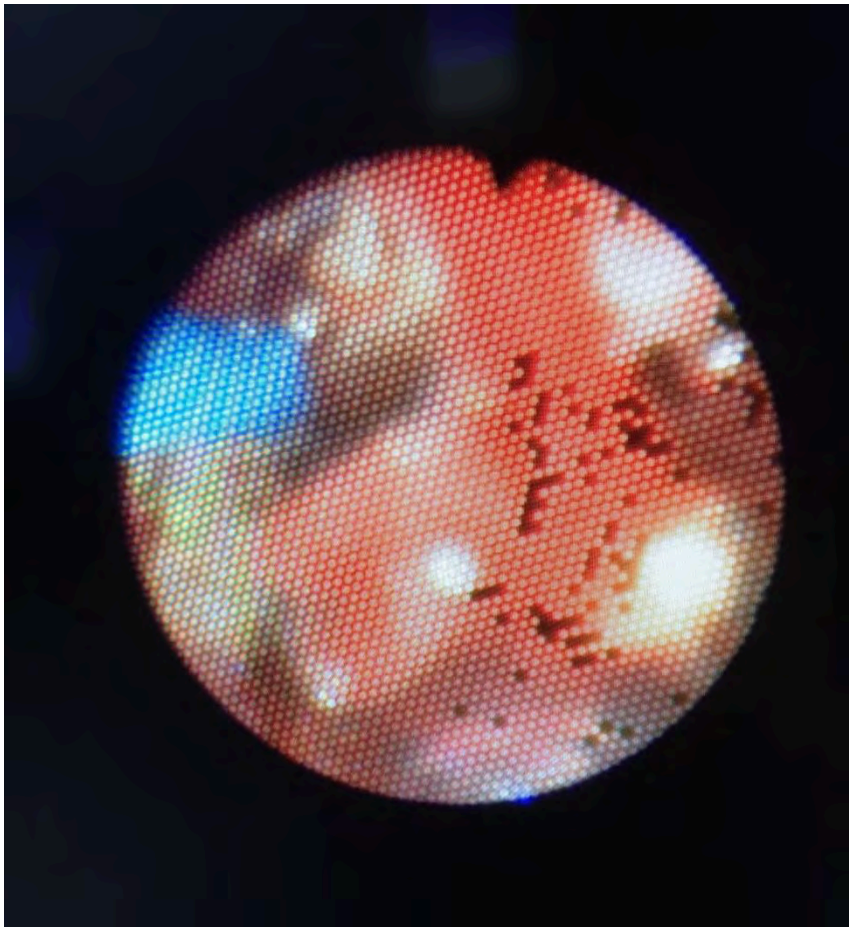
ESWL

ıre 4. Percent of patients receiving shockwave lithotripsy from 2011 to 2019. (Color version available online.)

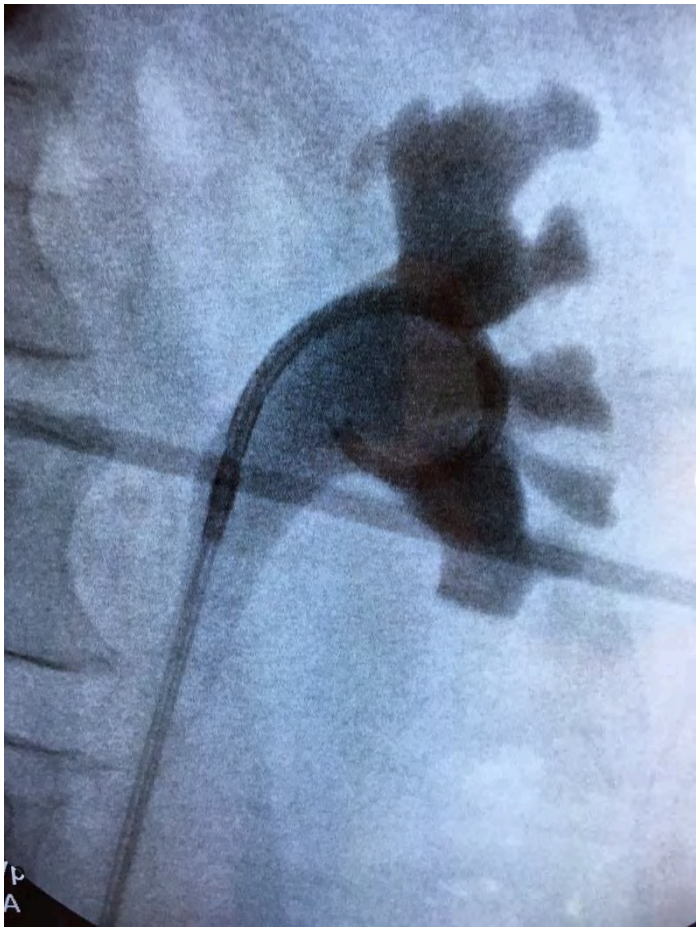
Monga et al. Urology 2023 (176) 63-8

Evolution & Refinement of Instruments (Ureteroscopes)

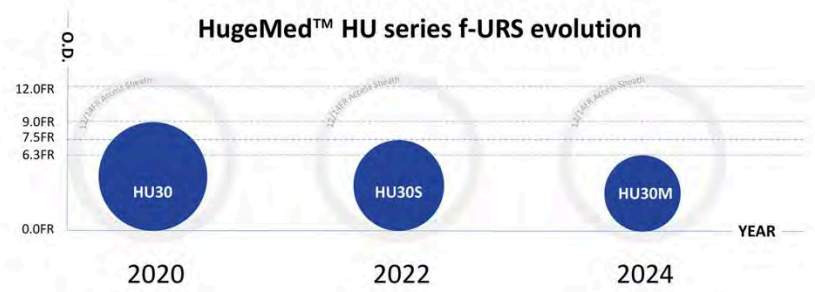




Evolution & Refinement of Instruments (Ureteroscopes)



Evolution in Ureteroscopy Continues



- 6.3 Fr OD single-use digital flexible ureteroscopes now exist with working channel = 3.6 Fr
- Likely to see improved primary ureteroscopic access
  - 36/38 (95%) successful primary access in pts not previously stented with small stone burden (no UAS)
- More room in lumen of access sheath to allow residual fragment passage

Ebner B et al. Diagnostics 2025 (15) 2522

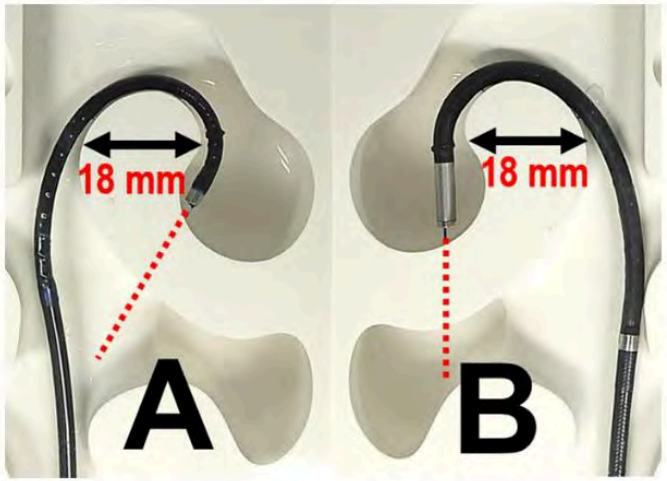
Single-Use vs Reusable Ureteroscope

Single-Use

- Risk of Breaking Reusable
  - Urinary Diversions
  - Antegrade Cases
  - Excessive Torque
- Bilateral Cases
- Large or multiple stones
- Lower pole stones
- Nothing else available

Reusable

- Small Stones
- Straightforward Diagnostics
- Certain Upper Tract Tumors
  - Superior "End-Tip Deflection"



Keller et al. World J Urol. 2019 (37) 2325-2333

Formal Classification of Ureteroscopic Complications

- **Exist to Provide Uniformity in Reporting**

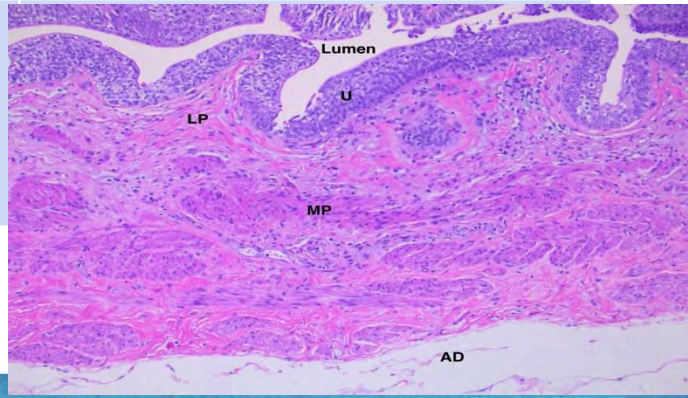
- American Association for the Surgery of Trauma (AAST) Organ Injury Severity Scale for the Ureter
- **Dindo-Modified Clavien Classification of Surgical Complications**

- Post-Ureteroscopic Lesion Scale
- Traxer Ureteral Injury Scale
- UCI Post-ureteroscopic Injury Scale

Moore et al. J Trauma 1992 (33) 337– 339
Dindo et al. Ann Surg. 2004 (240) 205 – 213
Schoenthaler et al. J Endourol. 2012 (26) 1425-1430
Traxer & Thomas. J Urol. 2013 (189) 580– 584
Cumpanas et al. J Endourol. 2025 (39) 679 - 685

Practical Classification of Complications: Chronological Order / Severity

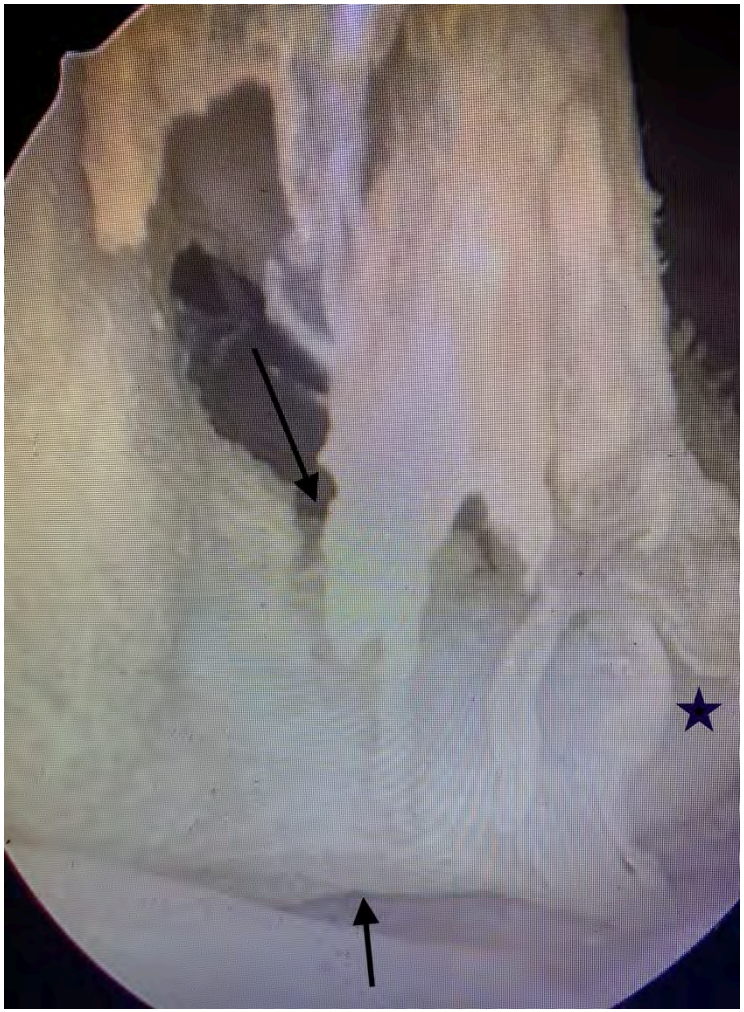
	MAJOR	MINOR
INTRAOPERATIVE	• **Avulsion** • **Intussusception**	• Abrasion • False Passage • Perforation • Extravasation • Bleeding • Difficult Access
POSTOPERATIVE (EARLY)	• Sepsis • Steinstrasse	• Ureteral Obstruction • Reflux
POSTOPERATIVE (LATE)	• Stricture	



Johnson and Pearle. Urol Clin N Am 2004 (31) 157-171

Mechanisms for Ureteral Avulsion

- **Stone basketing**
- **Entrapment of Ureteroscope**
  - Locked Deflection
  - Scabbard Avulsion
  - Bunching of distal bending rubber
  - Steinstrasse during ureteroscopy



Ureteral Avulsion During Ureteroscopy

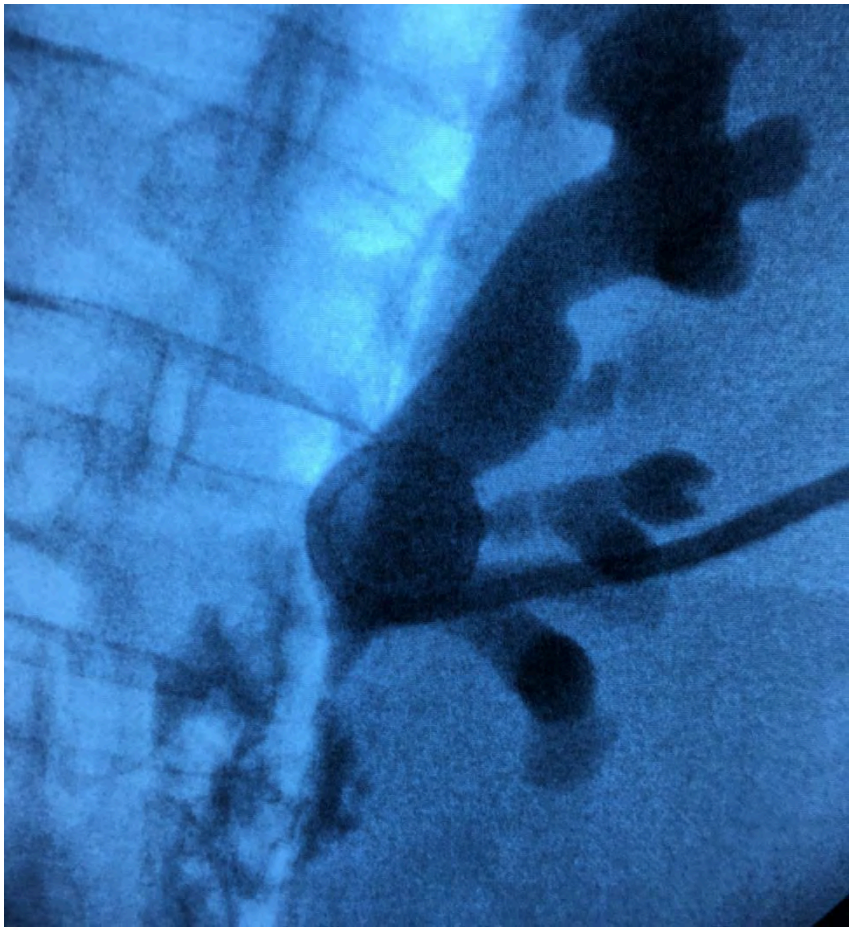
- **"Ureteral avulsion should never occur."***
- **Most likely mechanism**: ***STONE BASKETING***
  - Only under direct ureteroscopic vision – **"see mucosa move by.."**
  - **Small fragments**
  - Reversible Nitinol graspers or baskets
  - Safety wire highly recommended during stone removal with baskets (2016 guidelines)**

36. A safety guide wire should be used for most endoscopic procedures. (Index Patients 1-15)
Expert Opinion

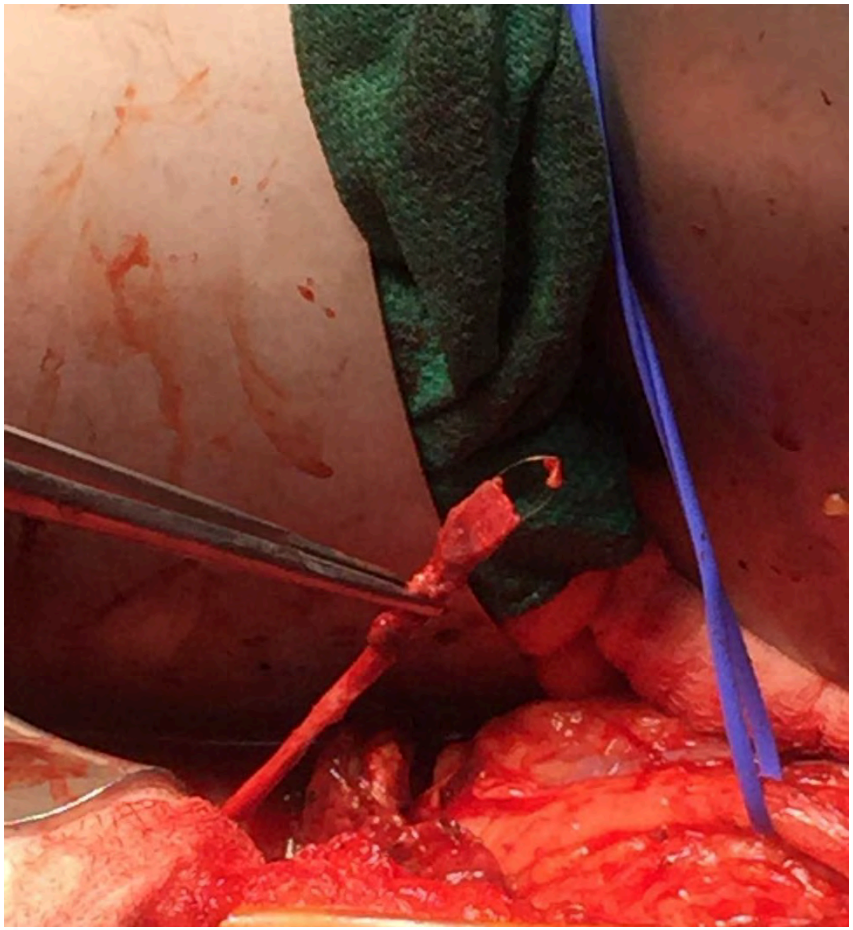
*Johnson and Pearle. Urol Clin N Am 2004 (31) 157
** Assimos D et al. J Urol. 2016 (196) 1153-60

Nov 2016 CONSULT: 8 mm stone

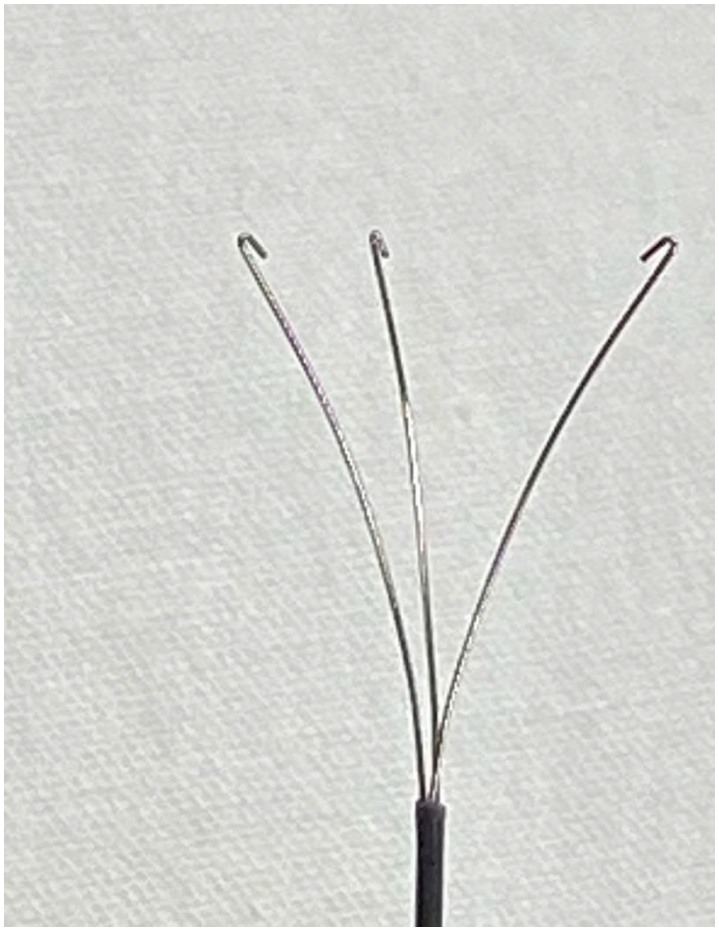
URETERAL AVULSION:
Stone Basketing

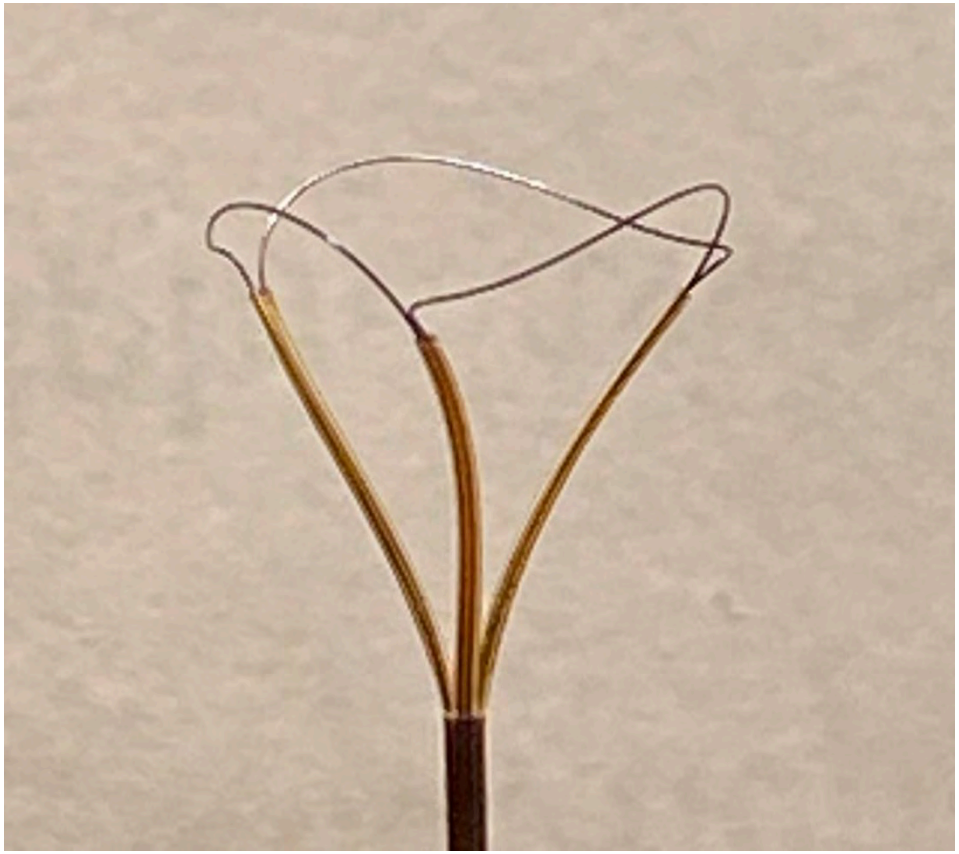


URETERAL AVULSION:
Stone Basketing

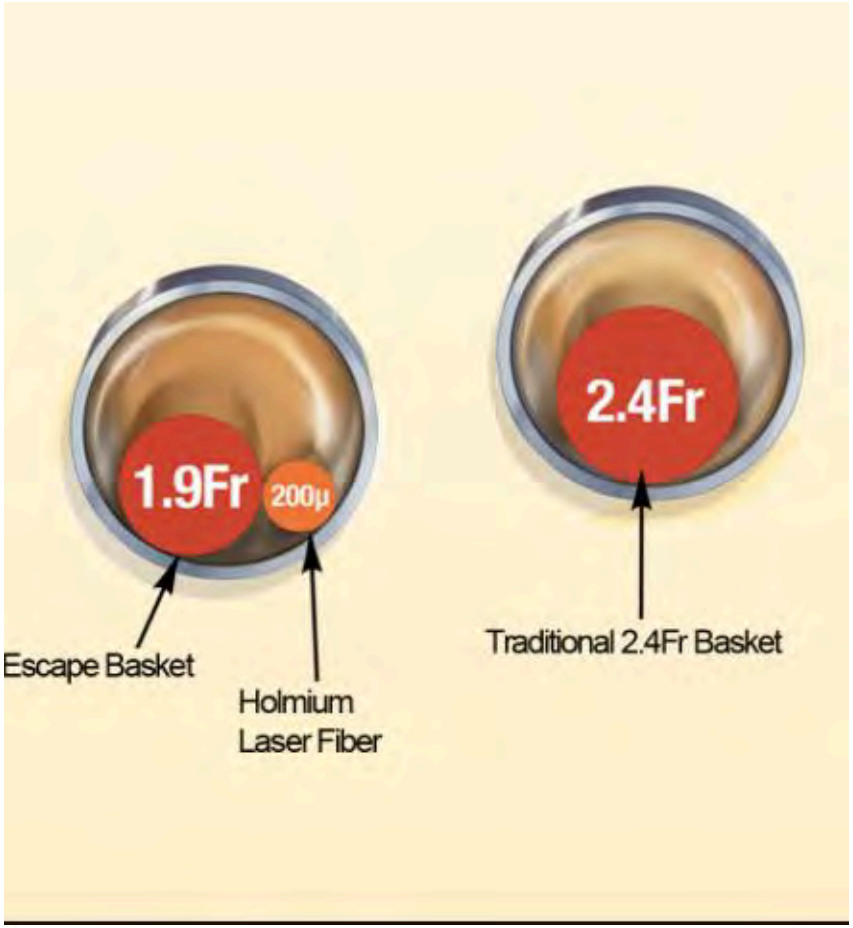


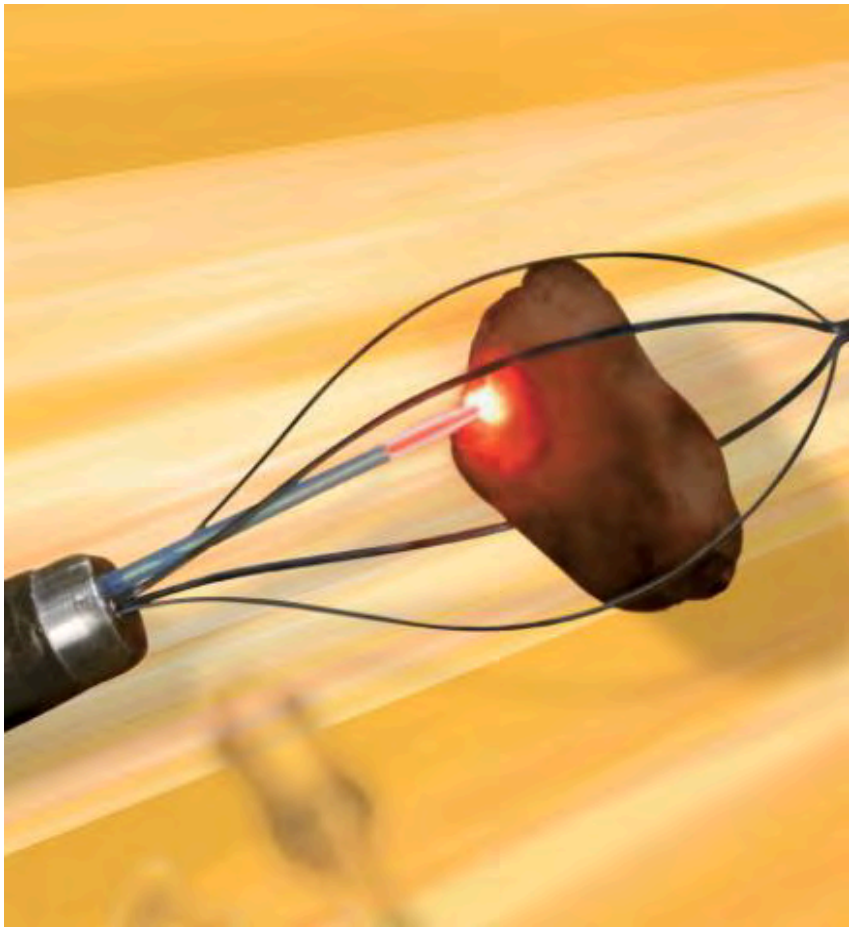
Retrieval Devices / Graspers





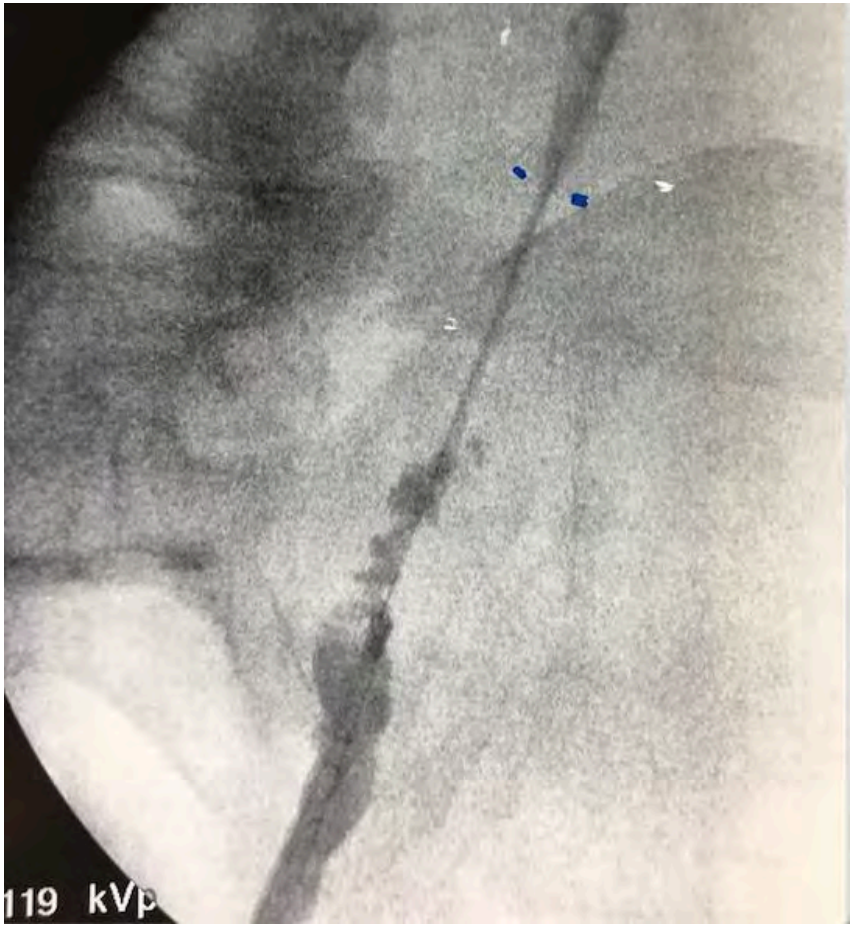
Benefit of 1.9 Fr Baskets:





