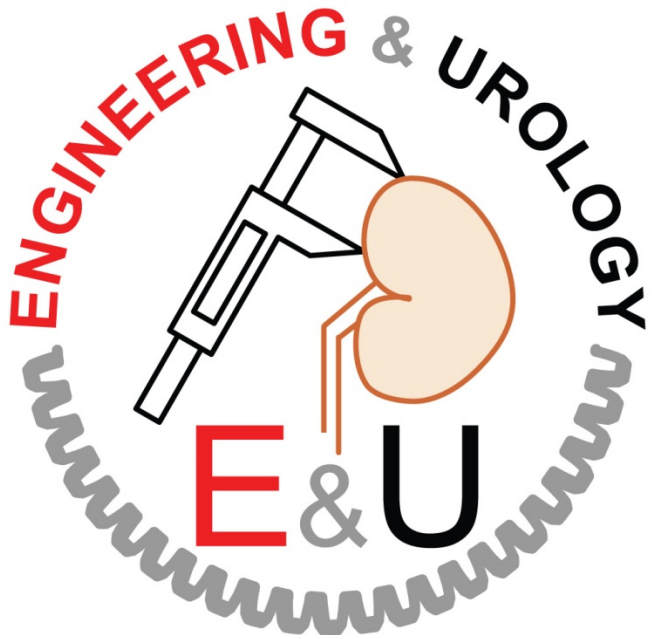
Engineering and Urology Society



27th Annual Meeting

Saturday May 19th, 2012

Georgia World Congress Center
Atlanta, GA

http://engineering-urology.org/

Following a long tradition, the Annual meeting of the Engineering and Urology Society offers the delegates of the American Urological Association an opportunity to present and learn about the latest research developments in urologic technology. Among other medical specialties, Urology has traditionally been at the forefront of technology innovation and continues to adapt or develop novel technologies at a fast pace. The Engineering and Urology Society offers a unique forum where engineering innovation meets clinical demand in a collaboration that leads to unparalleled exchange of ideas.

This year's meeting is organized by the program chairmen Jeff Cadeddu and Koon Rha. The first session will focus on combination presentations with engineers and urologists. Additional talks will discuss a range of topics that are just beyond the horizon including next daVinci instruments, historipsy, and innovations in focal therapy. The focus then shifts to horizons in surgical robotics with an international flavor and advanced imaging techniques. The afternoon sessions highlight advances and debates in prostate cancer imaging and the latest in the areas of Laparoendoscopic Single Site Surgery and Natural Orifice Translumenal Endoscopic Surgery. Additional symposiums will be held for Image Guided Therapy and Stents. Finally, engineers and clinicians will present their latest research in the two afternoon poster sessions.

The review of the abstracts for the poster sessions has been performed online by a group of 85 reviewers from around the world. Each paper received between 25 and 28 reviews. We would like to thank the reviewers, listed at the end of this program book, for their constructive comments and essential contribution to the quality of the meeting.

Based on the peer review, the Best Paper Award goes to abstract "Preclinical Safety and Efficacy of Ultrasonic Propulsion of Kidney Stones" from the University of Washington and Indiana University, and the Outstanding Paper Award to abstract "Robot-Assisted Direct MRI-Targeted Transrectal Prostate Biopsy" from the Johns Hopkins University and the Memorial Sloan-Kettering Cancer Center. The Top 10 abstracts are listed in the program. Their authors will be invited to submit full articles to the Journal of Endourology.

We gratefully thank all reviewers for their hard work, objective scoring, and contribution to the success of the meeting. The society presents Best Reviewer Awards for the online review process, based on the grading performance and the number of reviews performed. The Best Reviewer Awards are presented to Drs. Riccardo Autorino, Thorsten Bach, Mahesh Desai, Mohamed Elkoushy, Arvind Ganpule, Petrisor Geavlete, Bodo Knudsen, Thomas Lawson, Kamol Panumatrassamee, and Sutchin Patel. We congratulate all award winners and welcome all urologists, engineers, and scientists to join us for this unique multi and interdisciplinary experience. As always, we are grateful to Dr. George Nagamatsu, the founder and first president of the society for setting the foundations based upon which we meet.

Please visit the website http://engineering-urology.org for a complete version of this program including the abstracts presented.

Thank you for your continued scientific support,

Stephen Nakada
Sean Hedican
Dan Stoianovici

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Cadeddu, Jeffrey A.: Ethicon Endosurgery, Inc: Consultant or Advisor, Scientific Study or Trial, Owner, Product Development; Applied Medical: Meeting Participant or Lecturer.

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Naito, Seiji: Novartis: Consultant or Advisor, Meeting Participant or Lecturer.

Peltier, Alexandre: Nothing to disclose.

Rane, Abhay: Nothing to disclose.

Rassweiler, Jens: Nothing to disclose.

Rha, Koon Ho: Nothing to disclose.

Roberts, William: Terumo Cardiovascular Systems: Consultant or Advisor; HistoSonics, Inc.: Consultant or Advisor, Scientific Study or Trial, Investment Interest, Owner, Product Development

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Salas, Nelson: Nothing to disclose.

Schips, Luigi: Nothing to disclose.

Stoianovici, Dan: Nothing to disclose.

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PROGRAM

27th Annual Meeting

Saturday, May 19th, 2012
Atlanta, Georgia
Room A302
Georgia World Congress Center

Program Chairmen: Jeffrey Cadeddu and Koon Ho Rha

7:15 – 7:30	**Registration**	
7:30 –9:00	**SESSION 1: ENGINEERS IN UROLOGY** **Combo presentations of MD and PHD**	**Jeffrey Cadeddu**
7:30 AM	Direct Image-Guided Robots for the Prostate	Misop Han Dan Stoianovici
7:50 AM	MAGS for LESS and NOTES	Jeffrey Cadeddu Raul Fernandez
8:10 AM	State-of-the-art Science of Thermal Ablation	Raymond Leveillee Nelson Salas
8:30 AM	Histotripsy: Mechanical Tissue Ablation	William Roberts Tim Hall
8:50 AM	Questions and Answers	
9:00 – 9:40	**SESSION 2: NEW HORIZONS IN SURGICAL ROBOTICS**	**Koon Ho Rha**
9:00 AM	Surgical Robotics: Germany/Austria	Gunther Janetschek
9:15 AM	Surgical Robotics: Canada	David Albala
9:30 AM	Surgical Robotics: Japan	Seji Naito
9:45 AM	Surgical Robotics: Korea	Chang Wook Jeong
10:00 AM	Questions and Answers	
10:15 – 10:30	**AWARDS PRESENTATIONS**	**Dan Stoianovici**
10:20 AM	Best Paper Award: Preclinical Safety and Efficacy of Ultrasonic Propulsion of Kidney Stones	Mathew Sorensen
10:30–12:00	**SESSION 3: ESUT SESSION**	**Jens Rassweiler** **Roland van Velthoven** **Pilar Laguna**
10:30 AM	Lymph Node Illumination with Cyanine Green	Günter Janetschek
10:40 AM	Photodynamic Diagnosis During Laparoscopic Radical Prostatectomy	Roman Ganzer
10:50 AM	Optical Coherence Tomography for Bladder & Kidney	Jean de la Rosette
11:00 AM	Update on Navigation	Dogu Teber
11:10 AM	3D-Endoscopy-Where are we Apart from daVinci	Thomas Knoll
11:20 AM	MRI Sonography Image Fusion Biopsy of the Prostate	Alexandre Peltier
11:30 AM	Robotic Flexible Ureterorenoscopic Surgery	Remzi Saglam
11:40 AM	Questions and Answers	
12:00–1:00	**LUNCH BREAK**	

PROGRAM

1:00-2:00	**SESSION 4: ESUI SESSION** **Where are We in Prostate Cancer Imaging? An Update on the Most Promising Imaging Tools for Prostate Cancer**	**Jochen Walz**
1:00 PM	Contrast Enhanced Ultrasound (CEUS) in the Management of Prostate Cancer	Hessel Wijkstra
1:15 PM	Real Time Elastography in the Management of Prostate Cancer	Jochen Walz
1:30 PM	ANNA/C-TRUS in the Management of Prostate Cancer	Tillmann Loch
1:45PM	Multiparametric MRI in the Management of Prostate Cancer	Arnauld Villers
2:00-3:00	**SESSION 5: NOTES AND LESS**	**Abhay Rane** **Matthew Gettman**
	LESS Donor Nephrectomy: Is this the new gold standard?	Joseph DelPizzo
	LESS Adrenalectomy	Luigi Schips
	Retroperitoneal LESS	B. C. Jung
	Advances in LESS:	
	- Single port instrument delivery extended reach (Spider)	Raymond Leveillee
	- Imaging, Dissection & Retraction	Mihir Desai
	Robotic LESS: Current Status	Jihad Kaouk
	Update on NOTES: What's out there so far	Riccardo Autorino
	LESS: Where's the Evidence? – New Studies	Brian Irwin
1:50-2:25 PM	**TALKS**	**Matthew Gettman**
1:50 PM	Little LESS	Ed Cherullo
1:57 PM	Pitfalls in LESS	Jay Raman
2:04 PM	What's New in LESS	Inderbir Gill
2:11 PM	What's New in NOTES	Mitchell Humphreys
2:18 PM	White paper on LESS trials, Inclusion Criteria	Brian Irwin

POSTER SESSIONS:

1:00–2:30PM	**Poster Session 1**	Session 1A Room: A315	Li-Ming Su Petrisor Geavlete
		Session 1B Room: A316	William Roberts Nelson Salas
3:00–4:30PM	**Poster Session 2**	Session 2A Room: A315	Manoj Monga Christian Chaussy
		Session 2B Room: A316	John Denstedt Hessel Wijkstra

POSTER SESSION 1A

1:00 PM – 2:30 PM

Moderators
Li-Ming Su
Petrisor Geavlete

No.	Title	Presenting Author
1	NOVEL LAPAROSCOPE DEFOGGING AND CLEANING DEVICE UTILIZED DURING ROBOT-ASSISTED LAPAROSCOPIC PROSTATECTOMY (RALP): 20 CASE EXPERIENCE	Carson Wong
2	SPARKER ARRAY FOR LITHOTRIPSY	Michael Grapperhaus
3	PULSED FLUOROSCOPY IN URETEROSCOPY AND PERCUTANEOUS NEPHROLITHOTOMY	Mohamed Elkoushy
4	FIVE ARM ENHANCED OPTICAL MAGNIFICATION APPROACH FOR ROBOTIC ASSISTED MICROSURGERY	Ahmet Gudeloglu
5	NEPHRON SPARING SURGERY WITH ZERO ISCHEMIA	Eric Taylor
6	ROBOTIC ULTRASOUND PROBE IN ROBOTIC PARTIAL NEPHRECTOMY	Bartosz Kaczmarek
7	NONINVASIVE HISTOTRIPSY OF THE PROSTATE USING VORTX RX™: FEASIBILITY IN A CANINE MODEL	William Roberts
8	NOVEL ULTRA-LOW DOSE NON-CONTRAST CT (NCCT) FOR UROLITHIASIS: PROSPECTIVE COMPARISON OF DIAGNOSTIC ACCURACY WITH CONCURRENT STANDARD DOSE IMAGING	Sri Sivalingam
9	SURGTRAK: EVOLUTION OF A MULTI-STREAM SURGICAL PERFORMANCE DATA CAPTURE SYSTEM FOR THE DA VINCI SURGICAL ROBOT **TOP 10 ABSTRACT**	Lee White
10	XENX: EVOLUTION OF DESIGN BASED ON CLINICAL EVALUATION	Ofer Zigman
11	RAPID EXTRACORPOREAL STONE COMMINUTION: MECHANISTIC INSIGHTS IN-VITRO	Alexander Duryea

12	DESIGN OF AN AUTOMATED CYSTOSCOPE FOR BLADDER CANCER SURVEILLANCE **TOP 10 ABSTRACT**	Xianming Ye
13	A NOVEL VAS CLAMP FOR USE IN NONINVASIVE LASER VASECTOMY	Christopher Cilip
14	A COMPARISON OF DIFFERENT ACUTE ANGLES BETWEEN STRAIGHT INSTRUMENTS USED DURING LAPAROSCOPIC SUTURING AND KNOT TYING	Ernesto Iii Arada
15	INITIAL EXPERIENCE WITH PERCUTANEOUS MICROWAVE ABLATION OF RENAL TUMORS: MULTICENTER EVALUATION OF SAFETY AND EFFICACY	Sara Best
16	TARGETED ROBOTIC ASSISTED MICROSURGICAL DENERVATION OF THE SPERMATIC CORD FOR CHRONIC ORCHIALGIA	Ahmet Gudeloglu
17	A NOVEL SYNTHETIC VAS DEFERENS MODEL FOR MICROSURGICAL TRAINING	Ahmet Gudeloglu
18	EVALUATION OF SCOPESAFE FIBERS AND THE SCOPE GUARDIAN SHEATH IN PREVENTION OF URETEROSCOPE ENDOLUMINAL WORKING DAMAGE	Achim Lusch
19	PRECLINICAL SAFETY AND EFFICACY OF ULTRASONIC PROPULSION OF KIDNEY STONES **BEST PAPER AWARD**	Mathew Sorensen
20	HOW TO USE AN OPTICAL TRACKER FOR MORE ACCURATE MEASUREMENTS	Ryan Decker

POSTER SESSION 1B

1:00 PM – 2:30 PM

Moderators
William Roberts
Nelson Salas

21	15 YEARS TRANSRECTAL HIGH INTENSITY FOCUSED ULTRASOUND IN LOCALIZED PROSTATE CANCER THERAPY: IMPACT OF NEOADJUVANT TURP BEFORE HIFU ON ONCOLOGICAL EFFICACY	Christian Chaussy
22	IN VITRO COMPARISON OF OUR NOVEL SPEAR HEADED PNEUMATIC INTRACORPOREAL LITHOTRIPTOR WITH HOLMIUM YAG LASER	A V Rawandale
23	CYSTOLITHALOPAXY USING CYBERWAND IS EFFICIENT AND SAFE FOR LARGE BLADDER STONE BURDENS	Matthew Maurice
24	COMPARISON BETWEEN SYSTEMATIC AND MRI TARGETED PROSTATE BIOPSY FOR PATIENT WITH NO HISTORY OF PROSTATE CANCER ATTENDING A FIRST ROUND OF TRANS-RECTAL ULTRASOUND BIOPSY	Pierre Mozer
25	ROBOTIC TRANS-RECTAL ULTRASONOGRAPHY DURING ROBOTIC-ASSISTED RADICAL PROSTATECTOMY	Sunao Shoji
26	COMPARATIVE IN VITRO EVALUATION OF XENX	Carl Sarkissian
27	URETEROSCOPIC VERSUS FLUOROSCOPIC GUIDED RENAL ACCESS: A COMPARATIVE ANALYSIS OF INTRAOPERATIVE OUTCOMES FOR PCNL	Wahib Isac
28	A NOVEL DEVICE TO PREVENT MIGRATION OF STONE FRAGMENTS DURING PERCUTANEOUS LITHOTRIPSY	Stephen Faddegon
29	APPLYING THEORETICAL CHEMISTRY TO THE STUDY OF CALCIUM OXALATE NEPHROLITHIASIS	Julie Riley
30	DESIGN AND EVALUATION OF IMAGE GUIDANCE SYSTEMS FOR RARP	S. Thompson
31	HISTOTRIPSY TREATMENT OF FORMALIN FIXED TISSUE	Sarah Darnell

32	LASER INTERSTITIAL THERMOTHERAPY FOR SMALL RENAL MASSES: PRELIMINARY INVESTIGATION IN EX-VIVO PORCINE KIDNEYS	Nelson Salas
33	QUALITY MEASUREMENT OF SYSTEMATIC TRANSRECTAL PROSTATE BIOPSY: AN IN-VITRO STUDY **TOP 10 ABSTRACT**	Doyoung Chang
34	LIVE ROBOTIC SURGERY: ARE OUTCOMES COMPROMISED? **TOP 10 ABSTRACT**	Jeffrey Mullins
35	ROBOT-ASSISTED DIRECT MRI-TARGETED TRANSRECTAL PROSTATE BIOPSY **OUTSTANDING PAPER AWARD**	Chunwoo Kim
36	TACTILE MEMS-BASED SENSOR ELEMENT FOR ROBOTIC SURGERY	Young Soo Park
37	VISUAL MEASUREMENT OF SUTURE TENSION FOR MINIMALLY INVASIVE SURGERY	Young Soo Park
38	MINI-PERCUTANEOUS NEPHROLITHOTOMY WITHOUT MINI INSTRUMENTS: A NOVEL TECHNIQUE	Edan Shapiro
39	WHAT IS THE BEST METHOD TO DELIVER ADJUVANT THERAPY TO THE UPPER URINARY TRACT FOR UROTHELIAL CARCINOMA? AN EVALUATION OF THREE TECNIQUES IN AN EX VIVO PORCINE MODEL	Matthew Pollard

POSTER SESSION 2A

3:00 PM – 4:30 PM

Moderators
Manoj Monga
Christian Chaussy

40	15 YEARS TRANSRECTAL HIGH INTENSITY FOCUSED ULTRASOUND IN PROSTATE CANCER THERAPY: DEVELOPMENT OF SIDE EFFECTS	Christian Chaussy
41	TREATMENT OF LOCALLY ADVANCED PROSTATE CANCER WITH TRANSRECTAL HIGH INTENSITY FOCUSED ULTRASOUND (HIFU) DELAYS ANDROGEN DEPRIVATION THERAPY (ADT)	Stefan Thueroff
42	RETROGRADE CHEMOTHERAPEUTIC IRRIGATION OF THE UPPER TRACT	Matthew Maurice
43	IS THERE A DIFFERENCE IN LATERALITY DURING ROBOT ASSISTED RADICAL PROSTATECTOMY? ASSESSMENT OF LYMPH NODE YIELD AND NEUROVASCULAR BUNDLE DISSECTION	Michael Lipsky
44	PRELIMINARY EVALUATION OF THE ENDOGO HD PORTABLE CYSTOSCOPIC CAMERA	William Berg
45	BIOHEAT MODEL FOR UNINTENDED FREEZE DETERMINATION	Cervando Ortiz-Vanderdys
46	BIPOLAR PLASMA VAPORIZATION OF SECONDARY BLADDER NECK SCLEROSIS – MORE EFFICIENT THAN STANDARD TUR?	Bogdan Florin Geavlete
47	RENAL TUMOR CONTACT SURFACE AREA: A NOVEL CT-PARAMETER FOR PREDICTING PERI-OPERATIVE OUTCOMES USING ADVANCED IMAGE-PROCESSING SOFTWARE	Scott Leslie
48	SIMULATION FOR TRAINING INTRA-DETRUSOR INJECTION OF BOTULINUM TOXIN TO TREAT URINARY INCONTINENCE	Yunhe Shen
49	THE "AL DENTE" RADIOFREQUENCY ABLATION OF RENAL TUMORS: USE OF PERIPHERAL FIBEROPTIC TEMPERATURE MONITORING SAVES NEPHRONS.	Vladislav Gorbatiy
50	PRELIMINARY TESTING OF A TRANSURETHRAL DEXTEROUS ROBOTIC SYSTEM FOR BLADDER RESECTION **TOP 10 ABSTRACT**	Ryan Pickens

51	RELIABILITY OF PROSTATE HISTOSCANNING IN LOCALIZATION OF PROSTATE CARCINOMA: INDIAN EXPERIENCE	Arvind Ganpule
52	3D-HOLOSCOPIC IMAGING: A NEW DIMENSION TO ENHANCE IMAGING IN MINIMALLY INVASIVE THERAPY IN UROLOGICAL ONCOLOGY **TOP 10 ABSTRACT**	Jonathan K. Makanjuola
53	GREENLIGHT HPS-120W VS GREENLIGHT XPS-180W LASER VAPORIZATION OF THE PROSTATE FOR BENIGN PROSTATIC HYPERPLASIA: A PROSPECTIVE COMPARATIVE OUTCOMES ANALYSIS	Kevin Zorn
54	AUTOMATED ANALYSIS OF RETROPERITONEAL ABNORMALITIES USING BOX COUNTING ALGORITHMS	Cristian Surcel
55	ROBOT ASSISTED TRANSVAGINAL NOTES RETROPERITONEAL NEPHRECTOMY: FEASIBILITY STUDY IN THE CADAVER	Humberto Laydner
56	USER FEEDBACK FOR SUTURING USING BLACK LIGHT ASSESSMENT OF SURGICAL TECHNIQUE (BLAST) AND IMAGE PROCESSING	Lauren Poniatowski
57	THE XENXTM – A NEW DEVICE TO PREVENT STONE MIGRATION DURING LASER LITHOTRIPSY	Eugene Kramolowsky
58	IN VITRO AND IN VIVO COMPARISON OF OPTICS AND PERFORMANCE OF A DISTAL SENSOR URETEROSCOPE (STORZ FLEX-XC) VS. A STANDARD FIBEROPTIC URETEROSCOPE (STORZ FLEX-X2)	Achim Lusch

POSTER SESSION 2B

3:00 PM – 4:30 PM

Moderators
John Denstedt
Hessel Wijkstra

59	PHANTOM STUDY OF A NOVEL STEREOTACTIC PROSTATE BIOPSY SYSTEM INTEGRATING PREINTERVENTIONAL MRI AND LIVE US FUSION **TOP 10 ABSTRACT**	TIMUR H KURU
60	"VERSION 2- 5 PART PERCUTANEOUS ACCESS NEEDLE WITH GLIDEWIRE (5-PANG)": A MULTIUTILITY PUNCTURE SYSTEM FOR PERCUTANEOUS RENAL ACCESS	A V RAWANDALE
61	AUTOMATED VOLUMETRIC ASSESSMENT BY NONCONTRAST COMPUTED TOMOGRAPHY IN THE SURVEILLANCE OF NEPHROLITHIASIS	SUTCHIN PATEL
62	ROBOTIC ASSISTED LAPAROSCOPIC PARTIAL NEPHRECTOMY IN PATIENTS WITH PREVIOUS ABDOMINAL AND PLEVIC SURGERY	WAHIB ISAC
63	ROBOTIC VERSUS OPEN URETERONEOCYSTOSTOMY: A SINGLE INSTITUTION COMPARATIVE OUTCOME ANALYSIS	WAHIB ISAC
64	REGISTRATION OF ULTRASOUND AND HISTOLOGY DATA FOR VALIDATION OF EMERGING PROSTATE CANCER IMAGING TECHNIQUES	MASSIMO MISCHI
65	MULTI-INSTITUTIONAL ANALYSIS OF ROBOTIC PARTIAL NEPHRECTOMY FOR SOLITARY KIDNEY	SHAHAB HILLYER
66	SYSTEMATIC PROSTATE BIOPSIES MAY DETECT MORE INSIGNIFICANT CANCER THAN MRI LESION TARGET PROSTATE BIOPSIES	PIERRE MOZER
67	LONG-TERM OUTCOMES OF INTRA-RENAL BCG/IFN FOR BIOPSY-PROVEN UPPER-TRACT CARCINOMA IN SITU	EDAN SHAPIRO
68	PROSTATIC SWELLING AND SHIFT OF INTRA-PROSTATIC TARGET DURING HIFU: IMPLICATION FOR TARGETED FOCAL THERAPY	SUNAO SHOJI
69	NOVEL MICRO-ULTRASOUND PROBE TO IDENTIFY MICROVESSELS IN THE SPERMATIC CORD	AHMET GUDELOGLU

70	NEUROPROTECTIVE WRAP FOR THE SPERMATIC CORD AFTER DENERVATION PROCEDURES	AHMET GUDELOGLU
71	ROBOTIC ASSISTED PARTIAL NEPHRECTOMY IN PATIENTS WITHOUT HILAR CLAMPING - A MULTI-INSTITUTIONAL STUDY	BARTOSZ KACZMAREK
72	APPLICATIONS OF SPIDER IN UROLOGY, THE UNIVERSITY OF MIAMI EXPERIENCE	ARTURO JR. CASTRO
73	DEVELOPMENT AND VALIDATION OF A RAPID CIRCUMCISION DEVICE TO FACILITATE DISSEMINATION OF SAFE ADULT MALE CIRCUMCISION AMONG U.S. VETERANS	JAMES HOTALING
74	FIBER OPTIC SUCTION AND PULLING OF URINARY STONE PHANTOMS USING A HIGH PULSE RATE THULIUM FIBER LASER	RICHARD BLACKMON
75	ROBOTIC ASSISTED LEGO® CONSTRUCTION AS A MODEL FOR ROBOTIC MICROSURGERY SKILLS TRAINING	AHMET GUDELOGLU
76	RAPID DETERMINATION OF SYSTEMIC LEVELS OF OXALATE USING A NEWLY DEVELOPED OXOMETER **TOP 10 ABSTRACT**	BENJAMIN CANALES
77	PROSPECTIVE EVALUATION OF THE DURABILITY OF REFURBISHED FLEXIBLE URETEROSCOPES IN AN 860 BED TERTIARY CARE CENTER WITH MULTIPLE SURGEONS.	ROBERT CAREY

ABSTRACTS

ABSTRACT 1

NOVEL LAPAROSCOPIC DEFOGGING AND CLEANING DEVICE UTILIZED DURING ROBOT-ASSISTED LAPAROSCOPIC PROSTATECTOMY (RALP): 20 CASE EXPERENCE

Carson Wong, MD[1,2,3] and Xiao Gu, MD, PhD[4]

[1]SouthWest Urology, Inc.
[2]Ahuja Medical Center, University Hospitals
[3]Parma Community General Hospital
[4]The First Clinical Medical College at Yangzhou University

Introduction: Maintaining efficiency and optimal visualization are critical components of any surgical procedure, particularly in robot-assisted cases, where removal of the laparoscope to defog or clean the lens requires time and can be cumbersome. We evaluate the Advanced Laparoscopic Care Kit (New Wave Surgical, Coral Springs, FL) as a novel set of accessories that defogs and cleans the laparoscope during RALP.