Ureteral Intussusception

- Partial Thickness Circumferential Injury
- Stripping of mucosal surface while muscularis stays intact
- **ETIOLOGIES**
  - **Stone basketing**
  - **Broad-Based Neoplasm**
    - **UTUC**
    - **Fibroepithelial Polyp**
- Resect the base of neoplasm or refine the stone

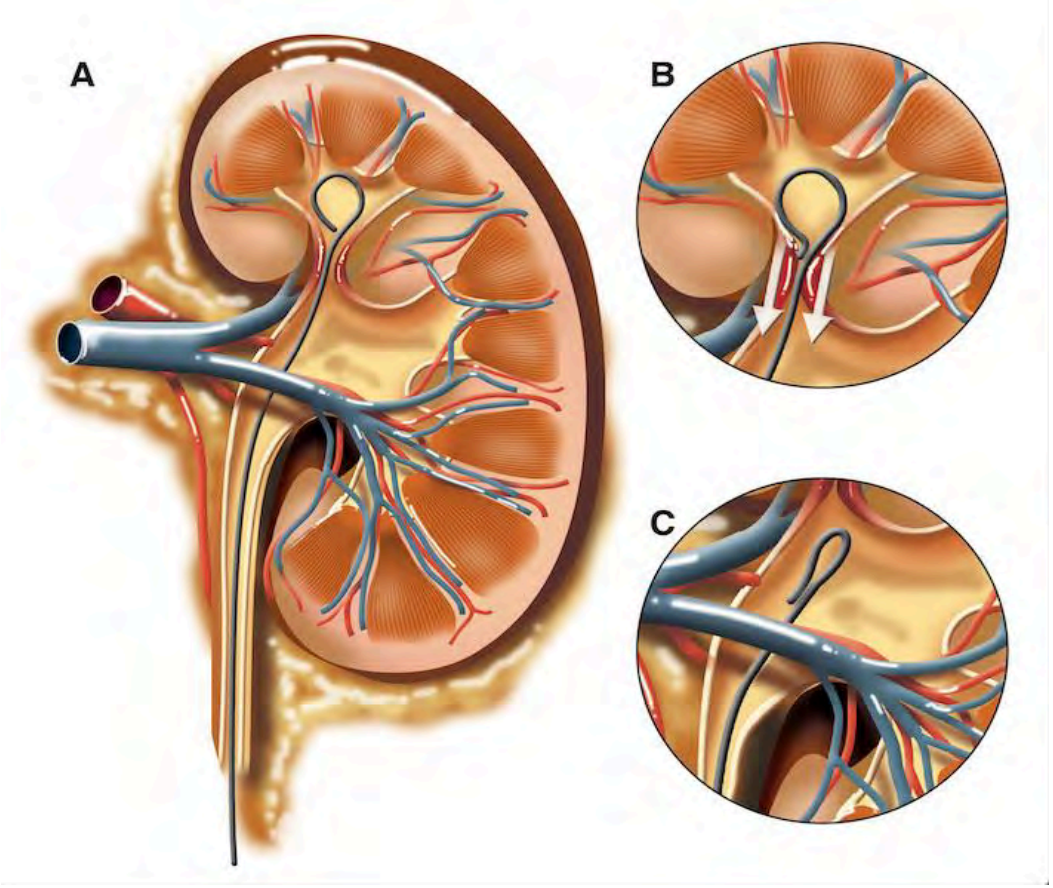


Suzuki et al. Clin Imag. 2015 (39) 901– 903
Gabriel et al. Urology 1986 (28) 310 - 312

Mechanisms for Ureteral Avulsion

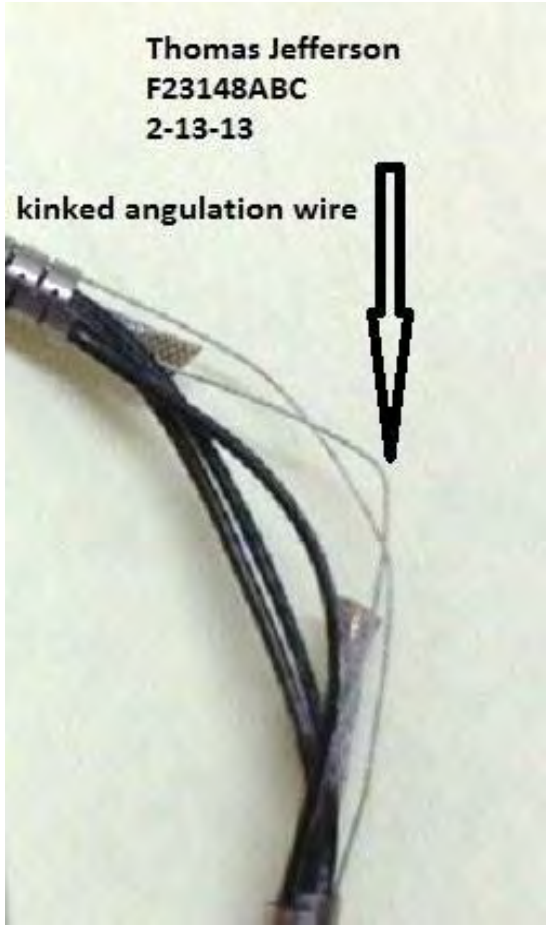
- Stone basketing
- **Entrapment of Ureteroscope**
  - Locked Deflection
  - Scabbard Avulsion
  - Bunching of distal bending rubber
  - Steinstrasse during ureteroscopy

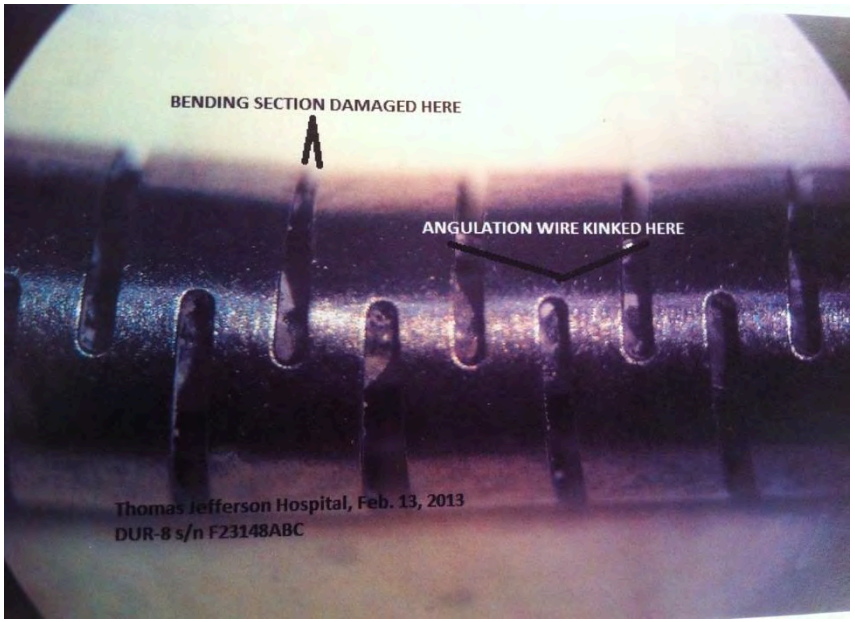
MECHANISM: Locked Deflection



Hubosky et al. J Endourol. 2015 (29) 907-912

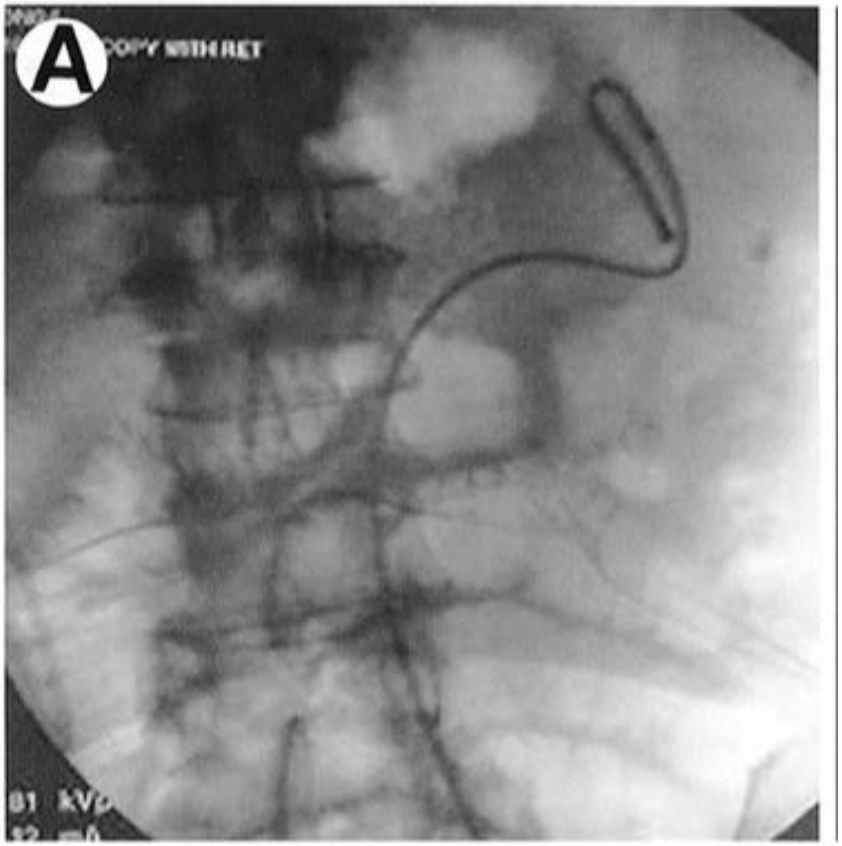
MECHANISM:
Locked Deflection Cable

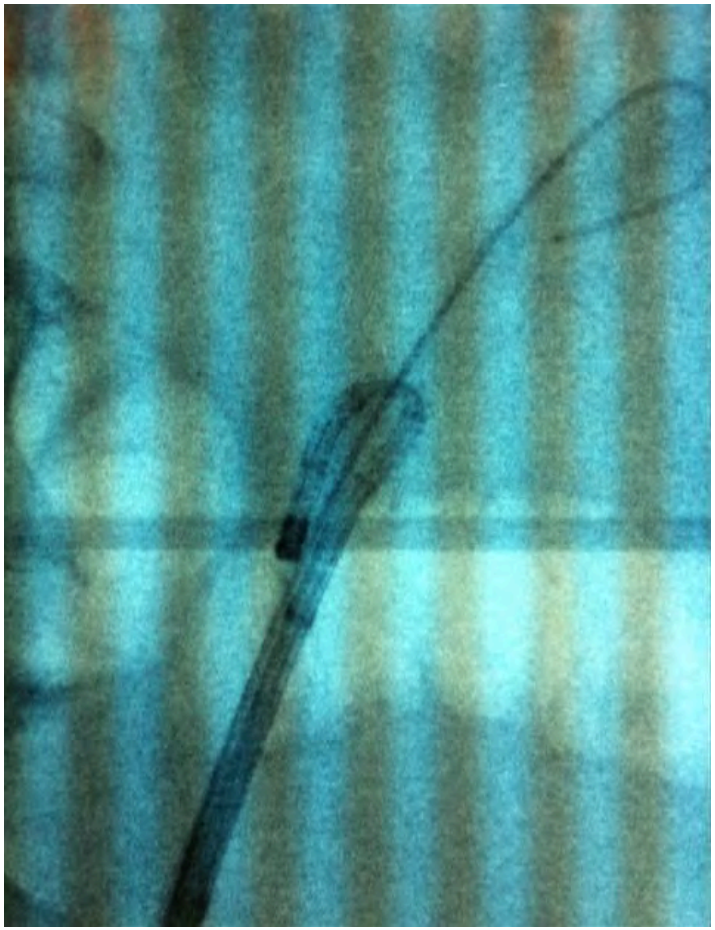




Hubosky et al. J Endourol. 2015 (29) 907-912

LOCKED DEFLECTION
during flexible ureteroscopy

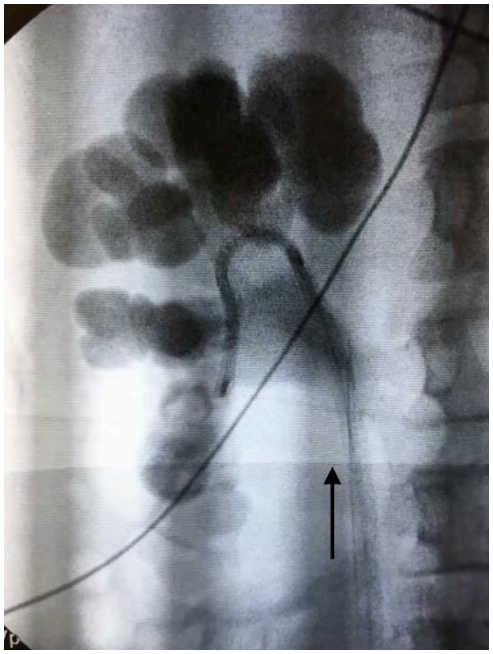


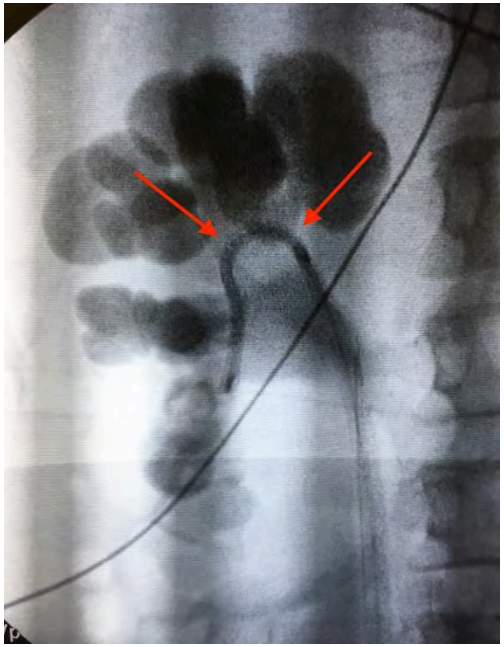


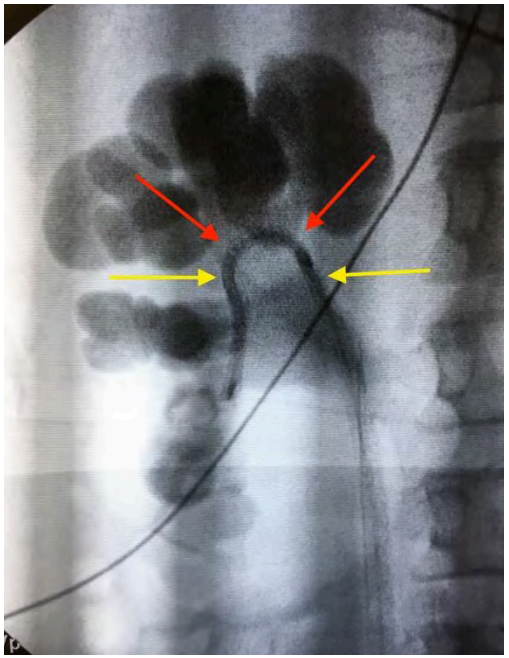
Anderson et al. J Urol 2004 (171) 335
Hubosky et al. J Endourol. 2015 (29) 907-912

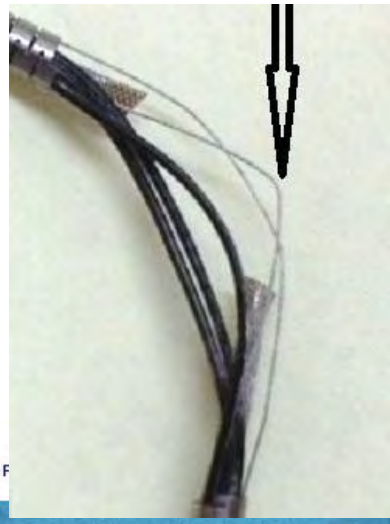
Another way to Kink a Deflection Cable

“Pinching” the Inner Bend Radius









Locked Deflection: Estimated Incidence

- Estimated at 1 / 100,000 flexible ureteroscopies performed
- Likely under-reported

Hubosky et al. J Endourol. 2015 (29) 907-912

Scabbard Avulsion

- Semi-rigid ureteroscope **without basket**
- Tight intramural ureter
- 2-point avulsion
- Must look for mucosa moving when extracting ureteroscope

Ordon et al. J Endourol. 2011 (25) 1259-1262

BUNCHING OF DISTAL BENDING RUBBER

- **“Accordianing Effect”**
- Avulsion reported 2014*
- Retained ureteroscope reported in 2017**
- **Rippling deformity caused by sheer stress with upward advancement**
- Medical device safety notice was issued 2016

*Tanimoto et al. J Endourol. 2016 (30) 257 -261
**Huynh et al. J Endourol Case Reports 2017 (3.1) 24-27

"Between a Rock and a Hard Place": A Case Report of Stone Fragment Impaction Causing a Retained Ureteroscope Requiring Open Surgical Intervention

Brendan Wallace, MD,[1] Emily Nham, BSc,[2] James Watterson, MD,[1] John Mahoney, MD,[1] and Thomas Skinner, MD, MSc[1]

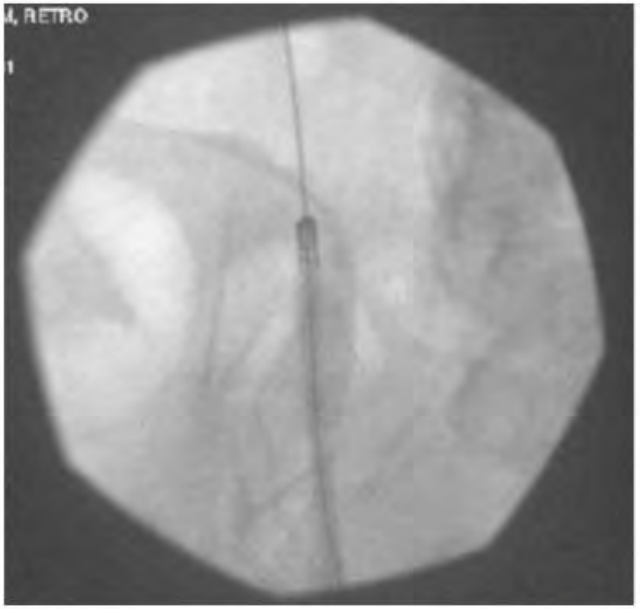


FIG. 2. Significant stone burden encasing flexible ureteroscope.

Wallace et al. J Endourol Case Reports 2019, DOI: 10.1089/cren.20190064

Practical Classification of Complications: Chronological Order / Severity

	MAJOR	MINOR
INTRAOPERATIVE	• Avulsion • Intussusception	• **Abrasion** • **False Passage** • **Perforation** • **Extravasation** • **Bleeding** • **Difficult Access**
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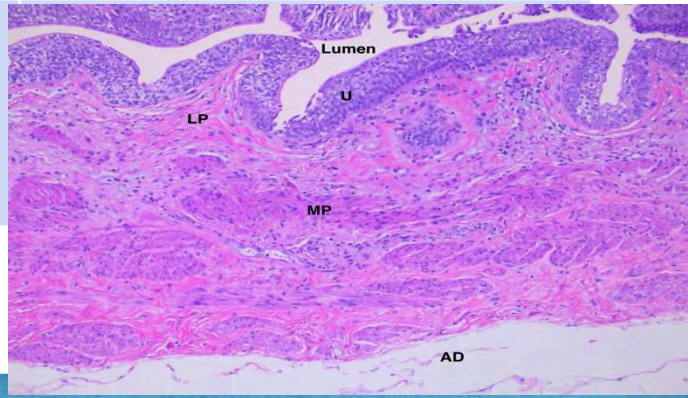


Johnson and Pearle. Urol Clin N Am 2004 (31) 157-171

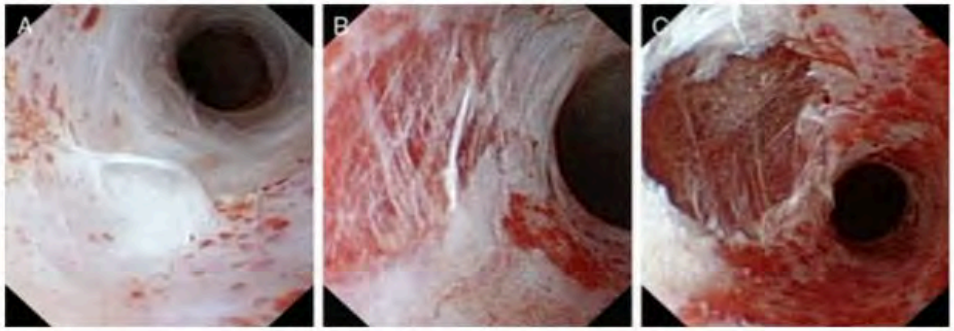
Abrasions & Perforations

APPENDIX

Endoscopic classification of ureteral wall injury after RIRS using UAS

Injury Grade	Endoscopic Findings
Low:	
0	No lesion found or only mucosal petechiae
1	Ureteral mucosal erosion without smooth muscle injury
High:	
2	Ureteral wall injury, including mucosa and smooth muscle, with adventitial preservation (periureteral fat not seen)
3	Ureteral wall injury, including mucosa and smooth muscle, with adventitial perforation (periureteral fat seen)
4	Total ureteral avulsion

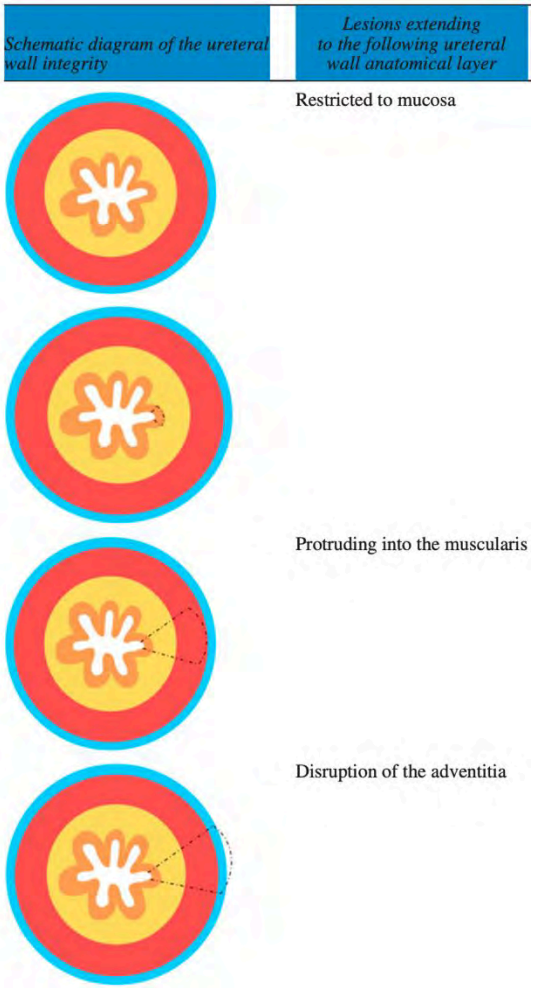
URETERAL WALL INJURIES FROM URETERAL ACCESS SHEATH INSERTION

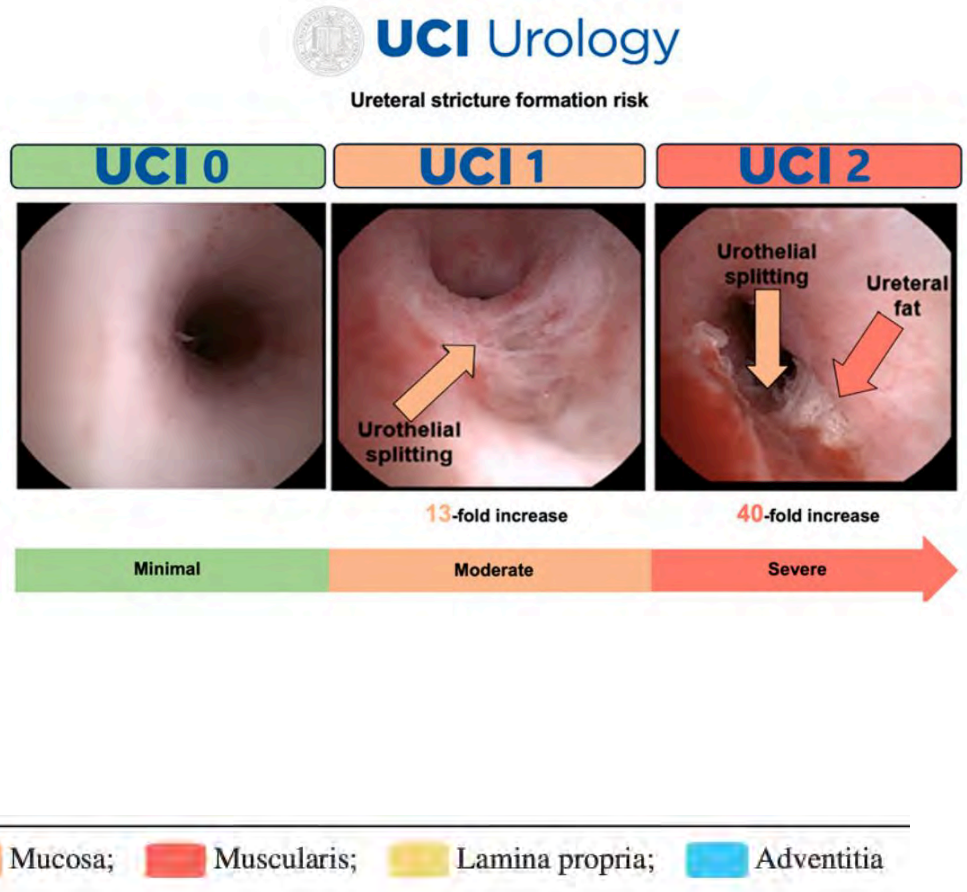


Endoscopic views of ureteral wall injuries. *A*, grade 1. *B*, grade 2. *C*, grade 3.

Traxer & Thomas J Urol. 2013 (189) 580-4

UCI System – Simplicity with Two Tiers





Cumpanas et al. J Endourol. 2025 (39) 679 - 685

Ureteral necrosis from Extension of a False Passage

Lytton B et al. J Urol. 1987 (137) 649-53

Hemorrhage

- CROES study: transfusion rate for URS is only 0.2%*
- Most likely scenario is endopyelotomy (transfusion rate 1 -16%)
- Lateral crossing vessels exist!!
  - Up to 18% have a lateral branch**
- Consider CT Angiogram or endoluminal US

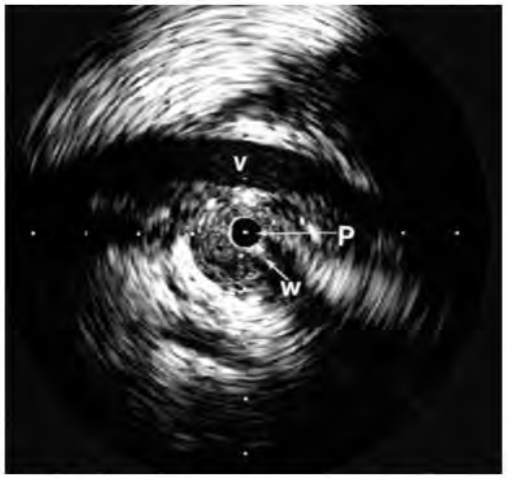


FIG. 2. Endoluminal ultrasound image of anterior vessel crossing right UPJ. *V*, crossing vessel. *P*, ultrasound transducer. *W*, guide wire.

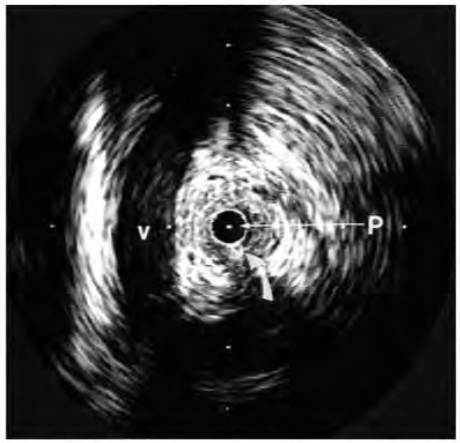


FIG. 3. Endoluminal ultrasound image of lateral vessel crossing right UPJ. *V*, crossing vessel. Curved arrow represents guide wire. *P*, ultrasound transducer.

*De la Rosette et al. J Endourol. 2014 (28) 131-9
**Zeltser et al. J Urol 2004 (172) 2304-7

Contemporary Hemorrhage Problem:
Renal Artery **Pseudoaneurysm** after laser lithotripsy

Stone size (mm)	Kidney	Location	Laser source	Laser fiber (μm)	Pulse energy (J)	Pulse fequency (Hz)	Total power (W)	Operative time (min)	Days to emboli-zation
10	Left	MP	Ho:YAG	200	N.A.	N.A.	N.A.	N.A.	14
11 4	Left	RP LP	Ho:YAG	200	N.A.	N.A	N.A.	N.A.	21
25	Right	RP	Ho:YAG	N.A.	0.8	25	20	60	47
6 7	Left	UP	TFL	N.A.	0.4 2	40 20	16 40	N.A.	22
20	Bilateral	N.A	Ho:YAG	N.A.	0.8	25	20	N.A.	31
8	Left	UP	TFL	N.A.	0.8–1	30	24–30	N.A.	27
12 8	Left Left	LP MP	TFL	150	1 1	30 30	30 30	75	2
20	Right	PU	TFL	150	0.2	100	20	59	19
13	Left	UP	TFL	150	0.6	40	24	60	2

- Heat generated from high powered laser (TFL or Ho)
- AUA guidelines 2026: “lowest total power to accomplish stone ablation”
- Awareness will help with timely embolization

Corrales et al. WJ Urol. 2024 (42) 280

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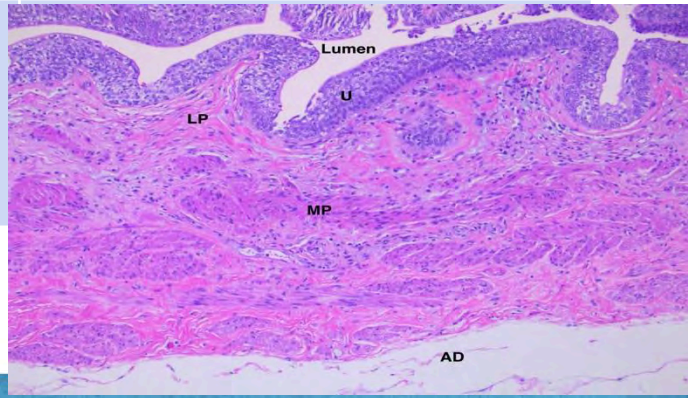


Johnson and Pearle. Urol Clin N Am 2004 (31) 157-171

SEPSIS after Ureteroscopy

- CROES study*
  - 11,885 patients
  - 1.72% postop fever
  - 0.30% severe urosepsis
- Large meta-analysis**
  - 24,373 patients
  - Infectious complications 3.9%
  - “urosepsis” in 0.51%

Somani et al..World J Urol. 2017 (35) 675-681
Chugh et al. Curr Urol Rep. 2020 (21) 16

Mortality and flexible ureteroscopy: analysis of six cases

Luca Cindolo[1] · Pietro Castellan[2] · Cesare Marco Scoffone[3] · Cecilia Maria Cracco[3] · Antonio Celia[4] · Andrea Paccaduscio[5] · Luigi Schips[1] · Silvia Proietti[6] · Alberto Breda[7] · Guido Giusti[6]

Table 1 Demographic data and clinical characteristics

No.	Age/sex	Stone size (cm)/HU	Anatomic abnormalities	Metabolic comorbidity	Cardiac or neurological comorbidity	Preoperative uroculture	Preoperative stent/nephrostomy	Prophylactic antibiotics	Operative time (min)	UAS or nephrostomy	Cause of death	Pathogens
1	66/F	1 + 1.5/550	Absent	Pathologic obesity	Mitral insufficiency, cardiac arrhythmia	N	Y	Y	113	No	Septic shock and acute respiratory failure	NA
2	70/F	NA	Filling defect in the renal pelvis	Absent	–	NA	Y	Y	20	Y (12/14)	Septic shock	*Enterococcus faecalis* (?)
3	44/F	1.7/600	Solitary kidney	Absent	Advanced multiple sclerosis	N	N	Y	55	Y (12/14)	Septic shock	*Candida glabrata*
4	75/F	3.3/NA	Absent	Absent	Arterial hypertension, cardiac arrhythmia	N	N	Y	90	Nephrostomy	Hemorrhagic complication	Multiresistant *E. coli*
5	48/M	1.2/NA	Absent	Absent	–	N	N	Y	65	No	Septic shock and acute respiratory failure	*Proteus mirabilis*
6	48/M	1.1/900	Absent	Absent	–	N	N	Y	NA	NA	Cardiac arrest	–

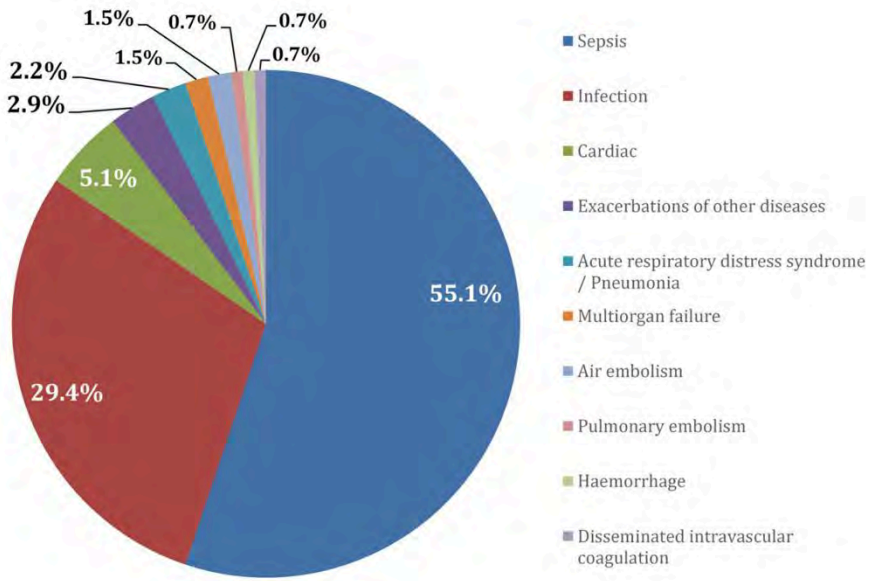
Cindolo et al. World J Urol 2016 (34) 305-10

EAU Endourology Section: Mortality from Ureteroscopic Stone Treatment

- Meta-Analysis
  - 24 studies
  - 1,057,707 patients
  - 1,009 deaths

- Overall Mortality Rate: 0.1%

- 84.5% deaths attributed to Sepsis and/or Infection.
- Mortality rate from Sepsis: 0.08%
  - 1 / 12,500 ureteroscopies

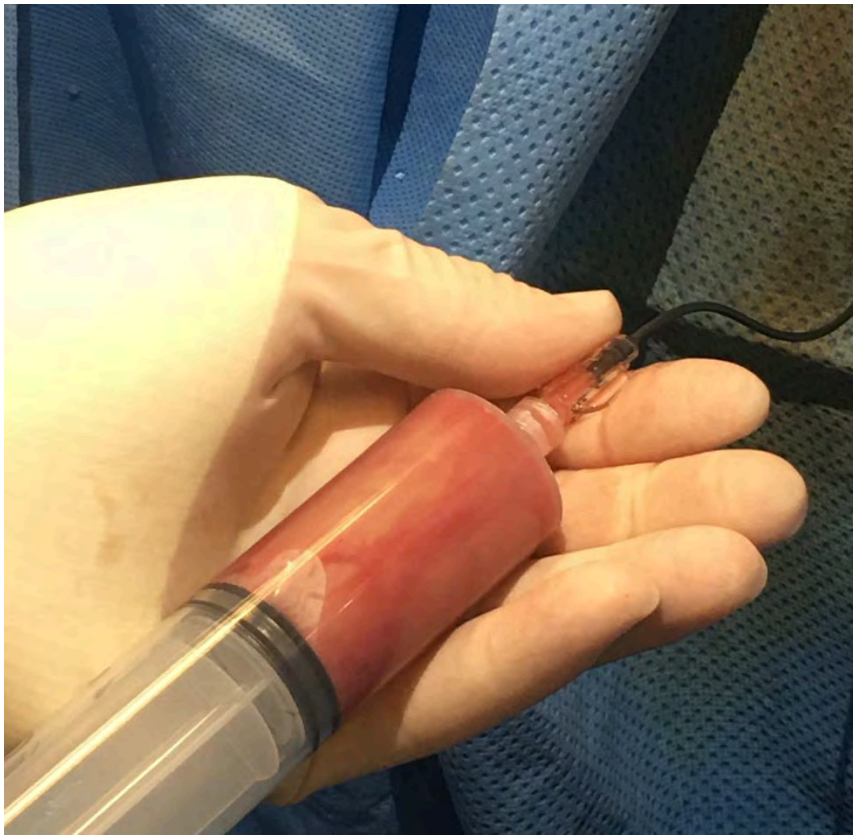


Dassanayake et al. World J Urol 2025 (43) 432

Urosepsis: Recipe for Disaster

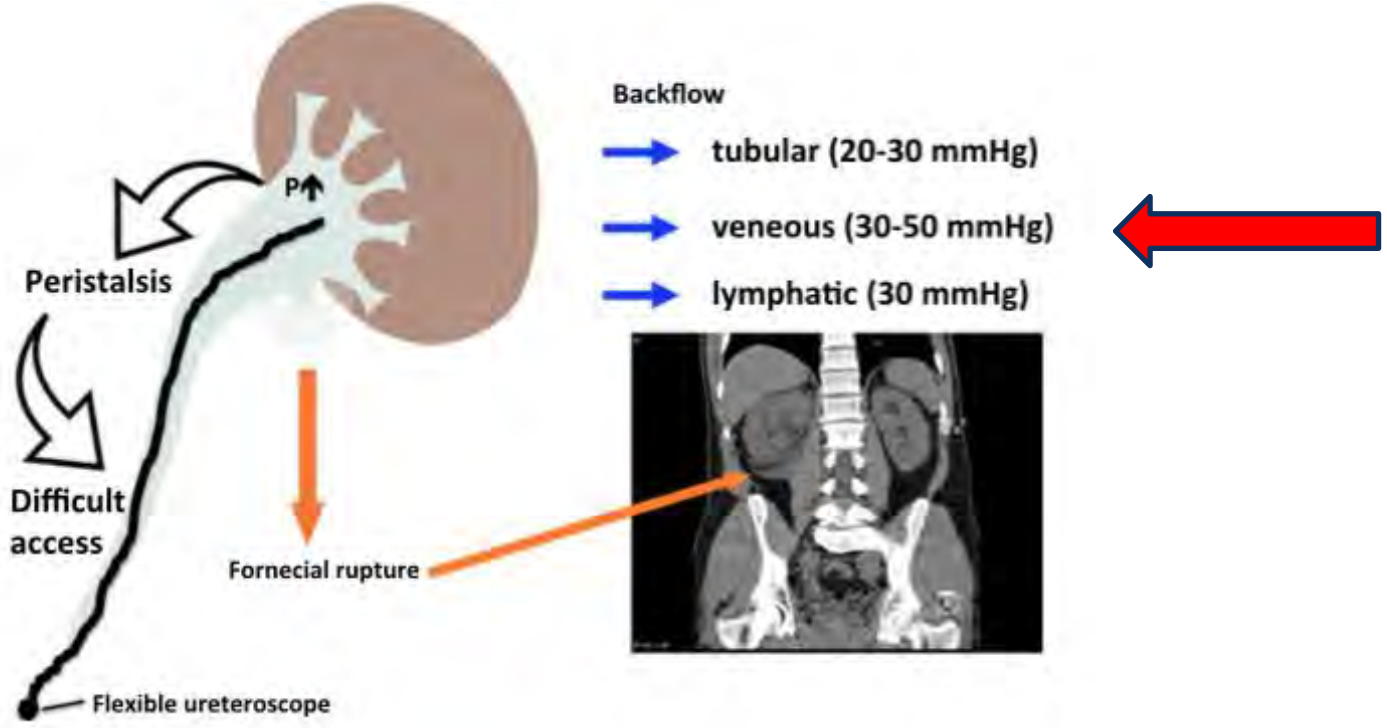
Pyelovenous Backflow

High Colony Counts



Risks of flexible ureterorenoscopy: pathophysiology and prevention

Palle J. S. Osther[1,2]



(Fig. 2). Just by introducing a semirigid or a flexible ureteroscope into the ureter results in intrarenal pressure increases (scope effect), and mean intrarenal pressures in the range of 60–100 mmHg during fURS with irrigation (without access sheaths) have been measured [25, 26]. With the use of forced irrigation during laser lithotripsy, pressure rises above 300 mmHg are not unusual [25]. We know from animal and

Osther. Urolithiasis. 2018 (46) 59-67

Renal Pelvic Pressure and Post-Ureteroscopy Bacteremia in Swine Model

- Test arm had ureteroscopic saline infusion with pathogenic

E. Coli concentrated at 15 million CFU per mL at varied pressure of 37 mm Hg or 75 mm Hg for 60 minutes.

- Suggests threshold pressure for bacteremia development

Table 1 Blood and organ cultures in control animals (Group 1) and in experimental animals with *Escherichia coli* in the irrigation solution, with renal pelvis pressure maintained at either 37 mmHg (Group 2) or 75 mmHg (Group 3).

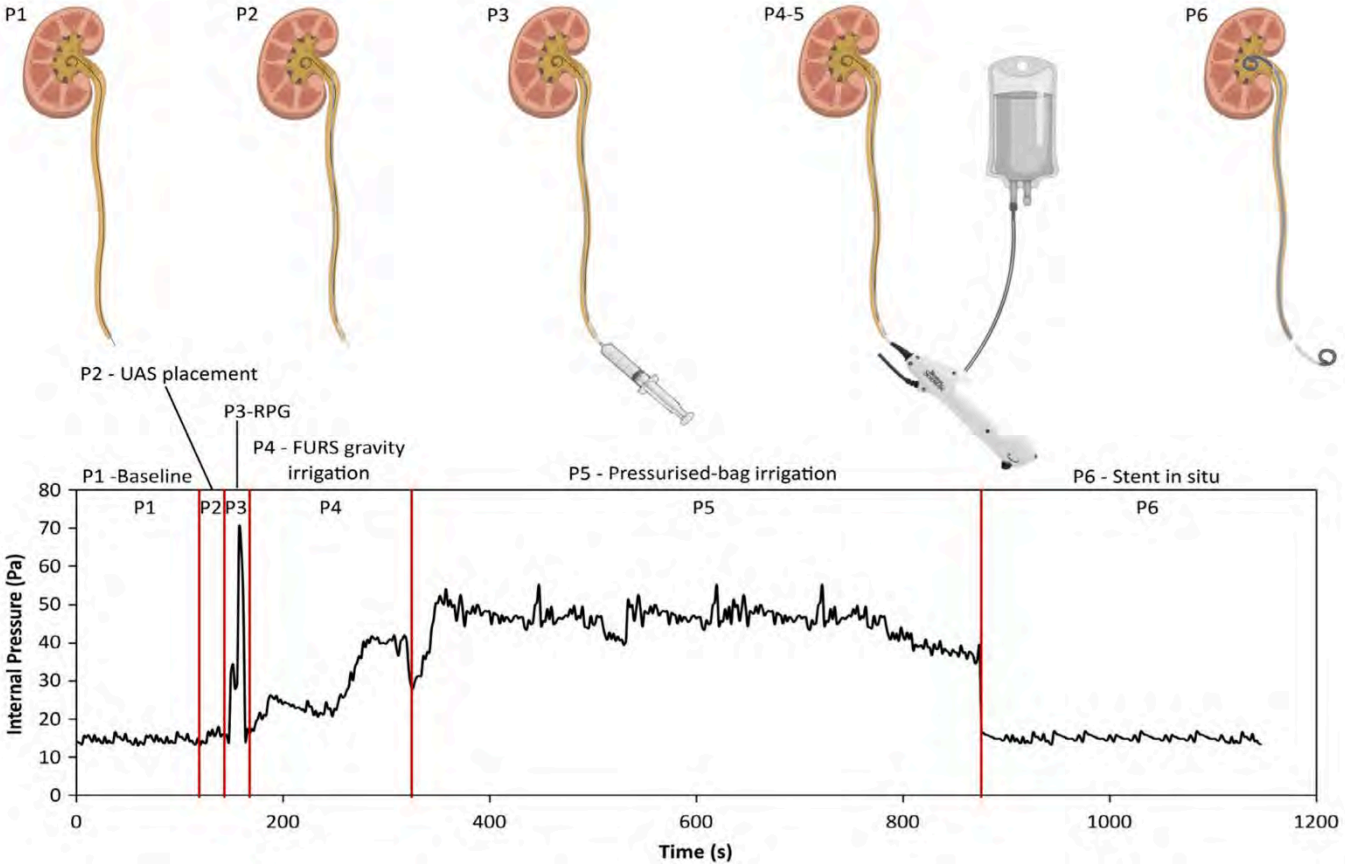
	Group 1 Control (n = 7)*		Group 2 37 mmHg (n = 7)‡		Group 3 75 mmHg (n = 7)‡		P
Positive *Escherichia coli* in blood							
Within 24 h	0 out of 7	0%	0 out of 7	0%	5 out of 7	71%	0.003
Positive *E. coli* in tissue (24 h)							
Kidney	1† out of 7	14%	5 out of 7	71%	7 out of 7	100%	0.005
Liver	1† out of 7	14%	0 out of 7	0%	1 out of 7	14%	1.00
Spleen	1† out of 7	14%	0 out of 7	0%	1§ out of 7	14%	1.00
Lung	0 out of 7	0%	0 out of 7	0%	0 out of 7	0%	NA

**Control subjects include both intra-renal pressure groups (37 and 75 mmHg). †No E. coli in irrigation solution. ‡Experimental groups with E. coli in irrigation solution. §Same animal as positive E. coli in blood.*

Hinojosa-Gonzalez et al. BJUI 2025 (135): 279-285

In vivo ureteroscopic intrarenal pressures and clinical outcomes: a multi-institutional analysis of 120 consecutive patients

Stefanie M. Croghan[1,2], Eoghan M. Cunnane[9,10,11], Sorcha O'Meara[1,2], Muheilan Muheilan[3], Connor V. Cunnane[9,10,11], Kenneth Patterson[4], Andreas Skolarikos[12,13], Bhaskar Somani[12,14], Gregory S. Jack[15], James C. Forde[2,4], Fergal J. O'Brien[5], Michael T. Walsh[9,10], Rustom P. Manecksha[3,6], Barry B. McGuire[7,8] and Niall F. Davis[2,4,12]



What Intra-Renal Pressure do we Achieve ?

(every day)

Variable	IRP, mmHg		P
	Mean (SD)	Maximum	
Total intraoperative period (n = 120)	40.1 (22.01)	334.2	
Individual variance (n = 100) (mean intra-trace variance across total intraoperative period)	412.73 (570.66)	3495.26	
Mean differential pressure (n = 77) (mean intraoperative − mean baseline IRP)	22.77 (20.7)	105.09	
Retrograde pyelography (n = 58) (peak pressure)	72.9 (81.78)	334.2	
Semi-rigid URS (n = 34)			
All URS (n = 34)	40.08 (17.3)	228.9	
Irrigation			
Gravity (n = 26)	34.93 (11.66)	158.8	<0.001
Pressurised bag (mean 150 mmHg) (n = 8)	56.81 (20.66)	228.9	
FURS (n = 122 pressure traces; 90 patients)			
All FURS	42.06 (28.02)	240.2	
Irrigation			
FURS without UAS (n = 15)			
Gravity (n = 2)	29.23 (10.21)	50.8	
100 mmHg (n = 3)	35.98 (15.57)	68	
150 mmHg (n = 2)	32.66 (14.8)	103.7	
Manual (n = 8)	56.6 (15.8)	240.2	
FURS with 10/12-F UAS (n = 10)			
Gravity (n = 2)	30.1 (6.07)	162.2	
100 mmHg (n = 2)	47.76 (5.3)	87.8	
150 mmHg (n = 6)	64.34 (19.62)	143.9	
FURS with 11/13-F UAS (n = 89)			
Gravity (n = 35)	29.8 (19.45)	167.3	<0.001*
100 mmHg (n = 18)	38.9 (22.38)	204.1	
150 mmHg (n = 32)	45.83 (28.56)	228.5	
200 mmHg (n = 4)	87.27 (66.85)	236.3	
FURS with 12/14-F UAS (n = 6)			
Gravity (n = 1)	26.78 (5.84)	54.3	
150 mmHg (n = 4)	46.36 (29.3)	219.9	
200 mmHg (n = 1)	59.11 (10.46)	92.6	
FURS with 13/15-F UAS (n = 1)			
Manual (n = 1)	50.09 (11)	92.7	
FURS with suction-assisted UAS (11/13 F) (n = 1)			
150 mmHg	24.98 (10.16)	75.9	

Profile of the Post-Ureteroscopic Septic Patient

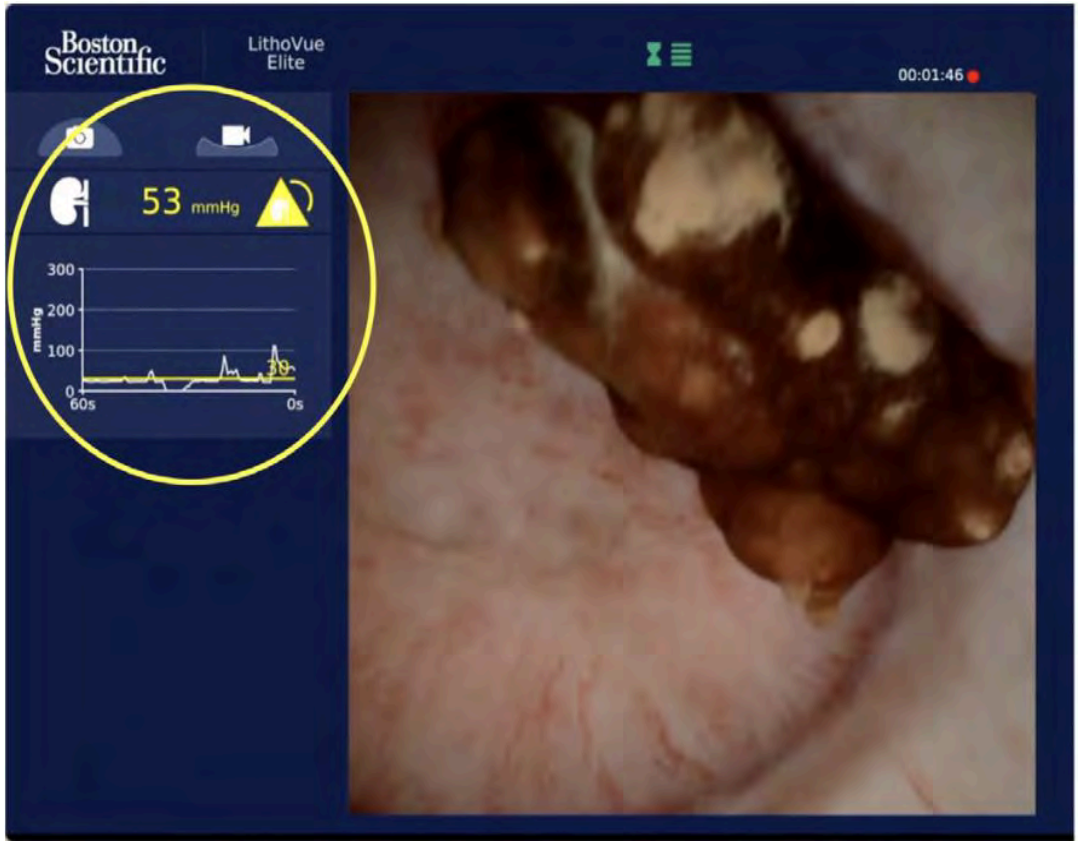
Urosepsis			
Incidence, *n* (%)	6 (5)		
	Urosepsis (*n* = 6)	**Controls (*n* = 89)**	***P***
Preoperative stent, *n/N* (%)	3/6 (50)	24/89 (27)	0.23
Preoperative positive urine culture, *n/N* (%)	3/6 (50)	10/89 (11)	0.007
Diabetes, *n/N* (%)	0/6	12/89 (13)	ns
Stone size (single maximum dimension), mm, mean (SD)	13.6 (11.26)	12 (6.14)	0.6
Mean baseline IRP, mmHg, mean (SD)	18.59 (8.7)	16.96 (10.73)	0.74
	5 observations	72 observations	
UAS used, *n/N* (%)	6/6 (100)	72/89 (81)	ns
IRP overall operative period, mmHg, mean (SD)	71.16 (36.85)	38.62 (22.51)	0.001
Variance of IRP overall operative period, mmHg, mean (SD)	1042.12 (919.16)	346.62 (495)	0.002
IRP during FURS, mmHg, mean (SD)	81.7 (49.52)	38.53 (22.6)	<0.001
Overall operative duration, min, mean (SD)	24.17 (12.22)	18.87 (10.1)	0.23