Methods: Laparoscope warming and cleaning equipment were replaced in our operating suite with the Advanced Laparoscopic Care Kit ("Care Kit") for 20 consecutive patients who underwent transperitoneal RALP. Our observations and the features of the Care Kit are reviewed.

Results: The Care Kit includes a defogging device that heats an internal reservoir of surfactant based alcohol-free anti-fog solution to 120° F. The device remains heated for 5 hours. The heated surfactant acts as a soap that can quickly remove dried debris from the lens. Because the device is self-contained and hand held, it can be brought to the laparoscope with minimal displacement of the laparoscope from the trocar. The Care Kit also includes microfiber cleaning pads (fibers 2000 times smaller than surgical gauze) that clean oils better than surgical gauze and avoid scratching the delicate lens. A trocar cleaning sponge for removing debris that can be trapped inside the trocar cannula is also supplied. Subjectively, the Care Kit proved to be simple to use by the bedside assistant and effective at maintaining optimal laparoscope visualization. Transfer of the laparoscope to the back table for warming intraoperatively was not required in all 20 cases. The Care Kit protects the laparoscope while it is initially lying flat on the back table from the dangers of scratching and falling associated with using traditional laparoscope warmers.

Conclusions: The Care Kit was effective in preventing fogging of the laparoscope during RALP. It has the potential to minimize delays that can result from laparoscope defogging and cleaning, thereby reducing operative times. Further studies will be required to quantify the potential time savings and determine whether there is a reduction in laparoscope damage and subsequent repair costs associated with use of this device.

ABSTRACT 2

SPARKER ARRAY FOR LITHOTRIPSY

Michael Grapperhaus, Raymond Schaefer

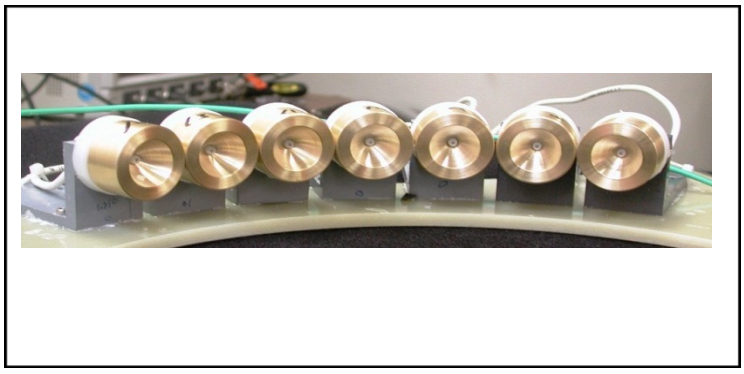
Phoenix Science & Technology, Inc.

Introduction: Despite the positive clinical outcomes (greater than 90% success rate) of early electro-hydrodynamic lithotripters (EHLs), such as the Dornier HM3, the use of shock wave lithotripsy (SWL) has decreased in the last 20 years. This is attributable to several factors, including the short lifetime of sparker electrodes in the HM3, which prompted a move to non-sparker shock-wave sources in 2nd and 3rd generation lithotripters. As a result, the success rate of SWL has decreased to less than 50% in recent years, while the success rate of invasive techniques, such as flexible ureteroscopy, have success rates greater than 90%. We have developed a new shock wave source using an array of small sparker sources for use in SWL that can resolve lifetime and other issues of sparker based SWL.

Methods: Two arrays of 7 sparkers were built and operated simultaneously, with the sparkers arranged along the circumference of a circle in a single plane. The pressure field was measured with PVDF hydrophones (Onda HGL-0400 at low pressure and Onda HNS-0500 at higher levels) both at focus and along three axes around focus. The pressure field from a single sparker was also measured and used to simulate the pressure field from different array configurations and operating conditions. The sparker arrays were also used to break artificial stones made with Ultracal-30 gypsum.

Results: The sparker array produced a pressure pulse that delivered a peak pressure of 40 MPa with a pulse width of 0.7 msec to the focus. The planar sparker array produced a pressure field with a focal spot (50% of peak) that is 38 mm long the direction normal to the plane of the array, 2.5 mm within the plane of the array and perpendicular to the direction of propagation and 15 mm long in the direction of propagation. The pressure pulses were highly repeatable, with a coefficient of variation of 1.5%. Simulation of the pressure field reproduced this, and also predicted a more symmetric focal region for a compact 3-dimenstional arrangement with the sparkers on a spherical surface. The model predicts that this configuration will produce a focal region approximately 5 mm in the plane perpendicular to propagation and 50 mm long in the direction of propagation. The sparker array was used to break artificial stones in 7 tests using 2400 shock wave pulses in each test. Additional testing resulted in the array delivering more than 20,000 pulses without a decrease in output pressure.

Conclusion: The sparker array provides a consistent, configurable electro-hydrodynamic shock wave source that lasts multiple shock wave lithotripsy procedures. The configurable array allows the inclusion of in-line diagnostics during the procedure without altering the pressure pulse delivery.



Seven element sparker array

ABSTRACT 3

PULSED FLUOROSCOPY IN URETEROSCOPY AND PERCUTANEOUS NEPHROLITHOTOMY

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Introduction and Purpose: Urologists strive to minimize the use of intra-operative fluoroscopy during endourological procedures that usually associated with small but measurable amounts of radiation exposure. The aim of the present study was to assess the impact of pulsed fluoroscopy on the total fluoroscopy time during ureteroscopy (URS) and percutaneous nephrolithotomy (PCNL).

Methods: A retrospective review of prospectively collected data was performed for consecutive patients undergoing URS and PCNL by a single surgeon between July 2009 and July 2011. Pulsed Fluoroscopy (PF) at a rate of 4 frames per second (4 fps) was routinely used in all URS procedures since January 2011 and in all PCNL procedures since November 2010. Prior to these, Standard Fluoroscopy (SF) at a rate of 30 fps was used. Therefore, for each procedure, patients were divided into 2 groups based on whether standard or pulsed fluoroscopy was used. Patient and stone characteristics together with operative data were compared between both groups of each procedure using univariate and multivariate analyses to correct for patients, stone and surgical variables.

Results: A total of 163 URS (117 SF and 46 PF) and 100 PCNL (50 SF and 50 PF) consecutive procedures were included in the study. In the URS cohort, there were no significant differences between both SF and PF groups in terms of age, gender, BMI, stone location, and multiplicity ($p \geq 0.20$). The SF group in the URS cohort had significantly larger stone size (12.9 vs. 10.2 mm; $p=0.03$) which lost its significance in the multivariate analysis. Duration of surgery and stone-free rates were also comparable in both groups of URS and PCNL ($p \geq 0.06$). Compared with SF groups, patients in the PF groups were exposed to significantly less fluoroscopy during URS (109.1 vs. 44.1 sec, $p<0.001$) and PCNL (341.1 vs. 121.5 sec, $p<0.001$). These differences in mean fluoroscopy time retained their significance in the multivariate analyses ($p<0.001$). Female gender**,** right sided stones**,** increased number of punctures and post-operative double-J stenting were significantly higher in the pulsed fluoroscopy in PCNL group in the multivariate model.

Conclusion: The use of PF during URS and PCNL was associated with significantly lower fluoroscopy time thus, reducing radiation exposure.

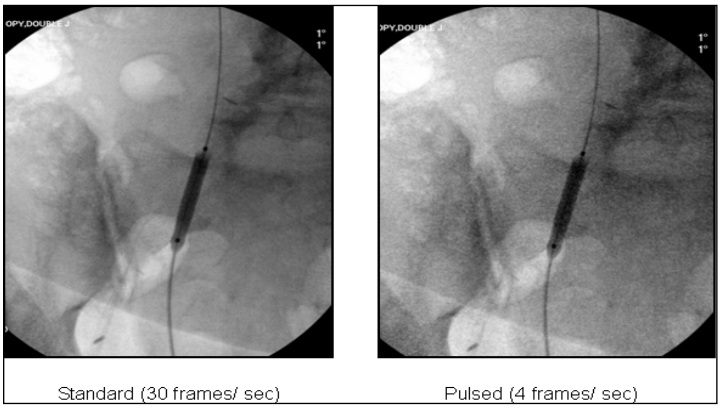

Figure 1: Difference in image quality between standard (30 fps), the left image, and pulsed (4 fps) fluoroscopy, the right image, in a patient undergoing balloon dilation of a mid-ureteral stricture

ABSTRACT 4

FIVE ARM ENHANCED OPTICAL MAGNIFICATION APPROACH FOR ROBOTIC ASSISTED MICROSURGERY

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Winter Haven Hospital & University of Florida

Introduction: Previous studies have shown the potential benefits of robotic assistance in microsurgery. However, one caveat of the robotic platform is the limited 12-15x digital magnification with the standard 3D HD camera that reveals pixilation when microsurgeons are performing complex reconstructive procedures at high magnification. This study presents an enhanced optical high magnification camera (16-18x optical magnification) that can be incorporated to the robotic platform to provide the microsurgeon with a real-time enhanced multi-view experience.

Methods: Review of 191 robotic assisted microsurgical cases performed with the new platform from Dec 2010 to March 2012 by a single microsurgeon. Case breakdown was: 56 vasectomy reversals, 90 microsurgical denervation of the spermatic cord, 37 varicocelectomies and 8 micro TESE (testicular sperm extraction). The VITOM (Karl Storz Inc, Tuttlingen, Germany) optical high magnification lens-camera system was utilized with the TilePro (Intuitive Surgical, Sunnyvale, CA) robotic surgical console software system to provide three simultaneous real-time video images to the microsurgeon during robotic assisted microsurgery. Figure 1 illustrates this tri-view: 1) a 12-15x 3D digital magnification image via the HD robotic camera, 2) a 16-18x optical high magnification view via the VITOM system and 3) a 40x optical microscopic view of fluid being examined by the laboratory technician (for example - vasal fluid evaluation for sperm). The VITOM camera system was held by a nitrogen powered 5th arm (Point setter arm, Karl Storz Inc, Tuttlingen, Germany).

Results: All cases were completed successfully without any technical difficulties. The enhanced platform provided the microsurgeon with improved visual acuity at higher magnifications. The microsurgeon had a cockpit view of all three simultaneous video images in the surgeon console. This allowed for improved efficiency in terms of being able to visualize complex reconstructive maneuvers from two different angles and at two different focal lengths (for standard microsurgery – it common to have to zoom in and out at various stages of the procedure – this platform obviates the need for this).

Conclusion: This novel five-arm robotic microsurgical approach appears to overcome the magnification caveat of the standard robotic platform.

Figure 1: A view from the surgeon console: 3 simultaneous real-time video images

ABSTRACT 5

NEPHRON SPARING SURGERY WITH ZERO ISCHEMIA

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Introduction: Detection of incidental renal lesions has risen sharply. Most are small, < 7 cm-sized lesions. During robotic or laparoscopic nephron sparing surgery renal hilar clamping is often employed. Unfortunately, there is no simple technique to cool renal parenchyma during laparoscopic surgery and longer warm ischemia times are associated with renal damage. Our purpose was to analyze outcomes of patients undergoing laparoscopic and robotic partial nephrectomies without hilar clamping.

Methods: A retrospective database of patients undergoing partial nephrectomy from 2003-2010 was reviewed. Small renal masses suspicious for malignancy were excised by conventional laparoscopic partial nephrectomy (LPN) or robotic-assisted laparoscopic partial nephrectomy (RALPN) without renal vessel clamping. Data from these clinical interactions was retrospectively collected and analyzed, which included patient age, pathologic diagnosis, operative time, surgical margins, serum creatinine change, EBL, post-operative hemoglobin change, transfusion rate, length of follow up, recurrences, and complications.

Results: Twenty-nine patients underwent partial nephrectomy without renal hilar clamping; 15 were performed by LPN while 14 underwent RALPN. No intra-operative complications occurred and 6 (20%) post-operative complications occurred without any reoperation. The mean pre- and post-operative serum creatinine levels were 1.2 and 1.1, respectively. The mean hemoglobin change was -2.7(g/dL), with 3 (10.3%) patients requiring a blood transfusion. Of the masses, 72.4% were malignant, with a mean size of 2.2 cm. One positive margin occurred, but at a median follow -up of 34 months there have been no recurrences in these patients.

Conclusion: Laparoscopic partial nephrectomy with or without robotic assistance can be performed safely without hilar clamping in select patients providing renal functional protection.

ABSTRACT 6

ROBOTIC ULTRASOUND PROBE IN ROBOTIC PARTIAL NEPHRECTOMY

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Introduction: Precise tumor identification during partial nephrectomy (PN) is important for successful oncologic control. Intraoperative ultrasound can help with tumor identification during partial nephrectomy. Robotic partial nephrectomy (RPN) using a laparoscopic ultrasound probe (LUP) for tumor identification requires the probe to be controlled by the bedside assistant. A robotic ultrasound probe (RUP) allows the surgeon to control intraoperative ultrasound, but the use of the RUP has not yet been evaluated in comparison to LUP. We evaluate robotic partial nephrectomy using a RUP in comparison to a LUP.

Methods: Data from 75 consecutive RPNs performed with a LUP between January 2009 and November 2010 were analyzed retrospectively against 75 consecutive RPNs performed with a RUP between November 2010 and November 2011.

Results: A total of 72 patients underwent 75 consecutive RPN using the LUP with a mean tumor size followed by 73 patients that underwent 75 consecutive RPNs using the RUP. The patient population data did not differ significantly. The robotic group had a larger tumor endophytic percentage (42.8 vs. 55.3%, p=0.004), but other perioperative factors, such as mean OR time (233 vs. 218 mins), mean console time (173 vs. 156 mins, p=0.095) and mean blood loss (164ml vs. 171 mL, p=0.79) and positive pathologic margin rates (1 vs. 2, p=1) did not achieve statistically significant difference. All patients are free of cancer recurrence after a mean FU of 25.7 months in the LUP group and 10.2 months in the RUP group.

Conclusion: A RUP under surgeon control during RPN offers comparable tumor identification and margin rates as a LUP with advantages of increased surgeon autonomy.

Figure: robotic ultrasound probe utilizes articulation range of a robotic instrument

ABSTRACT 7

NONINVASIVE HISTOTRIPSY OF THE PROSTATE USING VORTX R_X™: FEASIBILITY IN A CANINE MODEL

William W. Roberts, MD*[1], Dejan Teofilovic,*[2], Russell C. Jahnke*[2], M. Christine Gibbons*[2], Jack M. Risdahl, DVM, PhD[3], James A. Bertolina, PhD*[2]

University of Michigan, Department of Urology[1], HistoSonics, Inc.[2], The Integra Group[3]

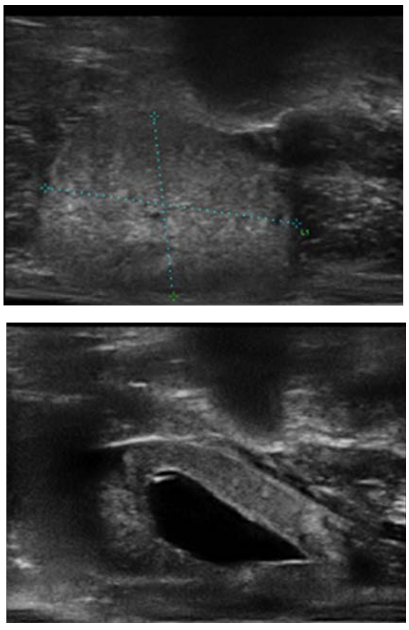
Introduction: Histotripsy is a noninvasive, pulsed, focused ultrasound technology that uses controlled acoustic cavitation to homogenize targeted tissue. The objective of this study was to demonstrate treatment safety and noninvasive debulking of prostate tissue in a canine model using the VORTX R_X™ prototype system developed by HistoSonics, Inc. for treatment of BPH.

Methods: Following animal care and use committee approval, histotripsy treatment of the prostate was performed on ten male canine subjects. The therapy transducer (36-element, 700 kHz, 11 cm focal distance) delivered acoustic bursts (3-cycle, 500 Hz pulse repetition frequency) transabdominally to the prostate. The resultant cavitation cloud was manually translated throughout the targeted volume for 60 minutes in each subject followed by TRUS and cystoscopic assessment. Laboratory tests (CBC, comp, UA) were collected pretreatment, POD 2, 7 and weekly. Prostates were harvested on POD 2 (2 subjects) or POD 28 (8 subjects) following repeat TRUS and cystoscopic evaluation.

Results: A treatment cavity was apparent within each prostate on TRUS and cystoscopy. On POD 2, the cavity contained necrotic debris and was lined by inflammatory cells, hemorrhage and edema. By POD 28, the targeted zone was a widely patent cavity lined by urothelium with minimal to no residual debris. In the subjects harvested at POD 28, pre-treatment prostate size averaged 38.6 cm^3 (range 30.6-44.1 cm^3). A mean of 14.2 cm^3 (range 7.1-20.8 cm^3) of prostate tissue was removed, corresponding to an average debulking of 36% (range 19-53%) of total prostate volume. Expected changes in urinalysis (hematuria, pyuria, and proteinuria) and transient elevation in WBC were observed following treatment. Though not producing clinical signs or symptoms, notable pathologic findings at necropsy consisted of rectal wall muscle degeneration (2 subjects) concerning for potential histotripsy effect and 1 cm diameter areas of fibrosis in the abdominal rectus muscle (2 subjects) consistent with thermal injury along the acoustic propagation path to the prostate.

Conclusion: Transabdominal application of histotripsy to prostate tissue in the canine model from the VORTX R_X™ system produced cavitation activity that was easily identified with TRUS imaging. A substantial treatment cavity was apparent at harvest in all subjects and generally appeared well healed by POD 28. Although not producing clinical effects, the pathologic findings of degeneration of muscle in the rectal wall and zones of fibrosis in the abdominal rectus muscle are of concern as they may represent suboptimal confinement of cavitation activity and heating of overlying tissues respectively. Further work is underway to quantify the pre- and post-focal acoustic and thermal fields to eliminate these effects prior to human application.

Funding: HistoSonics, Inc., *Financial interest / other relationship with HistoSonics, Inc.



Prototype system (left). Sagittal US images of canine prostate before treatment (top) and on POD 28 demonstrating central treatment cavity (bottom).

ABSTRACT 8

NOVEL ULTRA-LOW DOSE NON-CONTRAST (NCCT) FOR UROLITHIASIS: PROSPECTIVE COMPARISION OF DIAGNOSTIC ACCURACY WITH CONCURRENT STANDARD DOSE IMAGING

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Introduction: NCCT is the gold-standard diagnostic study for urolithiasis evaluation. However, concerns over the potential risks related to ionizing radiation may limit its use. Ultra-low dose (ULD) NCCT could potentially lower radiation exposure below that of a conventional KUB, but an acceptable level of diagnostic accuracy must be maintained. We report preliminary results of our ongoing prospective ULD NCCT trial for renal stone detection.

Methods: Following informed consent, NCCT for urolithiasis evaluation was performed in 10 consecutive adults (mean age, 55.8 years; mean BMI, 27.5), using our standard-dose (SD) protocol immediately followed by a matched ULD series. All scans were performed on a GE Discovery CT750 HD scanner and two software rendering protocols for image reconstruction were used, FDP and ASiR. Axial and coronal 5x3mm reconstructions were obtained for each series. The 40 total series were anonymized and interpreted in random order for urolithiasis detection.

Results: For the ULD series, the range of dose reduction relative to SD was 82-90% (mean, 87% reduction), with a mean effective dose ranging from 0.88 mSv to 1.54 mSv (mean, 0.99 mSv). Seven cases were below 1.0 mSv. A total of 29 renal calculi (range, 1-22 mm; mean, 4.1 mm) were identified at SD NCCT, of which 22 (75.9%) and 22 (75.9%) were detected at ULD with FBP and ASiR, respectively. Overall sensitivity was 76%, however, subgroup analysis by stone size showed improved detection rates for stones ≥3 mm, i.e. all 19 calculi ≥3 mm were seen on both ULD reconstructions. Only 10-30% of stones ≤2 mm was prospectively identified on the ULD series.

Conclusion: Ultra-low dose NCCT for urolithiasis in the 1 mSv range can accurately detect calculi ≥3 mm but fails to detect most stones ≤2 mm. Typically the clinical ramifications of these stones (≤2 mm) is less relevant acutely. The degree of dose reduction that preserves diagnostic accuracy for tiny calculi remains uncertain, but may be influenced by further improvements in iterative reconstruction techniques.

ABSTRACT 9 **TOP 10 ABSTRACT**

SURGTRAK: EVOLUTION OF A MULTI-STREAM SURGICAL PERFORMANCE DATA CAPTURE SYSTEM FOR THE DA VINCI SURGICAL ROBOT

Lee W White[1], Timothy M Kowalewski[2], Blake Hannaford[2], Thomas S Lendvay[3]

[1] *BioEngineering Department, University of Washington*
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Introduction: The da Vinci surgical robot lacks open access to the surgeon motion data which is the foundation of automated and objective performance assessment. Thus we developed a robotic tool and video tracking platform, SurgTrak (White, et. al., SAGES 2011). The system uses readily adaptable custom software to merge streams of tool position and orientation data with the motion of the end-effectors and high definition (HD) video. We have since expanded the system to record three new wireless data sources: intraoperative electroencephalogram (EEG) of surgeons, surgeon hand motion data, and end-effector motion data. This enables unencumbered data capture in the operating room.

Methods: This generation of SurgTrak features the following improvements:

- Record surgeon EEG during surgery using the B-Alert X10 by Advanced Brain Monitoring, Inc. which evaluates the surgeon's level of engagement, distraction, and cognitive workload.
- Time synchronized hand motion data is recorded using a pair of AcceleGloves from Anthrotronix, Inc.
- End-effector motion data produced by the rotation of the spindles in the proximal portion of the da Vinci tool are wirelessly transmitted by custom electronics featuring a 16 Mhz. Atmel microprocessor and an XBee wireless serial module capable of communicating at 115.2 kbps.
- Standard Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) allow the system to receive data streams from other data sources.

Results: The system was tested for reliability and is in use in two studies currently underway: 1) recording simultaneous HD video and surgeon EEG during robotic assisted prostatectomy, and 2) recording da Vinci tool motion, HD video, and surgeon hand motions while performing bladder cystotomy closures on a live porcine model. The objective of both studies is to elucidate the potential benefit of virtual reality based training and warm-up on surgical performance.

Conclusion: The SurgTrak system is configurable, deployable and capable of capturing many facets of surgical performance on the da Vinci surgical robot including surgeon motion, cognitive and psychomotor skills, mental workload, and surgery video documentation.