Croghan et al. BJUI. 2023 (132) 531 - 540

Measuring Intra-Renal Pressure

- Percutaneous
- Retrograde Wire*
- Access Sheath
- Ureteroscope**

- **Lower Pressures noted with
  - Conventional ureteral access sheath (11/13 or 12/14)
  - Pre-stented patients
  - Mean IRP = 28.5 mm Hg
  - Max IRP = 174 mm Hg

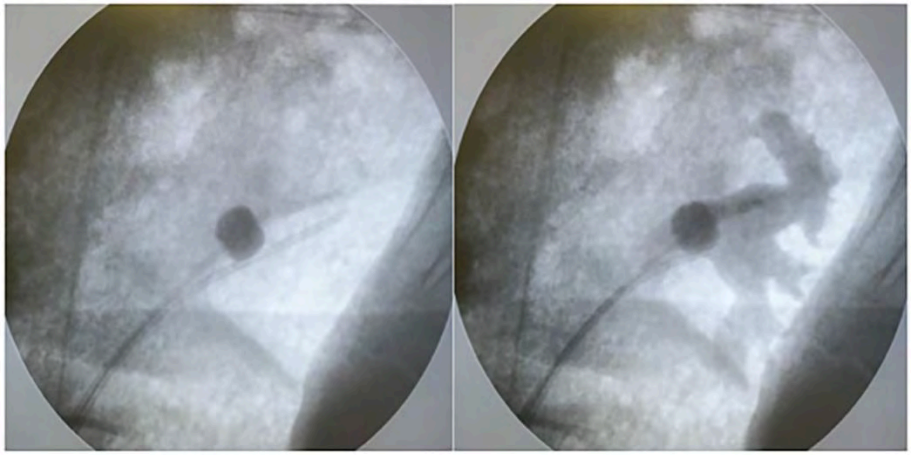


*Doizi et al. 2021 World J Urol. (39): 555-561
**Bhojani et al. 2023 BJUI. 132 (6): 678-685

Relationship between Intra-Renal Pressure (IRP) and Intra-Renal Backflow (IRB)

- Intra-Renal Backflow is the “likely event immediately before sepsis”
- Intra-Renal Backflow is a function of Intra-Renal Pressure and time

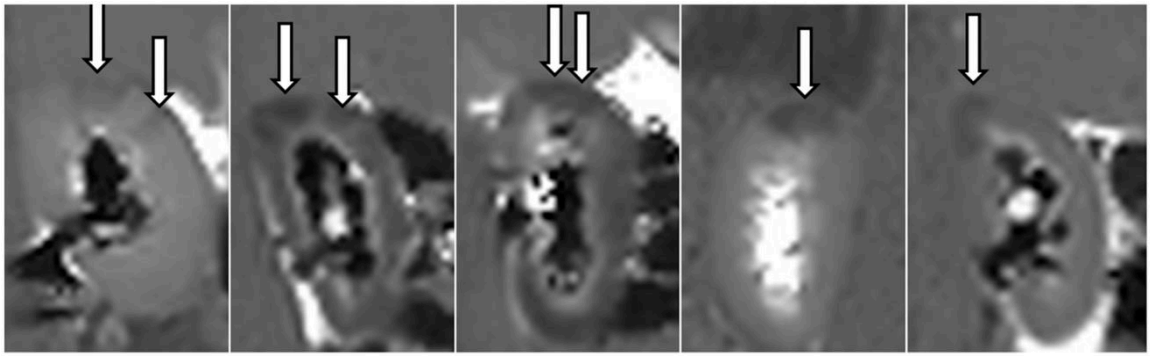
- Porcine model, Gadolinium infused saline with occlusion balloon
- Serial MRI’s



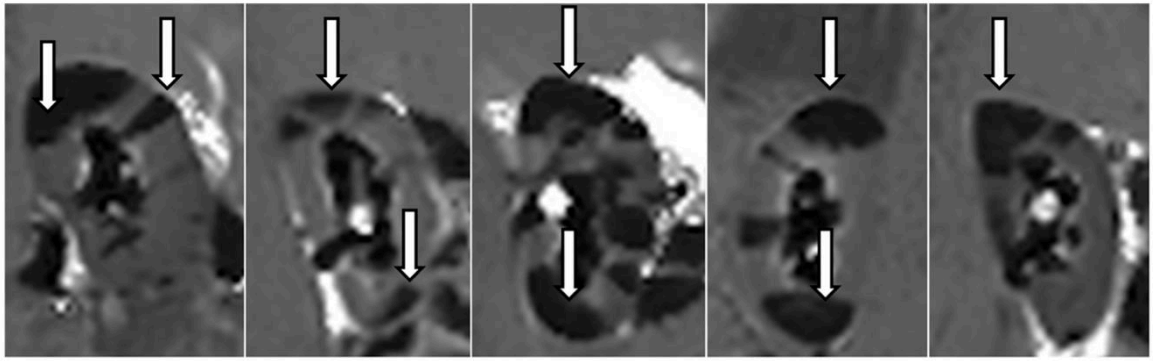
Lildal et al. PLoS One 2023; 18e0281676

PORCINE MODEL: INTRA-RENAL BACKFLOW

Initial Changes: 16 – 25 mm Hg

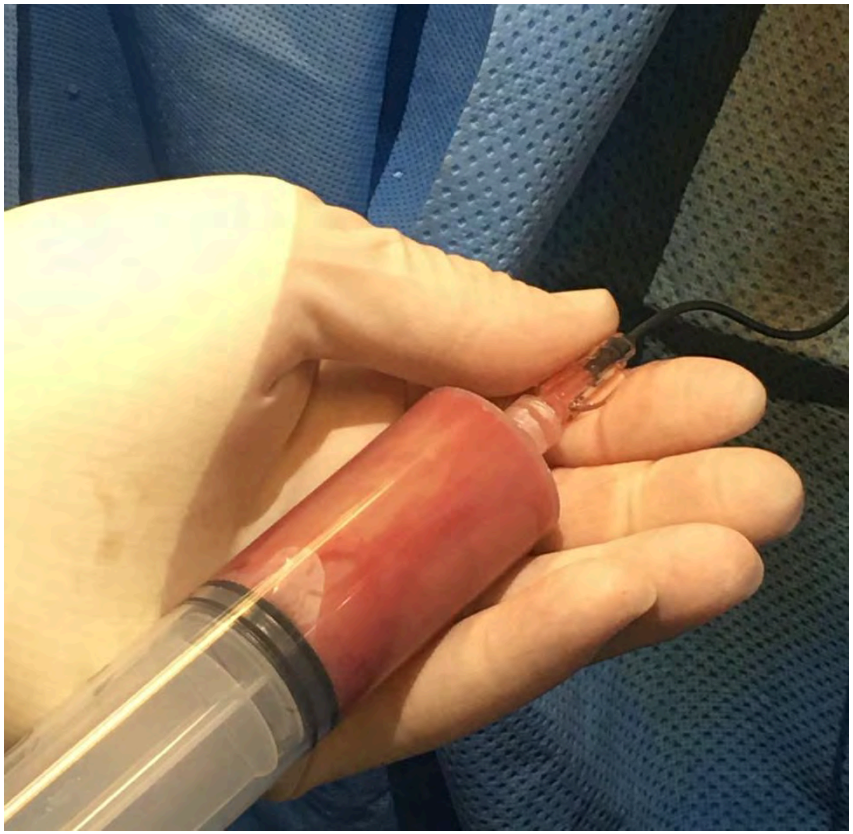


Final Changes: 40 – 54 mm Hg



Lildal et al. PLoS One 2023; 18e0281676

Intra-Renal Pressure: More questions than answers?



- We likely get Intra-Renal Backflow during every ureteroscopy
- Staying under a pressure threshold may not be protective and can hinder visibility
- Pressure monitor can help inform how high to set irrigation pressure or guide manual pressure systems
- Sepsis = Multi-Factorial Problem
  - We must risk stratify !!

META-ANALYSIS: Risk Factors for Sepsis After Ureteroscopy for Stone Treatment

TABLE 6. SUMMARY OF RISK FACTORS FOR POSTOPERATIVE UROSEPSIS IN PATIENTS UNDERGOING URETEROSCOPY FOR STONE DISEASE

		Effect size					*Heterogeneity*	
Risk factor	*No. of studies*	*Unit of measure*	*Statistic*	*Value*	*95% CI*	p[a]	I^2	p
Preoperative stent	**6**	**Yes *vs* no**	**Odds ratio**	**3.94**	**2.36 to 6.60**	**<0.001**	**0%**	**0.59**
Positive preoperative urine culture	**6**	**Yes *vs* no**	**Odds ratio**	**3.56**	**2.11 to 6.01**	**<0.001**	**32%**	**0.19**
Ischemic heart disease	**2**	**Yes *vs* no**	**Odds ratio**	**2.49**	**1.38 to 4.48**	**0.002**	**0%**	**0.51**
Age	**6**	**Years**	**Mean difference**	**2.7**	**1.0 to 4.4**	**0.002**	**44%**	**0.11**
Procedure time	**1**	**Minutes**	**Mean difference**	**9**	**2 to 16**	**0.02**	[b]	[b]
Diabetes mellitus	**6**	**Yes *vs* no**	**Odds ratio**	**2.04**	**1.04 to 4.03**	**0.04**	**64%**	**0.02**
Stone size	4	Millimeters	Mean difference	10	−1 to 20	0.07	48%	0.12
Recent UTI	2	Yes *vs* no	Odds ratio	2.74	0.55 to 13.66	0.22	82%	0.02
Male sex	8	Yes *vs* no	Odds ratio	0.63	0.28 to 1.44	0.27	75%	<0.001
Stone history	1	Yes *vs* no	Odds ratio	1.63	0.35 to 7.51	0.53	[b]	[b]
Pyuria	1	Yes *vs* no	Odds ratio	1.33	0.42 to 4.22	0.63	[b]	[b]
Hydronephrosis	1	Yes *vs* no	Odds ratio	1.53	0.20 to 11.78	0.68	[b]	[b]
BMI	3	kg/m^2	Mean difference	0.2	−1.2 to 1.6	0.78	15%	0.31

Bhojani et al. 2021 J. Endourol. 35 (7): 991 - 1000

Long duration of stent = High risk for infection

- 1,256 consecutive patients for URS and stone removal
- Treated with empiric abx or culture specific when indicated
- 601/1256 (48%) were previously stented

- Stented patients more likely to develop postoperative infection versus those not pre-stented (4.6% versus 1.2%)

- **Stent duration greater than 30 days more likely to get infected (6.2% versus 1.1%)**

- Recommend getting stented patients definitively treated within 30 days of original stent placement

Nevo et al. BJUI 2017 (120) 117 - 122

2026 AUA Guideline on Surgical Treatment for Renal and Ureteral Stones

(Antibiotic prophylaxis for Ureteroscopy)

35. **For adult patients with kidney or ureteral stones undergoing URS and PCNL, clinicians should administer pre-operative prophylactic antibiotics. (*Moderate Recommendation; Evidence Level: Grade B*)**

- Situation 1
  - Asymptomatic patient
  - No bacteruria on preoperative culture or UA
  - Single preoperative abx dose based on local antibiogram for typical gram positive & negatives

3. **For adult and pediatric patients with kidney and/or ureteral stones and untreated bacteriuria/funguria, clinicians should not proceed with definitive stone surgery. (*Clinical Principle*)**

- Situation 2
  - Pt with symptomatic UTI
  - Pt with positive urine culture
  - "Longer duration" antibiotic based on local antibiogram

- **Give culture specific abx, or use Best Practice Guidelines.**

Pearle M et al. J Urol. 2026 215 (2): 113-123

Urological Procedures and Antimicrobial Prophylaxis (2019)

Table V: Recommended antimicrobial prophylaxis for urologic procedures

The recommendations listed herein are based on general consensus. Antibiotic choices should be based on "local" resistance patterns, antibiograms, and institutional polices, which may supersede the guidance listed in the Table below.

Procedure	Likely Organisms	Prophylaxis Indicated	Antimicrobial(s) of Choice	Alternative Antimicrobial(s), if required	Duration of Therapy[¶]
Ureteroscopy, all indications; clean-contaminated	GNR, rarely enterococci,	All cases; of undetermined benefit for uncomplicated diagnostic only procedures.	TMP-SMX ***or*** 1st/2nd gen. Cephalosporin	Aminoglycoside +/- Ampicillin ***or*** Aztreonam[¥] +/- Ampicillin ***or*** Amoxicillin/Clavulanate	Single dose

Lightner et al. J Urol 2020; 203: 351 - 356

2008 Abx Best Practice Policy

TABLE 3a. *Recommended antimicrobial prophylaxis for urologic procedures*

Procedure	Organisms	Prophylaxis Indicated	Antimicrobial(s) of Choice	Alternative Antimicrobial(s)	Duration Therapy
		Lower Tract Instrumentation			
Removal of external urinary catheter	GU tract†	If risk factors‡,§	- Fluoroquinolone¶ - TMP-SMX¶	- Aminoglycoside ± Ampicillin¶ - 1st/2nd gen. Cephalosporin¶ - Amoxacillin/Clavulanate¶	≤24 hour
Cystography, urodynamic study, or simple cystourethroscopy	GU tract	If risk factors§	- Fluoroquinolone - TMP-SMX	- Aminoglycoside ± Ampicillin - 1st/2nd gen. Cephalosporin - Amoxacillin/Clavulanate	≤24 hour
Cystourethroscopy with manipulation‖	GU tract	All	- Fluoroquinolone - TMP-SMX	- Aminoglycoside ± Ampicillin - 1st/2nd gen. Cephalosporin - Amoxacillin/Clavulanate	≤24 hour
Prostate brachytherapy or cryotherapy	Skin	Uncertain	- 1st gen. Cephalosporin	- Clindamycin**	≤24 hour
Transrectal prostate biopsy	Intestine††	All	- Fluoroquinolone	- Aminoglycoside + Metronidazole or Clindamycin**	≤24 hour
		Upper Tract Instrumentation			
Shock-wave lithotripsy	GU tract	All	- Fluoroquinolone - TMP-SMX	- Aminoglycoside ± Ampicillin - 1st/2nd gen. Cephalosporin - Amoxacillin/Clavulanate	≤24 hour
Percutaneous renal surgery	GU tract and skin‡‡	All	- 1st/2nd gen. Cephalosporin - Aminoglycoside + Metronidazole or Clindamycin	- Ampicillin/Sulbactam - Fluoroquinolone	≤24 hour
Ureteroscopy	GU Tract	All	- Fluoroquinolone - TMP-SMX	- Aminoglycoside ± Ampicillin - 1st/2nd gen. Cephalosporin - Amoxacillin/Clavulanate	≤24 hour

SUMMARY

SSIs and UTIs are major sources of postoperative morbidity. Antimicrobial prophylaxis is an important preventative measure and is an easily modifiable component of a program to reduce postoperative infections. The decision to use antimicrobial prophylaxis in urological surgery and the selection of agent and dosing can start with guidelines such as the ones presented in this document. The appropriate use of antimicrobial prophylaxis in an individual patient, however, requires consideration of not only these guidelines but also a comprehensive evaluation of the patient's specific circumstances.

Wolf JS et al. J Urol. 2008 (179) 1379-90

Pre-Op Urine Cultures: Don't tell the whole story

- 328 consecutive patients treated 84% URS / 18% PCNL
- 11/328 (3%) developed sepsis
- **1/11 (9%) correlation of pre-op urine culture with sepsis pathogen.**
- 7/11 (64%) correlation of stone culture with sepsis pathogen
- Positive preoperative urine cultures were mostly gram-negative (65%)
- Most pathogens causing sepsis were gram-positive or fungus (80%)

Table 4 Pathogens grown from preoperative urine culture, intraoperative stone culture, and readmission urine culture

	Preoperative urine culture ($N = 23$)	Stone culture ($N = 96$)	Sepsis pathogen ($N = 10$)
Staphylococcus (unspeciated)	2	21	2
S. aureus	3	5	1
Streptococcus	0	3	1
Enterococcus	2	19	2
Corynebacterium	0	1	0
Propionibacterium	0	3	0
Micrococcus	0	1	0
Gram positive cocci	0	7	0
Gram positive coccobacilli	0	1	0
Gram variable rods	0	1	0
Gardnerella	0	1	0
Pseudomonas	1	2	0
E. coli	9	7	1
Lactobacillus	0	2	0
Proteus	1	3	0
Klebsiella	0	2	1
Stenotrophomonas	2	0	0
Enterobacter	2	1	0
Morganella	0	1	0
Candida	0	14	2
Mixed	2	1	0

Eswara et al. Urolithiasis 2013 (41) 411-14

Unplanned Readmissions after URS Laser Lithotripsy

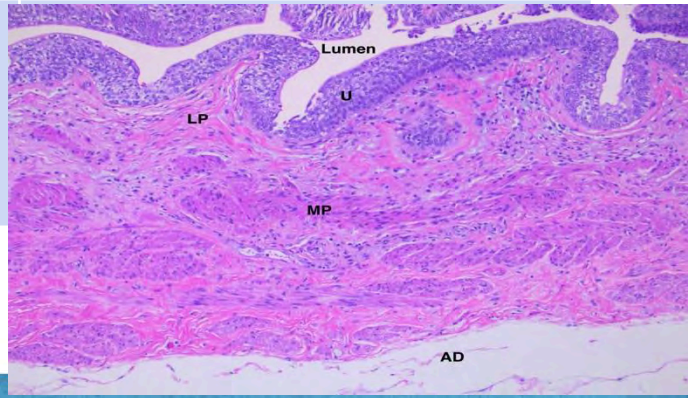
- Retrospective review of 550 consecutive URS, all cultured
- 19/550 (3.4%) returned with infection
- Infected patients more likely to
  - Have stent preoperatively
  - OR times greater than 120 mins
  - Have followed AUA Best Practice Guidelines (Cipro or Culture specific)
- 42% of unplanned return (UR) had negative preop culture
- **73% had different or new organism on re-presentation**
- 47% had organism resistant to preop antibiotic
- 84% of those infected had previously placed stent
- **13/19 (68%) were infected with gram-positive (12) or fungus(1)**

- **Consider Empiric Gram positive coverage for pre-stented patients!!**

Moses et al. J Urol 2016 (195) 931-936

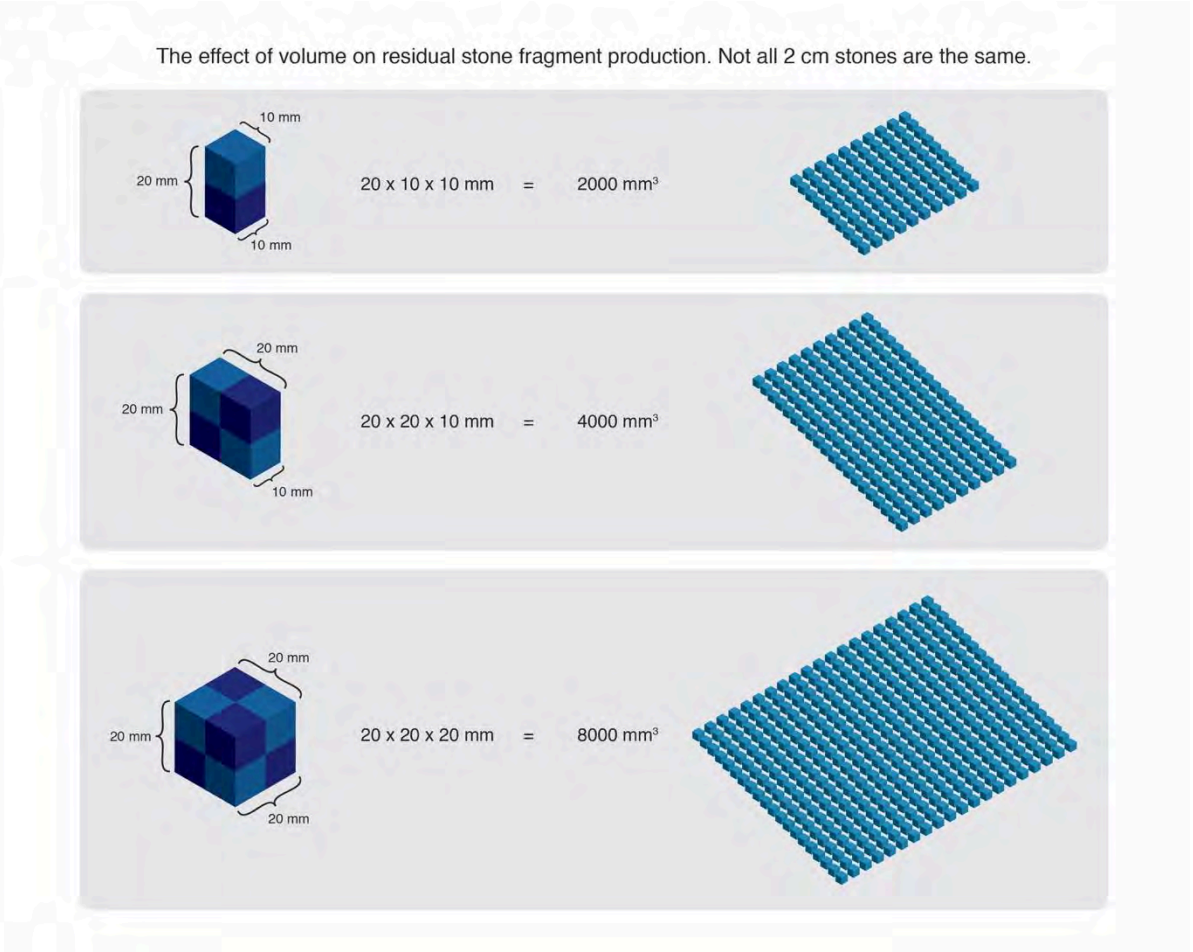
Practical Classification of Complications: Chronological Order / Severity

	MAJOR	MINOR
INTRAOPERATIVE	• Avulsion • Intussusception	• Abrasion • False Passage • Perforation • Extravasation • Bleeding • Difficult Access
POSTOPERATIVE (EARLY)	• Sepsis • **Steinstrasse**	• Ureteral Obstruction • Reflux
POSTOPERATIVE (LATE)	• Stricture	



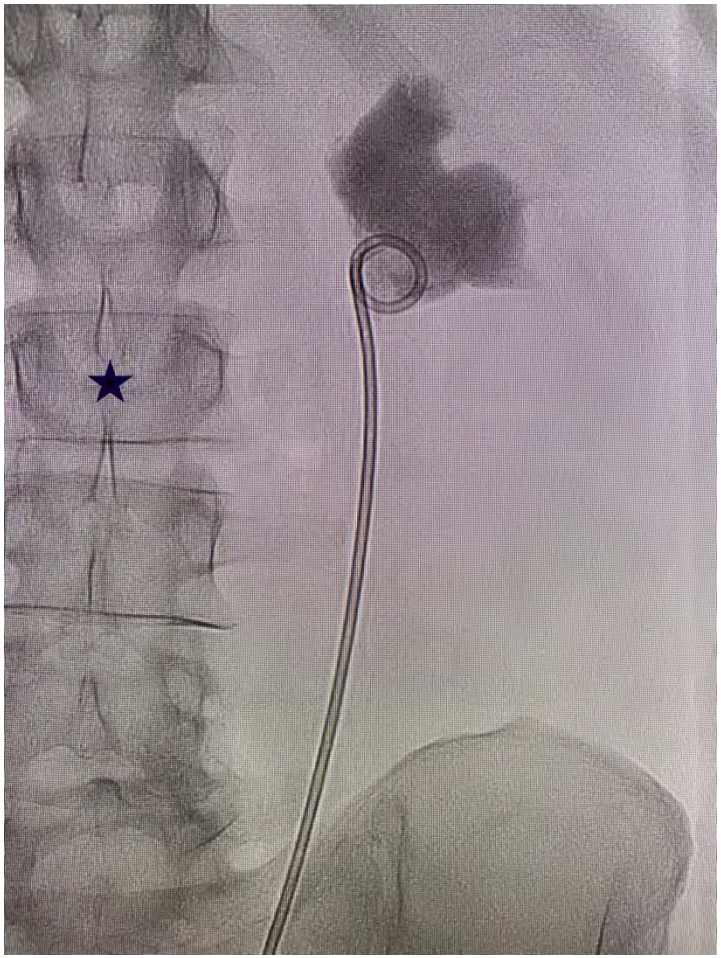
Johnson and Pearle. Urol Clin N Am 2004 (31) 157-171

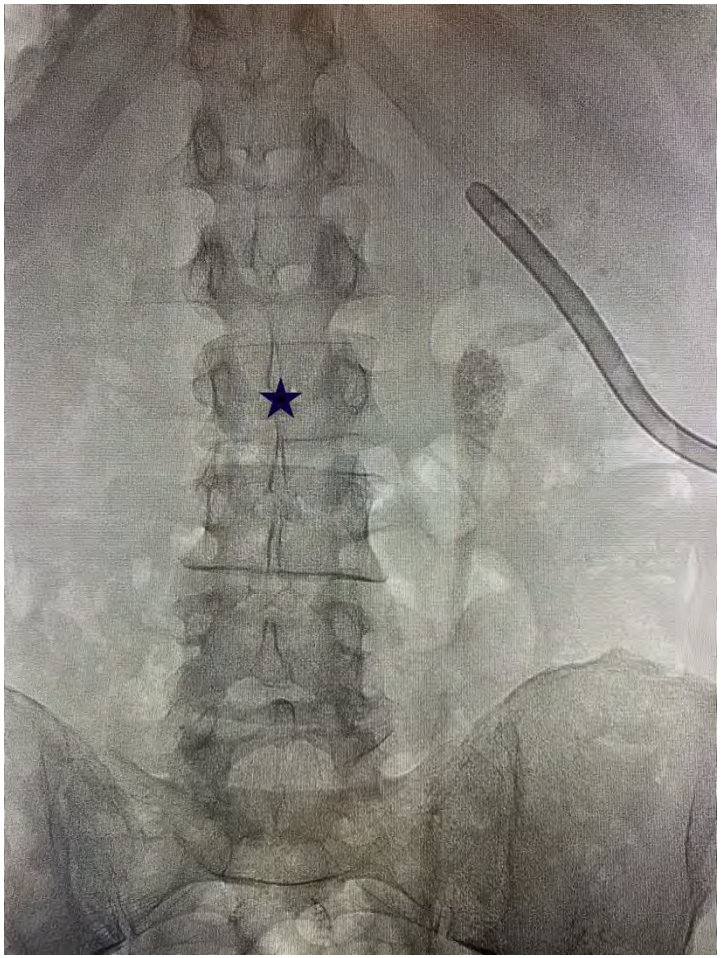
Reasonable Patient Selection: Must Consider STONE VOLUME



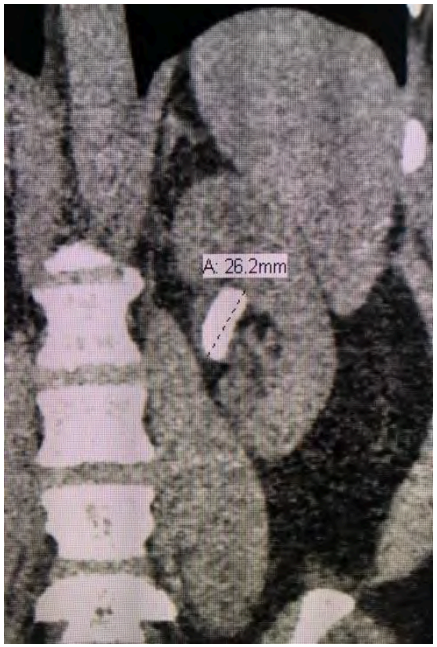
Hubosky et al. Advanced Ureteroscopy. Cham, Springer Nature; 2022

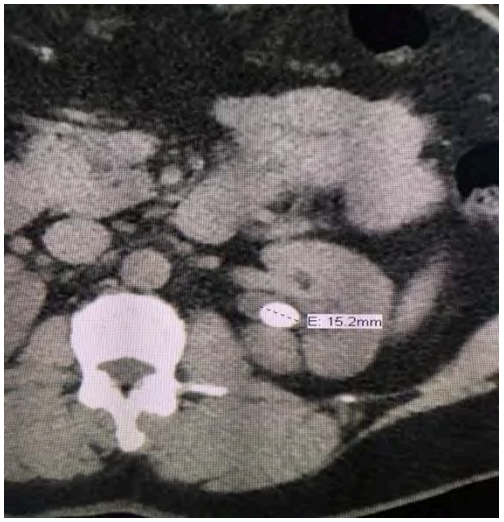
NOT Reasonable Patient Selection





“Favorable” 2 cm stone



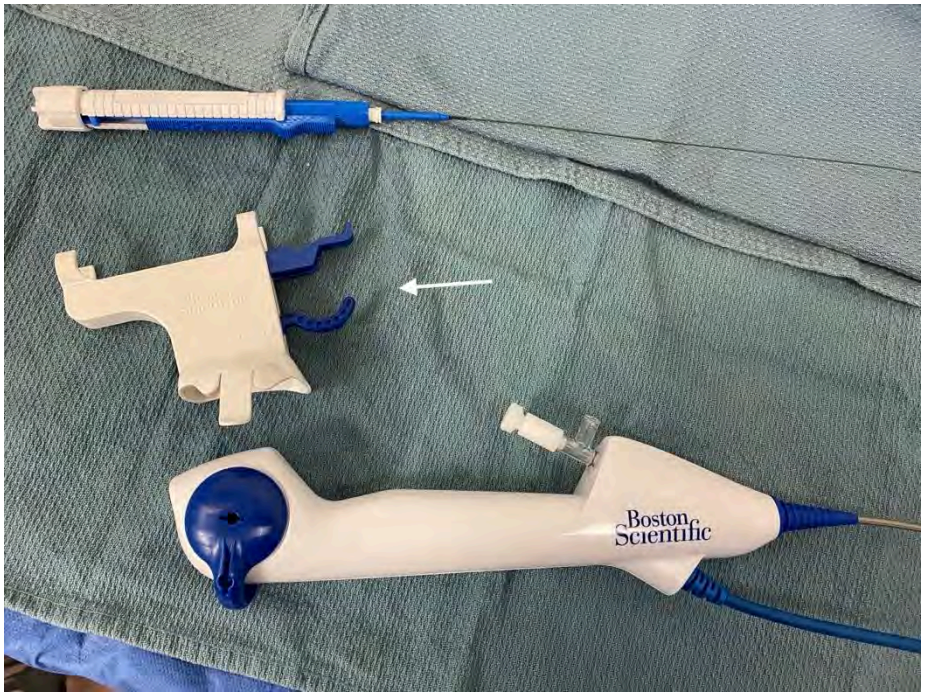


Favorable 2 cm stone

Benefits of Ureteral Access Sheaths

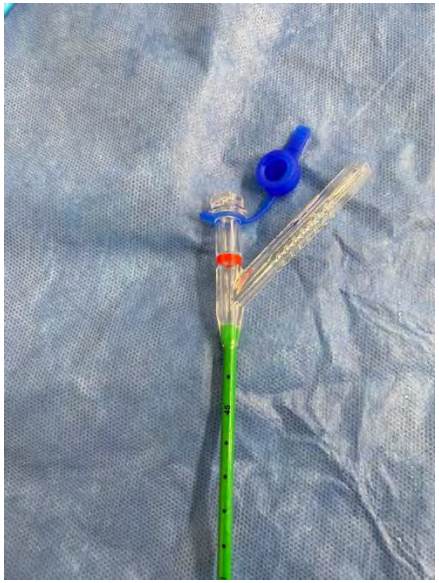
- Better Irrigation
- Decreased Intrarenal Pressure
- Ease of Multiple Passes to Collecting System
- Less damage to ureteroscope

Retrieval Deployment Device: Empower
- For large stone volumes without an assistant



SUCTION DEVICES IN URETEROSCOPY

FLEXIBLE & NAVIGABLE SHEATHS (FANS)



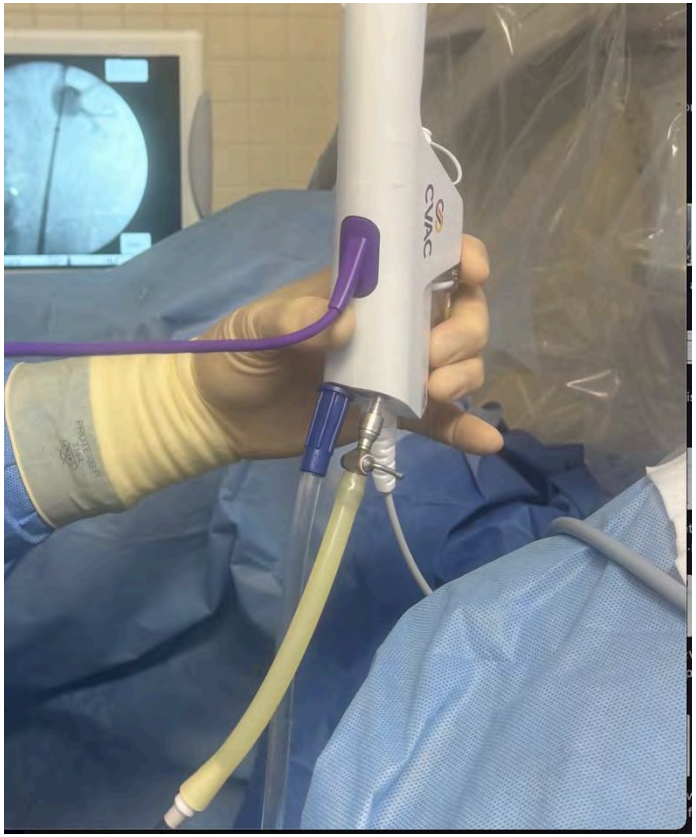
STEERABLE URETEROSCOPIC RENAL EVACUATION (SURE)

DIRECT IN SCOPE SUCTION (DISS)

WHAT'S GOT YOU TETHERED ?

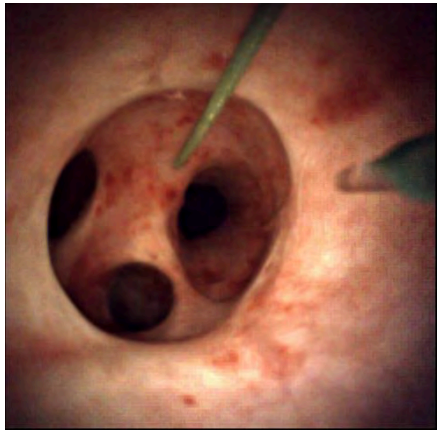
FANS

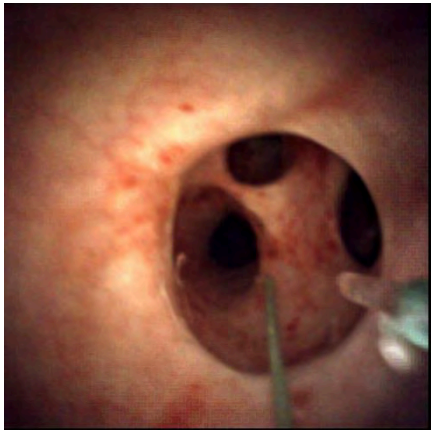
SURE / DISS

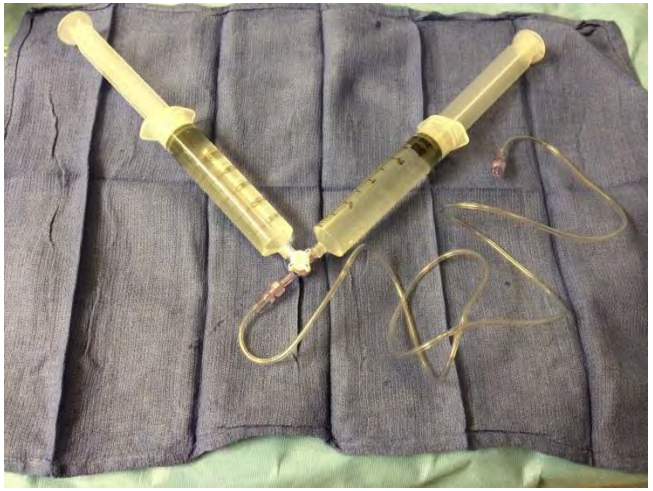


FLEXIBLE AND NAVIGABLE SHEATHS

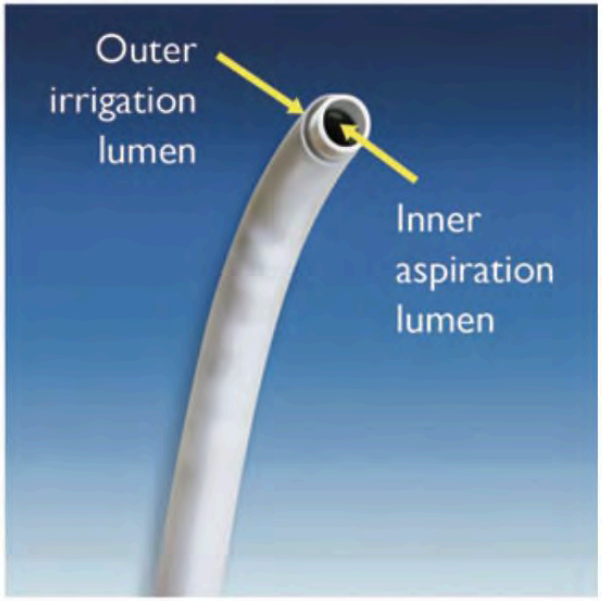
- Utilize “Preferred Ureteroscope”
  - Allows for more precise maneuvering
    - Less Tethers = **EASIER ROTATION**
    - Put the laser fiber on the stone
    - More precise basketing, if needed it acts like a usual sheath
  - Easier to switch irrigants
    - Pressure bags or Syringes
- Requires thoughtful planning
  - Not one size fits all
    - Default to longer sheath
  - Pick smallest diameter ureteroscope with largest ID Sheath
- Generally Less Expensive







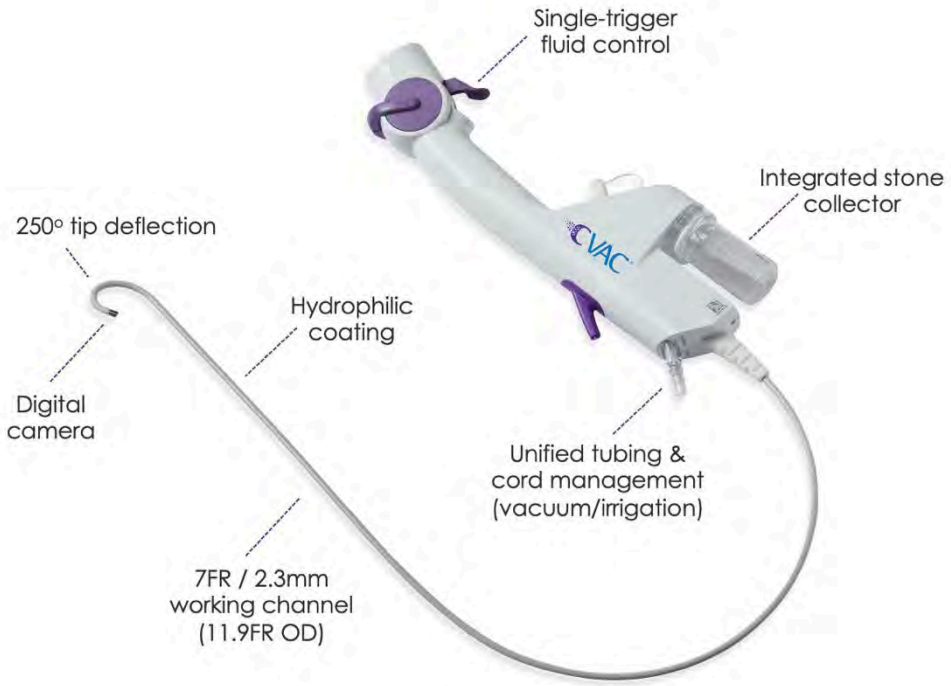
Steerable Vacuum Stone Extraction (following laser lithotripsy)



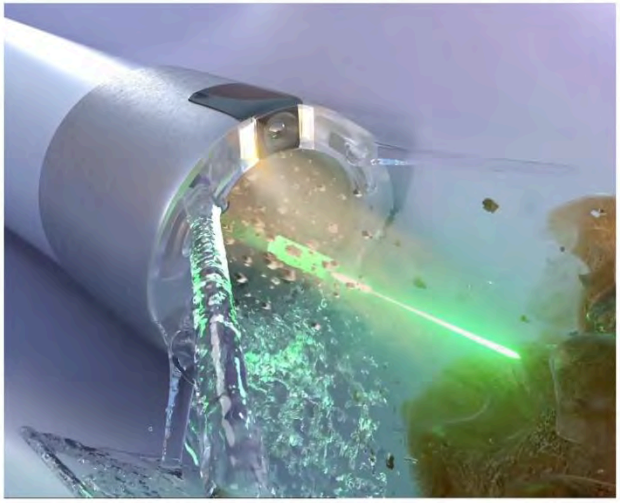
Steering Control Dial Position	Catheter Tip Deflection
	
	
	

Sur RL et al. 2022 J Endourol. (9) 1161-1167

CVAC 2.0



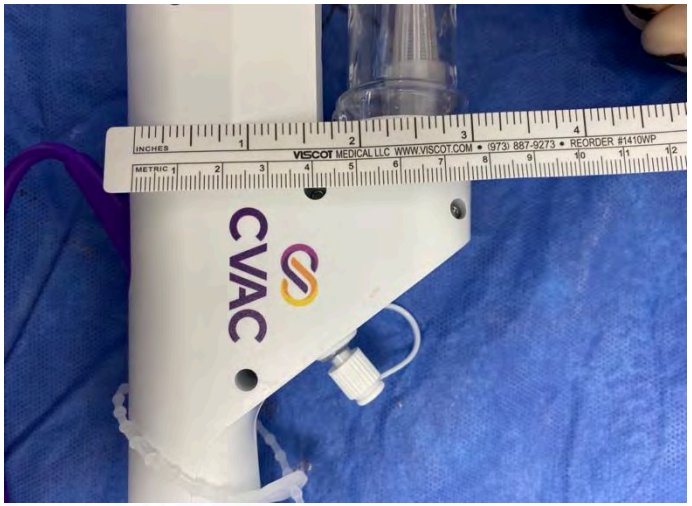
Passive Aspiration during Lithotripsy

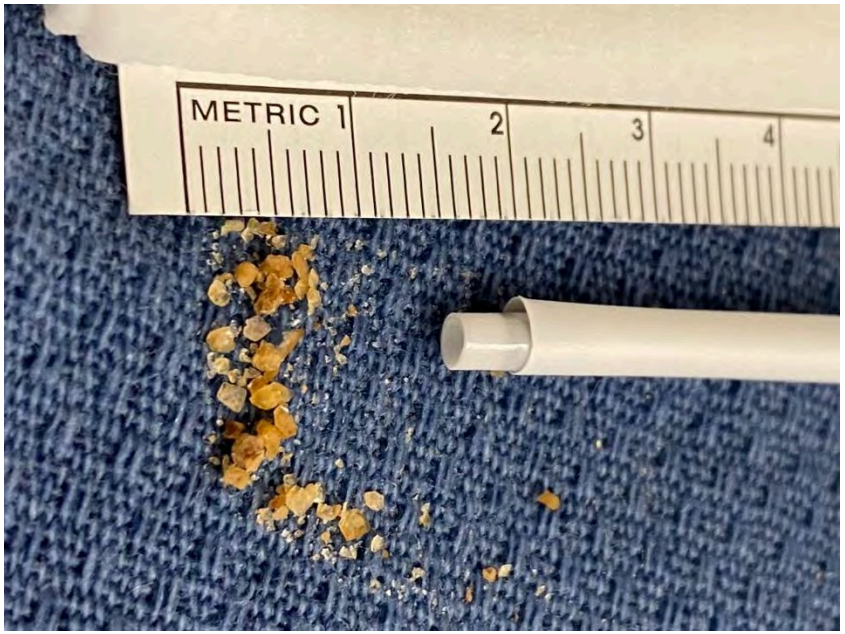


Active Aspiration after Lithotripsy

STEERABLE URETEROSCOPIC RENAL EVACUATION

- One size fits all
- Only need to move one unit
- Large 7 Fr suction channel
- Lots of trouble shooting
- Many tethers makes it difficult to achieve precise maneuvering
- Expensive





Steerable Ureteroscopic Renal Evacuation (SURE) for Large Renal Stones: A Multi-Institutional Center Study

- 43 patients treated,
- 24 had postoperative CT
- Mean stone burden: 29.3 mm
- Mean stone volume: 3092 mm^3
- 2nd stage expected: 21
- 2nd stage actual: 2

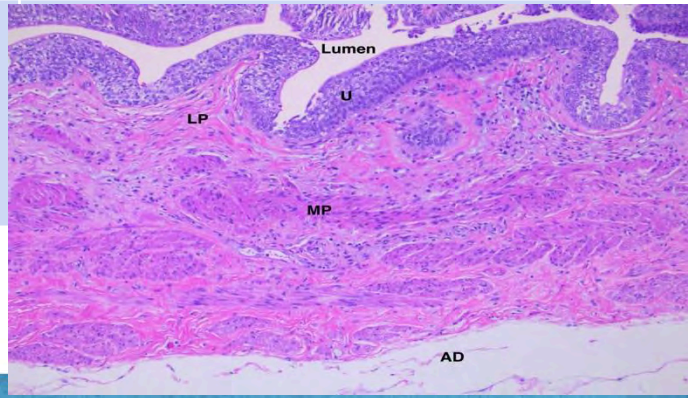
TABLE 2. STONE CLEARANCE THRESHOLD ANALYSIS AMONG PATIENTS WITH FOLLOW-UP COMPUTED TOMOGRAPHY IMAGING ($n=24$)

Stone clearance threshold	*Patients, n (%)*	*Mean volume of stone removed, $mm^3 \pm SD$*
100% (stone free)	8 (33.3)	2266.8 ± 1893.8
>90%	22 (91.7)	2588.5 ± 1930.0
>80%	23 (95.8)	2593.1 ± 1885.8
>60%	24 (100.0)	2513.9 ± 1884.7

Stern et al. J Endourology 2023 (37) 1179-83

Practical Classification of Complications: Chronological Order / Severity

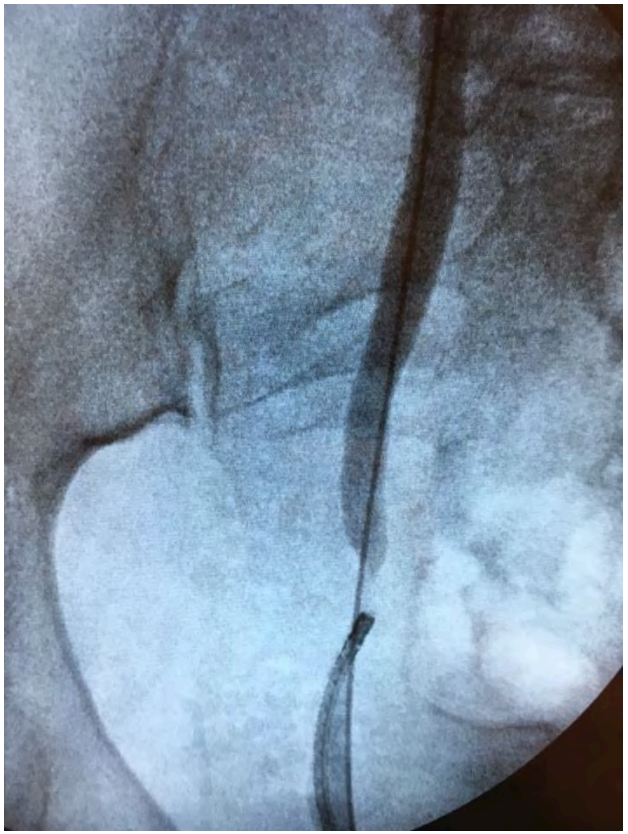
	MAJOR	MINOR
INTRAOPERATIVE	• Avulsion • Intussusception	• Abrasion • False Passage • Perforation • Extravasation • Bleeding • Difficult Access
POSTOPERATIVE (EARLY)	• Sepsis • Steinstrasse	• Ureteral Obstruction • Reflux
POSTOPERATIVE (LATE)	• **Stricture**	



Johnson and Pearle. Urol Clin N Am 2004 (31) 157-171

Ureteral Strictures after Ureteroscopy

- **Rate**
  - Stone disease
    - 0.1%
    - Post-op US
  - Tumor treatment
    - 8 – 17%
    - Multiple procedures
- **Risks**
  - Ischemia
    - Chronic/impacted
    - Hx XRT
    - Hx surgery



Johnson & Pearle 2004 Urol Clin North Am 31: 151-71
Roberts et al. 1998 J Urol 159: 723-6

Treatment Options

- Balloon Dilation
  - Lower patency rates vs. endoureterotomy
  - Best results with short non-ischemic stricture
- Endoureterotomy
  - Retrograde vs. Antegrade vs. Combined
  - Lasers, Electrocautery, Cold Knife
- Formal Reconstruction
  - Robotic/Laparoscopic or Open

Success of Endoureterotomy

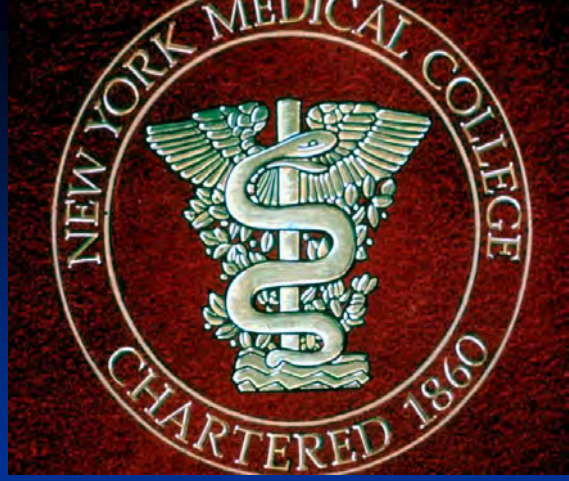
- Variable rates of success: **55% to 85%**
- Series comparison difficult due to variation
  - Cutting modalities
  - Follow-up
  - Stricture etiology
  - Location
  - Length
  - Size/Duration of Stent

Hafez et al 2003 J Enourol 2003 (17) 453

Factors resulting in poor outcome: Endoureterotomy

- Location (mid ureter – lowest success)
- Etiology (ischemic /compression)
- Length (>2cm)
- Renal function (<25%, cortical thinning)

Hafez et al J Endourol 2003 (17) 453



Diagnostic Ureteroscopy and Comprehensive Management of Upper Urinary Tract Carcinoma

Michael Grasso, M.D.