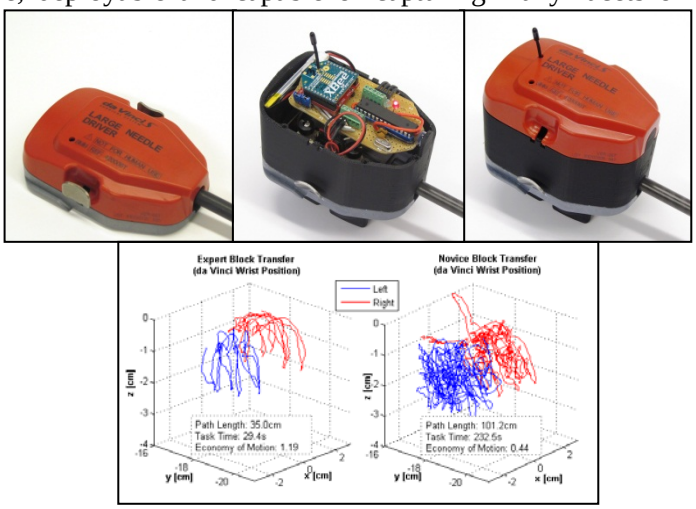

Figure 3: (Top from left) Unmodified da Vinci Large Needle Driver, SurgTrak wireless tracking system electronics, finished

ABSTRACT 10

XenX: EVOLUTION OF DESIGN BASED ON CLINICAL EVALUATION

Ofer Zigman, Carl Sarkissian, Idan Tamir, Manoj Monga

Introduction: The XenX (Xenolith Medical, Ltd) is a new ureteral occluding device intended to serve as a safety guidewire, prevent retrograde stone migration during ureteroscopic lithotripsy, and place ureteral stents. A total of 13 ureteroscopy procedures for ureteral stones were performed with the XenX at two institutions by five board certified physicians. We present results from in vitro testing designed to validate modifications based on issues encountered during the first clinical evaluations. Physician feedback with regard to the ability to gain ureteral access, deploy the occluding braid, prevent stone migration, basket alongside the device, radiopacity, kink resistance, and retrieval of the device, was used to identify the most effective modifications for improving performance. Some modifications include increasing the occluding braid diameter for retention in dilated ureters, varying floppy tip length for improved maneuverability, and reducing sheath diameter for improved stent compatibility.

Methods: Device migration as a result of ureteroscope manipulation within the ureter was found to affect several feedback areas and reduce overall efficiency associated with the use of this device during multiple cases. Accordingly, an in vitro set-up was devised to evaluate the extent to which the most recent design modification (PTFE-coating over the polyimide sheath and nitinol core wire) affects frictional characteristics between the device and ureteroscope. A 2.99 mm outer diameter 43 cm long stainless steel (SS) tube was placed within a 4.0 mm inner diameter PTFE tube, designed to model a semi-rigid ureteroscope within a non-dilated ureter. The XenX polyimide sheath was attached to a load cell and motorized test stand, placed alongside the SS tube within the model ureter, and extracted from the tubing for a distance of 80 mm at a speed of 100 mm/min. Forces were measured throughout the entire extraction, and a total of 5 repetitions were conducted using a new device each time. Individual trials were conducted with the PTFE coated and uncoated models of both the sheath and core wire. A similar set-up was used to conduct a comparative assessment of the extent to which device migration occurs as a result of scope movement. The SS tube was extracted 300 mm, and total displacement of the wire/sheath from the original position was measured. The average displacement of 5 repetitions was calculated and compared to results using a Sensor (Boston Scientific) guidewire.

Results: Forces associated with movement of the uncoated core wire and sheath alongside the SS tube ranged from 14-64.3 g and 26.4-40 g, respectively, increasing in a linear fashion as a function of total displacement (see figure 1). The PTFE coated core wire and sheath were found to produce forces ranging from 3.3-15.1 g and 18.5-30.2 g, respectively, demonstrating a slope reduction trend as a function of displacement in comparison with the uncoated units. The uncoated and PTFE coated core-wire migrated an average of 64.8±4.6mm and 6.6±1.8 mm, respectively, while the outer sheath demonstrated a similar reduction in migration from 63.8±5.1 mm to 36.6±4.6 mm. The Sensor guidewire migrated an average of 31.4±5.4 mm.

Conclusion: PTFE-coated wire and sheath components significantly reduced static and dynamic friction and resulting migration when compared to uncoated components. Recent modifications suggest the XenX holds promise for performing similar to commercially available guidewires, such as the Sensor, in an in vivo setting with regard to ureteroscope compatibility.

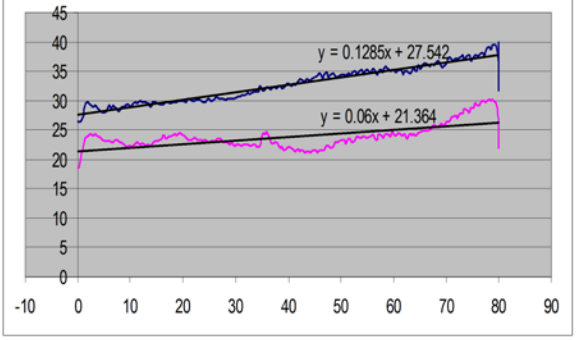

Figure: Force (g) vs. displacement (mm) for coated (magenta) and uncoated (blue) XenX sheath

ABSTRACT 11

RAPID EXTRACORPOREAL STONE COMMINUTION: MECHANISTIC INSIGHTS IN VITRO

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Introduction: Previous work has demonstrated that cavitationally-based pulsed ultrasound therapy (histotripsy) effectively comminutes model stones, eroding the surface to fine debris <100-µm in size. Here, histotripsy was evaluated as a potential adjunct to conventional SWL procedures, with the hypothesis that a synergistic interplay of the two modalities will yield faster and more complete stone comminution.

Methods: Composite model stone cylinders (d=10-mm) formulated to mimic naturally occurring cystine calculi were treated in-vitro with a research system capable of delivering electrohydraulic SWL (1 Hz) and histotripsy (100 Hz) confocally. Five stones were sonicated with each of five different treatment schemes: **1** - Ten minutes electrohydraulic SWL; **2** - Seven minutes histotripsy; **3** - Treatment 1 (SWL) followed by 2 (histotripsy); **4** - Treatment 2 (histotripsy) followed by 1 (SWL); **5** - Ten minutes electrohydraulic SWL interleaved with histotripsy pulses. Following each treatment, stone debris was collected and sequentially sieved through 8-mm, 6-mm, 4-mm, and 2-mm filters.

Results: Stone debris size distributions are displayed in Figure 1. Following ten minutes of electrohydraulic SWL, stones were reduced to a broad range of fragment sizes, with an average of 33% of the original stone mass remaining >6-mm. The addition of histotripsy therapy (Treatments 3, 4, and 5) resulted in a higher degree of stone comminution, with electrohydraulic SWL followed by histotripsy achieving the most complete state of stone subdivision.

Conclusion: Incorporating histotripsy with electrohydraulic SWL enhanced the degree of stone comminution following truncated stone sonication. When applied prior to lithotripsy, it is likely that surface defects induced by histotripsy erosion act as nuclei for shockwave crack propagation. When applied after lithotripsy, the increased stone surface area afforded by shockwave stone subdivision enhances the efficacy of histotripsy stone erosion. It is likely that both these effects are at play to some extent during the interleaved therapy. However, further optimization of this interleaved pulse scheme is required in order to minimize potential microbubble shielding effects of remnant histotripsy nuclei on subsequent shockwaves.

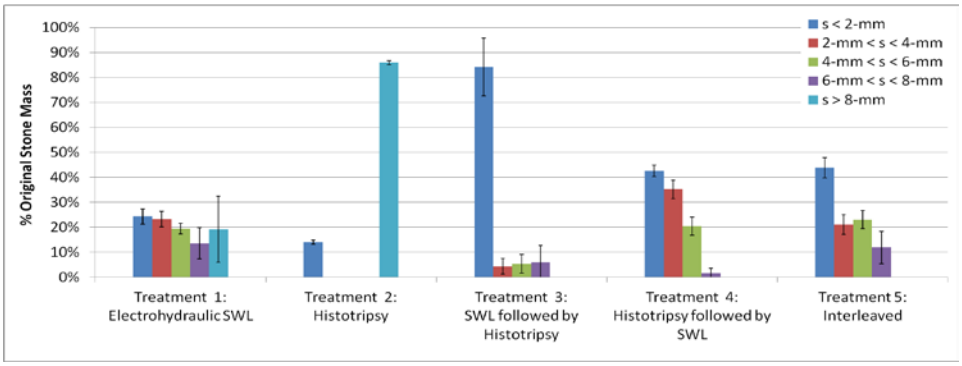

Figure 1: Stone Debris Size Distributions

Funding: NIH R01-DK09126701
*Financial interest/other relationship with HistoSonics, Inc.

ABSTRACT 12 **TOP 10 ABSTRACT**

DESIGN OF AN AUTOMATED CYSTOSCOPE FOR BLADDER CANCER SURVEILLANCE

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Introduction: Bladder cancer has the highest recurrent rate. Several years of diligent and accurate postoperative surveillance are necessary to monitor the recurrences of tumors. The current surveillance procedure is carried out by an urologist who manually manipulates a cystoscope to visually inspect the bladder inner surface. In order to improve the efficiency and accuracy of cystoscopies, an automated cystoscope is proposed to scan the entire bladder surface by steering an imaging probe to follow an optimal pre-programmed scan trajectory. Images abstracted from the cystoscopic video can be used for building a 3D panorama of the bladder surface [1].

Methods: The proposed cystoscopic system consists of a three-segment bending mechanism (Fig. 1). With the flexibility of multi-segmented mechanism, the positions and the orientations of the camera located at the tip of the imaging probe can be controlled independently. Therefore, perpendicular views on the bladder surface and the safety distance between the camera and the bladder wall are guaranteed. Compared to the previous design based on shape-memory alloy actuators [2], the proposed design is driven by thin mechanical wires (Fig. 2), thus eliminates the possibility of intrinsic thermal hazards to tissues. Kinematic simulations of following spiral scan trajectories are performed in MATLAB.

Results: The simulation results prove that with synchronized bending motions of all three segments, the distal camera can follow different specified scan trajectories. Using an optimized spiral scan trajectory with minimized translation/rotation motions and appropriate view center (camera position) density control, the anticipated time required for a complete scan is simulated as less than three minutes. In order to maintain the best quality in 3D panorama construction, this optimized trajectory maintains 50% spatial overlap between the adjacent image frames.

Conclusion: A new automated cystoscopic procedure is designed to improve the overall performance of the bladder cancer surveillance and this can reduce the workload of urologists as well. The simulated results show a significant reduction in surveillance time for a complete scan compared to the previous study. The miniaturized flexible robotic articulation combined with 3D image reconstruction is under construction and may up the new potential to revolutionize the bladder cancer examination.

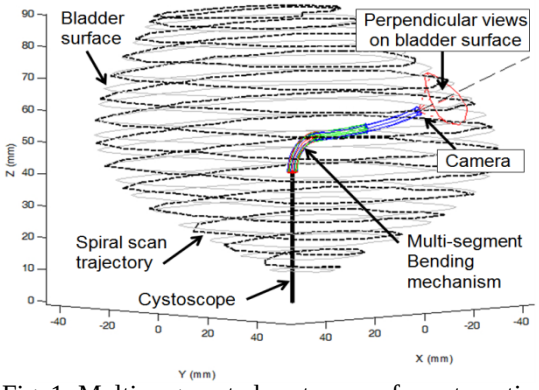

Fig. 1: Multi-segmented cystoscope for automatic scanning. This spiral scan trajectory ensures 50% image overlap.

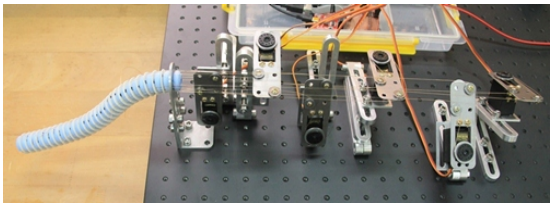

Fig. 2: Bigger scale proof-of-concept prototype of the proposed bending mechanism.

[1] E.J. Seibel, T.D. Soper, M.R. Burkhardt, M.P. Porter, W.J. Yoon, Multimodal flexible cystoscopy for creating co-registered panoramas of the bladder urothelium, Photonic Therapeutics and Diagnostics VIII, *Proc. of SPIE* Vol. 8207, 82071A (2012)

[2] W.J. Yoon, S. Park, P.G. Reinhall, and E.J. Seibel, Development of and Automated Steering Mechanism for Bladder Urothelium Surveillance, Journal of Medical Devices, 2009, 3(1): 11004.

ABSTRACT 13

A NOVEL VAS CLAMP FOR USE IN NONINVASIVE LASER VASECTOMY

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Introduction: Approximately 500,000 vasectomies are performed in the United States per year, making it the most common urological procedure in the U.S. Although vasectomy is more effective and less likely to have complications than tubal ligation, the number of men undergoing surgical sterilization is about three times less than women. Fear of complications related to surgical vasectomy is a major factor in a couples' choice of surgical sterilization. A completely noninvasive technique for male sterilization may improve acceptance of vasectomy. Our laboratory is currently developing a noninvasive vasectomy technique using near-infrared laser irradiation in conjunction with cryogen spray cooling of the scrotal skin for thermal occlusion of the vas. During preliminary studies, we reported successful thermal occlusion and scarring of the vas in *ex vivo* and *in vivo* canine models, with the thermally coagulated vas segment withstanding burst pressures over twice that of normal ejaculation pressures. However, rare complications associated with sub-optimal alignment of laser and cryogen spots with the vas (e.g. scrotal skin laser-induced heat and cryogen-induced freeze burns) resulted in delays and aborted procedures. These problems were in part due to misalignment and may be solved using an improved vas clamp.

Methods: We describe the design and testing of a novel vasectomy ring clamp attachment which allows the surgeon to rapidly and precisely co-align both the laser spot and cryogen spot with the vas deferens for consistent and reproducible targeting of the vas. This design allows the surgeon to continue to use a standard no-scalpel vasectomy (NSV) ring clamp to isolate the vas, and to maintain a field-of-view during non-contact delivery of the laser radiation to the vas.

Results: If a NSV ring clamp is used as the main axis of reference, it is possible to achieve any orientation necessary for a successful procedure with only four degrees of freedom. Three orthogonal degrees of freedom allow the necessary components to be placed anywhere, spatially, in relation to the ring of the NSV clamp. An additional fourth degree of freedom, roll, provides the user with the ability to correct for any rotation of the clamp inside the secured device. By using a cylindrical coordinate system it is possible to minimize the material necessary to achieve all three orthogonal degrees of freedom (ρ,ϕ,z), and thus provide a lightweight, handheld stainless steel design. Roll is then added by allowing the stabilizing arm which controls the ρ component to rotate freely before it is locked into place with a set screw (Figure 1).

Conclusion: A prototype NSV clamp attachment was designed and successfully tested during noninvasive laser vasectomy procedures performed in an in vivo canine model. Previous problems involving misalignment of the laser and cryogen spots with the vas were eliminated. Azospermia and recanalization studies are currently being conducted to determine the long-term efficacy of this technique.

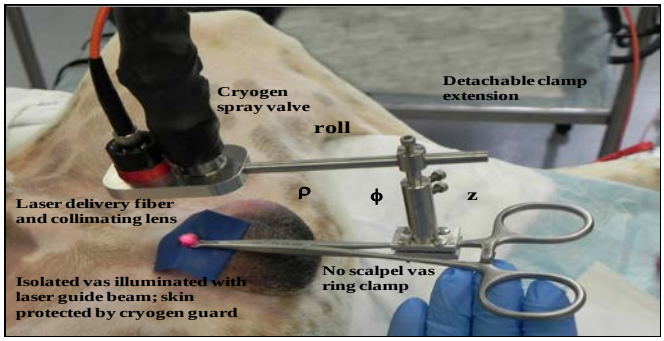

Figure: Clamp attachment allowing precise co-location of laser spot, cryogen spot, and vas segment grasped in standard NSV clamp.

ABSTRACT 14

A COMPARISON OF DIFFERENT ACUTE ANGLES BETWEEN STRAIGHT INSTRUMENTS USED DURING LAPAROSCOPIC SUTURING AND KNOT TYING

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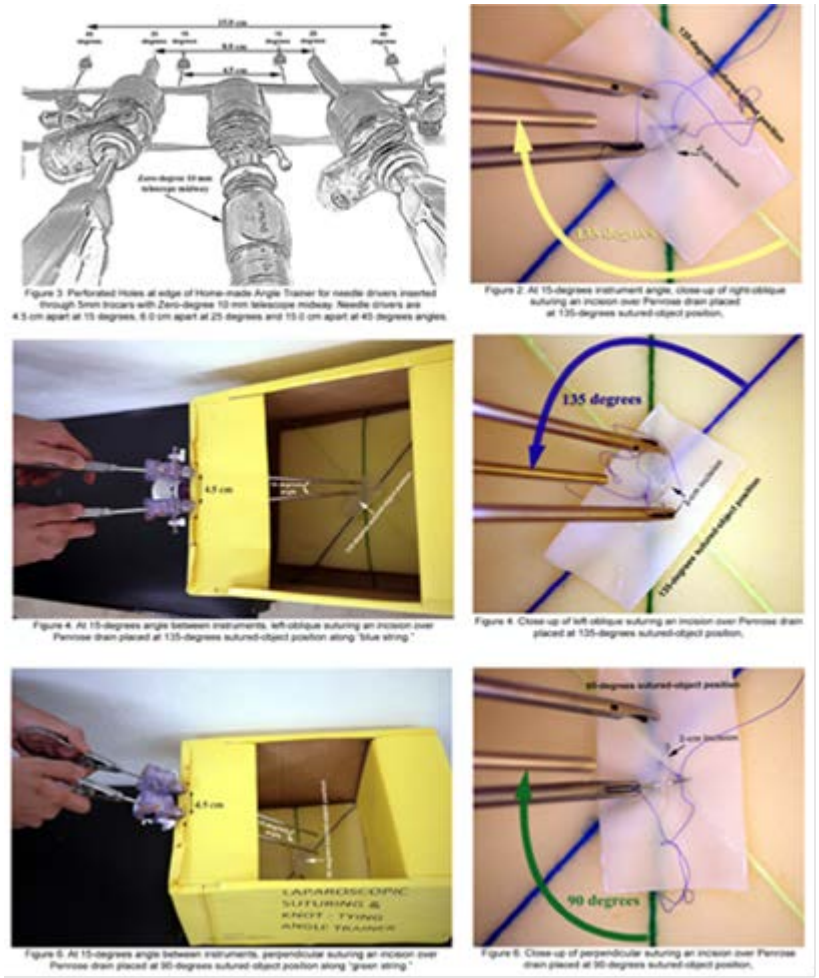
Introduction: Traditionally, laparoscopic suturing and knot tying are done using straight needle holders and graspers at acute angles between these instruments. Our objective is to compare angles of 15°, 25° and 45° between straight instruments used during laparoscopic suturing and knot tying.

Methods: Timed exercises by six urologists were done by making five sutures and tying three knots with 3-O Polyglycolic acid with HR-26 needle in a 2 cm. incision model inside the "Home-made Laparoscopic Suturing and Knot-Tying Angle-Trainer." Straight laparoscopic needle drivers and graspers were placed at instrument angles between them of 15°, 25° and 45° respectively. Two sets of exercises were done by suturing penrose drain in oblique 135° (simulating laparoscopic suturing in pyeloplasty, partial nephrectomy, or ureteral surgery) and perpendicular 90° positions relative to telescope axis (simulating laparoscopic suturing in prostatectomy or cystorrhapy) respectively.

Results: In the first exercise of sutured-object position in oblique 135° relative to telescope axis: at 15° instrument angle, suturing and knot tying was 1046 seconds (range 698 - 1454); at 25° instrument angle, suturing and knot tying was 785 seconds (range 487 - 1313); and at 45° instrument angle, suturing and knot tying was 744 seconds (range 480 - 1128). In the second exercise of sutured-object position in perpendicular 90° relative to telescope axis: at 15° instrument angle, suturing and knot tying was 929 seconds (range 360 - 1576); at 25° instrument angle, suturing and knot tying was 736 seconds (range 345 - 1325); and at 45° instrument angle, suturing and knot tying was 695 seconds (range 408 - 1157). Using Wilcoxon Signed Rank Test, suturing and knot tying was significantly longer (p = 0.0061) at 15° instrument angle compared with 25° instrument angle and with 45° instrument angle, in both 135° and 90° sutured-object positions. No significant difference (p = 0.1167) in suturing and knot tying was noted at 25° instrument angle compared with 45° instrument angle.

Conclusion: The more acute 15° angle between straight instruments, compared to both 25° and 45° angles between instruments, result in significantly longer duration of laparoscopic suturing and knot tying. However, comparing 25° and 45° angles between instruments, no significant difference was noted in duration of laparoscopic suturing and knot tying.



ABSTRACT 15

INITIAL EXPEREINCE WITH PERCUTANEOUS MICROWAVE ABLATION OF RENAL TUMORS: MULTICENTER EVALUATION OF SAFETY AND EFFICACY

Sara L. Best,[1] Timothy J. Ziemlewicz,[2] Aaron M. Fischman,[3] E. Jason Abel,[1] J. Louis Hinshaw,[2] Fred T. Lee Jr.,[2] Christopher L. Brace,[2] Meghan G. Lubner,[2] Stephen Y. Nakada,[1,2] Marci L. Center,[2] Anna J. Moreland[2]

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Introduction: Microwave ablation offers the potential advantages of high temperature and faster tissue heating, but prior instrument development has been limited by overheating of the antenna shaft and supply cables. Recently, a novel gas-cooled microwave generator and antenna has been developed and approved for tumor ablation by the FDA. We report the feasibility, safety, and preliminary effectiveness of this high-powered, gas-cooled microwave ablation system in the treatment of renal parenchymal tumors.

Methods: Between 1/2011 and 3/2012, renal parenchymal tumors (n=17) were treated at two medical centers with intent to cure using ultrasound and CT-guided microwave ablation with a high-powered, gas-cooled microwave ablation system (NeuWave Medical, Madison, WI). Tumors included biopsy-proven renal cell carcinoma (n=13; grade 1=4; grade 2=6, ungraded=3), oncocytoma (n=1), insufficient tissue for diagnosis (n=1), and angiomyolipoma (n=2, diagnosis made by imaging). Mean patient age was 66 years, with 13 males and 4 females. Post-procedure imaging was performed by contrast-enhanced CT or MRI to evaluate for recurrence.

Results: Mean maximum tumor diameter was 3.0 cm (range: 1.9-5.4). Tumor diameter decreased by a mean of 13% (range: 0-30%; SD = 8%) as assessed on immediate post-ablation CT. A mean of 1.5 antennae were used per tumor, and the mean and median duration of power application was 6.1 and 5.0 minutes, respectively. Mean and median generator powers were 83.0 and 70.0 W, respectively (range: 55-140). Technical success (no residual enhancing tumor) was achieved for all tumors. No major complications were reported. Two minor complications occurred, each consisting of small, asymptomatic sub-capsular hematomas. Length of hospitalization following the ablation procedure was 1 day in each case. Mean and median length of follow-up was 3.4 and 2.0 months, respectively. Among the patients who have reached follow-up imaging time-points, no local tumor progression was identified in any case (n=1, 4-month; n=1, 6-month; n=1, 12-month).

Conclusion: Preliminary experience with high-powered, gas-cooled percutaneous renal microwave ablation demonstrates immediate technical success in treatment of small renal tumors. Further studies are warranted to demonstrate long-term oncologic outcomes and optimal surveillance protocols after ablation.

ABSTRACT 16

TARGETED ROBOTIC ASSISTED MICROSURGICAL DENERVATION OF THE SPERMATIC CORD FOR CHRONIC ORCHIALGIA

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Introduction: Previous groups have shown microsurgical denervation of the spermatic cord (MDSC) as a less invasive treatment option for chronic orchialgia. Pathology and anatomical studies have identified specific nerve bundles within the spermatic cord that may be responsible for chronic pain in these men. This study presents outcomes for a robotic assisted targeted MDSC approach (RMDSC) utilizing a mapped nerve protocol to maximize preservation of vessels and lymphatics.

Methods: Review of a prospectively maintained consented outcomes database. A four-arm RMDSC technique was developed using the da Vinci platform (Intuitive Surgical, Sunnyvale, CA). Analysis of 371 RMDSC cases from Oct 2008-Mar 2012 was performed (median follow up 21 months: 1 to 41). Patient selection criteria for RMDSC: chronic testicular pain (>3 months), failed all other standard pain management treatments and negative urologic workup. Pain scores where recorded based on a standardized externally validated pain assessment tool - PIQ-6 (QualityMetric Inc., Lincoln, RI) preoperatively and then postoperatively at 1, 3, 6, 9 &12 months.

Results: 86.5% (321/371) of the patients had a significant decrease in their pain defined as a score of ≤50 (no impact on quality of life) or a greater than 50% reduction in pain by 6 months post-op. The procedure failed to provide pain relief in 50 patients. The median operative duration was 15 min (10-150). Complications were: 1 testicular ischemia, 9 hematomas, and 2 seromas. There were two testicular artery and one vasal injury: these were repaired intra-operatively with robotic assisted microsurgical techniques without any further sequela. The 4th robotic arm allowed the surgeon to control one additional instrument (micro Doppler) leading to less reliance on the microsurgical assistant.

Conclusion: Targeted robotic assisted microsurgical denervation of the spermatic cord is feasible and the preliminary results appear promising. Further follow up and evaluation is warranted

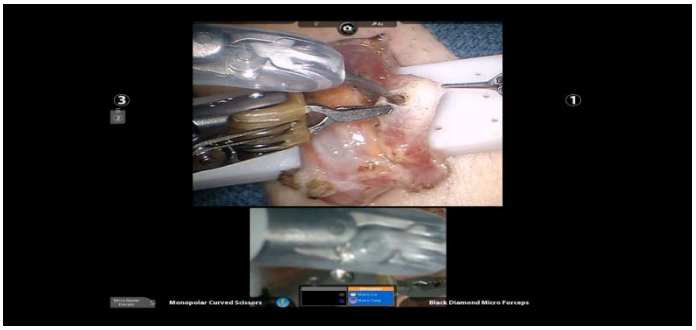

Figure: The peri-vasal nerve fibers are being ablated

ABSTRACT 17

A NOVEL SYNTHETIC VAS DEFERENS MODEL FOR MICROSURGICAL TRAINING

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Introduction: Microsurgical vasovasostomy is a technically challenging procedure. Our current training models for microsurgical skills training for this procedure include live rodent and cadaver vas deferens models – both of which are expensive and require appropriate training lab facilities. The goal of this study was to develop an inexpensive, easily accessible synthetic vas deferens (SVD) model for microsurgical skills training.

Methods: A synthetic vas deferens (SVD) model was developed based on an inexpensive hydrocarbon material (SynDaver Labs, Tampa). Mechanical tissue shear and puncture properties where modeled to mimic human vas deferens tissue. The shape, diameter and lumen size was based on 6 human vas deferens samples. The new model was then tested on 21 trainee microsurgeons during a hands-on microsurgical training lab. Measures recorded where ease of use, tactile similarity to human vas and suturing ability.

Results: Mean width and wall thickness for the human vas was 5.08mm and 1mm, respectively. For SVD, 5.08mm and 2mm, respectively. For shear (break point) testing, the mean break stress was 12.07psi for SVD and 12.16psi for human vas (parametrically congruent). For puncture testing (1mm blunt needle inserted into tissue at 50mm/min), the mean peak load for 7 SVD samples was 9.71N, and 14.53N for 6 human vas samples ($p = 0.02$). During the 21 microsurgeon trainee lab, all the surgeons reported ease of use, tactile sensation similar to human vas and ability to suture an anastomosis similar to human vas. There were 3 minor complaints: 1) lack of consistency of the vas lumen size along the length of the SVD in some samples, 2) diffusion of the microdots placed on the transected SVD surface (used during the microdot vasovasostomy technique), and 3) difficulty in securing the SVD to the vasovasostomy holder in some cases where the SVD outer lining was very smooth and slippery.

Conclusion: The preliminary results in the mechanical and clinical testing of the synthetic vas deferens model appear promising. Further refinements to the model have been made based on the above feedback. This model may provide a very cost-effective, portable alternative to our current microsurgical training models.

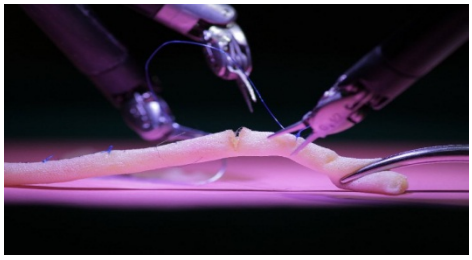

Figure: Synthetic vas deferens during robotic assisted microsurgical vasovasostomy training.

ABSTRACT 18

EVALUATION OF SCOPESAFE FIBERS AND THE SCOPE GUARDIAN SHEATH IN PREVENTION OF URETEROSCOPE ENDOLUMINAL WORKING DAMAGE

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Introduction: The Holmium:YAG/Neodymium:YAG laser is an adjunct for endoscopic stone treatment. While endoscope damage due to laser energy is well recognized, mechanical damage to the working channel due to repeated insertions of laser fibers is a less understood and appreciated mechanism for ureteroscope damage via working channel perforation. We evaluated ureteroscope performance metrics and working channel damage with ScopeSafe fibers and the Scope Guardian Sheath.

Material and Methods: A 200μm/272μm ScopeSafe fiber with Scope Guardian Sheath (Optical Integrety Inc., Panama City Beach, Florida) was objectively assessed in a new 7.5 Fr flexible distal sensor chip ureteroscope (Storz X^C). We measured active upward and downward deflection (up and down) and irrigation flow rates with this novel fiber and sheath system, and with standard 200μm/272μm laser fiber (Cook Urological Inc., Spencer, Indiana). Additionally 8 non assembled working channel elements from the Storz X^C ureteroscope were tested in a 90° and 210° deflection model. 200μm/272μm ScopeSafe fibers with Scope Guardian Sheath and 200μm/272μm standard laser fibers were inserted into an irrigated working channel (0.9% NaCl) in cycles of 10 insertions. After 40 insertions the insertion cycle was reduced to 5 insertions. Test cycles were followed by an external inspection and an endoluminal video examination of the working channel by a 2.4Fr flexible Storz fiberscope. Damage to the working channel was classified as superficial scratches, demarcated abrasions, or perforations.

Results: There were no channel perforations or damage with one hundred laser fiber insertions with the 200μm/272μm ScopeSafe fibers with Scope Guardian Sheath in the 90° model as well as in the 210° model. With the standard laser fiber, in the 210° model superficial scratches and demarcated abrasions were visible after 10 and 60–70 insertions for the 272μm laser fiber and after 30 insertions (superficial scratches) for the 200μm laser fiber. In the 90° model, superficial scratches occurred after 20 insertions for the 272μm fibers and after 40 insertions for the 200μm laser fibers. No demarcated abrasions were seen after 100 insertions. In the 210° model we saw 1 perforation after 110 insertions with the 272μm fiber, but none with 200μm fiber. The Scope Guardian Sheath resulted in a 4.7°/3.8° (1.2%/1.5%) diminishment in deflection (up/down) for the 200μm and a 3.5°/4.3° (1.8%/1.5%) diminishment for 272μm laser fiber compared to standard 200/272μm laser fiber. Irrigation flow rate was diminished with the use of the sheath on both the 200μm and 272μm laser fiber by 9.33ml/s (28.7%) and 9.13ml/s (32.6%), respectively.

Conclusion: In this *in vitro* study, the scope Guardian Sheath prevented damage to ureteroscope working channels. There was some limited diminishment of deflection and irrigation flow rate compared to standard laser fibers alone.

ABSTRACT 19 **BEST PAPER AWARD**

PRECLINICAL SAFETY AND EFFICACY OF ULTRASONIC PROPULSION OF KIDNEY STONES

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Introduction: Our research group is pursing FDA approval for a human feasibility study of a non-invasive transcutaneous ultrasound device to expel small kidney stones or fragments from the kidney. The goal is to facilitate clearance of small stones or residual fragments post-treatment. Extensive testing of this device has been completed in the porcine model. The purpose of this study was to evaluate the safety and efficacy of ultrasonic propulsion of surgically implanted stones in a live porcine model.

Methods: In each kidney of 8 domestic female swine (50-60 kg) human stones and metalized glass beads (1-6 mm) were implanted by retrograde ureteroscopy. A bead was placed in the upper pole as a position reference and additional stones/beads were placed in the mid and lower pole to reposition. Ultrasonic propulsion was performed using a Verasonics ultrasound engine and a Philips HDI C5-2 commercial imaging transducer. Stone propulsion was visualized ureteroscopically, using fluoroscopy and our ultrasound system. The kidneys were perfusion-fixed with glutaraldehyde and evaluated for injury by a blinded independent expert.

Results: Stones were successfully implanted in 14 kidneys. Over 75% of stones/beads were moved from the lower pole calyx to the ureteropelvic junction or ureter. Ultrasound procedure time was less than 20 minutes to move each stone. No damage was identified from the ultrasound propulsion procedure other than that created by the ureteroscopic stone implantation.

Conclusion: In preclinical trials in a porcine model, ultrasonic propulsion is effective with most stones being relocated to the ureteropelvic junction or ureter in a timely fashion. The procedure appears safe with no evidence of tissue damage. The angle and alignment of directional force is critical for the efficacy of stone propulsion. There was an improvement over the study period emphasizing this skill likely requires training.

Work supported by NIH DK43881, DK092197 and NSBRI through NASA NCC 9-58.

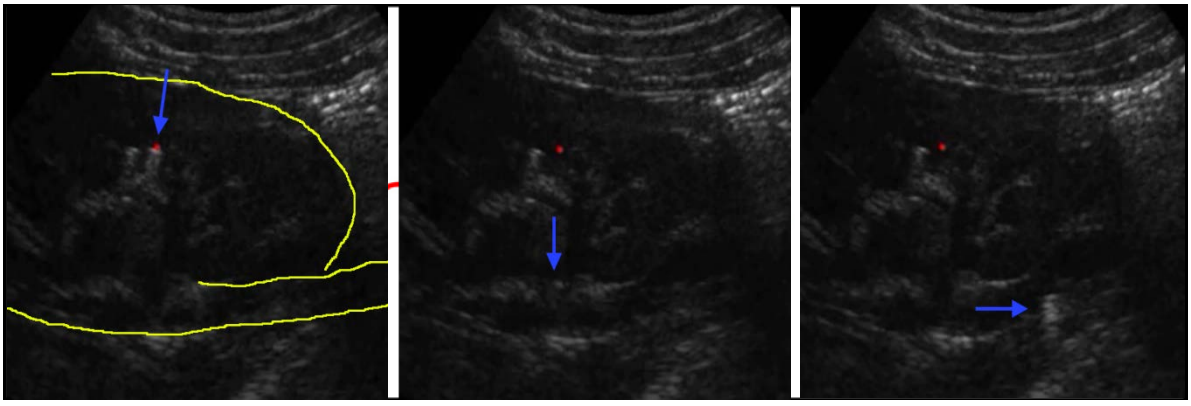

Figure: Real-time B-mode imaging and guidance inherent in the system. The blue arrow indicates the stone and direction of stone motion in the collecting system. After targeting (red dot), a single 0.5 second burst of ultrasound pulses is applied and the stone makes a single movement from the calyx to the proximal ureter. All motion occurs in about 1 second.

ABSTRACT 20

HOW TO USE AN OPTICAL TRACKER FOR MORE ACCURATE MEASUREMENTS

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http://urobotics.urology.jhu.edu/

Introduction: Optical and magnetic tracking systems are widely used to measure the location of medical instruments in order to provide image-based intraoperative navigation. The basic tracking device measures the 3D coordinates of one or more special markers. Tracker manufacturers typically provide a global upper limit of these systems' measurement accuracy and precision. In our studies we observed that these values can be substantially improved under ideal conditions. This would allow optical trackers to be used for applications with stricter measurement requirements, such as validating the kinematics of a medical robot. Here, we present an optimized setup and data acquisition protocol for the Polaris Hybrid optical tracker (NDI, Canada) which may improve its precision and accuracy of measurement.

Methods: A passive optical marker was placed in the spindle of a Computer Numerically Controlled (CNC) Vertical Machining Center (Haas VF-1), as shown in Figure 1. A Polaris Hybrid position sensor was attached with an extension to the table of the CNC. As such, the marker can be moved relative to the tracker with three CNC axes translations. This allowed the marker to be precisely positioned within 2µm. A CNC program commands the marker to a set of predefined points and sends the respective coordinates to a PC over a serial port. The PC records the coordinates and triggers the Polaris to take a series of marker location measurements. The CNC data is used as a gold-standard for evaluating the Polaris. The CNC-to-Polaris space registration is performed using Arun's point-cloud method. Precision and accuracy follow their standard definitions. The set of predefined marker points includes 91 locations in a pyramid shape with 6 square point arrays growing away from the tracker, chosen to be as close as possible to the tracker within the working envelope of the CNC.

Figure 1: Test setup showing optical tracker and CNC machine

Results: Figure 2 shows the cumulative average of samples acquired successively at the same static location of the marker plotted in the XYZ Polaris directions. As expected, these show that the cumulative average provides a more stable measurement. 500 static samples were acquired and averaged at each location of the predefined set of points. Table 1 shows the global precision and accuracy over this set. The similar factory-stated value (Spec) of global accuracy norm is 350µm.

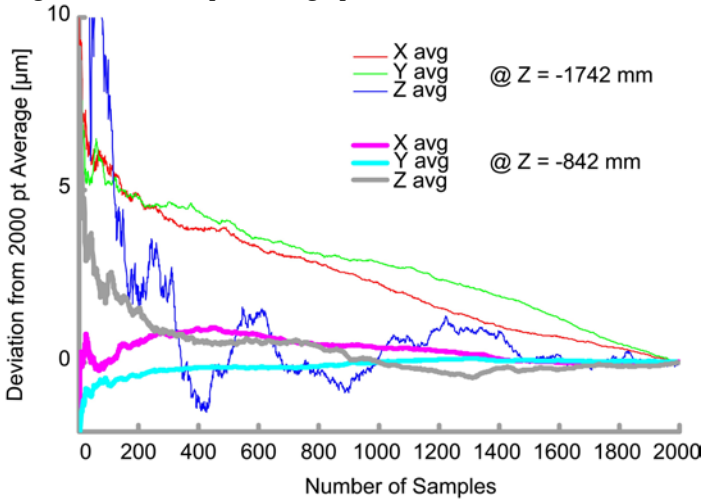

Figure 2: Cumulative average at two static locations along Z

Conclusion: The precision and accuracy of the Polaris tracker can be improved if the measurements are performed statically and averaged. The measurement performance deteriorates in the depth (Z) direction from the scanner. If possible, measurements should be taken closer to the scanner and/or preferentially using the frontal plane (XY). In most ideal conditions the Polaris may provide extremely accurate and precise measurements.

Acknowledgement: The authors would like to thank Professor Russell H. Taylor of the Johns Hopkins Computer Science Department for his guidance on registration methods and the varying models of optical trackers.

Table 1: Precision and accuracy over 500 samples

[µm]	X	Y	Z	Norm	Spec
Precision	13	53	404	408	200
Accuracy	15	35	190	195	350

ABSTRACT 21

15 YEARS TRANSRECTAL HIGH INTENSITY FOCUSED ULTRASOUND IN LOCALIZED PROSTATE CANCER THERAPY: IMPACT OF NEOADJUVANT TURP BEFORE HIFU ON ONCOLOGY EFFICACY

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Introduction: Goal of the study was to analyze the efficacy of combined TURP and HIFU as definitive therapy for localized prostate cancer (PCa) according to PSA Nadir. Three different strategies of HIFU therapy were compared: "HIFU Monotherapy", "TURP and HIFU in one session" and "TURP one month before HIFU". Furthermore, the relative influence of neoadjuvant TURP on PSA levels before HIFU was evaluated.
Material & Method: The prospective monocentric "Harlaching HIFU Database" (n>2.300, since 96) was used as data source for analysis. 3 patient cohorts (T1-2, N0, M0): were analyzed: A) 1998-2000 (HIFU Monotherapy), B) 2001-2004: (TURP & HIFU), C) 2005-2010: (TURP 1 month before HIFU): None of the patients had any previous PCa/PSA influencing therapy. All patients were treated completely with Ablatherm ® (EDAP-Lyon-France). Prostate volume, PSA at diagnosis and in follow up were analyzed.
Results: During a median follow up time of 5.5 years (range 0.5 – 15 years) a PSA Nadir
< 0.1 ng/ml and a PSA velocity of <0.05 ng/ml/year were observed. Patients with initial PSA values of >10 ng/ml showed median levels of < 0.3 ng/ml after 5 years of median follow up.
Conclusion:

- PSA Nadir <0.1 ng/ml, PSA velocity/year of < 0.05 and last PSA levels after 5 years of < 0.3 ng/ml proved the oncological efficacy of HIFU.
- The decrease of PSA Nadir in the three cohorts is caused by radical debulcking TURP and development in HIFU technology.
- Debulcking TURP leads only to a moderate PSA decrease.
- TURP before HIFU resolves technical restrictions, expands the indications and enables the inclusion of any prostate.

Source of Funding: Harlachinger Krebshilfe e.V. and Lingen foundation. Thanks to Mrs. Regina Nanieva for HIFU database management.

Ablatherm® device:	Prototype	Maxis	Integrated imaging
Period of use	1996-1999	2000-2004	since 2005
evaluable T1-2 patients	170	358	176
Prostate volume (cc) median	23	38	45
PSA at diagnosis (median)	9.9	11.5	9.6
% resected volume	0%	40%	49%
Prostate volume at HIFU	22	22	21
PSA at HIFU (median)	6	5.9	5.4
PSA Nadir (median)	0.2	0.06	0.06
Prostate volume final (cc)	10	7	5

ABSTRACT 22

IN VITRO COMPARISON OF OUR NOVEL SPEAR HEADED PNEUMATIC INTRACORPOREAL LITHOTRIPTOR WITH HOLMIUM YAG LASER

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Introduction: We describe and compare the stone pulverisation properties of our innovative Spear headed intracorporeal lithotripter with Holmium YAG laser

Methods: The conventional pneumatic intracorporeal lithotriptor probe has a flat disc like or minimally champered tip. The Spear Headed lithotripter probe has a conical tip (Fig1). Pulverisation dynamics of the Spear headed lithotriptor (at 2,3, 4 bars) was compared with Holmium laser (6, 10, & 15 watts) using a standard hands-free in vitro system and phantom stones. The predetermined end points were:
Impacts at which 1. A dent was produced in the stone (First hit effect), and 2. The stone bivalved or the probe bore through the stone. The data was analysed using SPSS for different energy subgroups.

Results: The Spear head at 2,3 and 4 bars was equally efficient to 6, 10 and 15 watts laser, respectively, in causing the first dent ($P<0.05$). The spear head bivalves the stone. This ability increases with increasing bar settings. The laser bores through the stones.

The Spear head generates impact pressure of 3570 bars at the “First Hit” comparable to Holmium.
As opposed to holmium as fragmentation progresses (“Followup Hits”):
1. Centrifugal vectors of force result in mechanical separation/ bivalving of stones
2. Tip pressure exponentially decreases

Conclusion: The Spear head generates:

Highly focused impact force comparable to laser at the first hit.
Graduated tip impact force (exponentially decreasing)
Centrifugal vectors of force: Augments pulverisation into larger fragments (suitable for PCNL)
Laser bores through (suitable for ureteroreoscopy)

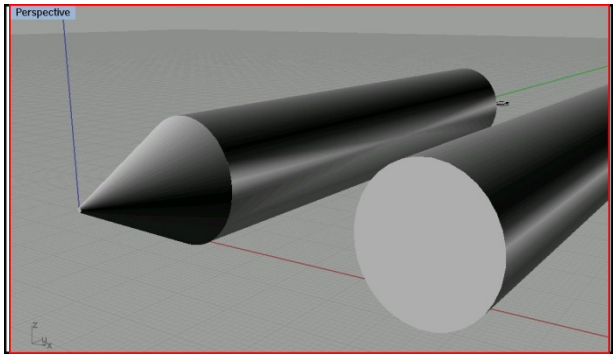

Figure: Spear Headed Lithotriptor with the Conventional Lithotriptor

ABSTRACT 23

CYSTOLITHALOPAXY USING CYBERWAND IS EFFICIENT AND SAFE FOR LARGE BLADDER STONE BURDENS

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Introduction: Open suprapubic cystolithotomy is traditionally reserved for large bladder stone burdens. Laser cystolitholapaxy (CLP), while minimally invasive, is often laborious and time-consuming. We report a case series using the Cyberwand® (CW) lithotripter (Gyrus ACMI; Southborough, MA) for large bladder stone burdens.

Methods: Three cases using CW for large stone burdens were retrospectively reviewed. The stone burden was calculated by the volume formula for ellipsoids. The CW was inserted via a 24F right angle nephroscope transurethrally. The calculi were fragmented and evacuated simultaneously with the CW.

Results: The mean stone volume was 260 cc (103 to 429 cc). The mean stone attenuation was 1222 HU (722 to 1498 HU). After laser and electrohydraulic lithotripters failed to make progress, the CW achieved complete stone clearance. The mean combined operative time was 269 min (174 to 436 min), including time using other lithotripters (2 cases) and performing transurethral prostate resection (1 case). For the largest stone volume, 4 CW probes were required. There were no complications perioperatively or during follow up (median: 3 months).

Conclusion: Transurethral CLP with the CW is a highly efficient and safe option for large stone burdens that can be performed via a standard nephroscope to avoid suprapubic cystolithotomy.

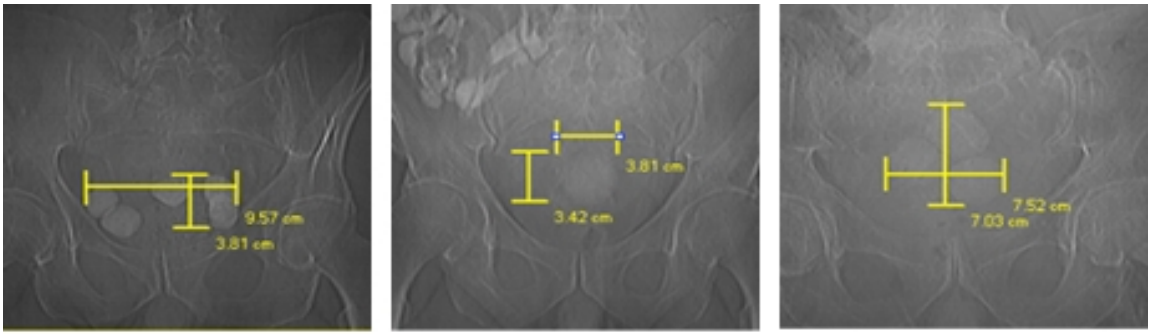

Figure 1: CT scout films demonstrating 3 cases of large bladder stone burdens effectively treated with Cyberwand cystolithalopaxy

ABSTRACT 24

COMPARISON BETWEEN SYSTEMATIC AND MRI TRAGETED PROSTATE BIOPSYS FOR PATIENTS WITH NO HISTORY OF PROSTATE CANCER ATTENDING A FIRST ROUND OF TRANS-RECTAL ULTRASOUND BIOPSY PROCEDURE

Coffin G[1,2], Chevreau G[1], Renard-Penna R[3], Comperat E[4], Vitrani MA[2], Torterotot C[2], Conort P[1], Bitker MO[1], Mozer P[1,2]

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Introduction: Localized prostate cancer diagnosis is a challenging topic which impacts on health policy because of the increasing number of prostate biopsy procedures and their side effects which can be related to the number of biopsy cores. Development of prostate MRI imaging allows better characterization of prostate radiological lesions and it is now possible to perform lesion targeted biopsies. We wanted to compare the effectiveness of systematic biopsies and MRI targeted biopsies for a first round of prostate biopsy procedure among a population of men at risk of localized prostate cancer with no history of prostate cancer.

Methods: We retrospectively reviewed all patients who came at our department for a first round of prostate biopsies and who were at risk of localized prostate cancer.

Exclusion criteria were: history of prostate cancer, previous prostate biopsy, local advanced (≥T3a TNM stage)or metastatic prostate cancer at examination (digital rectal and clinical examination, PSA serum level>20ng/mL, prostate MRI staging ≥T3a). Inclusion criteria were:prostate multiparametric MRI showing suspicious intra-prostatic lesion.

All patients attended trans-rectal ultrasound biopsies with a Medison V10 Ultrasound system and the Urostation® registration device (Koelis, France): 12 systematic cores were realized and 2 or 3 additional cores in the MRI targeted lesion. Positive core was defined by the presence of prostate cancer on anatomopathological examination.

Results:

Table 1. Patients Characteristics. Results are showed as Mean±Sd[Range] . DRE: Digital Rectal Examination

Number of patients	80
Age (years)	63.9±7.34 [49.9; 81.2]
Prostate Volume (mL)	44±22 [17; 160]
Suspicious DRE (clinical stage≤T2c)	20
PSA (ng/mL)	7.85±3.45 [2.8; 20]

Table 2. Anatomopathological results of prostate biopsy cores

	Systematic Biopsies	MRI Targeted Biopsies	p
Number of cores	948	201	
Number of positive cores	158	77	
% of Positive cores (number)	16.67%	38.31%	<0.001
Cancer mean length by core (mm)	6.72	8.93	0.002

Conclusion: MRI targeted cores seem to be more accurate than systematic cores to detect localized prostate cancer and could prevent the use of systematic prostate biopsies to detect cancer and consequently decrease the number of cores for a prostate biopsy diagnosis procedure.