Professor, Department of Urology
New York Medical College
Valhalla, New York

Evolving Management Of Upper Urinary Tract Urothelial Carcinoma

- Diagnosis = Diagnostic Ureteroscopy
- Ureteroscopic Therapies
- Topical Adjuvant Therapies
- Laparoscopic/Robotic Nephroureterectomy

- Outcomes
- Systemic Therapies
  - Adjuvant and Neo-Adjuvant

Endoscopic Mapping Of Upper Urinary Tract

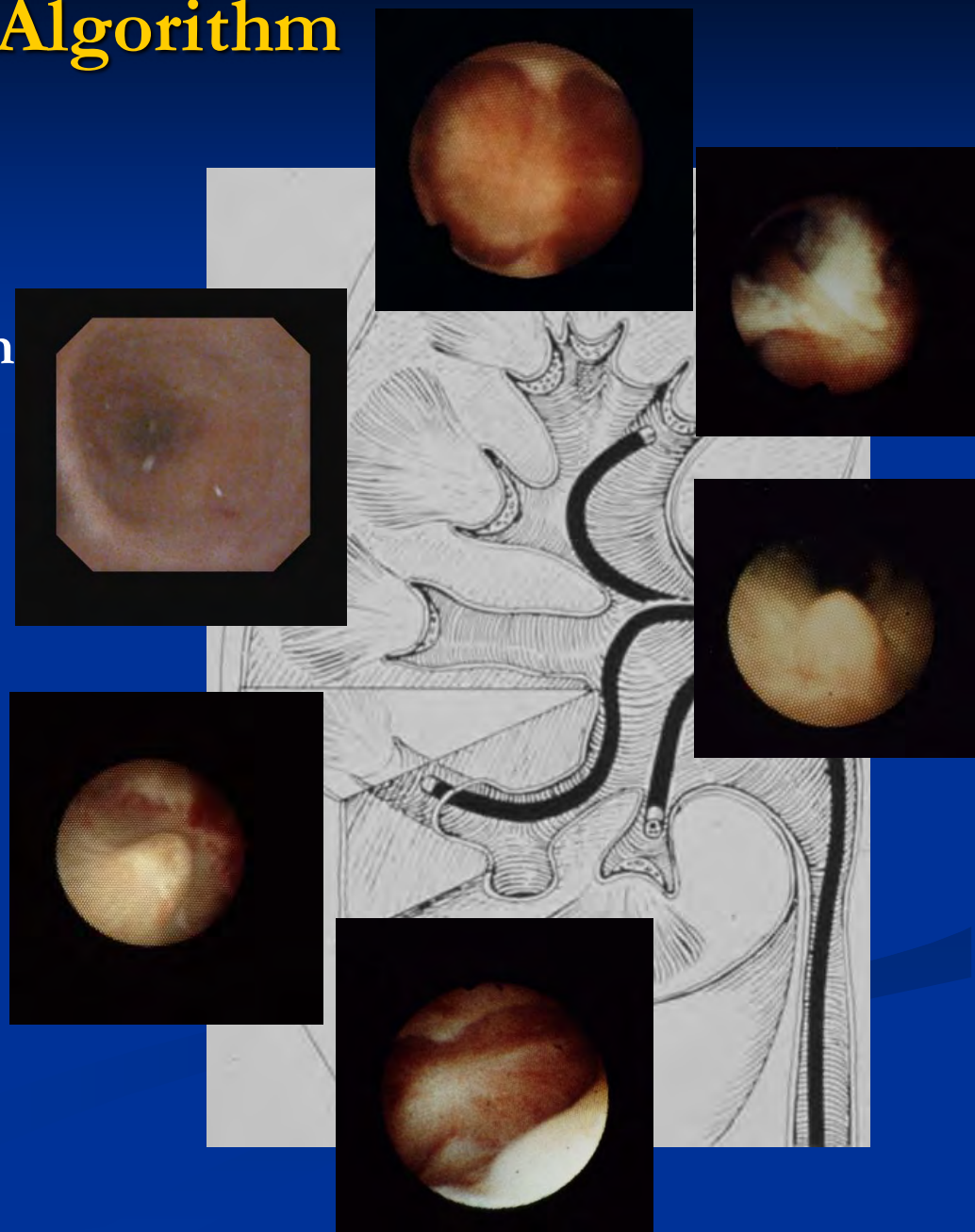
- No Touch Ureteroscopy

  (No Guidewire or Sheath)

  - Minimize Guide Wire Trauma
  - No Dilation For Access
  - Complimentary Endoscopes
    - Small Diameter Semirigid
    - Actively Deflectable Flexible

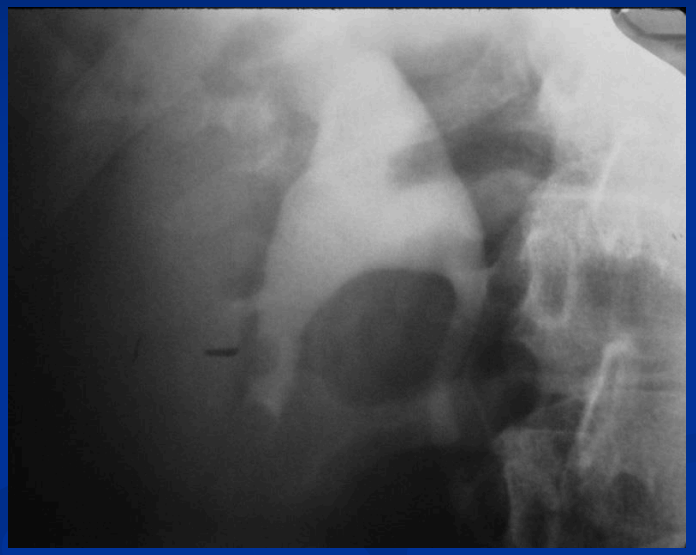
Filling Defects In the Upper Urinary Tract: Diagnostic Algorithm

- Bladder Cytology
  - Barbotage
- Retrograde Ureteropyelogram
  - Real Time Fluoroscopy
  - Modest Volume Of Contrast
- Endoscopic Mapping
  - Complimentary Endoscopes
  - No Touch Technique
- Tissue Sampling
  - Intrarenal Barbotage
  - Sample Suspicious Lesions



Upper Urinary Tract Urothelial Lesions

- Transitional Cell Carcinoma
- Inverted Papilloma
- Fibroepithelial Polyp
- Metastatic Lesions
- Invasive Renal Cell Carcinoma
- Inflammatory Lesions
- Pseudo-tumors



Solid Lesions
Papillary/Polypoid Lesions
Flat Lesions

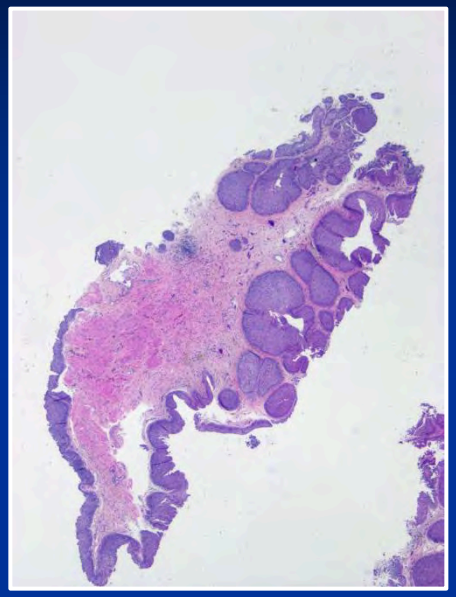
Upper Urinary Tract Urothelial Lesions

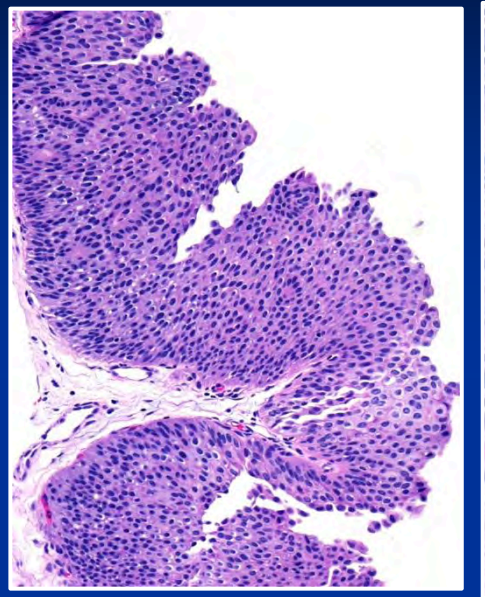
- Invasive Renal Cell Carcinoma

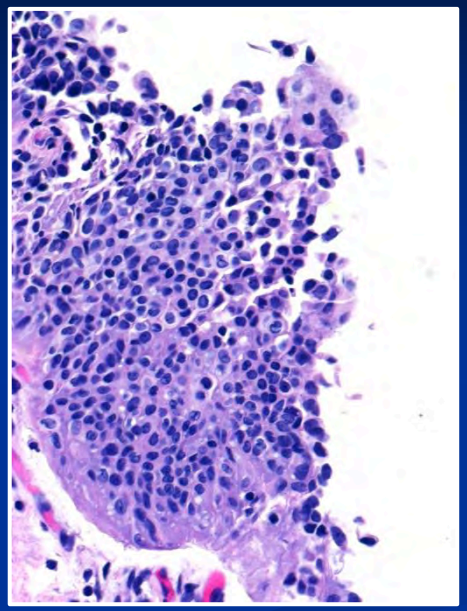
Multiple urothelial recurrences of renal cell carcinoma after initial diagnostic ureteroscopy

Grasso M, McCue P, Bagley, DH: J Urol 147:1358-1360, 1992.

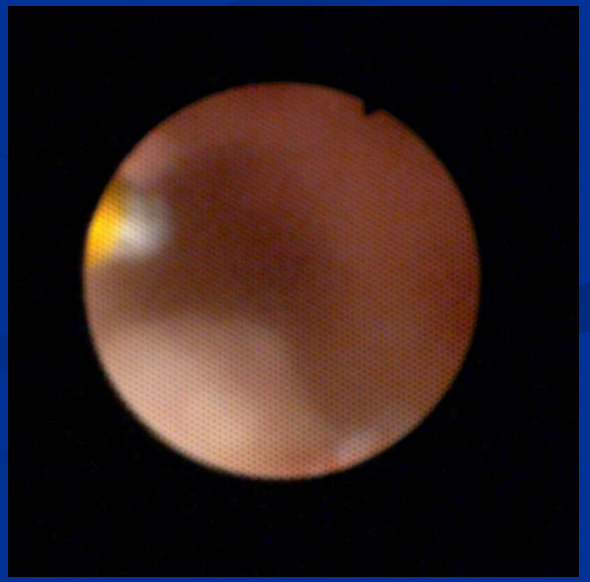
Inverted Papilloma





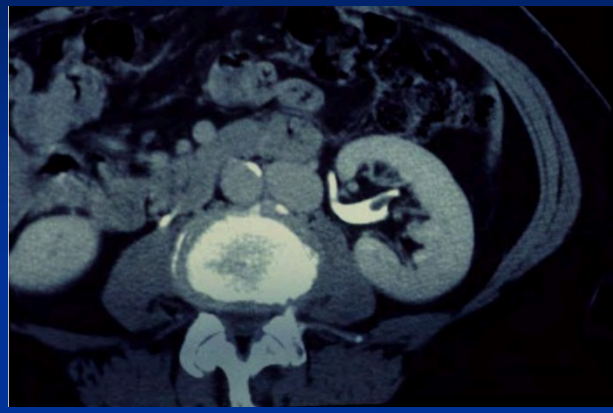


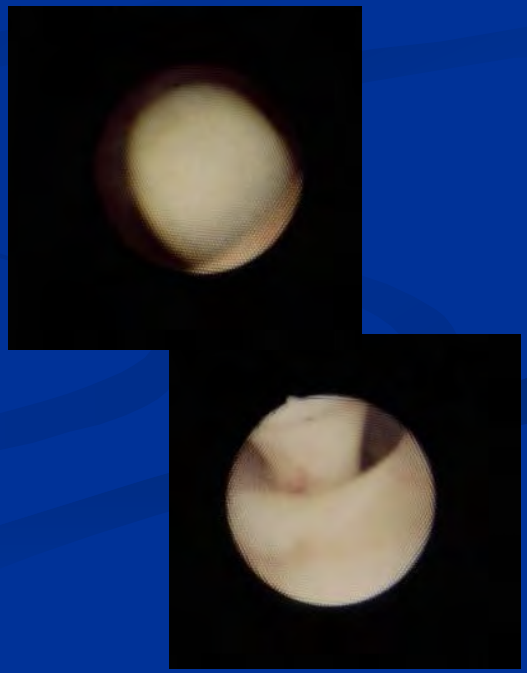
- Low Grade Lesion
- Recurrence Similar To TCCa
- Endoscopic Resection Technically Feasible



Fibroepithelial Polyp

- Rare Benign Inflammatory Lesions
  - Can Cause Hydronephrosis/ Obstruction
  - Large Lesions Can Fill Segments Of Upper Tract
  - Attached By Discrete Stalks
- Endoscopic Resection Technically Feasible

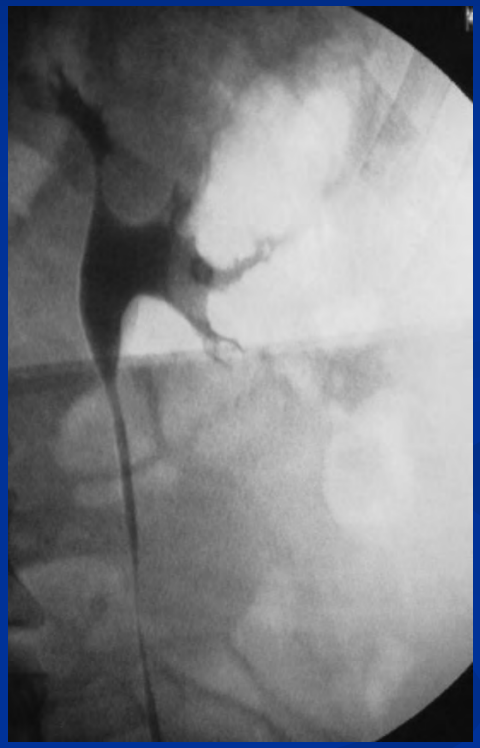


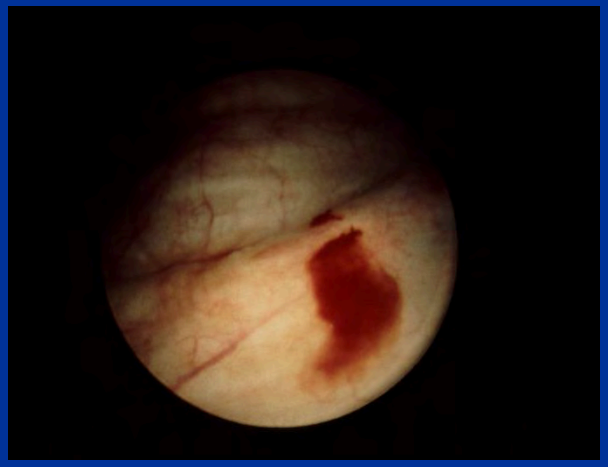


Benign Essential Hematuria: Ureteroscopic Diagnosis & Treatment

Bagley 1990, Kumon 1990

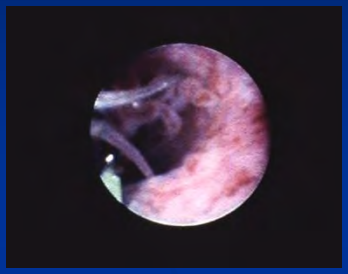
- Gross Hematuria
- Localized To Upper Tract
- Normal Radiographic Imaging
- Non-diagnostic Cytology

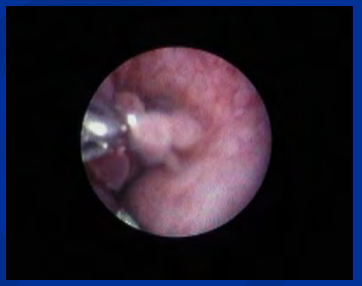




Upper Urinary Tract Urothelial Lesions: Ureteroscopic Biopsy Techniques

- Papillary Lesion
  - Flat Wire Basket
- Flat or Solid Lesions
  - Cup Forceps
  - Gill Brush
- Barbotage for Cytology
- Tissue Handling
  - Submerge Immediately
    - Hanke's Solution or Saline
  - Combine Small Specimens
    - Conical Tube
    - Hand Deliver To Cytopathologist
  - Microstrain, Cell Block





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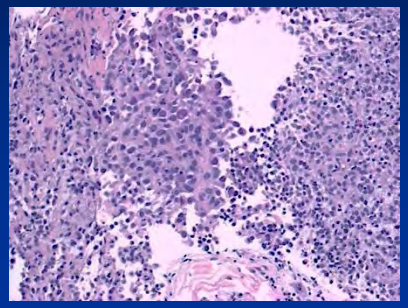
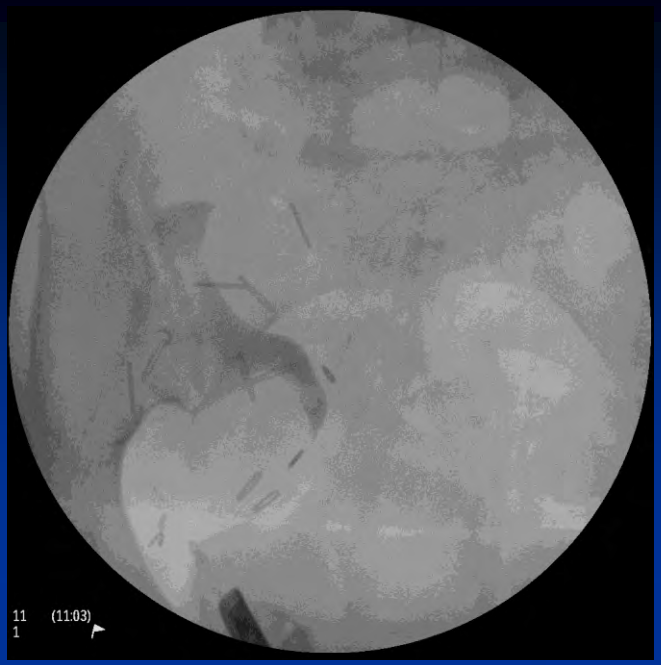
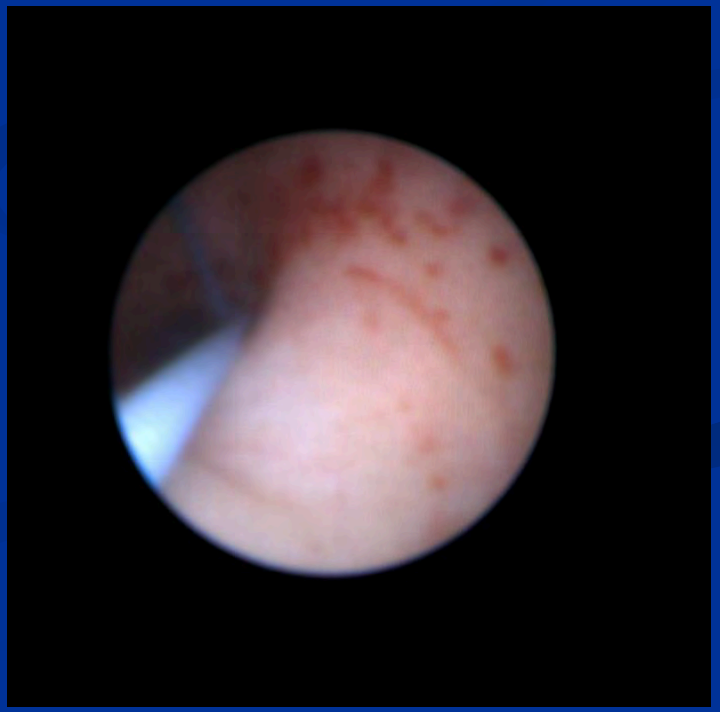
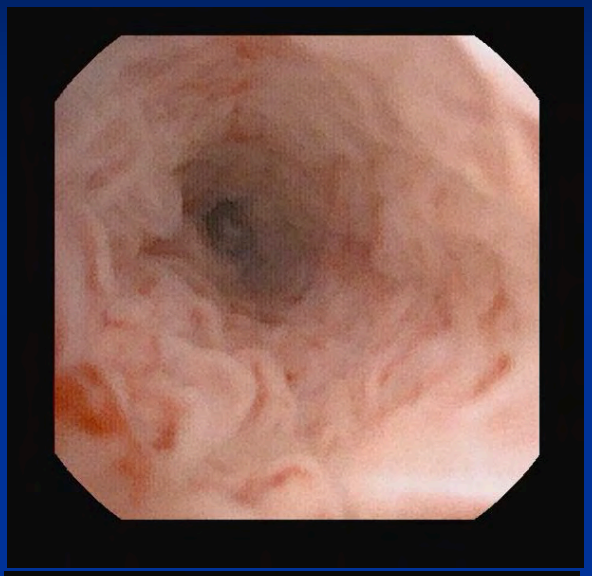
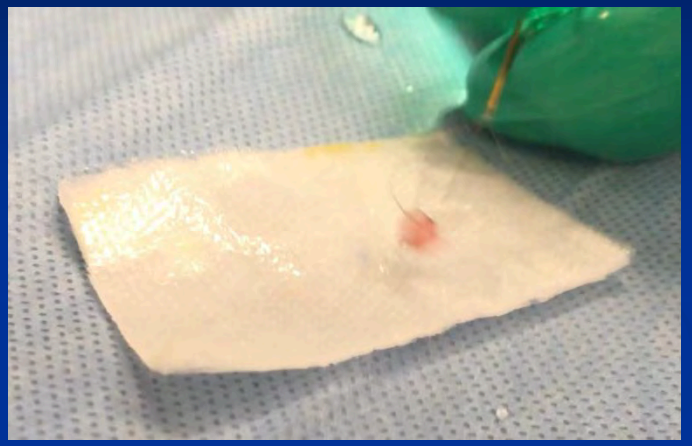






The Mixed Grade Conundrum



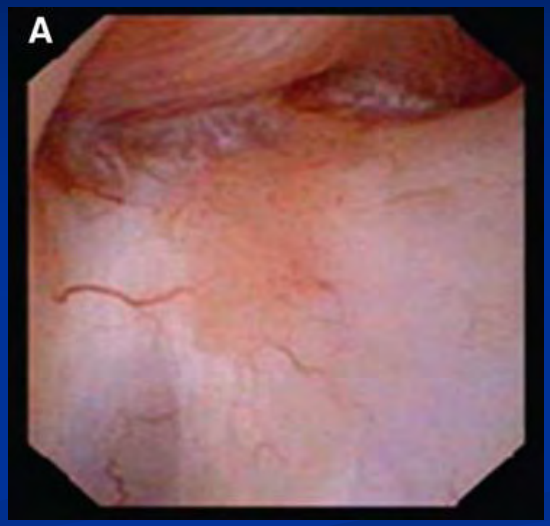


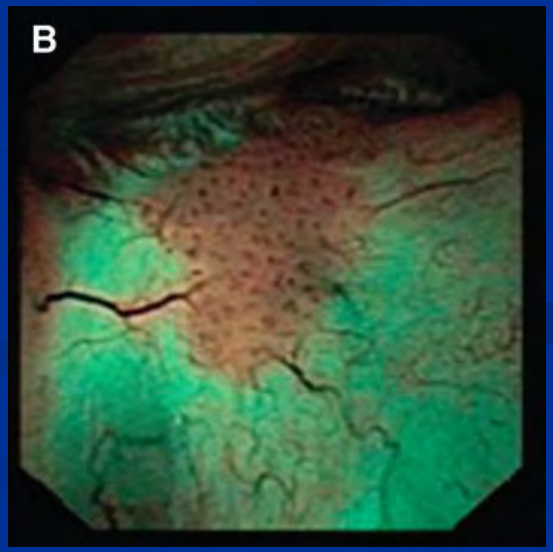
Narrow-band Imaging Digital Flexible Ureteroscopy in Detection of Upper Urinary Tract Transitional-Cell Carcinoma: Initial Experience

Olivier Traxer, M.D.,1 Bogdan Geavlete, M.D.,1 S. Gil diez de Medina, M.D.

J Endourol. Vol. 25, Number 1, January 2011

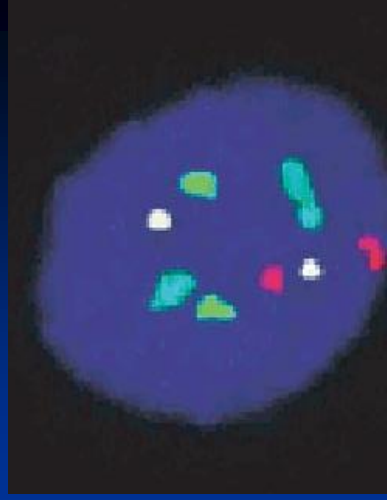
- Comparison of Digital WL and NBI
- Two Groups
  - Positive Control 14pts
    - Known Cases Of UUT-TCCa
    - Positive Control
  - Initial Diagnostic 13pts
- Increases Sensitivity 14%
- Increased Tumor Volume 9%





Is There a Role for FISH in the Management and Surveillance of Patients with Upper Tract TCCa?

Andy Chen and Michael Grasso. J Endourol 22, 1371, June 2008



- 94 FISH specimens taken from patients monitored for upper-tract TCC.
- 43 patients had one or more FISH assays performed as part of the workup and management of upper-tract TCC
- Sensitivity of FISH 52%, compared with 26% for urinary cytology.
- FISH and cytology
  - Higher sensitivity for high-grade (79% and 50%)
  - Poor for low-grade tumors (41% and 12%)
- Selective upper-tract washings were more sensitive and specific for upper-tract TCC than bladder washings or voided specimens.
- Conclusions: overall Fish similar to cytology in this high-risk patient population.

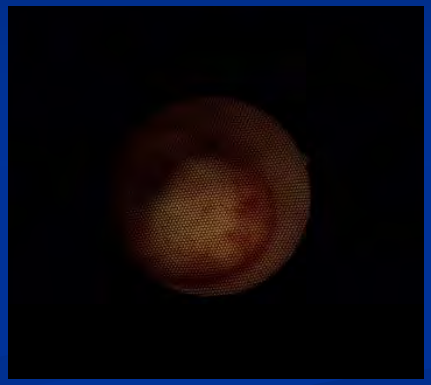
Impact Of Diagnostic Ureteroscopy On Long Term Survival In Patients With Upper Urinary Tract TCCa

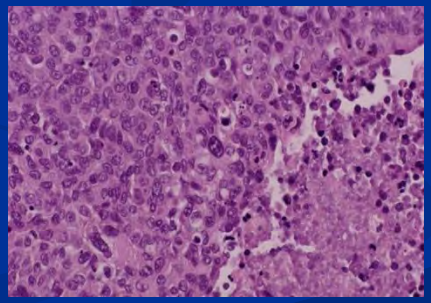
Hendin, Streem, Levin, Klein, Novick J Urol 161:783, 1999

- Two Groups With Upper Tract TCCa n=96
- All Ultimately Underwent Open Resection
- Diagnostic Ureteroscopy vs Control Group

Grade		
1 + 2	71%	52%
3 + cis	29%	48%
Stage		
Tcis	8%	4%
Ta	50%	46%
T1	19%	15%
T2	2%	4%
T3+4	19%	29%
Metastasis	12.5%	18.8%
Deaths	10.5%	10.5%

- Metastasis Free Five Year Survival Identical





WHY ENDOSCOPIC MANAGEMENT? CLASSIFICATION OF INDICATION

Five-year survival rates of patients with end-stage renal disease

Age Group (years)	5-Year Survival (%)
0–14	87
15–24	84
25–34	69
35–44	61
45–54	47
55–64	32
65–74	19
75–84	10

- **ABSOLUTE**
  - Solitary kidney
  - CRI
  - Unable to tolerate surgery
- **RELATIVE**
  - Bilateral disease
  - Severe comorbidities
- **ELECTIVE**
  - No contraindication for elective extirpation
- **PALLIATIVE**
  - Established metastatic disease
  - Recurrent hematuria
  - Unable to tolerate extirpation

Soderdahl et al, Urol Oncol. 2005 (23) 114

Energy Sources: Laser

- Nd:YAG
- Holmium:YAG
- Thulium:YAG
- 1470 nm
- Thulium Fiber Laser

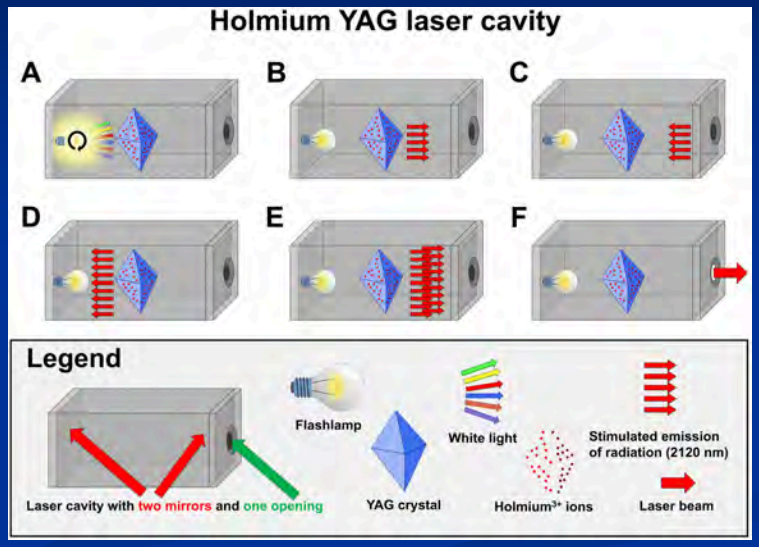


Table 2. Major emission wavelengths

Chemical element	Neodymium	Holmium	Erbium	Thulium	Ytterbium
Emission wavelength	1064 nm	2100 nm	1540 nm	1940 nm	1070 nm

Ureteroscopic Treatment Of Upper Urinary Tract TCCa

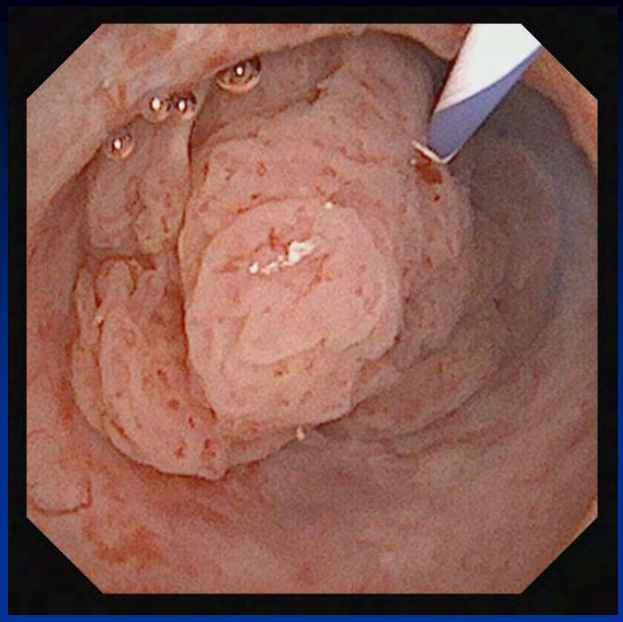
- Post Procedure Surveillance
  - Staged Therapy Until Clear
  - Serial Upper Tract Endoscopy
    - Initially every 3 months
    - Longer intervals with negative parameters
    - Minimum annual ureteroscopy
  - Metastatic Evaluation
    - Semi-annual initially
    - Annual with acceptable evaluations
  - Lifelong Endoscopic Follow-up