ABSTRACT 25

ROBOTIC TRANS-RECTAL ULTRASONOGRAPHY DURING ROBOTIC-ASSISTED RADICAL PROSTATECTOMY

Sunao Shoji, Andrew J. Hung, André Luís De Castro Abreu, Alvin C. Goh, Andre K. Berger, Toyoaki Uchida, Mihir M. Desai, Monish Aron, Inderbir S. Gill, Osamu Ukimura

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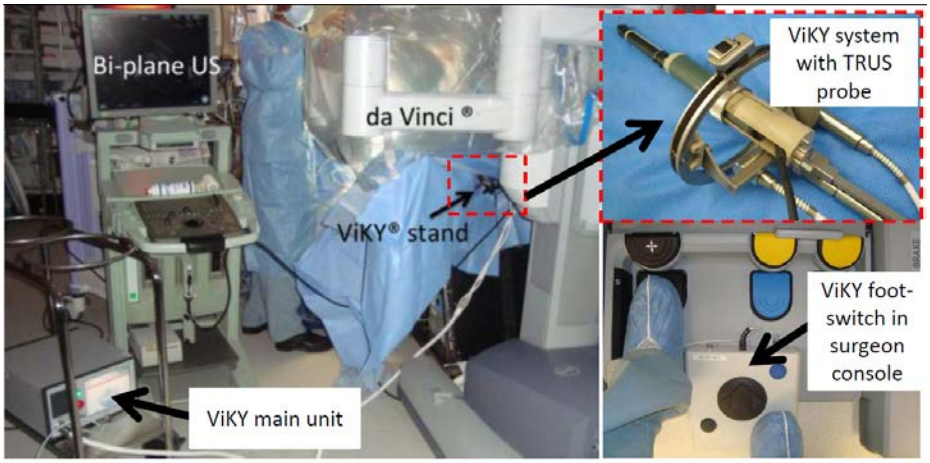
Introduction: We evaluate the use of robotically-manipulated transrectal ultrasound (TRUS) for real-time monitoring of prostate/peri-prostatic anatomy during robotic-assisted prostatectomy (RAP).

Methods: Ten patients with clinically organ-confined prostate cancer undergoing RAP underwent pre-operative and real-time intra-operative bi-planar TRUS evaluation utilizing a robotically-manipulated TRUS device (ViKY® system, EndoControl Medical, Grenoble, France). Median patient age was 66 years (range 54-88), baseline PSA was 5.3 (1.3-17.9), and 4 patients (40%) had clinical high-grade and high-stage disease. Bilateral or unilateral nerve-sparing was performed in 9 patients (90%).

Results: Median time for VIKY device setup-to-insertion of TRUS probe was 7 minutes (4-12). Complete robotic TRUS evaluation was successful in all patients. Five patients (50%) had TRUS-visible hypoechoic lesion, confirmed cancerous on pre-operative biopsy. Relevant intraoperative TRUS findings were relayed real-time to the robotic surgeon, particularly a) during dissection of bladder neck and prostatic apex, b) during neurovascular bundle preservation, and c) when hypo-echoic prostate lesions approximated nerve-preserving dissection. Negative margins were achieved in 9 patients (90%), including cases where significant intra-prostatic lesions abutted or extended through the prostate capsule. No complications occurred.

Conclusion: Real-time robotic TRUS guidance during RAP is feasible and safe. Robotic TRUS can provide the console surgeon with valuable anatomic information, thus maximizing functional preservation and oncologic success.



[***Left***] Operating room set-up of ViKY® robotic system, which is attached to the operative table railing, and positioned in the rectum prior to docking the da Vinci robot to the patient.
[***Right upper***] ViKY® system holding standard TRUS probe.
[***Right bottom***] Foot switch pedal placed under surgeon console

ABSTRACT 26

COMPARATIVE *IN VITRO* EVALUATION OF THE XENX

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Objective: To conduct a comparative assessment of two stone retention devices to several commercially available guidewires for an evaluation of safety and functionality.

Methods: An in vitro ureter model (4.76 mm ID silicone tubing) was used to manually evaluate maneuverability through measurement of insertion forces (unsuccessful attempts to pass impacted stone), passing forces (force required for successful stone passage), number of attempts and time until successful stone passage. Guidewires evaluated included the Sensor (Boston Scientific), Glidewire (Boston Scientific), RoadRunner PC Nimble (Cook Medical), RoadRunner PC Firm (Cook Medical), HiWire (Cook Medical), and retention devices included the XenX (Xenolith Medical) and Accordion (PercSys). A motorized test stand and digital force gauge were used to evaluate tip bending characteristics as a function of distance (10 mm) in an occluded 10 mm diameter tube. The ability of each device to pass through a range of five fixed apertures (3.0-5.0F) was evaluated, and retention capabilities of the XenX and Accordion were compared by flushing a controlled distribution of gypsum stones through 4 and 10 mm diameter tubing.

Results: The RoadRunner Firm was found to have the lowest average insertion force (14.18 ± 2.32 g) when compared to all devices ($p<0.035$), and a significantly lower passing force (12.76 ± 6.39 g) than the RoadRunner Nimble (18.70 ± 5.56 g, $p=0.031$), Accordion (24.51 ± 7.00, $p=0.00055$), and HiWire (28.47 ± 12.15 g, $p=0.0013$). Aside from the Roadrunner Firm, the average insertion and passing forces of all other devices demonstrated minor significant differences, with values ranging between 21.36 – 26.37 g and 17.49 - 28.47 g, respectively. The HiWire was found to require the most time (13.13 ± 5.10 sec, $p<0.0001$) and number of attempts (12.08 ± 5.18, $p<0.0002$) among all devices, while other devices were found to have passing times ranging between 2.43 - 4.81 sec, and average number of attempts between 1.42 - 4.9, with the Glidewire requiring the least number of attempts on average. Measurements of tip bending force as a function of distance revealed a similar force response pattern among all devices for the first 5 mm traveled, characterized by a plateau of forces indicating the "safety bending zone" for each device (Figure 1). A more dramatic increase in force was noted for the Accordion from a distance of 6-9 mm, until resulting in a final force measurement more than double that of all others (40 vs. <16 g), which was also found to correlate to the extent of tip buckling that was observed. All devices were able to pass through an aperture diameter of 5.0F, while more significant differences were found when attempting to pass devices through a 3.0F aperture. No discernable particle migration was observed for the Accordion and XenX using 4 mm tubing, while over 30 particles were up to 3 mm in diameter were observed to migrate beyond the Accordion in 10 mm tubing.

Conclusion: The XenX and Accordion both provide a similar degree of maneuverability and safety when compared to several commercially available guidewires, with more significant differences observed in tip bending and retention ability in large diameter tubing. *In vivo* evaluations are warranted to confirm if such differences translate to clinical advantages.

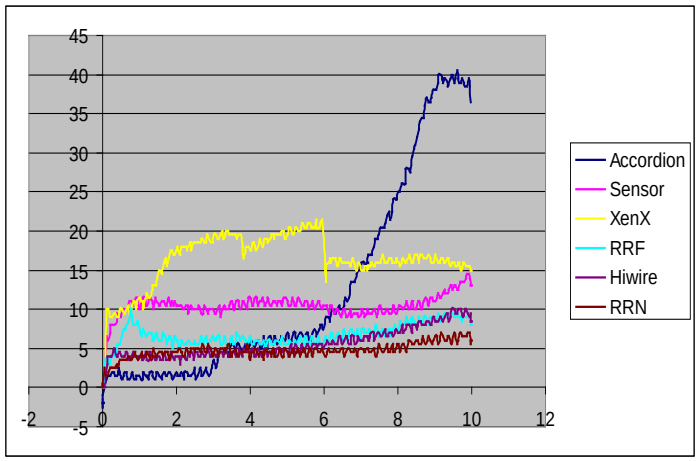

Figure 1: Tip bending force (g) vs. distance (mm)

ABSTRACT 27

URETEROSCOPIC VERSUS FLUOROSCOPIC GUIDED RENAL ACCESS: A COMPARATIVE ANALYSIS OF INTRAOPERATIVE OUTCOMES FOR PCNL

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2. Quantitative Health Sciences department, Cleveland Clinic, Cleveland, Ohio

Introduction: An accurate puncture is the most critical step for percutaneous nephrolithotomy (PCNL). Renal access is achieved using fluoroscopy (FGA), ultrasound or ureteroscopic guidance (UGA). Herein we present our technique (fig.1) of gaining renal access under UGA and comparing intraoperative outcomes with those who had FGA.
Methods: Retrospective review of charts of patients who underwent PCNL at our institute, categorized based on the method of achieving renal access. Patient demographics, baseline characteristics, operative and postoperative outcomes were compared. Univariable and multivariable analysis were used to evaluate the relationship between access and outcomes of interest.
Results: One hundred and fifty nine patients, who underwent PCNL at our institute from the 8/2010 to 1/2012, were included. Sixty two patients (39.2%) underwent UGA, as compared to 96 (60.8%) for RGA. No significant difference was observed between groups as regarding age (p=0.06), ASA (p=0.7), number (p=0.058) and volume of stones (p=0.051), number of calyces involved (p=0.82), and stone density (p=0.49). Patients undergoing UGA had higher BMI (p=0.013). Patients undergoing UGA had shorter fluoroscopy time (3.2 min vs. 16.8min, p<0.001), lower access number (1.03 vs. 1.22 p= 0.002), and shorter hospital stay (1.8 days vs. 2.7 days p=0.001). Radiation time was longer for FGA as compared to UGA after adjusting for BMI, staghorn stones, access number (p<0.001). No significant difference was noted in change in hemoglobin and rate of blood transfusion, operative time, or occurrence of intraoperative complications between groups. Procedures were aborted due to bleeding more commonly in the FGA (8%) compared to the UGA group (0%, p=0.02) Three (6.7 %) of the UGA group had a secondary procedure for stone management as compared to 12 (12.5%) of the FGA group.
Conclusion: the UG approach provides a safe and effective renal access for the percutaneous management of kidney stones in the hands of the urologist, leading to decreased fluoroscopy time, shorter hospital stay and decreased need for multiple access.

Fig 1: Gaining access using ureteroscopic guided puncture. A: An appropriate posterior renal calyx is identified, showing the air bubble at a posterior calyx. B,C: Using the ureteroscope the Chiba needle is visualized through the tip of the papillae. D, E the halo basket is advanced to grasp the Benston wire introduced through the Chiba needle. F: the Bentson has been exchanged for an Amplatz superstiff using a 5-Fr. Open-ended catheter. G, H: the balloon dilator is introduced along the wire under vision to avoid underdilation (into parenchyma) or overdilation (causing perforation of the collecting system). I: the Amplatz sheath is introduced along the balloon dilator and visualized to ensure accurate positioning.

ABSTRACT 28

A NOVEL DEVICE TO PREVENT MIGRATION OF STONE FRAGMENTS DURING PERCUTANEOUS LITHOTRIPSY

Stephen Faddegon, M.D.[1], Heather Beardsley, Ph.D.[2], Yung K Tan, M.D. [1], Ephrem O Olweny M.D. [1], Gang Yin, M.D. [1], Woong Han. [1], M.D., Zhuo-Wei Liu. [1], M.D., Raul Fernandez, Ph.D. [2], Margaret S. Pearle, M.D. [1], Jeffrey A Cadeddu, M.D. [1]

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Introduction: Up to 50% of patients with residual stone fragments after percutaneous nephrolithotomy (PCNL) will experience a stone-related event which might require secondary surgical intervention. We sought to create a device that can capture large stones in an enclosed bag, thereby enabling stone fragmentation during PCNL or cystolithopaxy without fragment migration.

Methods: The 'PercSac' device slides over a rigid nephroscope and opens beyond the tip of the scope to accommodate a renal stone. The bag opening is then cinched closed to prevent any stone fragments from escaping. It can be advanced and retracted to facilitate stone capture. The stone can then be treated by ultrasonic lithotripsy through the nephroscope and within the 'PercSac'.

Results: Stones as large as 3 cm in diameter could be reliably entrapped within the 'PercSac'. The cinching mechanism allowed closure of the bag and did not allow escape of fragments during lithotripsy and stone evacuation.

Conclusions: Although the device was tested in a bladder model, the 'PercSac' has the potential to reduce residual fragments after PCNL by maintaining the stone and fragments in an enclosed space until all fragments are aspirated, thereby preventing migration of stone fragments into inaccessible calyces. Further in vitro testing in both bladder and kidney models using a control comparison is planned.

ABSTRACT 29

APPLYING THEORETICAL CHEMISTRY TO THE STUDY OF CALCIUM OXALATE NEPHROLITHIASIS

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[2] *Carnegie Mellon University*

Introduction: Many questions exist regarding the interactions of molecules during stone formation, particularly how promoters and inhibitors of stones actually produce their effects. Currently there are no inexpensive, easily accessible models to evaluate real time molecular interactions of these compounds. With collaboration of physical chemistry and practicing urologists, a theoretical model allows for the study molecular interactions in regards to calcium oxalate stone disease.

Methods: Molecular dynamics computer simulation techniques were utilized to evaluate the interaction of Ca^{2+} and oxalate ions (Oxa^{2-}) in water. The model was used to examine the interaction of Ca^{2+} and Oxa^{2-} alone and then in the presence of known stone promoters and inhibitors. All ions are described at an atomic level using force field models. The short-range repulsion and dispersion (Lennard-Jones interactions) and long-range Coulombic forces are evaluated during the molecular interactions. The ions are allowed to move throughout the simulation box until they form stable crystalline structures.

Results: Initial studies allow for measurement of interaction forces between Ca^{2+} and Oxa^{2-} in the presence of physiologic concentrations of known stone promoters and inhibitors. The model allows for real-time monitoring of crystal structure formation and evaluating the forces between Ca^{2+} and Oxa^{2-}. With very short (<200 nanoseconds), Calcium oxalate crystal formation was already observed (Figure 1). This model has also allowed us to understand what happens to the crystal structure when promoters and inhibitors are added to the theoretical box (Figure 2). In addition free energy calculations are possible during the interactions to provide real-time monitoring of Ca^{2+} and Oxa^{2-} interactions.

Conclusion: While our model is not completely realistic due to the limited number of ionic species present in the experiments, it provides a system to examine the formation of calcium oxalate crystals in the presence of inhibitors and promoters at physiologic concentrations. Future studies will allow for expansion of ions used and understanding how promoters and inhibitors exert their effect on calcium oxalate binding

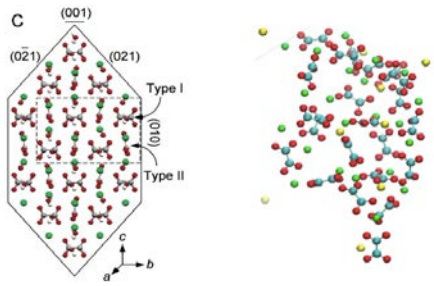

Figure 1: Calcium Oxalate crystal. Left is expected structure, right is achieved structure from simulation

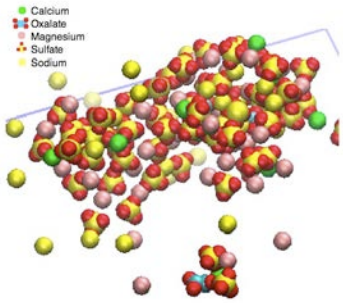

Figure 2: Calcium Oxalate crystal structure in the presence of Magnesium

ABSTRACT 30

DESIGN AND EVALUATION OF IMAGE GUIDANCE SYSTEMS FOR RARP

S. Thompson[1], G. Penney[2] , B. Challacombe[3] , D. Hawkes[1] , P. Dasgupta[3]
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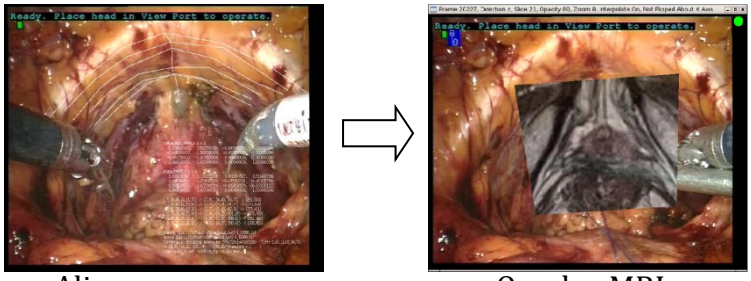
Introduction: There is a strong appetite amongst laparoscopic surgeons for image guidance during the procedure. It seems intuitively obvious that providing the surgeon with additional information on the location of unseen anatomy can only improve patient outcomes. This is not necessarily the case however. If the system gives information that is not relevant to the procedure it becomes a distraction. Similarly, if the system has large alignment errors the information may be dangerously wrong. One danger is that image guidance systems can be developed on an ad-hoc basis based not on targeted clinical goals but on the technical expertise and research goals of the scientists and engineers involved. Such a system may or may not benefit the patient. However, there is a real danger, as discussed by [1], that such systems will be introduced into surgical practice without proper assessment. We present our minimalist image guidance system for robot assisted radical prostatectomy together with a design and evaluation framework built upwards from the desired clinical outcomes.

Methods: Our system allows the surgeon to refer to pre-operative MRI images of the patient aligned to the visible anatomy. The MRI is aligned manually to the intra-operative scene as shown in Figure 1. The surgeon is able to intuitively match anatomy shown in the MRI to its intra-operative location.

Results: We have measured the system accuracy and so far tested the system during 11 clinical cases. Despite having a very low accuracy (around 2cm) the system has scored highly when rated by the surgeons. Table 1 lists the desired clinical outcomes and the design goals.

Conclusion: We present a simple image guidance system and a framework to evaluate its performance. The framework will also be used to evaluate the performance of comparable systems. Despite its limitations our current system has been very well received clinically and been used to inform intra-operative decision making. This indicates that careful thought must be given to the real surgical needs before the development of more complex systems.



Align Overlay MRI

Figure: The patient's MRI is aligned to the surgical scene using a wireframe image of the visible inner surface of the pubic arch (left). The process takes less than 30 seconds. Once aligned the patients MRI can be shown to the surgeon overlaid on the surgical scene (right).

Table 1: The design and development process begins with the identification of desired clinical outcomes. These inform a list of system design goals, which are linked to underlying system parameters. Correlations between the system parameters and how well the design goals are met are use d to control the design and development process.

System Parameters	Design Goals	Clinical Outcomes
Accuracy	Show Tumour location	Positive margin rate
Update rate	Show Bladder/Prostate Interface	Biochemical PSA Reccurence
Visualisation design	Show Extent of Prostate Capsule	Urinary Continence
User interface design	Show rectum	Erectile Function
	Show Neuro- Vascular Bundles	Damage to rectum
	Aid Pre-Op. Planning	Conversion to open

[1] McCulloch, P et al. "No surgical innovation without evaluation: the IDEAL recommendations." Lancet 2009;374 (9695):1105 -1112.

ABSTRACT 31

HISTROTRIPSY TREATMENT OF FORMALIN-FIXED TISSUE

Sarah E. Darnell[1], Xu Cheng[2], *Timothy L. Hall[1], *William W. Roberts[1,2]
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Introduction: Histotripsy is a non-invasive, pulsed, focused ultrasound technology based on controlled acoustic cavitation to achieve tissue homogenization. Previous attempts to validate transperineal delivery of histotripsy for noninvasive prostate tissue debulking in human cadavers were confounded by the presence of tissue gas from decomposition. Accumulation of this non-physiologic gas within tissue impedes transmission of US energy. It seems plausible that tissue fixation would ameliorate the difficulties with interstitial gas production, facilitate specimen degassing, and thereby allow better assessment of adequate acoustic aperture for human cadaveric prostate histotripsy. However, formalin fixation induces protein cross-linking and alters tissue characteristics that may impact mechanical homogenization. The objective of this study was to elucidate the threshold for histotripsy homogenization of formalin fixed tissue compared to fresh tissue and thereby assess the use of formalin fixed tissue as a relevant model for histotripsy experimentation.

Methods: Fresh and formalin-fixed canine kidneys were submerged in de-gassed water and renal cortex targeted with histotripsy (750 kHz, 5 cycle pulses, 500Hz pulse repetition frequency). Real-time in-line US imaging allowed confirmation of cavitation cloud location and monitoring of targeted tissue. In experiment #1, histotripsy was applied to each focal volume for 10-90 seconds. In total, 46 lesions in 8 fixed kidneys were created and compared to 25 lesions produced in 6 fresh kidneys. For experiment #2 the focal volume was translated along a prescribed path (1-8 times) at 2mm/s to uniformly treat a 1 cm^3 target volume. 14 volumes were targeted in 8 fixed kidneys and were compared to 9 targeted volumes in 4 fresh kidneys. In experiment #3 a fixed human cadaveric prostate was treated with the volume protocol (10 passes) at two locations. After treatment, specimens were sectioned through each treatment zone to assess treatment effect.

Results: A cavitation cloud was observed with US during all treatments. In experiment #1 homogenization was grossly visible upon sectioning and revealed minimal homogenization with 10 seconds of treatment and complete homogenization (thin liquid) by 30 seconds. In fixed tissue, no visible damage was seen with less than 20 seconds of treatment. Complete homogenization required 60 seconds of treatment. In experiment #2, 2 passes through the target volume resulted in thick homogenate with 4 passes producing liquefaction of the cortical tissue in both fresh and fixed tissue specimens. In experiment #3, homogenate consisting of thick paste was produced after 10 passes.

Conclusion: Formalin-fixed tissue can be used as a reasonable model to study histotripsy tissue effects. Cavitation is easily monitored with real-time US. When targeting a single focal volume, double the number of histotripsy pulses are required to achieve equivalent homogenizationi in fixed tissue compared to fresh tissue. However no dose adjustment appears necessary when scanning through a volume of tissue. Research is underway to assess prostate histotripsy in formalin-fixed human cadaveric whole pelvis specimens.

Funding: NIH R01-DK087871
*Financial interest / other relationship with HistoSonics, Inc.

Histotripsy transducer targeted on a formalin fixed kidney in a tank of degassed water. Liquefaction of cortical tissue apparent after treatment.

ABSTRACT 32

LASER INTERSTITIAL THERMOTHERAPY FOR SMALL RENAL MASSES: PRELIMINARY INVESTIGATION IN EX-VIVO PORCINE KIDNEYS

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Introduction: Laser interstitial thermotherapy (LITT) is a minimally-invasive treatment modality that utilizes heat to treat small tumors. Heat is induced by the absorption of near-infrared radiation emitted from an optical fiber inserted within the tumor site under MRI, ultrasound, or computed tomography guidance. Despite its use in other organs, there are few studies concerning the feasibility of LITT for small renal masses, according to our literature search, when implementing a diffusing tip optical fiber (Figure 1) and a 980 nm diode laser. The purpose of this investigation is to determine the feasibility of LITT in ex-vivo porcine kidneys when using a 980 nm diode laser and a diffusing tip optical fiber.

Methods: Ten ex-vivo porcine kidneys (average dimensions = 10.1 ± 1.0 x 5.2 ± 0.3 x 2.1 ± 0.3 cm) were used in this study. Each kidney was heated in a water bath to approximately 35.5±2.0 C and irradiated continuously for ten minutes with an AOC 25, 980 nm, diode laser system (AOC Medical Systems, South Plainfield, NJ) coupled to a 1.0 cm diffusing tip optical fiber (Indigo Corp, Palo Alto, CA) while in the water bath. Temperatures were recorded during irradiation with 12 T-type copper-constantin thermocouples placed 5, 10, and 15 mm from the fiber axis. Five kidneys were irradiated at an output power of 2 W and 4 W, respectively. After irradiation, photocoagulation dimensions were measured with a ruler. The average maximum temperature and photocoagulation dimensions were calculated for each output power and compared using a paired t-test (OriginLab, Northampton, MA).

Results: The geometry of the photocoagulation zone was elliptical (Figure 1). Average axial length, cross-sectional maximum, and cross-sectional minimum radius at 2 W and 4 W were 1.9±0.3 x 0.8±0.2 cm x 0.4±0.2 cm and 2.8±0.3 x 1.4±0.3 x 0.92±0.1, respectively. Average maximum temperatures at 2 W and 4 W ranged from 51.3±2.3–67.7±6.5 C and 77.1±7.4–87.5±6.9 C, respectively, at 5 mm, 41.9±0.8–51.2±1.7 C and 52.4±1.6–66.8±6.6 C, respectively, at 10 mm, and 41.7±1.0–45.2±1.4 C and 47.8±1.2–49.7±2.5 C, respectively, at 15 mm from the fiber axis. Thermal damage dimensions and maximum temperatures were significantly different between 2 and 4 W ($p<0.05$) with exception for one thermocouple at 15 mm from the fiber axis.

Conclusion: Elliptical photocoagulation zones up to 2.8 cm in length and temperatures greater than 60 ^{o}C at 10 mm from the fiber axis were achieved in ex-vivo porcine kidneys when irradiated at 980 nm with a 1 cm diffusing tip optical fiber within 10 minutes at low power. Future in-vivo studies utilizing a larger tip size are warranted before LITT can be considered a viable, nephron-sparing alternative treatment for small renal masses.

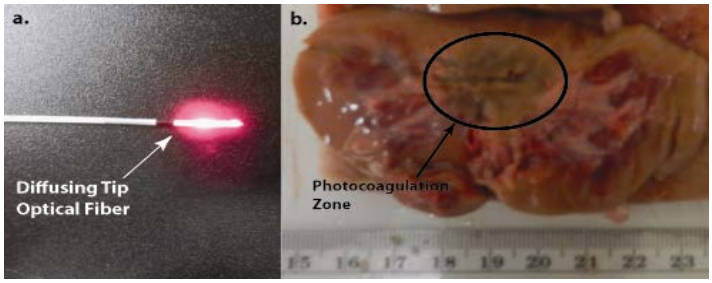

Figure: (a) Indigo 1.0 cm diffusing tip optical fiber and (b) photocoagulation zone observed after laser irradiation with a 980 nm diode laser at 4 W and a diffusing tip optical fiber

ABSTRACT 33 **TOP 10 ABSTRACT**

QUALITY MEASUREMENT OF SYSTEMATIC TRANSRECTAL PROSTATE BIOPSY: AN IN-VITRO STUDY

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http://urobotics.urology.jhu.edu/

Introduction: Extended sextant biopsy under transrectal ultrasound (TRUS) guidance is the most common method to diagnose prostate cancer (PCa). The results of the biopsy rely on two major factors: the biopsy schema and the physician's ability to accurately target the gland with the biopsy needle. However, the accuracy of the freehand TRUS-guided biopsy is typically unknown due to the difficulty of measurement and quantification.

Methods: To determine the accuracy of freehand TRUS biopsy *in-vitro*, a biopsy simulation system with a gelatin-based pelvic mockup and optical tracking system was used to measure the orientation and relative position of the biopsy needle. The gold standard schema was defined using a 12-core, extended sextant biopsy template.

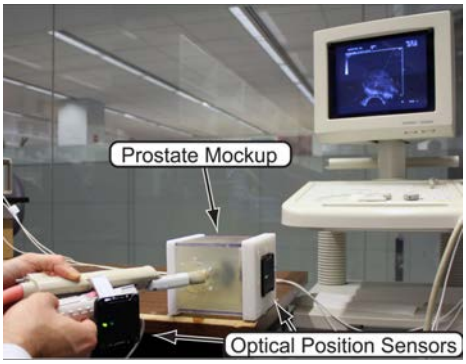

Figure 1: Biopsy simulation system

Five experienced urologists and the TRUS Robot, a novel robotic device that can precisely manipulate the TRUS probe, performed 6 sets of extended sextant template biopsies. The exact geometric distribution of biopsy cores was measured and the biopsy targeting error, accuracy and precision of repeat biopsies were determined. Also, a probability-based model was used to estimate the "significant" PCa (> 0.5 cc) detection rate by freehand- versus TRUS Robot-assisted biopsy.

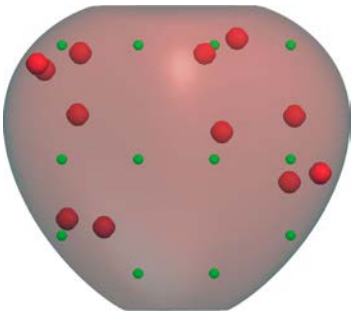
Figure 2: Golden standard biopsy schema (green) and core distribution of freehand biopsy (red).

Results: The urologists acquired cores in clustered patterns and left a significant portion of the prostate under-sampled while the TRUS robot closely followed the biopsy schema. The mean targeting error by the urologists and the TRUS Robot was 9.0 mm and 1.0 mm, respectively. Robot assistance improved the accuracy and precision of repeated biopsy from 10.1 mm to 1.7 mm and 23.6 mm to 0.6 mm, respectively. The mean "significant" PCa detection rate by the urologists and the TRUS Robot was 36% and 43%, respectively.

Conclusion: Systematic biopsy with freehand TRUS guidance does not closely follow the intended sextant biopsy plan and may result in suboptimal sampling and cancer detection. Both initial and repeat freehand biopsy following a biopsy schema is challenging. Robot-assistance can potentially improve targeting, precision and accuracy. Further research is needed to determine an optimized biopsy schema that improves PCa detection rates.

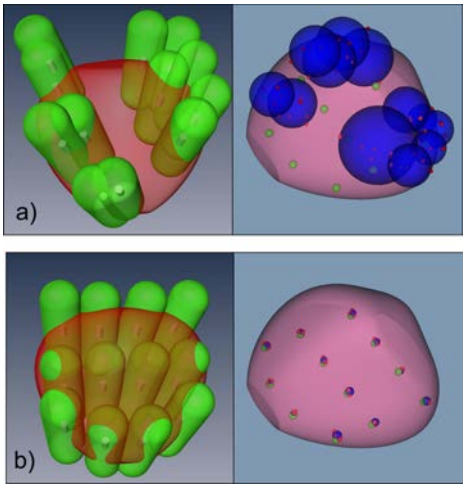

Figure 3: Initial and repeated biopsy error of a) Freehand biopsy, b) Robot assisted biopsy

Acknowledgements: The project described was supported in part by Award Number R21CA141835 from the National Cancer Institute, the Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins, and Hitachi-Aloka Medical Ltd. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NCI, NIH, SKCCC, or HAM.

ABSTRACT 34 **TOP 10 ABSTRACT**

LIVE ROBOTIC SURGERY: ARE OUTCOMES COMPROMISED?

Jeffrey K. Mullins[2], Michael S. Borofsky[1], Mohamad E. Allaf[2], Sam Bhayani[3], Jihad H. Kaouk[4], Craig C. Rogers[5], Shahab P. Hillyer[4], Bartosz F. Kaczmarek[5], Youssef S. Tanagho[3], and Michael D. Stifelman[1]

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[2] *Brady Urological Institute, Johns Hopkins Medical Institutions, Baltimore, MD*
[3] *Division of Urologic Surgery, Washington University School of Medicine, Saint Louis, MO*
[4] *The Glickman Urological Institute, Cleveland Clinic, Cleveland, OH*
[5] *Vattikuti Urology Institute, Henry Ford Hospital, Detroit, MI*

Introduction: Live educational surgery provides a powerful educational platform for academic urologists. However, education must not place patients at increased risk. The objective of this study is to determine the outcomes of patients treated during live educational surgery compared to a matched cohort treated without observers.

Methods: From 2007 – 2011 39 robotic partial nephrectomies were performed as live educational cases by 1 of 5 high volume surgeons. Live educational cases were defined as cases viewed by visiting urologists via live teleconference in which the visitor were able to interact with the operating surgeon. Live educational cases were matched with cases performed under standard operating procedure. Demographic, clinicopathologic, and peri-operative outcomes were compared between groups. Univariate analysis was performed to the test the association between educational surgery and adverse peri-operative outcomes.

Results: Demographic and clinicopathologic data were similar between both groups. Both groups experienced equivalent operative times (196.3 vs. 190.4 minutes, p=0.75), EBL (187.8 vs. 177.8, p=0.82), WIT (20.8 vs. 20.1, p=0.75), LOS (2.8 vs. 2.6 days, p=0.44), and rates of post-operative complications (5.1% vs. 10.3%, p=0.40). There were no Clavien III – V complications in either group. Univariate analysis demonstrated that live observational surgery was not associated with any unfavorable peri-operative parameter (all p> 0.05).

Conclusions: Live educational surgery is associated with excellent patient outcomes which compare favorably to cases done under normal operating procedures. Live educational surgery represents a useful educational tool which does not increase patient morbidity.

ABSTRACT 35 **OUTSTANDING PAPER AWARD**

ROBOT-ASSISTED DIRECT MRI-TARGETED TRANSRECTAL PROSTATE BIOPSY

Chunwoo Kim[1], Govindarajan Srimathveeravalli[2], Peter Sebrechts[1], Doru Petrisor[1], Paula Ezell[2], Jonathan Coleman[2], Stephen B. Solomon[2], Hedvig Hricak[2], Dan Stoianovici[1]
[1] *Urology Robotics Lab, Johns Hopkins University, Baltimore, MD*
[2] *Radiology Department, Memorial Sloan Kettering Cancer Center, New York, NY*
http://urobotics.urology.jhu.edu/

Introduction: Transrectal ultrasound (TRUS) guided prostate biopsy is the most frequently performed means for detecting prostate cancer (PCa) with over 1.2 million procedures performed annually in the US alone. However, standard gray-scale ultrasound imaging provides minimal cancer specific information in regard to localizing tumors, relying instead on non-targeted, systematic biopsy strategies. Accordingly, TRUS biopsies have typically low sensitivity and low negative predictive value. These uncertainties contribute to disease overtreatment. Prostate MRI offers better image sensitivity for identifying prostate cancers yet is difficult to use for directly guiding biopsies although indirect means for doing so are being developed using MRI-TRUS fusion techniques. Alternatively, we present a direct MRI targeting method that avoids co-registration errors typical of image fusion. We report the development and pre-clinical tests of a robot for transrectal prostate biopsy in the MRI scanner. Animal test results show the feasibility of the approach and approximately 2mm MRI-based targeting accuracy.

Methods: A pneumatic robot for transrectal prostate biopsy was developed. The robot is entirely made of non-metallic materials and is electricity free, using a new type of MRI motor (Pneumatic Stepper Motor, PneuStep). The robot presents 3 degrees of freedom (DoF), 2 for orienting a needle-guide and 1 for adjusting the depth of needle insertion. Needle insertion and biopsy are performed manually through the needle-guide. A registration marker and MRI coil are built within the endorectal extension. Image-to-model registration and navigation algorithms are developed with custom C++ modules in Amira Visualization (San Diego, CA).

In-vitro CT-guided experiments were completed to verify targeting accuracy. MRI-guided animal tests on 4 dogs were performed to verify the feasibility of approach and overall targeting accuracy, with approval of the Institutional Animal Care and Use Committee. The accuracies were measured by comparing the position of the needle tip with the selected target in the image.

Results: The presence and activation of the robot at the isocenter does not affect the MRI. The device is "MRI Stealth". The accuracy of in vitro experiments was 1.1 mm. In the animal experiments 4-6 biopsies per dog (total 21) were targeted due to size. Overall targeting accuracy was 2.2 mm. All dogs recovered and have been adopted.

Conclusion: Direct MRI-guided biopsy with robotic assistance is feasible. The device was successfully verified in pre-clinical tests. Its accuracy is adequate for targeting small lesions of MRI abnormality. This may provide an instrument for correlating MRI-abnormality with pathological finding from the biopsy samples, and increasing the sensitivity of biopsy.

Acknowledgement: Project supported by Award Number W81XWH0810221 from the Prostate Cancer Research Program of the Department of Defense. The content is solely the responsibility of the authors and does not necessarily represent the official views of the PCRP or the DOD.

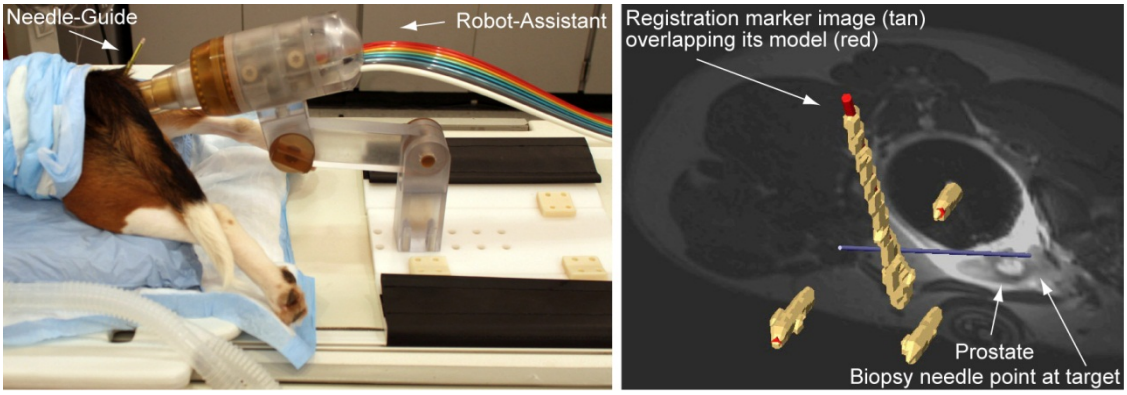


Figure: Animal experiment setup on the MRI table and 3D robot navigation based on MRI

ABSTRACT 36

TACTILE MEMS-BASED SENSOR ELEMENT FOR ROBOTIC SURGERY

Young Soo Park[1], Nachappa Gopalsami[1], Mohan Gundeti[2]
[1] *Nuclear Engineering Division, Argonne National Laboratory*
[2] *Department of Surgery, University of Chicago*

Introduction: To provide delicate haptic feedback in minimally invasive robotic surgery, a new type of tactile microsensor element is developed based on micro-electromechanical systems (MEMS) technology. The essential tactile feedback will broaden the applicability of robotic surgery.

Methods: The tactile microsensor element is designed as diaphragm form. The sensor element consisting of multiple diaphragm form is expected to be capable of detecting contact conditions with high spatial resolution and wide stiffness measurement range. Based on MEMS-technology, the sensor elements are fabricated using SU-8 as substrate and gold as piezoresistor. The advantages of the design are robustness of material, low fabrication cost and complexity, and low temperature process. Also the fabricated sensor element is highly flexible in structure. To measure the stiffness of the diaphragms of different sizes, characteristic tests were performed in which the diaphragm was deflected with a probe and the change in resistance was measured.

Results: Four sizes of diaphragms having 300, 500, 700 and 900μm-side length respectively were tested. Larger diaphragms having lower stiffness show lower rate of changes in resistance as a function of displacement of the probe. Test results show linear relationship between the resistance and deflection from which stiffness of the sensor elements were estimated.

Conclusion: We proposed a new type of flexible tactile sensor for haptic feedback in MIS. Based on MEMS technology, prototype sensor elements of high spatial resolution were fabricated. Characteristic tests revealed linear sensing characteristics. The integrated array of sensors of different sizes will prove measurement over wide stiffness range.

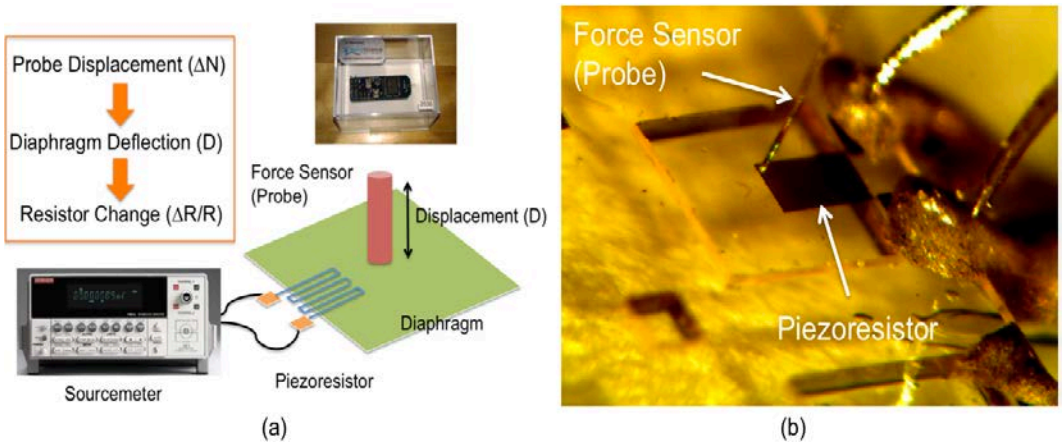


Figure. *(a) Schematic of testing setup (b) 600μm-side square diaphragm with 1.2kΩ resistor*

ABSTRACT 37

VISUAL MEASUREMENT OF SUTURE TENSION FOR MINIMALLY INVASIVE SURGERY

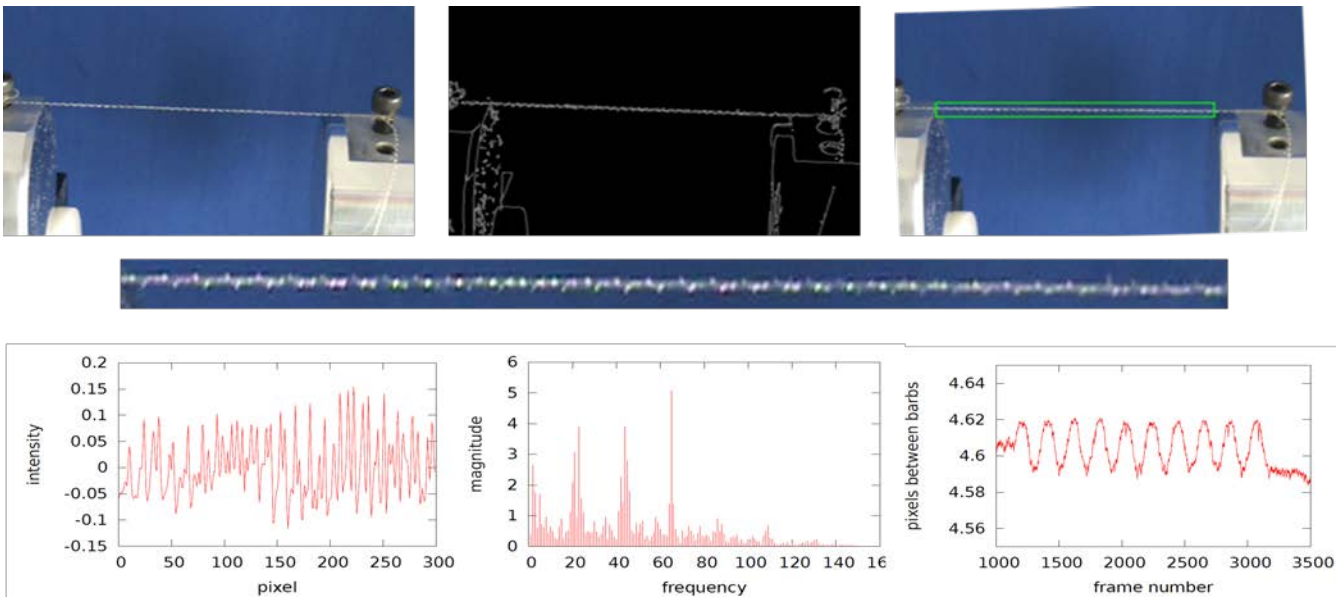
Young Soo Park[1], John Martell[2], Pawel Dworzanski[3], Thomas Elmer[1], Nachappa Gopalsami[1]
[1] *Nuclear Engineering Division, Argonne National Laboratory*
[2] *Department of Surgery, University of Chicago*
[3] *Department of Mathematics, University of Illinois-Chicago*

Introduction: We have demonstrated feasibility of real-time video image processing to measure suture strain during surgery. This will be instrumental for visual-haptic feedback in robotic and laparoscopic surgery.

Methods: A video image processing algorithm is developed which incorporates functionalities of suture line detection, intensity profiling, frequency analysis, and strain computation. The algorithm was implemented in C++ with image/data processing libraries. Particular data processing techniques are added to improve the accuracy and robustness of the measurement. The optimized code was validated to run at 25 frames per second. A series of cyclic strain tests was performed on barbed surgical suture using Instron strain test system. The algorithm was applied on the test video and the strain computation was evaluated against the test reference profile.

Results: The program was able to detect up to 0.2% strain, which is an order of magnitude (60 times) smaller than the lowest breaking strain of commercially available surgical sutures. In addition, the frequency based approach is expected to be more robust in real situations, such as occlusion, and applicable to wide variety of surgical sutures.

Conclusion: The developed non-contact approach will require minimal installation with existing endoscopy, and yet to provide sensory feedback with highly accurate measurement of suture strain. The sensing method will enable highly delicate sensory feedback during robotic and laparoscopic surgery.



ABSTRACT 38

MINI-PERCUTANEOUS NEPHROLITHOTOMY WITHOUT MINI INSTRUMENTS: A NOVEL TECHNIQUE

Edan Shapiro, Michael J. Lipsky, Doh Yoon Cha, Ketan K. Badani, Mantu Gupta
Department of Urology, Columbia University College of Physicians and Surgeons, New York, NY

Introduction: Minimally invasive PCNL (mini-PCNL) has the potential advantages of decreased bleeding and pain with a smaller sized tract of 14-20F. Various mini-PCNL techniques have been described in literature, most utilizing the ureteroscope as a surrogate for the nephroscope, and a laser fiber for fragmentation. These techniques, however, can be limited by decreased visualization, poor irrigation, the need for specialized instruments, and difficult fragment extraction. We assessed the efficacy, safety, and morbidity of a modified PCNL technique that allows for the use of standard PCNL equipment and lithotripters through a tract that is smaller than traditional PCNL (30F) but larger than reported for mini-PCNL.

Methods: A total of 118 consecutive patients undergoing mini-PCNL and standard PCNL from December 2010 to October 2011 were retrospectively reviewed. Mini-PCNL was performed using a 24F balloon dilating catheter (BDC) and standard PCNL was performed with a 30F BDC. Operative time, blood loss (EBL), use of stent, nephrostomy tube placement, post-operative pain scale, analgesic requirement, length of hospital stay (LOS), and stone-free rates (SFR) were compared.

Results: Fifty-two patients underwent mini-PCNL (group 1) and 66 underwent standard PCNL (group 2). Mean age at surgery was 54 and 56 years for group 1 and group 2, respectively. The mean stone burden was significantly lower in group 1 compared to the group 2 (19.4 mm vs. 28.1 mm, $p=0.003$). Mean operative time and length of hospital stay were significantly lower in group 1 compared to those in group 2 (116 min vs. 151 min, $p<0.001$; 1.19 days vs. 1.68 days, $p=0.002$). EBL was lower on average in group 1, but this was not statistically significant. The rates of ureteral stent and/or percutaneous nephrostomy tube placement, as well as the rate of totally tubeless procedures, were similar between the two groups. Postoperative analgesia with Ketorolac and morphine equivalents did not vary by group. Of the 118 total patients, 60 (51%) patients underwent PCNL for stones $\geq$ 2cm. Of these, 42 (70%) patients underwent a standard PCNL and 18 (30%) patients underwent our modified mini-PCNL technique. In a subset analysis of patients with stone burdens greater than 2.0 cm, mean operative time was shorter for group 1 than for group 2 ($p=0.026$). In addition, EBL was lower in group 1 than for group 2 ($p=0.045$). No difference was demonstrated in stent or nephrostomy tube placement rate, or post-operative analgesia. Mean hospital length of stay was significantly lower in group 1 ($p=0.008$). There was a 100% stone-free rate in both cohorts.

Conclusion: Our data suggest that a new, modified mini-PCNL can be safely performed using standard PCNL instruments, eliminating the need for special instruments associated with traditional mini-PCNL techniques. This technique offers comparable outcomes with the benefit of shorter operative time and LOS compared to that of the standard technique, even for stone burdens >2 cm. This warrants further studies that may elucidate other potential advantages for this new technique.

ABSTRACT 39

WHAT IS THE BEST METHOD TO DELIVER ADJUVANT THERAPY TO THE UPPER URINARY TRACT FOR UROTHELIAL CARCINOMA? AN EVALUATION OF THREE TECNIQUES IN AN *EX VIVO* PORCINE MODEL

Matthew E Pollard[1], Edan Shapiro[2], Doh Yoon Cha[2], Ketan K. Badani[2], Mantu Gupta[2], Adam W Levinson[1]

[1] *Department of Urology, Mount Sinai School of Medicine, New York, NY*

[2]*Department of Urology, Columbia University College of Physicians and Surgeons, New York, NY*

Introduction: Although nephroureterectomy (NU) remains the gold standard for the treatment of upper tract urothelial tumors, developments in percutaneous and endoscopic techniques have made nephron-sparing surgery feasible in select patients. In an effort to reduce disease recurrence, these minimally invasive approaches are often combined with adjuvant chemotherapy that is delivered directly to the upper tracts. Several delivery techniques have been described, including antegrade infusion through a nephrostomy tube, retrograde instillation through an open ended-ureteral catheter, or via reflux from the bladder with an indwelling double pigtail stent. Ideally the chemotherapeutic agent should coat the entire upper tract urothelium. However, no publications to date have evaluated the efficacy of these delivery methods. We developed a porcine model to evaluate the degree and extent of urothelial exposure to the treating agents using each of the three delivery methods.