Ureteroscopic and Extirpative Treatment Of Upper Urinary Tract Urothelial Carcinoma: 15 yr Comprehensive Review Of 160 Consecutive Patients

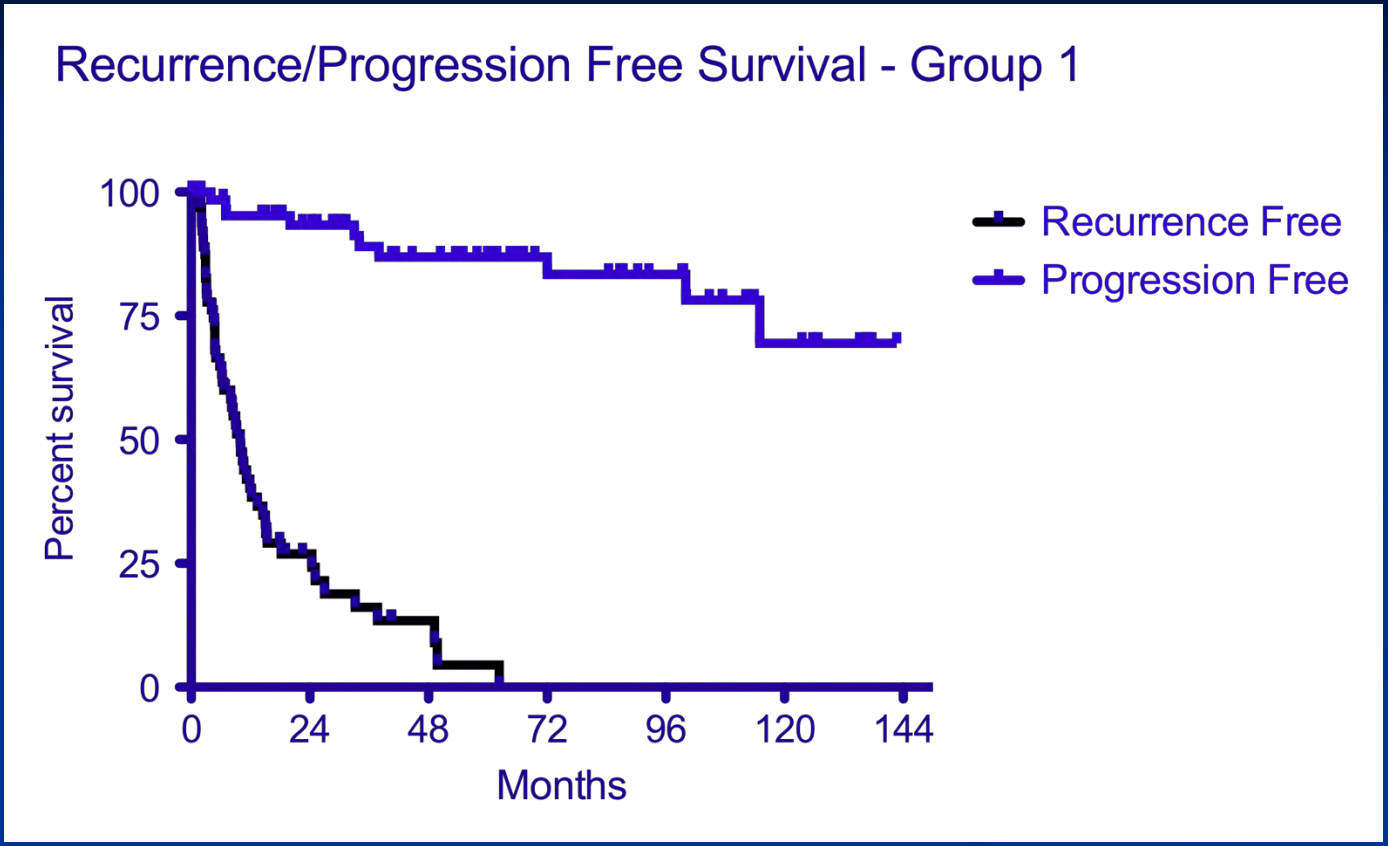
Grasso M, Fishman A, Cohen J, Alexander B. BJUI 2012

- Single Attending Surgeon
- Fifteen Year Experience
- Prospectively Accrued
- Patients Treated — N = 160
- Bilateral Disease — 17 (11%)
- Solitary Renal Unit — 25 (16%)
- Assigned to three groups
  - **Group 1: Ureteroscopic Therapy** — **66**
    - Low Grade Biopsy, Negative Cytologic Washing
    - Lifelong Ureteroscopic Surveillance
  - **Group 2: Palliative Ureteroscopic Therapy** — **14**
    - High Grade, Positive Cytology
  - **Group 3: Nephroureterectomy** — **93**
    - **Majority Laparoscopic**

Group 1: Ureteroscopic Treatment Of Upper Urinary Tract TCCa

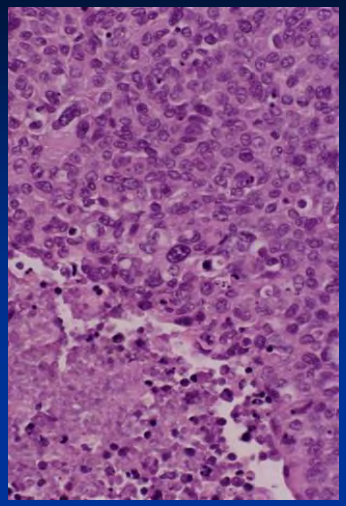


- Low Grade Treated — n=66
  - Mean Age/Median Age — 70/73 years
  - Charleston Co-morbidity Score — 5.5
  - Mean Tumor Burden — 2.3 cm
    - Large Tumor Burden (>3cm) — 18 (27%)
    - Medium (1-3cm) — 32 (48%)
    - Small (<1cm) — 17 (25%)
  - Bilateral Disease — 13 (20%)
  - Solitary Kidneys — 18 (28%)
  - Multifocal — 21 (32%)
  - History Of Bladder Ca — 29 (44%)
  - Concurrent Bladder Ca — 17 (26%)
- Results
  - Completely Cleared In One Sitting — 86%
  - Recurrent Disease — 48 (73%)
    - Bladder Recurrence — 40 (60%)
    - New Bladder Ca — 18/33 (55%)
  - Mean Time To Recurrence — 13 mos. (max 69 mos.)
  - Mean Follow Up — 52 mos. (max 166 mos.)



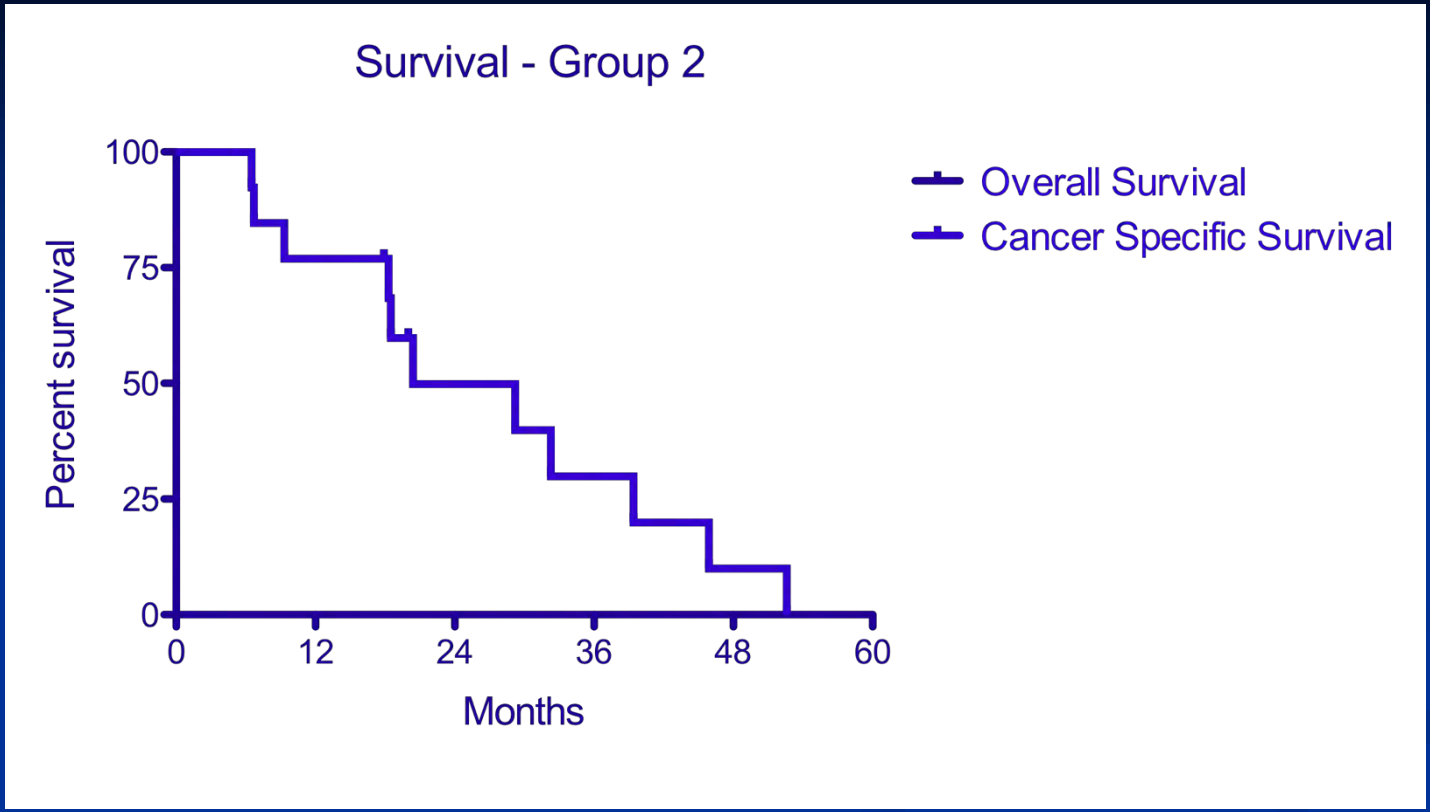
	1 year	3 year	5 year
Recurrence Free Survival	40%	16%	4%
Progression Free Survival	95%	89%	86%

Group 2: URS Treatment of High grade UUT TCCa



- Palliative Therapy Group
- High Grade — 14
  - Prior Tx For UTTCa elsewhere — 4 (29%)
  - Bilateral — 5 (36%)
  - Solitary Kidney — 5 (36%)
  - Hx Prior Bladder TCCa — 9 (64%)
    - Prior Cystectomy — 4
  - Mean Tumor Burden — 3.23 cms
    - Solid, Bulky Tumors
- Results
  - Clearance Of Tumor In One Stage — 69%
  - Pan-urothelial Recurrence
  - Average Survival — 25 months
    - Range — (6.5 to 52.6 months)

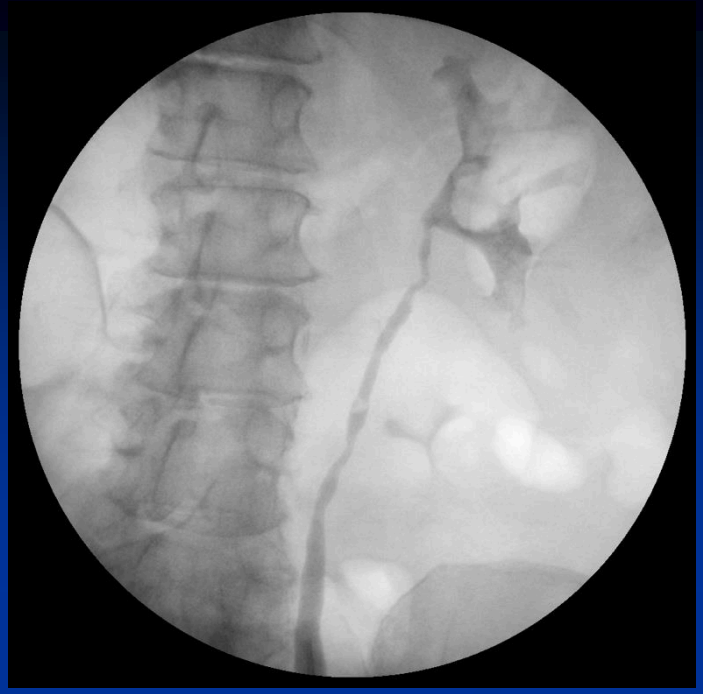
Group 2: URS Treatment Of High Grade UUT TCCa

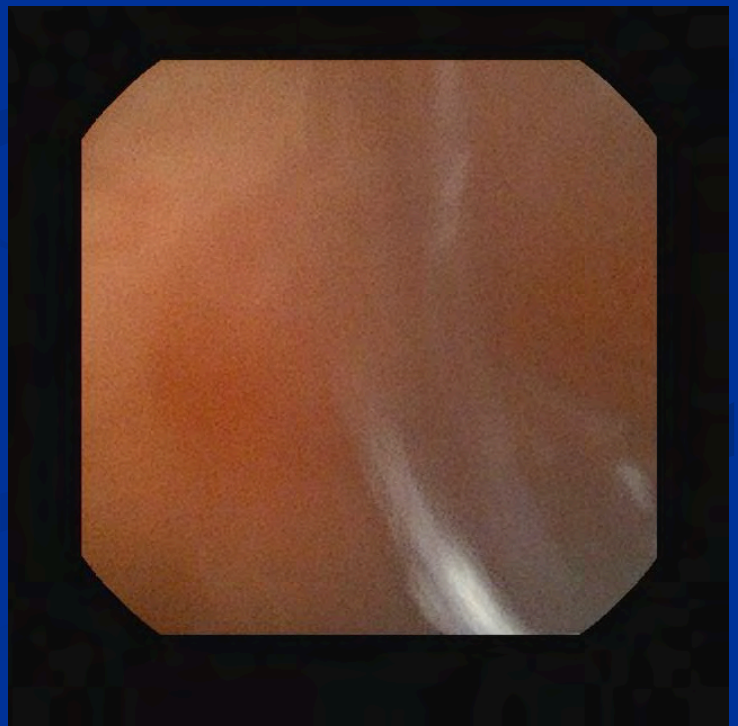


- Palliative Therapy Group
  - Mean Survival — 24 months
  - Median Survival — 21 months
    - Range — 6.5 to 52.6 mos.
  - Stage Progression — 12 (86%)
    - Mean — 19 months
  - Progressed To Renal Failure — 2 (14%)
- Future - Adjuvant PD1 Inhibitors

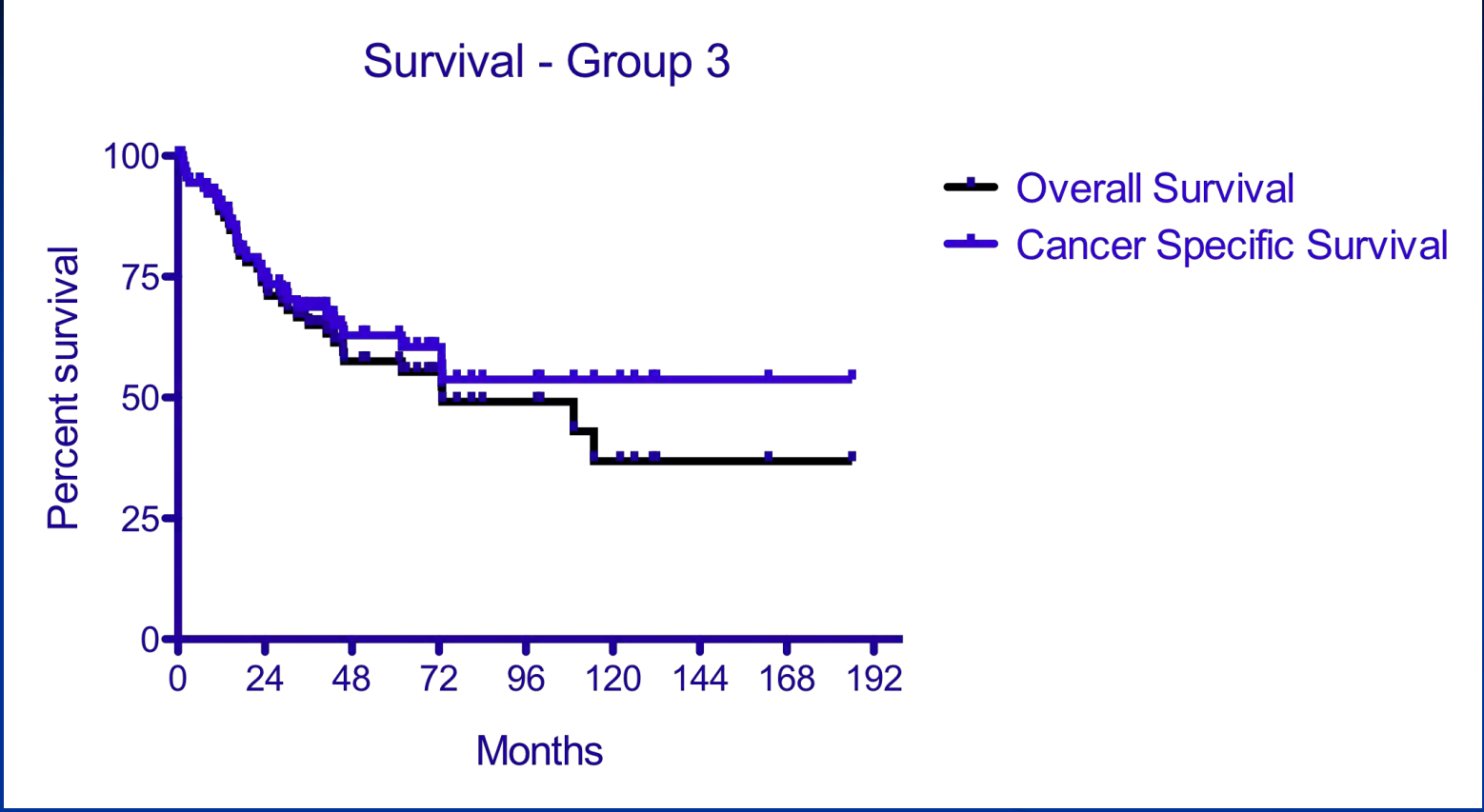
Group 3: Nephrouretectomy

- DISEASE TREATED WITH NEPHROURETERECTOMY N=93
  - INDICATIONS
    - HIGH GRADE / NMAL CONTRALAT 45 47%
    - LARGE TUMOR BURDEN 37 40%
    - POORLY FUNCTIONING KIDNEY 13 11%
    - RENAL HEMORRHAGE 2
  - PATHOLOGY PARAMETERS
    - MEAN TUMOR BURDEN **3.4 CM**
    - HIGH GRADE LESIONS **69 (74%)**
    - STAGE
      - PCIS 3 (3%)
      - PTA 32 (34%)
      - PT1 13 (14%)
      - PT2 13 (14%)
      - PT3 25 (27%)
      - PT4 7 (8%)
    - NODE + **16 (17%)**
    - POSITIVE MARGIN 3 (3%)



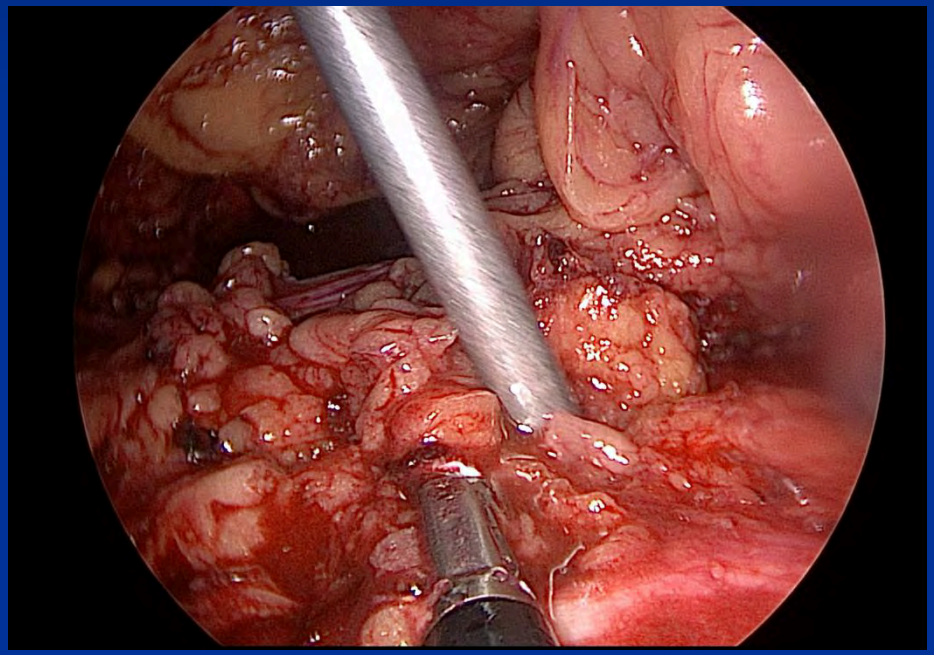


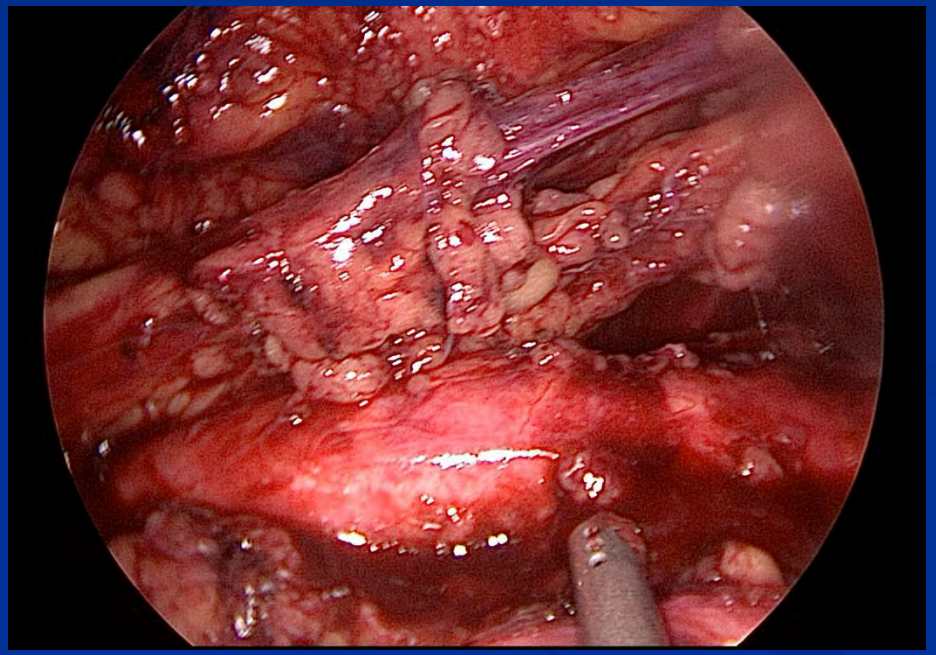
Group 3: Nephroureterectomy

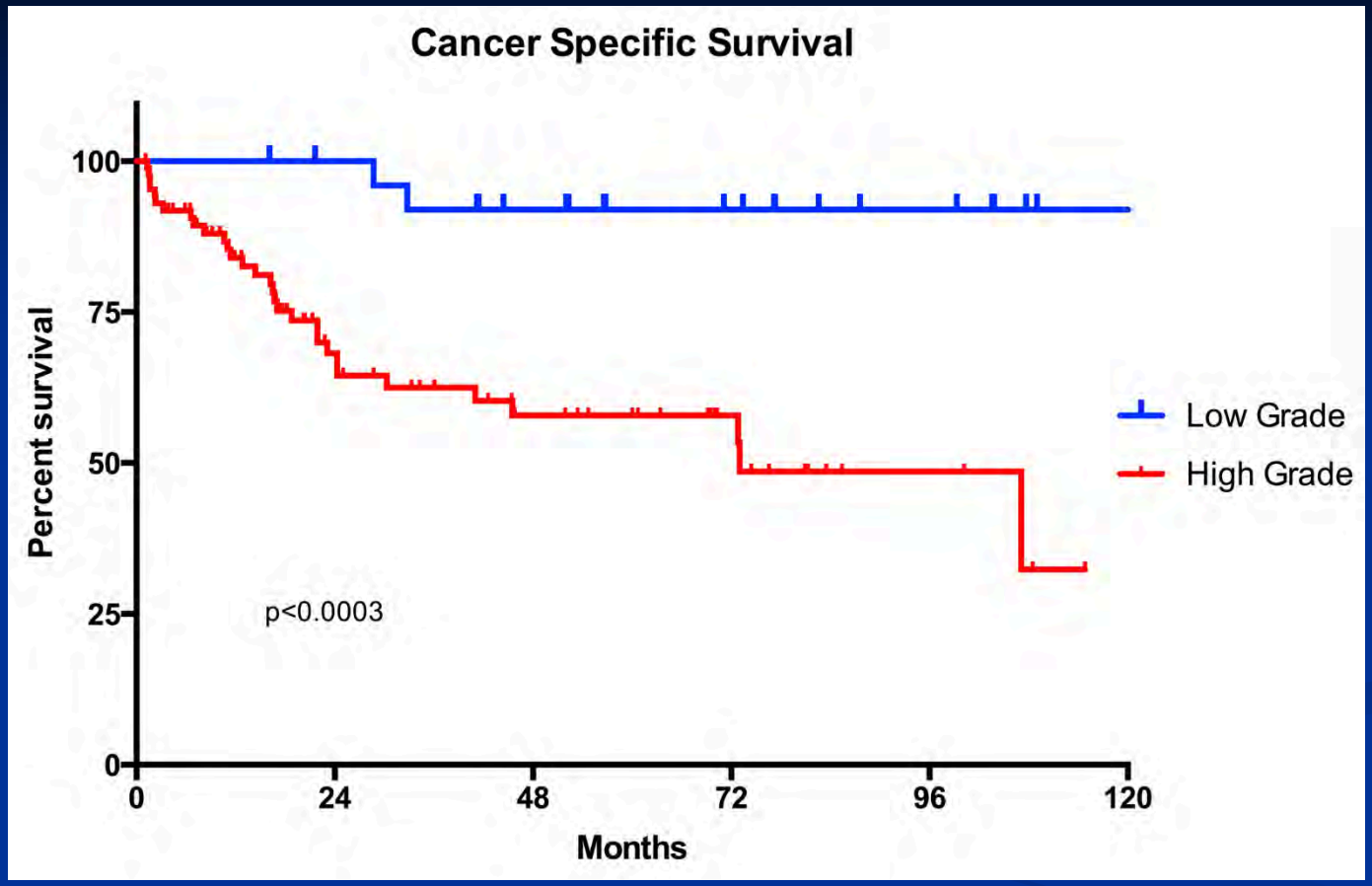


	2 year	5 year	7 year	10 year
N=93				
Overall Survival	77%	58%	43%	36%
Cancer Specific Survival	78%	64%	56%	56%

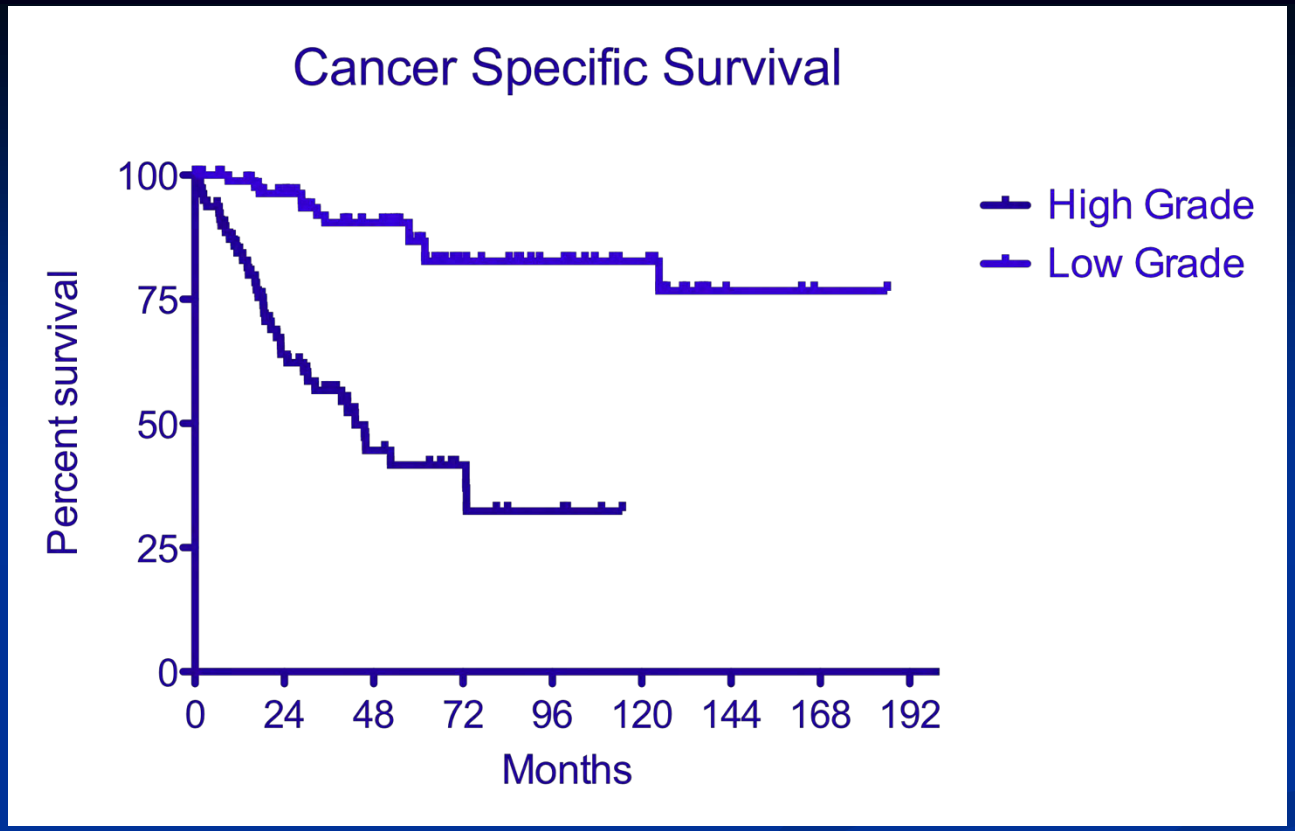
- Technical Considerations
  - Regional Lymphadenectomy
  - Pathology: High grade TCCa PT2, N0 (0/16 nodes)







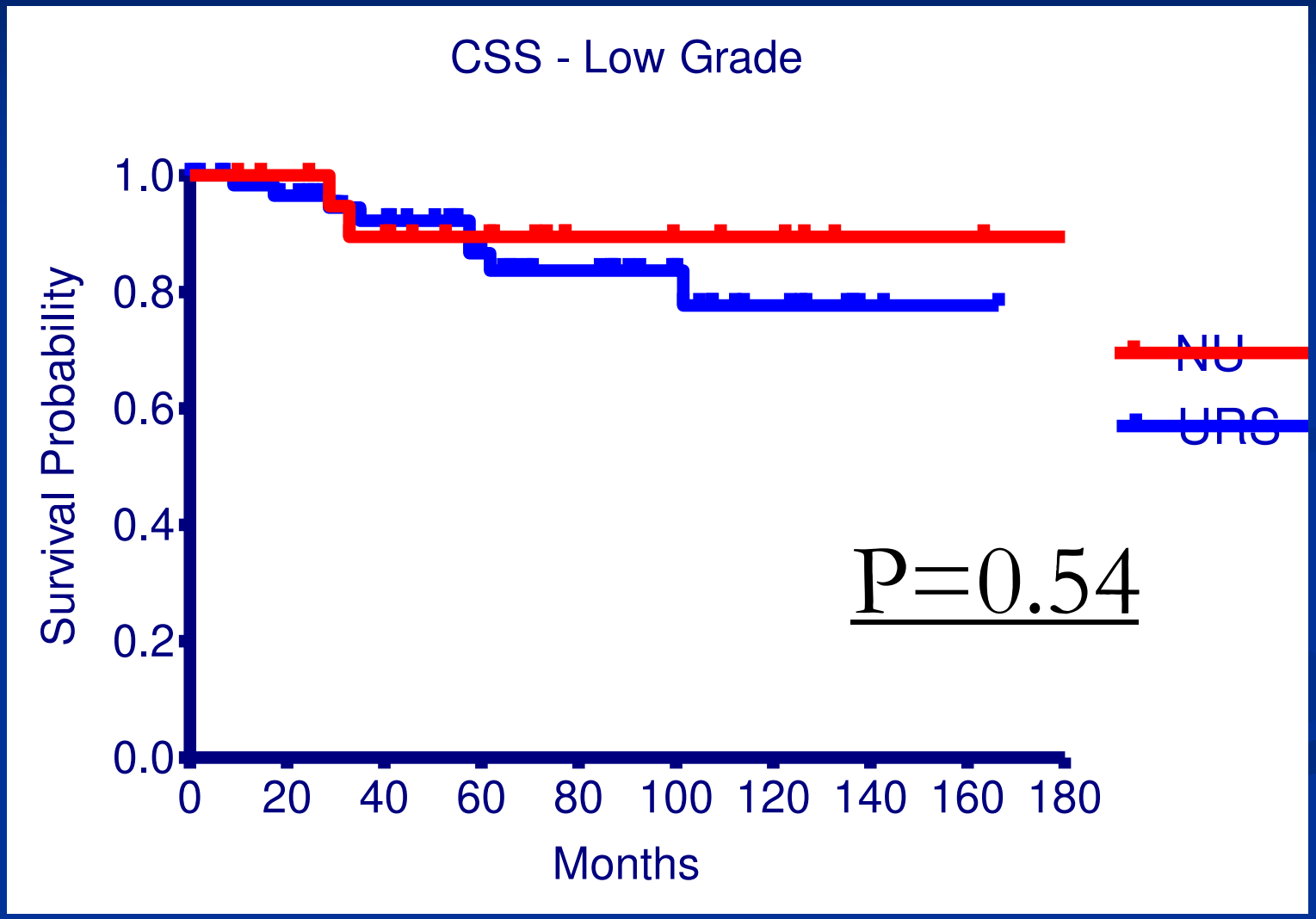
	2-year%			5-year%			10-year%		
	OS	CSS	MFS	OS	CSS	MFS	OS	CSS	MFS
Low Grade	92.6%	100.0%	92.6%	81.1%	92.0%	92.6%	67.6%	92.0%	92.6%
High Grade	65.8%	68.1%	68.6%	50.0%	57.9%	60.3%	25.2%	32.4%	39.2%



Hazard Ratio: 7.14 (95% CI 3.25 – 15.7)
P<.0001

N=160	2 year	5 year	7 year	10 year
High Grade	65%	35%	32%	23%
Low Grade	98%	87%	84%	81%

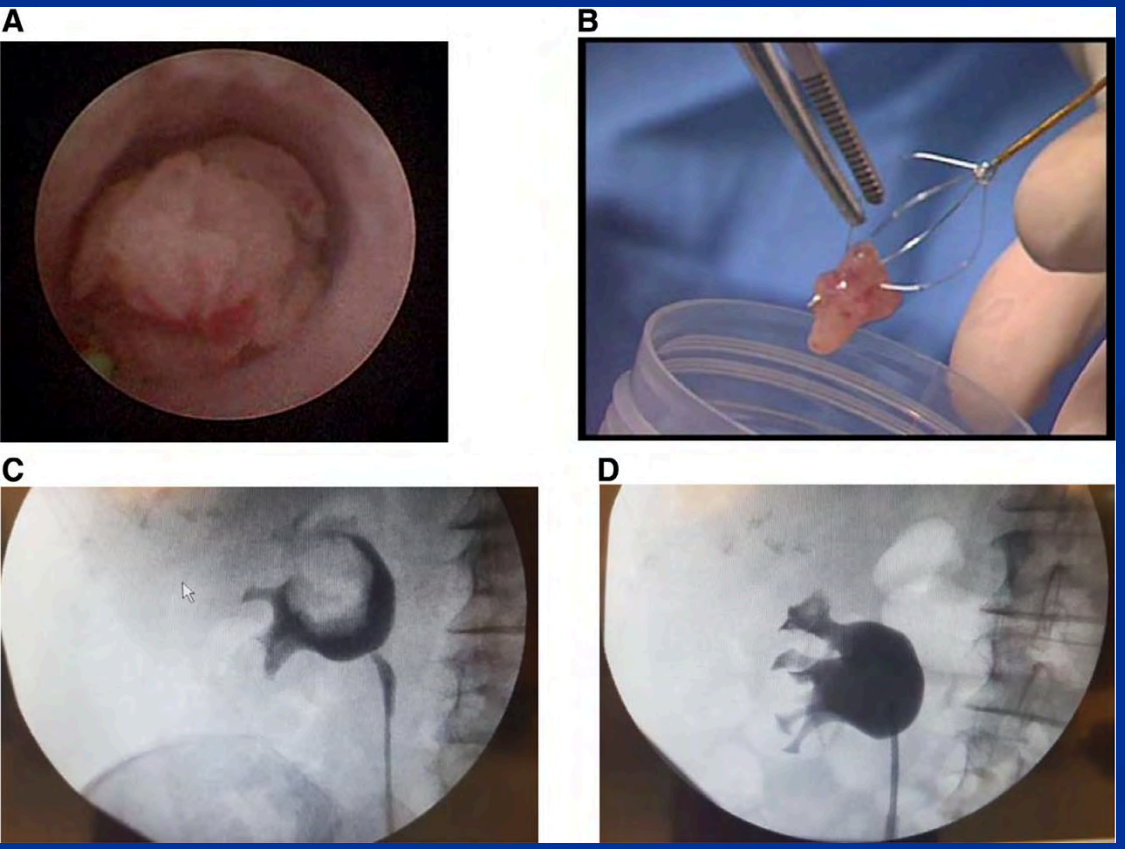
Surgical Technique



Ureteroscopic Management of Large ≥ 2cm UUT TCCa: 23 year Experience

Scotland, Dillon, Kleinmann, Cason, Hubbard, Tanimoto, Healy, Hubosky, Bagley

Urology 2018



- Large volume Low Grade
  - Biopsy + Cytology = grade
  - Staged Primary Resection
  - F/U mean 43.6 ms.
  - Ipsilateral Recurrence 90%
  - Progression in grade 31%
    - RNU 16 (20%)
  - 5 Year OSS 75%, CSS 84%
  - Strict Surveillance Essential

Large Volume, Low-Grade Urothelial Carcinoma: Long-Term Outcomes in Patients Undergoing Ureteroscopy Versus Nephroureterectomy

Verhovsky, Fishman, DeBeathem, Grasso EAU April 2024

- High Volume Low Grade TCCa (>3cm)
- 20 yr follow-up
- URS – high risk group (Elderly, CKD, etc.) vs NU

Outcome		URS 17	NU 28	p-value
Number of URS Procedures (Median)		10.2 [6-12]	6.1 [4-10]	0.03
Overall Survival Rates %	5 years	92%	91%	0.16
	10 years	81%	84%	0.21
	15 years	41%	51%	0.07
	20 years	9%	17%	0.052

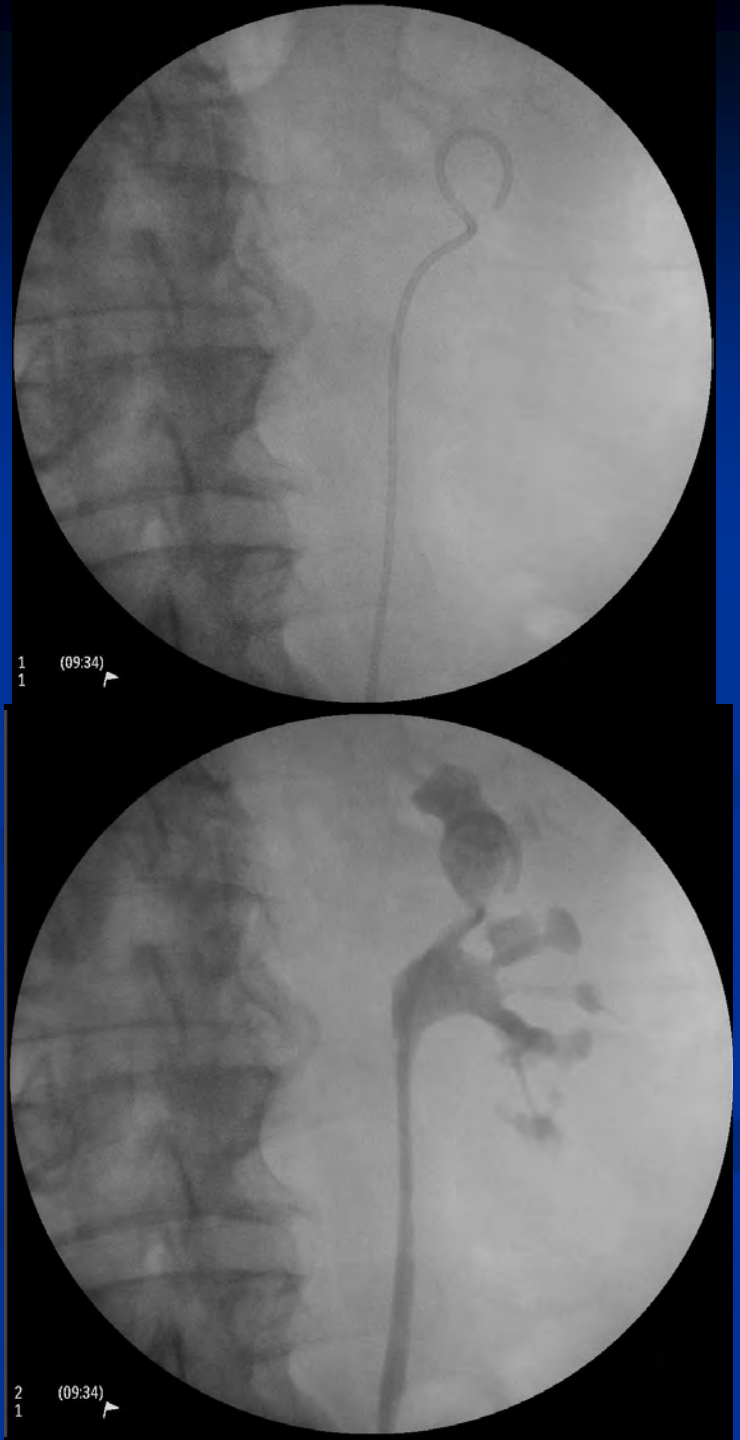
Ureteroscopy

	Progression free survival (%)	Metastasis free survival (%)
5 years	94%	94%
10 years	65%	65%
15 years	47%	59%

- URS technically feasible
- OS no statistically significant difference at 10 15 & 20 yrs
- Reasonable alternative to NU in elderly, high risk popul.
- 50% chance of progression in grade at 15 year
- Prog. in grade leads to prog. in stage - may not impact overall survival in this subset of elderly patients.

Topical Adjuvant Therapy In Treating Upper Tract TCCa

- Indications
  - Large volume
  - Recurrence on Surveillance
    - Increasing grade, multifocality, volume
  - Tcis
- Agents
  - BCG, Mitomycin C
  - Topical Mitomycin-C
    - Weekly, Daily, Post Procedural
    - Contact entire urothelium
    - Retrograde Placed Catheters
    - 20 – 40 mg in 50 to 100 cc's
    - Gravity drip
  - Jelmyto



Primary chemoablation of low grade UUT TCCa using UGN-1010, mitomycin containing reverse thermal gel

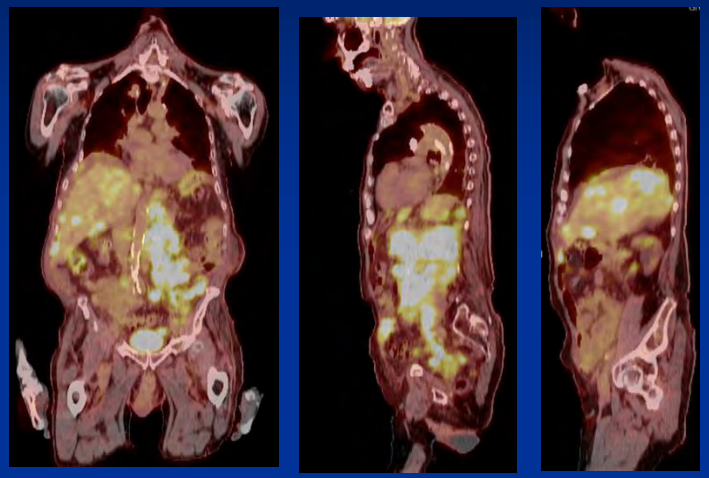
Lancet Vol 21, June 2020

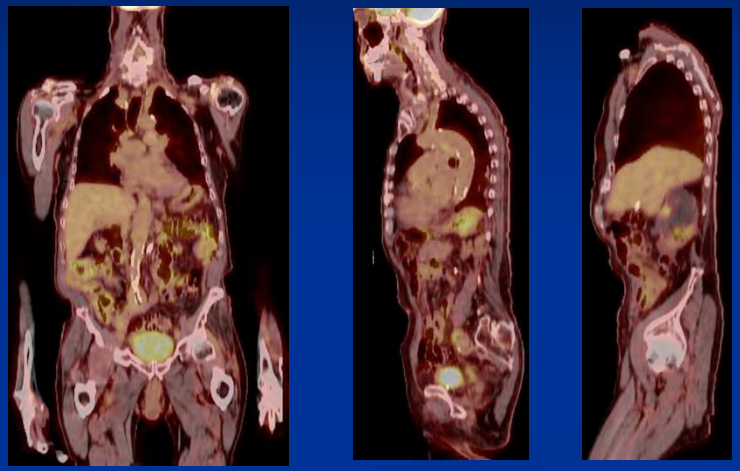
- Jelmyto Instillation – *Chemo-ablation*
  - Multicenter 12 centers – 71 pts enrolled/61 completed treatment
- Study Design
  - low grade, 5-15 mm volume - *leave sentinel tumor*
  - excluded some with multifocal disease.
  - Max. Dose 60 mg/15 ml, 6 weekly doses – monthly maintanance
  - URS at 3 months
- Results
  - CR 42/61 59% at 3 months – median 11 months f/u
  - 23/29 stopped maintenance: adverse events, non-compliance, recurrence
  - 6/61 continued maingaanence
- Complications 67/71 adverse events
  - Stricture 44%,
  - Urosepsis, Infection 32%
  - Impaired Renal Function 19%

Systemic Therapies for Upper Tract TCCA

- Cis-Platinum Based Therapies
  - Neoadjuvant Therapy with MVAC
    - MD Anderson 2008 Series - Retrospective
    - High grade disease on biopsy
    - 5 year OS 80.2 % with chemo vs. 57.6%
  - Adjuvant Chemotherapy
    - Int. Upper Tract Collaboration 2009, 1390 patients
    - N=542 – High risk (pT3,pT4, Pos. Nodes)
    - Cis Platinum Chemotherapy – **NO effect on Survival**
- Tyrosine Kinase Inhibitors (TKI)
  - Balversa – erdafitinir (FGFR2/3)
  - Cabozantinib (Multi-kinase Inhib.: MET, VEGF, AXL, Ret. Kinase)
- Antibody/Chemotherapy Conjugate
  - Padcev – enfortumab

Padcev (enfortumab vedotin)





- Antibody Chemotherapy Conjugate
  - Targets Nectin 4 protein
  - Releases monomethyl auristatin E (MMAE) into cell

- 97 yo male with 6 weeks of profuse clot colic
- Positive cytology – left kidney full of clot
- Emergent NU 5 High Grade PT3N1
- PET CT 8 weeks
- PET CT 14 post Padcev

Adjuvant Check Point Inhibitors

- Background Immunology
  - T cell activation via "AG presenting cells"
  - Upregulation of surface proteins
  - Immune Check Points: Control Immune Response (***Dampens***)
    - CTLA4
      - Only effects T cells
    - PD 1 (Program Death 1), PDL 1 and 2 (Ligands)
      - **Dampens** immune response post T cell activation
        - activated, exhausted, and infiltrating T cells,
        - AG presenting cells: B cells, Dendrites, Macrophages
- Immunotherapy
  - Drugs that inhibit check points
- Staining Expression $\geq$ 10% enhanced response

Indications For Adjuvant Immunotherapy

- Group 1 (URS Low Grade) Large volume low grade
  - Lynch Syndrome – High PDL1 expression
- Group 2 (Palliative URS High Grade)
- Group 3 (NU with high-risk features)

Adjuvant Check Point Inhibitors

Agent	FDA Approval	Check Point		Brand
Nivolumab	2017	PD1	IgG4	Opdivo
❖ Meaningful response irrespective of PDL1 expression				
❖ Combination with Ipilimumab phase 3 trial				
Pembrolizumab*	2017	PD1	IgG4	Keytruda
❖ Cis – Platinum Ineligible and no prior chemo				
❖ Combination with Epacadostat (Blocks T cell immune surveillance)				
Avelumab	2017	PDL1	IgG1	
❖ Anti PD1- PDL1 interaction				
Durvalumab	2017	PDL1	IgG kappa	Imfinzi
Ipilimumab	2011	CTLA4		Yervoy
Atezolizumab	2016	PDL1	IgG 1	Tecentriq
❖ FDA removed approval 2021				
❖ Rosenberg, Hoffman: Lancet 2016, 387: 1909				

* Platinum Ineligible: Low GFR, Hearing Loss, Poor Performance Status, CHF, Neuropathy

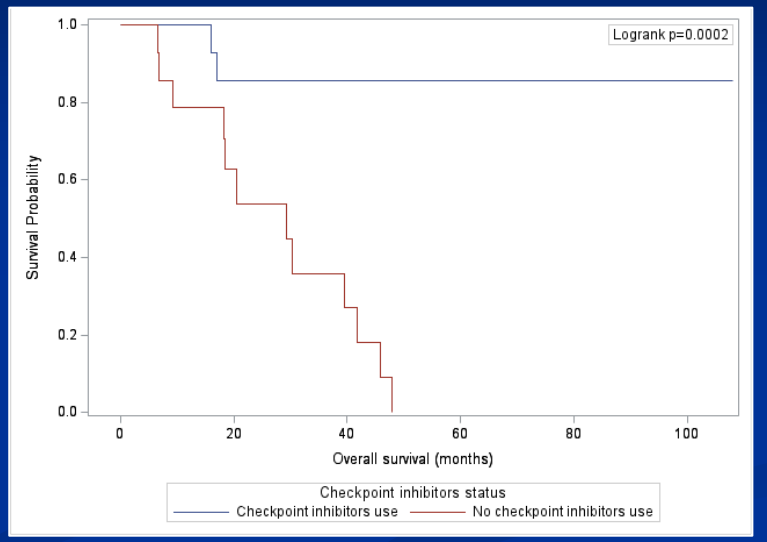
Immune Checkpoint Inhibitors in High-Grade Upper Tract Urothelial Carcinoma: Paradigm Shift Emphasizing Organ Preservation

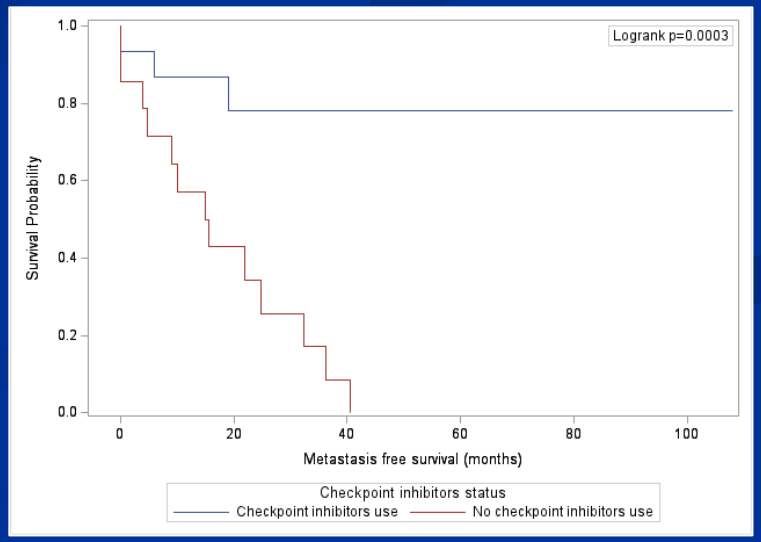
Khalil M, Fishman A, Komorowski A, Franco I, Grasso M. BJIU Compass, March 2024

URS for High Grade TCCa (N=29)

- Prior to 2012 – No Adj. Rx Group 1
- Post 2017 - Pembrolizumab Group 2

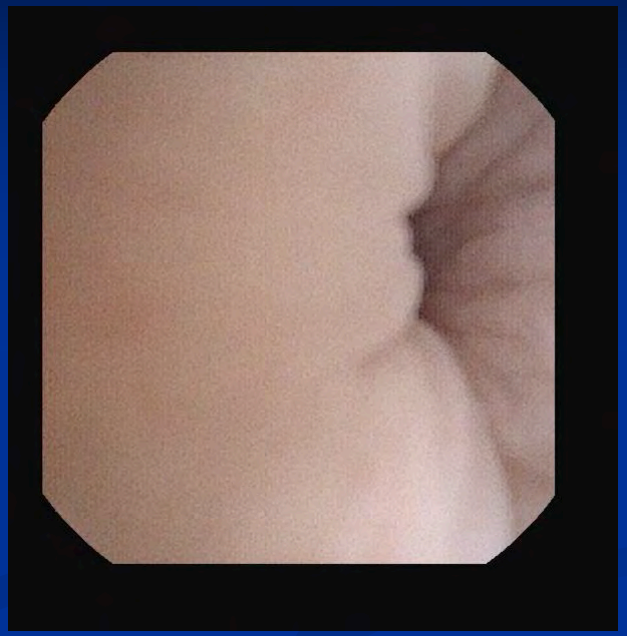
- Overall Survival (24 months)
  - Group 1 = 53.9%
  - Group 2 = 85.7%
- Mets. Free Survival (24 Months)
  - Group 1 = 34.3%
  - Group 2 = 78.0%
- CPI improved survival outcomes
  - hazard ratio 0.002





Adjuvant Check Point Inhibitors

- Toxicity = Autoimmune
  - Hypophysitis - Addisonian
  - Hypothyroid
  - Pneumonitis
  - Colitis
  - Nephritis
  - Sarcoid



- Treatment - Steroid Replacement
  - **Hydrocortisone 100 mg IV**
- Medications can be continued Peri-Op

Summary

- URS Treatment Of Upper Tract TCCa
  - Viable Treatment For Low Grade Disease
    - Flexible Ureteroscopic Laser Therapy Key
  - Organ preservation – High Grade (palliative?)
    - CPI - PD1/PDL1/CTLA4 Inhibitors
    - Padcev – chemo antibody conjugate
    - Balversa Kinase Inhib.
- Nephroureterectomy
  - Lap or Robotic
  - Higher Grade Lesions
  - Regional Lymphadenectomy - Standard
  - Combined With Systemic Therapies
    - Neo-Adjuvant Cis Platinum, CPI/Padcev
    - Adjuvant CPI, Padcev