Methods: An *ex vivo* model was created using excised, en bloc porcine urinary tracts. To evaluate the various techniques, an indigo-carmine solution was infused into the urinary tract using each of the 3 methods; each technique was performed in 3 renal units and the results were averaged. Following a 1 hour dwell time, the urinary tracts were evaluated to determine the degree and extent of urothelium exposure by measuring the staining intensity at 6 predefined points (3 in the renal pelvis, 3 in the ureter). The staining intensity was compared to a reference sample of maximally stained urothelium to calculate mean color difference using a previously validated equation from the International Commission on Illumination (CIE76); lower values represent more efficient staining. In addition, the percentage of total surface area stained by the three delivery protocols was compared.

Results: Mean color difference for nephrostomy tube, double pigtail stent, and ureteral catheter delivery were 40.9, 33.4, and 20.4, respectively ($p = 0.023$). In terms of percent of total surface area stained, mean values were 50.6%, 55.4%, and 75.2%, respectively ($p = 0.018$).

Conclusion: Our initial results suggest that delivery of topical therapies to the upper urinary tract appears to be most efficient when the agent is infused in a retrograde manner via a ureteral catheter, as opposed to either nephrostomy tube or double pigtail stent. In-vivo models and larger studies should be performed to further validate these findings.

ABSTRACT 40

15 YEARS OF TRANSRECTAL HIGH INTENSITY FOCUSED ULTRASOUND IN PROSTATE CANCER THERAPY: DEVELOPMENT OF SIDE EFFECTS

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Introduction: There were three topics for this study: 1st to analyze the overall side effects of combined TURP and HIFU as definitive therapy of localised prostate cancer (PCa).
2nd to analyze the influence of 3 different current therapeutic strategies in HIFU therapy, as there are "HIFU only", "TURP and HIFU in one session" and "TURP one month before HIFU". 3rd to evaluate the relative influence of neoadjuvant TURP on side effects.

Material & Method: The prospective monocentric "Harlaching HIFU Database" (n>2.380, since 96) served as data source for analysis. 3 patient cohorts (T1-2, N0, M0): were evaluated: A) 1998-2000 (HIFU only), B) 2001-2004: (TURP&HIFU), C) 2005-2010: (TURP 1 month before HIFU): all patients without any previous PCa/PSA influencing therapy, treated completely with Ablatherm ® (robotic HIFU at 3 MHz, EDAP-Lyon-France).
Peri- and postoperative side effects for the 3 consecutive cohorts were analyzed.

Results: In a median follow up of 5.5 years, side effects were registered. Furthermore, possible side effects which are described in other PCa therapies - though never occurred after HIFU - were identified. The range, timing and profile of TURP & HFU related side effects are listed below.

Rate of side effects	Prototype	Maxis	Integrated imaging
	96-99	2000-2004	since 2005
n	170	358	176
Incontinence < 3 months (%)	4.2	4.2	3.1
Incontinence > 3 months (%)	5.1	3.1	1.5
Recto-urethral fistula (%)	0.42	0.23	0.0
Urinary tract infections (%)	2.5	1.87	3.08
Perineal discomfort (%)	1.26	0.23	0.51
Others perioperative (%)	11.7	1.17	2.56
2nd endouro intervention (%)	24	19	24
Others in follow up (%)	1.26	0.0	0.0

Conclusion:

- Only a low number of severe side effects was observed
- TUR did not influence the overall side effect rate.
- ¼ of the patients needed 2nd endourological intervention during follow up.
- The spectrum of potential side effects, "which never occurred" showed the low invasiveness of the procedure.

Source of Funding:
Harlachinger Krebshilfe e.V. and Lingen foundation
Thanks to Mrs. Regina Nanieva for HIFU database management

ABSTRACT 41

TREATMENT OF LOCALLY ADVANCED PROSTATE CANCER WITH TRANSRECTAL HIGH INTENSITY FOCUSED ULTRASOUND (HIFU) DELAYS ANDROGEN DEPRIVATION THERAPY (ADT)

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*^ Dept. of Urology, University of Regensburg, * Krebshilfe Harlaching e.V.,*

INTRODUCTION: Goal of the study was to evaluate the efficacy of local HIFU treatment in a patient group with locally advanced Prostate Cancer and its consecutive influence on the necessity of ADT.

METHODS: Since 2000 146 PCa patients (T3-4, N0, M0) without previous long term androgen deprivation therapy (ADT) were included in this prospective, monocentric study. Three studygroups according to progression risk were established: A): initial PSA <20 (n=89); B): initial PSA 21-50 (n= 39); C): initial PSA >50 ng/ml (n= 18). Mean follow up was 3 years (0.3-9), staging: T3: 90%, T4: 10%, age: 70 (49-84). Overall mean initial PSAi was 26.5 ng/ml (0.6-211) and mean PSA at HIFU was 12.4 ng/ml (0-131). Short term ADT<3months in 38% (62% had no ADT at all). Single HIFU treatment with Ablatherm® (EDAP-TMS, Lyon) after debulcking TURP. Mean 662 HIFU lesions applied in 111 min. Patients did not receive any ADT after HIFU.

RESULTS: Mean follow up time was 36 (4.4-108) months, time to Nadir 2.5 months. Median PSA Nadir was for group A) 0.14 / B) 0.5 / C) 0.93 ng/ml respectively. Group related median PSA velocity was for A) 0.17, B) 0.42 and C) 5.94 ng/ml respectively. Last median PSA was A) 0.51 / B) 1.58 / and C) 5.08. Last PSA after 2 years was in 93 % still below initial PSA levels. Within the median follow up period of 3 years 95.5% of the patients remained without ADT**.**

CONCLUSION:

- TUR & HIFU ablation in this T3-4, N0, M0 PCa cohort of 146 patients resulted in an overall PSA Nadir of 0.28 ng/ml and a median PSA velocity of 0.26 (ng/ml/year).
- Until a mean follow up of 3 years, 95.5 % of the patients remained without ADT !
- Level of initial PSA showed to be a significant predictive value for therapeutic success.

Source of Funding:
Harlachinger Krebshilfe e.V. and Lingen foundation
Thanks to Mrs. Regina Nanieva for HIFU database management

ABSTRACT 42

RETROGRADE CHEMOTHERAPEUTIC IRRIGATION OF THE UPPER TRACT

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[2] *Georgia Health Sciences Medical Center, Augusta, GA*

Introduction: Upper tract urothelial carcinoma (UTUC) has a high recurrence rate after endoscopic treatment. Immediate post-operative topical chemotherapy may reduce recurrences, as is the case with bladder UC. Currently, no reliable method of UT chemotherapeutic delivery exists.
Methods: Following retrograde fulguration of a recurrent, bulky UTUC in a solitary kidney, contrast was infused into the renal pelvis via a 5-Fr ureteral catheter and IV pump. Serial fluoroscopy was performed. Intra-pelvic pressures were transduced. The infusion was repeated post-operatively with Mitomycin C (MMC). Systemic toxicity was assessed clinically.
Results: Contrast (100 ml/hour x 30 minutes) filled the renal pelvis and calyces uniformly without pyelo-renal backflow. Mean intra-pelvic pressure = 4.9 cm H_2O (1.4 to 6.8 cm H_2O). The patient denied symptoms during MMC infusion (40 mg/100 ml for 1 hour). No systemic toxicity or recurrence occurred in 13 months.
Conclusion: We are the first to describe retrograde UT chemotherapeutic irrigation with an IV pump. This technique may facilitate and standardize the delivery of intracavitary chemotherapy. Further investigation to determine whether it translates into improved safety and/or efficacy is warranted.

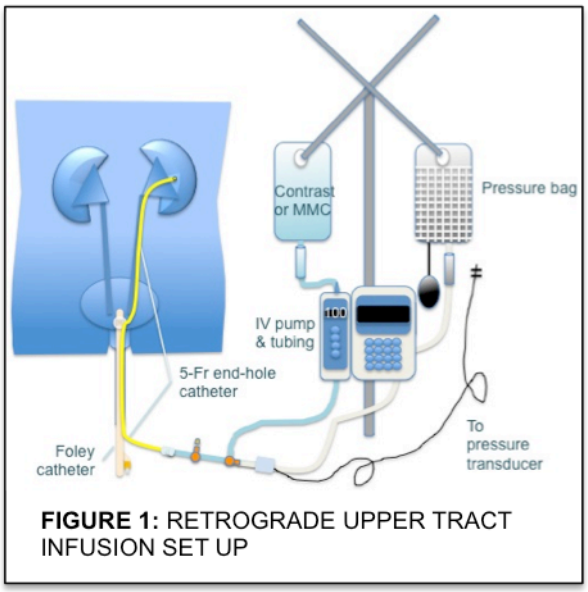

FIGURE 1: RETROGRADE UPPER TRACT INFUSION SET UP

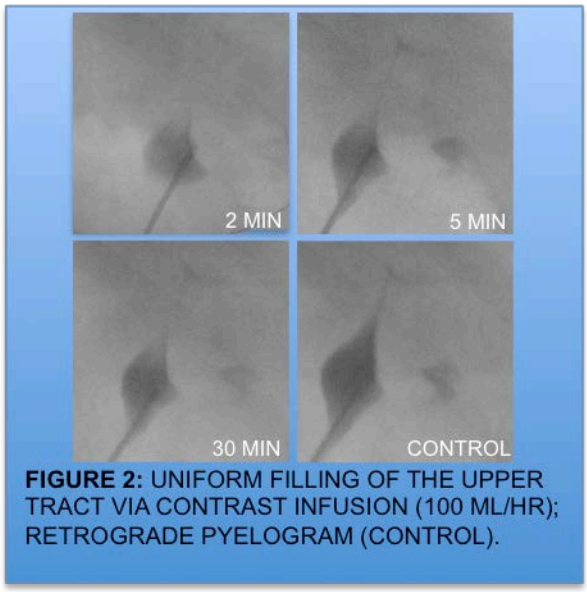

FIGURE 2: UNIFORM FILLING OF THE UPPER TRACT VIA CONTRAST INFUSION (100 ML/HR); RETROGRADE PYELOGRAM (CONTROL).

ABSTRACT 43

IS THERE A DIFFERENCE IN LATERALITY DURING ROBOT-ASSISTED RADICAL PROSTATECTOMY? ASSESMENT OF LYMPH NODE YIELD AND NEUROVASCULAR BUNDLE DISSECTION

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[2] Department of Urology, National Health Insurance Corporation Ilsan Hospital, Goyang, South Korea

Introduction: The da Vinci surgical system (dVSS) has been reported to eliminate innate hand dominance of the surgeon. There are no studies to date, however, that specifically address whether the dVSS has its own inherent 'handedness' resulting from the fixed left-right preference of specific instrument docking and assistant positioning. We identified the pelvic lymph node (LN) and neurovascular bundle (NVB) dissections as well as positive surgical margin rates as procedure points during robot assisted radical prostatectomy (RARP) that could be influenced by laterality and sought to illustrate left-right consistency.

Methods: Patients who underwent RARP by a single right-handed surgeon (KKB) between 2008 and 2010 were identified. Surgeon instrument preference and port placement were consistent across all cases. Pathological LN yield was stratified by the intended limits of dissection (limited or extended) and laterality. Additionally, fascial widths (FW) were prospectively measured for 93 consecutive patients; a narrower FW indicating a more precise intended NVB dissection. The pathologists were blinded to intended dissections.

Results: A total of 340 limited, 11 bilateral extended, 11 right extended, and 5 left extended LN dissections were performed. For patients undergoing limited LN dissection, the mean LN yield was greater on the right compared to the left (3.26 vs. 2.76, $p=0.010$). This difference was not seen in the extended LN dissection ($p=0.96$). Average FW was narrower on the right surgical margin compared to the left surgical margin (1.99 vs. 2.64mm, $p<0.001$).

Conclusion: Our findings suggest that a greater number of LNs and a closer NVB dissection are achieved on the right compared to the left using the dVSS during RARP. This can be attributed to surgeon handedness, robotic instrument laterality, or assistant instrument laterality. Surgeon awareness of these potential differences is important for the pre-operative planning prior to RARP.

ABSTRACT 44

PRELIMINARY EVALUATION OF THE ENDOGO HD PORTABLE CYSTOSCOPIC CAMERA

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Introduction: During office cystoscopy and hospital consultations, urologists may only have direct visualization cystoscopy available. The field of view and usability is often characterized as suboptimal compared to video tower based camera models. The EndoGo HD (Cook Medical), a portable battery powered cystosopic camera that attaches to a standard cystoscope, was created to more closely mimic the usability of the normal cystoscopic camera that connects to the video tower. We sought to objectively evaluate the utility of this new device.

Methods: 30 urology residents, fellows and students were consented and randomized to perform standard video tower cystoscopy, direct cystoscopy without a camera, and cystoscopy with the EndoGo HD on a previously used bladder model (Uro-Scopic Trainer, Limbs&Things, USA). Participants were timed and evaluated using a previously validated Objective Structured Assessment of Technical Skills (OSATS). Each participant then rated the usability and preferences for each of the 3 systems. All participants completed the three types of cystoscopy.

Results: Users found the field of view to be significantly better for the EngoGo compared to the direct cystoscopy ((p=0.03) and similar for the EndoGo and standard tower (p=0.7). Although the time needed to perform the cystoscopy was significantly longer for EndoGo versus Tower and Direct cystoscopy (71.9 sec vs. 43.3 and 46.8; p=0.01), the overall participant rating of ease of assembly and procedure was not significantly different for any type of cystoscopy (p=0.3 and p=0.1 respectively). Comparing novices to experts (>200 cases), experts completed all procedures more quickly, regardless of camera type. Tower cystoscopy was significantly less difficult, more comfortable, and was preferred by the majority of participants.

Conclusion: On objective and subjective measures, the EndoGo HD portable cystoscopic camera received similar marks to other types of cystoscopy currently widely available. It did require ½ minute longer time to set up on average and overall, participants preferred standard video tower cystoscopy. The EndoGo HD may be useful in the emergency department or office setting where no video tower is available. Further work exploring its utility as a teaching tool and the learning curve of use and will be evaluated.

ABSTRACT 45

BIOHEAT MODEL FOR UNINTENDED FREEZE DETERMINATION

Cervando G. Ortiz-Vanderdys[1], Bernardo Ortiz-Vanderdys[2]

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Introduction: The importance of reaching low temperatures below -20°C and -40°C has been established in cryoablation. Bioheat models can give guidance not only in planning but also in monitoring cryotherapy. Different probes run at different temperatures and the result of adjusting freezing power at settings other than 100% is not well described. A second goal is to illustrate significance of these settings on cryoablation effectiveness.

Methods: A Pennes Bioheat model was run to 2 cm diameter ice ball size with a model of a Galil 17 gauge icerod running at different freezing temperatures. Time to freeze to goal and size of -20°C and -40°C isotherms are recorded. The simulation was done with values used by Rabin et al for simulations in saline and a cell size of 0.5 mm on the side. The interval between iterations was 0.01 seconds. The models are calibrated with temperature data from cryoprobes run in gel.

Results: A relationship between the minimum temperature a probe effectively delivers and the time it takes to generate an ice ball to 2 cm in diameter was graphed with 95% confidence intervals calculated (Fig. 1). Isotherm profiles for the different probe temperature was plotted with 95% CI(Fig 2). The data at -60°C corresponds with the effective probe temperatures of the Galil IceRod, and -80°C to the effective probe temperature achieved with the Endocare Perc-17 tested in gel. Freeze times and 0°C isotherms were also calibrated with animal study data.

Conclusion: Extending a freeze beyond the time required to achieve the desired size of freeze necessarily compromises effective freezing, unintended freezing or both. Using a computer model and calibrating against focused lab runs results in efficient data gathering when compared to other models. It also allows the generation of graphs and tables to guide procedures. Using the goal of -20°C we also found that the unintended freeze area grew dramatically as the temperature of the probe was raised or as the freeze was extended in time. The data obtained provide tables that can guide clinical procedures to optimize effectiveness and minimize unintended consequences.

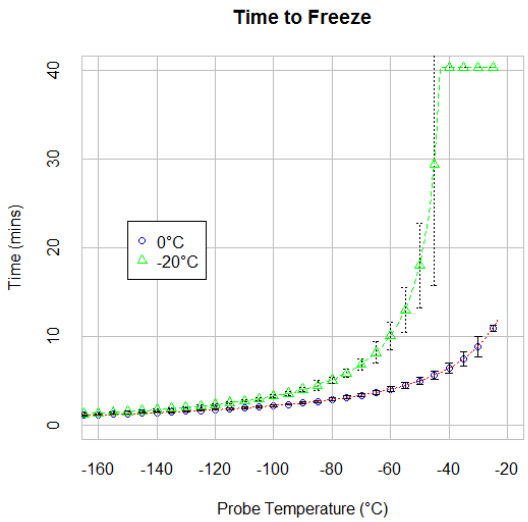

Figure 1: Time to generate an ice ball and a -20°C isotherm 2 cm in diameter. Can be used to estimate probe temperature from imaging.

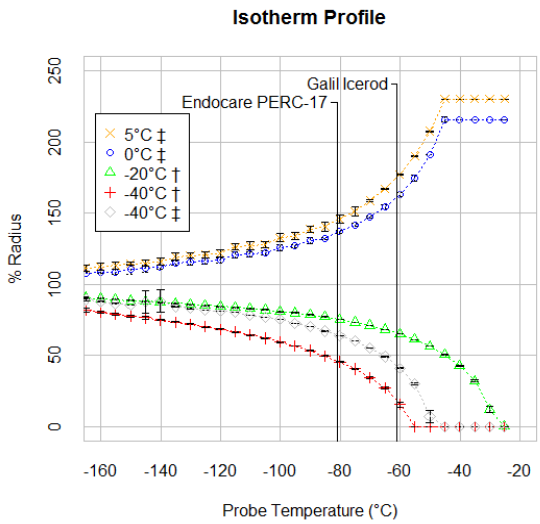

Figure 1: †Determined with goal of ice ball at 2 cm in diameter. ‡Determined with goal of -20°C isotherm of 2 cm in diameter.

ABSTRACT 46

BIPOLAR PLASMA VAPORIZATION OF SECONDARY BLADDER NECK SCLEROSIS—MORE EFFICIENT THAN STANDARD TUR?

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Introduction and Objective: This trial aimed to assess the therapeutic efficiency, overall safety and short-term postoperative results of bipolar plasma vaporization (BPV) in cases of secondary bladder neck sclerosis (BNS). A prospective, randomized comparison to the standard monopolar transurethral resection TUR was also performed.

Materials and Methods: A total of 60 patients (mean age of 72) with BNS secondary to TURP (41 cases), to open surgery for BPH (open prostatectomy – 14 cases) and to radical prostatectomy for prostate cancer (5 cases) were enrolled in the trial. The inclusion criteria consisted of Q_{max} < 10 ml/s and IPSS >19. All patients were evaluated preoperatively and at 1, 3 and 6 months after surgery by International Prostate Symptom Score (IPSS), quality of life score (QoL), maximum flow rate (Q_{max}) and post-voiding residual urinary volume (RV).

Results: Similar preoperative parameters were determined for patients from both series. BPV and TUR were successfully performed in all cases (30 patients each). The mean operative time, catheterization period and hospital stay were significantly reduced in the BPV series (16.5 versus 27 minutes, 18 versus 46.5 hours and 34.5 versus 73 hours). Capsular perforation only occurred in 2 cases of the TUR study arm, while the rate of irritative symptoms was similar in the 2 series (13.3% versus 16.7%). The 1, 3 and 6 months' follow-up emphasized superior parameters for the BPV group by comparison to the TUR group in terms of IPSS (3.4 versus 6.3, 3.6 versus 6.5 and 3.7 versus 6.8, respectively) and Q_{max} (23.8 versus 21.1 ml/s, 23.7 versus 20.6 ml/s and 23.0 versus 20.7 ml/s, respectively). At the same time intervals, QoL was also significantly improved in the BPV arm (1.2 versus 1.4, 1.4 versus 1.6 and 1.4 versus 1.7), while no significant differences were established in terms of RV between the 2 series. Only 2 patients of the TUR group required re-treatment during the follow-up period.

Conclusions: BPV constitutes a valuable endoscopic treatment alternative for secondary BNS. In a randomized analysis, the method emphasized superior efficacy, a satisfactory safety profile and significantly improved short-term follow-up parameters by comparison to the standard TUR.

ABSTRACT 47

RENAL TUMOR CONTACT SURFACE AREA: A NOVEL CT-PARAMETER FOR PREDICTING PERI-OPERATIVE OUTCOMES USING ADVANCED IMAGE-PROCESSING SOFTWARE

Scott Leslie[1], Andre Luis de Castro Abreu[1], Eric Yi-Hsiu Huang[1], Syed Rahmanuddin[2], Tania S Gill[1], Andre K Berger[1], Jie Cai[1], Vinay A Duddalwar[2], Inderbir S Gill[1], Mihir M Desai[1]

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Introduction: The surface area of contact that a tumor has with the adjacent renal parenchyma considerably determines the extent of resection of kidney tissue during partial nephrectomy (PN), and thus may impact on peri-operative outcomes. We present a novel method of calculating renal tumor contact surface area (CSA) using advanced image-processing technology and correlate it with peri-operative variables in patients undergoing PN.

Methods: From 01/2010-08/2011, 95 patients underwent minimally invasive PN for tumor, and had CSA data available using image rendering software (3D Synapse – Fuji film©). CSA was correlated with baseline demographics and peri-operative outcomes.

Results: Mean tumor size was 3.1cm and mean CSA was 18 cm^2. CSA significantly correlated with blood loss (p=0.026), operative time (p=0.001) and length of hospital stay (p=0.003). Matched-pair comparison of patients receiving or not receiving peri-operative transfusion demonstrated similar tumor size, R.E.N.A.L score, PADUA score and C-index between the groups, yet a significantly higher CSA in those who required transfusion (24.7 vs. 17.1 cm^2, p=0.007). Patients with tumor CSA greater than 20 cm^2 were 6.9 times more likely to require peri-operative transfusion than patients whose tumor CSA was less than 20 cm^2 (p=0.01).

Conclusion: In patients undergoing partial nephrectomy, tumors with greater contact surface area with surrounding renal parenchyma require a more extensive resection, thus impacting on peri-operative outcomes, including bleeding requiring transfusion. If these findings are validated in larger cohorts, future nephrometry systems could incorporate CSA measurements to objectively quantify renal tumor complexity and predict peri-operative outcomes of partial nephrectomy surgery.

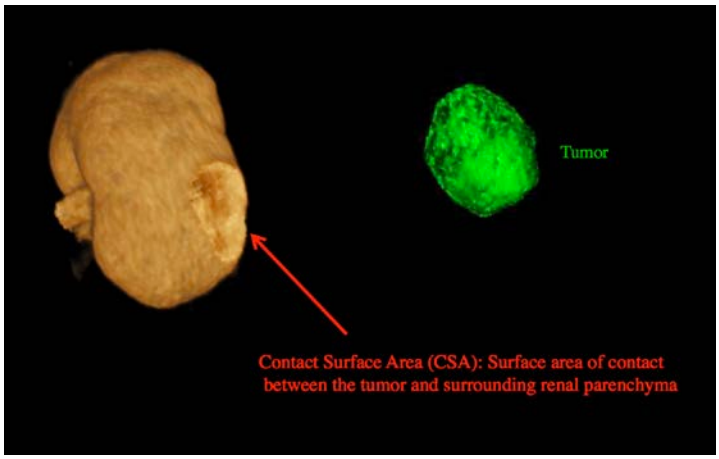

Figure 1. Contact Surface Area (CSA)

ABSTRACT 48

SIMULATION FOR TRAINING INTRA-DETRUSOR INJECTION OF BOTULINUM TOXIN TO TREAT URINARY INCONTINENCE

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[2] *Department of Computer Science and Engineering, University of Minnesota*
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[4] *Department of Physical Medicine & Rehabilitation, University of Minnesota*
[5] *Department of Urology, Medical School, University of Minnesota*

Introduction: We have built new simulation prototypes for training the urological procedure of intra-detrusor injection of Botox®, recently FDA approved for treating overactive bladder. Using this computer simulation tool, the cystoscopic injections can be practiced on virtual models. Quantitative data are measured as performance metrics during training for objective assessment of learning outcomes. The curriculum design is guided and verified by several expert urologists.

Methods: Physically-based modeling algorithms are derived from previous work and applied in this virtual environment, where 30 cystoscopic injections per exercise inside a virtual bladder are interactively simulated by the integrated system. Functional modules handle soft tissue deformation and swelling/blebs per injection, penetration/contact between tissue and needle/scope, graphics rendering and motion tracking of instruments – cystoscope body, camera, needle/syringe, plunger and irrigation-fluid controls. Bladder capacity ranges from 75cc to 250cc with anatomy presented by high-resolution mesh model suitable to interact with a 22 gauge needle model. An embedded sensor introduces dome deformation on the virtual bladder as the user physically pushes down on an artificial abdominal wall.

Results: Robust and realistic simulation methods have been implemented and integrated in two prototypes, which collect performance metrics, *e.g.*, injected amounts, locations and penetration depths. On gaming laptops, simulation as well as graphics rendering of a bladder mesh with a surface resolution of 50k vertices or 100k polygons can be updated above 100Hz. The prototypes have been test-run at EAU 2012 Annual Congress, Paris, and will be refined according to feedback.

Conclusion: Using computer simulation technologies to train cystoscopic procedure of botulinum toxin injection is a practical and promising approach.

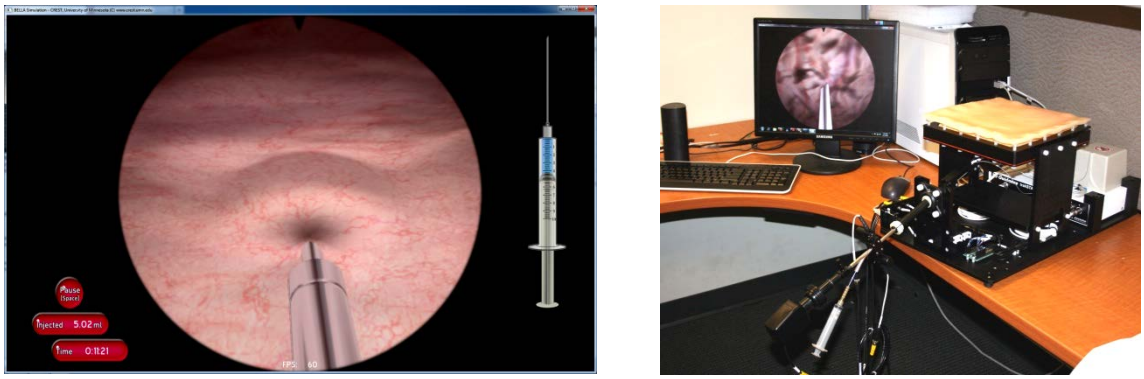

Figure: Simulation screen capture and the hardware interface

ABSTRACT 49

THE *"Al dente"* RADIOFREQUENCY ABLATION OF RENAL TUMORS: USE OF PERIPHERAL FIBEROPTIC TEMPERATUVE MONITORING SAVES NEPHRONS

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[2]Department of Urology, University of Florida, Gainesville, FL

Introduction & Objective: Nephron-sparing renal cancer surgery is aimed to preserve normal parenchymal volume while treating the malignancy. Though most centers have reported oncological and renal functional outcomes after radiofrequency ablation (RFA) of renal masses, the associated loss of normal parenchymal volume is yet to be described. The objective was to measure normal parenchymal volume loss with RFA of renal masses and whether the use of real-time peripheral temperature monitoring (PTM) around the tumor during RFA reduces renal volume loss.

Methods: We reviewed our prospectively collected database of patients with renal masses treated between November 2001 and January 2011 with laparoscopic (LRFA) or Computerized Tomography (CT) guided percutaneous RFA (CTRFA) with and without simultaneous real-time fiberoptic PTM. Patients with multiple tumors and those without available contrasted CT imaging were excluded from analysis.
DICOM data was exported and analyzed in the open-source, FDA approved, OsiriX Medical Imaging software. Volumetric calculation was internally validated and used to measure the normal, enhancing bilateral renal parenchyma and tumor volumes. Clinical outcomes were collected and analyzed. For continuous variables, independent student's t-test was used and for discrete variables Fisher's exact test was used. Multivariable linear regression was performed.

Results: A total of 63 patients (42 male) aged 36-86 years (mean 67.8) and 63 renal tumors underwent LRFA without PTM (17), LRFA with PTM (16) and CTRFA with PTM (30). Mean tumor size, volume and Nephrometry score were (2.6cm, 9.0cm3, 6.8), (2.9cm, 11.4cm3, 7.4) and (2.6cm, 9.6cm3, 7.6) in each group respectively. Average time interval between pre and postoperative imaging used in analysis is 23.6mo (3-65mo). Univariate analysis revealed a statistically significant (p=0.0001) average percent parenchymal volume loss in kidneys treated without PTM (-29.2%) compared to those treated with temperature monitoring (-11.7%) irrespective of the LRFA with PTM (-12.6%) or CTRFA with PTM (-11.2%) methods. Multivariate analysis looking at gender, age, time interval between pre and postoperative CT imaging, nephrometry, tumor volume and total parenchymal preoperative volume revealed that the only factor leading to a significant loss in normal renal volume was the lack of PTM (OR=4, 95% CI -7.9-23.6, p=0.001).

Conclusion: Our retrospective volumetric analysis of renal parenchyma before and after RFA of renal masses reveals that the use of peripheral real-time fiberoptic thermometry produced a statistically significant 40% relative reduction in normal parenchymal renal loss. We therefore encourage a wider adaptation of this technique to enhance the nephron-sparing qualities of renal RFA.

ABSTRACT 50 **TOP 10 ABSTRACT**

PRELIMINARY TESTING OF A TRANSURETHRAL DEXTEROUS ROBOTIC SYSTEM FOR BLADDER RESECTION

Ryan B. Pickens, M.D.[3,4], Andrea Bajo [1,4], Nabil Simaan, PhD [1,4], S. Duke Herrell, M.D[2,3,4]

[1]Vanderbilt University Departments of Mechanical Engineering and [2]Biomedical Engineering;
[3]Vanderbilt University Medical Center, Department of Urologic Surgery;
[4]Vanderbilt Initiative in Surgery and Engineering (VISE)

Introduction: Transurethral resection of bladder tumor (TURBT) and pathological staging are both standard surgical therapy for non-muscle invasive bladder (NMIB) cancer and integral parts of the diagnostic evaluation and progression monitoring of all bladder tumors. Anterior and bladder dome tumors can provide difficult sites of resection due to anatomy, visualization, and limitations of the instruments. We developed and tested a dexterous robot that can fit through a standard resectoscope for evaluation for possible en-bloc resection of bladder tumors especially tumors along the dome and anterior wall of the bladder.

Materials and Methods: Our dexterous robotic slave uses a continuum (snake-like) mechanical architecture with three working channels through which a fiberscope, biopsy graspers, and a holmium laser were placed (Fig. 1). The continuum robot has two segments. Each segment provides two degrees of freedom in bending. The two serially-connected segments allow the continuum robot to retroflex on itself providing an adequate view of the anterior wall of the bladder. Using indigo carmine, injections were performed through the detrusor muscle into the mucosa of the ex-vivo bovine bladders at a total of 11 positions throughout all quadrants of the bladder. The snake robot was used in conjunction with the holmium laser to ablate 9 of the lesions, 2 additional lesions were resected en bloc using the grasper and the laser down through the muscle layer. The bladder was then opened and all areas were checked for completion of ablation as well as the resection beds were taken down to the muscle layer.

Results: Both experiments showed that the robotic system was able to directly visualize all 11 targets. In both bladders, we were able to resect en bloc two tumors using the grasper and 200 micron holmium laser fiber down to the muscle layer indicating a good resection. All of the other targets were completely ablated using the holmium laser.

Conclusion: The dexterous robotic slave robot for TURBT allowed for visualization as well as provided adequate ablation and en bloc resection of bladder lesions throughout the entire bladder. Potential advantages of this system over standard rigid and flexible scopes would include: increased dexterity, using multiple tools simultaneously and en bloc tumor resection with controlled depth. Future applications of this system could be the use of optical time integration for robotically controlled en bloc tumor resection etc.

Figure 1: (left) Robot-assisted bovine bladder resection showing inflated bladder, (right) view of the robot inside the bladder

ABSTRACT 51

RELIABILITY OF PROSTATE HISTOSCANNING IN LOCALIZATION OF PROSTATE CARCINOMA: INDIAN EXPERIENCE

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Background: Prostate HistoScanning ™ (PHS), a new ultrasound-based technology which uses computer-aided analysis to quantify tissue disorganization induced by malignant processes, can identify and characterize foci of prostate cancer as compared with step-sectioned radical prostatectomy (RP) specimens. This study was done to determine the extent to which PHS can identify tumor foci that correspond to a volume of ≥ 0.50 mL.

Material and methods: Between October 2011 and February 2012, 16 men underwent HistoScanning before scheduled radical prostatectomy. The three dimensional raw (grey-scaled) data required for Histoscanning analysis were acquired by transrectal ultrasonography, and analyzed using organ-specific tissue-characterization algorithms. The Histoscanning analysis results were compared with the histology of the whole mounted prostate, step-sectioned coronally at 5-mm intervals, and each slide analyzed by grid analysis.

Results: A total of 96 sextants were studied in 16 patients. The prostate size and the PHS identified lesion size were 13.49± 13.85 and 3.10± 2.06 ml, respectively. PHS correlated well with step sectioned radical prostatectomy specimen total tumor volume (Spearman's coefficient of rank correlation of 0.624,p=0.009). Thus, using the clinically accepted volume threshold of 0.50 mL, the sensitivity, specificity, and positive and negative predictive values of Histoscanning were 94.4%, 50%, 85%, and 75%, respectively.

Conclusion: PHS has the capability to accurately detect cancer foci more than 0.5 mL within the prostate. Further studies to explore its role for the preoperative imaging in cancer prostate are required.

ABSTRACT 52 **TOP 10 ABSTRACT**

3D-HOLOSCOPIC IMAGING: A NEW DIMENSION TO ENHANCE IMAGING IN MINIMALLY INVASIVE THERAPY IN UROLOGICAL ONCOLOGY

Makanjuola JK[1], Aggoun A[2], Swash M[2], Grange P[3], Challacombe BJ[1], Dasgupta P[4]

[1]Department of Urology, Guys and St Thomas Hospital, London, UK, [2]3D Visual Information Engineering (3D VIE) Research Group, School of Engineering and Design, Brunel University, UK, [3] Department of Urology, Kings College Hospital, London, UK, [4]MRC Centre for Transplantation, NIHR Biomedical Research Centre, King's Health Partners Guys Hospital, London, UK

Introduction: Existing image representation of urological pathology (from CT/MRI) is limited by its 3-dimensional (3D) representation on a 2-dimentional screen (2D). Performing procedures like partial nephrectomy remains a technical challenge especially when the tumour is not always evident macroscopically and difficult anatomy of the arterial system complicates tumour removal. Accurate localisation of tumours and surrounding structures will enhance preoperative diagnosis, biopsy, therapeutic planning and intraoperative visualisation. We present 3D-Holoscopic imaging (figure 1) as a novel method of representing DIACOM data images (CT /MRI) to produce 3D-Holographic representations of anatomical structures that can be viewed pre and intra operatively (using augmented reality concept) without special eyewear in natural light.

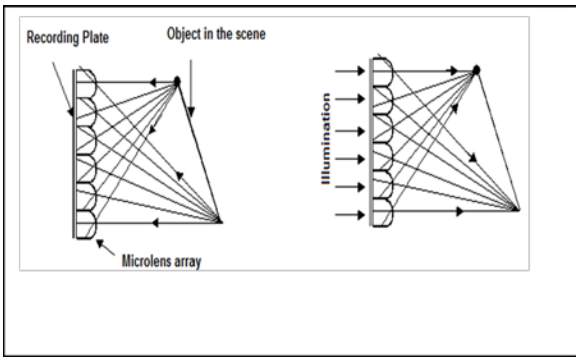

Figure 1: Recording and replay of the 3D-Holoscopic imaging

Figure 2: 3D-Holoscopic content on the autostereoscopic display

Methods: We have developed proof of concept static display models (figure.2). The proposed 3D-imaging technology allows natural accommodation and convergence to accomplish stress-free viewing. We are performing feasibility studies using the Alioscopy 3D-Display and have created software tools that allows 3D-Holoscopic images to be converted in the appropriate format supported by a commercial auto-stereoscopic display for viewing (figure 3).

Results: The results are extremely satisfactory and for the first time it is proved that medical 3D-Holoscopic content can be displayed on commercially available multi-view auto-stereoscopic display. As a result we are able to display a ground-breaking 3D-Holoscopic images relevant to minimally invasive urology. We are further developing display screen prototypes and advancing our algorithms required to convert DICOM data from CT, MRI and US into dynamic 3D images an a auto-stereoscopic display to facilitate development of true image-fusion surgical systems.

Conclusion: Our application to the medical field of this emerging technology may revolutionize the visualization spectrum from diagnosis, to staging investigations, simulation training and we believe will add a new dimension to augmented reality in tumour location during technically challenging procedures like partial nephrectomy.

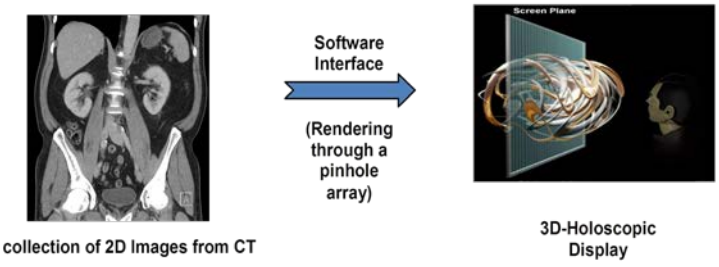

Figure 3: Principle of DIACOM data capture to 3D-Holoscopic image (optical model) display

ABSTRACT 53

GREENLIGHT HPS-120W VS GREENLIGHT XPS-180W LASER VAPORIZATION OF THE PROSTATE FOR BENIGN PROSTATIC HYPERPLASIA: A PROSPECTIVE COMPARATIVE OUTCOMES ANALYSIS

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University of Montreal Hospital Center, Montreal, Quebec, Canada

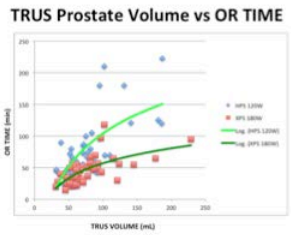
Introduction: To evaluate the safety, efficacy and short-term outcome of the new 532nm Greenlight XPS 180W laser system(AMS,Minnetonka, MI,USA) in comparison to the former generation HPS-120W system for treating benign prostatic hyperplasia(BPH) in a prospective non-randomized single-centre study.

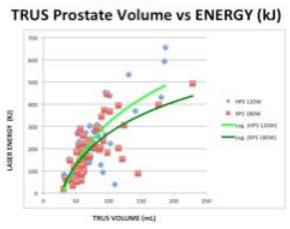
Methods: From June 2010 to September 2011, 145 consecutive patients with lower urinary tract symptoms secondary to BPH were included; 60 patients were treated with HPS-120W and 85 with XPS-180W laser vaporization of the prostate. Perioperative variables, and complications were evaluated. International Prostate Symptom Score (IPSS), maximum flow rate (Q(max)), post-void residual urine (PVR), Sexual Health Inventory for Men (SHIM), and quality of life score (Qols) were recorded at baseline, 1-, 3- and 6-months. Serum PSA was assessed at baseline and 6-month follow-up.

Results: Mean(range) age of the patients was 69.6(48-87) years(HPS) and 67.2(50-85) years(XPS), with a mean preoperative TRUS-prostate volume of 81.7(31-187) and 78.2(33-229)mL, respectively. Patient preoperative characteristics were comparable including retention rate (52% and 47%,respectively). Mean operative duration was significantly shorter for the XPS group (79vs44.2min;p<0.01) as was mean laser time (37vs24min;p<0.01). Mean energy delivery was however comparable between HPS and XPS groups(222.5vs188.7KJ;p=0.12). Mean fibre use (1.6vs1.0;p<0.01) and 3L Saline bags (4.1vs7;p<0.01) were significantly lower for the XPS group. The rate of visual impairment from bleeding (3% vs 4%;p< 0.74) and prostate capsule perforation (0% in each), were comparable. There were no significant differences in 30-day complication rate including dysuria(17% vs 21%), incontinence (3.3% vs 3.5%), retention (5% vs 7%), retrograde ejacuation (65% vs 60%) or erectile dysfunction (1.6%vs2.3%). With a mean follow-up of 11.8 and 7.5 months, no urethral strictures or retreatments were observed. Clinical follow-up is summarized in Fig.1. 6m-PSA reduction was significantly greater for the XPS group (54%vs78%;p<0.01).

Postoperative Outcomes

	Pre-op		3-months			6-months		
	HPS (n=60)	XPS (n=85)	HPS (n=55)	XPS (n=81)	P-value	HPS (n=53)	XPS (n=72)	P-value
Mean IPSS	25.4 (15-35)	24.2 (16-34)	8.4 (3-20)	9.8 (3-21)	0.23	6.2 (1-14)	6.4 (3-16)	0.30
Mean QOL	4.8 (3-6)	4.5 (3-6)	1.2 (0-4)	1.9 (0-5)	0.28	1.1 (0-4)	1.3 (0-5)	0.46
Mean Qmax (mL/sec)	7.2 (0-17)	6.1 (2-13)	18.1 (12-34)	19.3 (14-31)	0.48	18.4 (9-32)	23.2 (14-32)	0.09
Mean PVR (mL)	270 (54-620)	338 (51-1350)	45.9 (0-175)	21 (0-105)	0.05	39.3 (0-280)	5 (0-30)	0.11
Mean PSA (ng/mL)	4.85 (0.3-14)	4.0 (0.3-19)	-	-	-	2.2 (0.05-13)	0.9 (0.2-7.1)	**0.01**





Conclusion: Both Greenlight systems provide safe and effective tissue vaporization properties with significant clinical relief of BPH obstruction. The XPS-180W laser system appears to be more favorable with regards to reduced operative time, fibre need and PSA-reduction suggesting more effective tissue removal.

ABSTRACT 54

AUTOMATED ANALYSIS OF RETROPERITONEAL ABNORMALITIES USING BOX COUNTING ALGORITHMS

Cristian Surcel

Introduction: The retroperitoneal space contains multiple organs (abdominal aorta, inferior vena cava, lymphoid tissue, etc) which can be affected by multiple diseases, especially lymphoproliferative disorders and inflammatory/sclerosis processes. The most frequently used imaging technique for differential diagnosis is computed tomography, but its accuracy in discriminating between lymphoma and idiopathic retroperitoneal fibrosis (IRF) is small. The aim of this study is to evaluate an automated analysis of the CT scans using a fractal analysis-based software in order to differentiate between retroperitoneal lymphoma and IRF

Materials and method: We conducted a retrospective comparative study in our center which included 32 patients with histologically-proven IRF (19 patients) and retroperitoneal follicular non Hodgkin lymphoma type B (13 patients). We analyzed their CT scans using a using a fractal analysis-based software program. The groups were homogenous and well balanced according to age, sex, and CT protocol of image acquisition. The inclusion criteria were absence of ureteric involvement, normal kidney function, and only retroperitoneal involvement. All images were transferred after acquisition to a separate workstation and the contour of the region of interest (ROI) was extracted using a box counting algorithm. The results were compared to the readout performed by a diagnostic radiologist, considered as reference.

Results: The fractal dimension (FD) of the ROI's in IRF scans varied in the interval 1.33±0.57 while in the retroperitoneal lymphoma scans, the fractal dimension varied in the interval 2.14±1.14 ($p=0.04$), confirming the hypothesis that a higher FD is present in malignant cases. The concordance index between the automated and manual analysis of the IRF images was 0.874 (95% confidence interval 0.862, 0.884) and 0.912 (95% confidence interval 0.862, 0.924) for the retroperitoneal lymphoma scans, respectively.

Conclusion: There is a significant difference between the fractal dimension of the ROI of idiopathic retroperitoneal fibrosis and retroperitoneal lymphoma. The software provides equivalent results to the manual examination and can be used to differentiate between malignant and benign lesions of the retroperitonum

ABSTRACT 55

ROBOT-ASSISTED TRANSVAGINAL NOTES RETROPERITONEAL NEPHRECTOMY: FEASIBILITY STUDY IN THE CADAVER

Humberto Laydner, Riccardo Autorino, Wahib Isac, Ali Khalifeh, Kamol Panumatrassamee, Ahmad Kassab, Robert J. Stein, Jihad H. Kaouk

Center for Laparoscopic and Robotic Surgery, Urology, Cleveland Clinic, Cleveland, OH, USA

Introduction: Despite the feasibility of NOTES using laparoscopic instruments, technical difficulty of this approach significantly limits its clinical application. Hybrid robot assisted NOTES (R-NOTES) techniques have been described in the animal model. Herein, we evaluate the feasibility of R-NOTES retroperitoneal nephrectomy in a cadaver model.

Methods: Two R-NOTES retroperitoneal nephrectomies were attempted in 2 female cadavers. Transvaginal access to the retroperitoneum was obtained with the cadaver placed in a semi-prone jackknife position.

Results: In the first cadaver, a right transvaginal R-NOTES retroperitoneal nephrectomy was successfully completed without the addition of extra ports with no injuries to retroperitoneal organs or vessels. Time for setup was 128 min. Time to identify the ureter was 53 min. Dissection and control of the renal pedicle was completed in 21 min. Time to dissect the kidney out from its attachments and extract the specimen was 36 min. Total time to complete the procedure was 238 min. In the second cadaver, rectal injury occurred during the access and the completion of a left nephrectomy was not possible because the robotic instruments did not reach the kidney.

Conclusion: Transvaginal R-NOTES retroperitoneal nephrectomy in the cadaver model is feasible. Improvements in the technique and instrumentation are necessary in order to make this approach safe and reproducible.

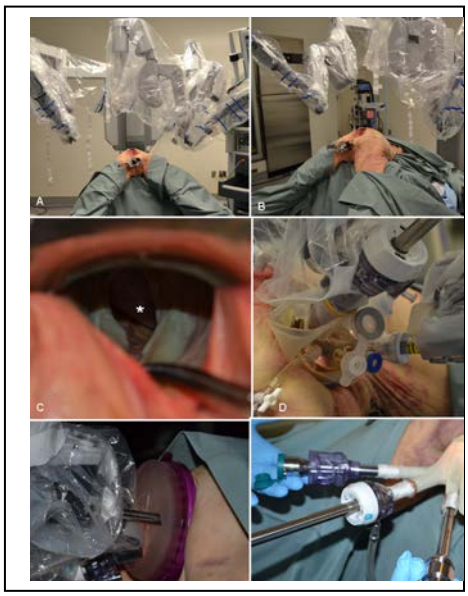


Figure 1:
A and B- semi-prone jackknife position;
C- retroperitoneal access through the vaginal posterior fornix (*rectum);
D- QuadPort+™;
E- GelPoint™;
F- Home-made port.

Figure 2: Identification of the right ureter (U) anterior to the iliac artery (IA)

Figure 4: A- hilar control; B- placement of the kidney into a laparoscopic endocatch bag;
C- extraction of the specimen through the vagina; D- closure of the vaginal incision

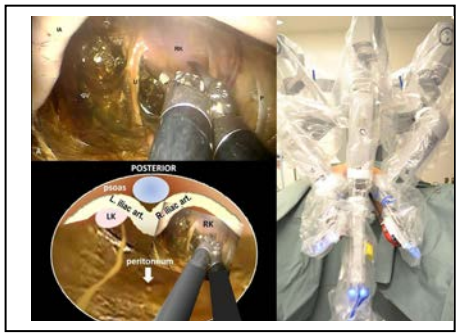


Figure 3: A- intraoperative view: right iliac artery (IA); right kidney (RK); right ureter (U); right gonadal vein (GV); peritoneum (P); B- figure A inserted into the context of a schematic representation of the whole retroperitoneal cavity; left kidney (LK);
C- External view

ABSTRACT 56

USER FEEDBACK FOR SUTURING USING BLACK LIGHT ASSESSMENT OF SURGICAL TECHNIQUE (BLAST) AND IMAGE PROCESSING

Lauren Poniatowski, Troy Reihsen, Robert Sweet, MD
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Introduction: Tissue analog models are used in simulation for the training and assessment of surgical technique, particularly for suturing skills. We have designed synthetic physical tissue simulators with integrated assessment lines allowing for Black Light Assessment of Surgical Technique (BLAST). Additionally, we have designed a method for giving quantitative and visual feedback to the user using image processing techniques in MATLAB®.

Methods: UV sensitive assessment lines were integrated into organosilicate-based material recipes with reference to mechanical properties of human tissue from the Center for Research in Education and Simulation Technologies (CREST) Human Tissue Database. Two models with integrated assessment lines are presented. An analog model for training laparoscopic pyeloplasty is presented to demonstrate patient specific modeling of anatomy using 3D printed molds. A skin analog model was also developed to demonstrate image processing analysis techniques of the integrated assessment lines in 2D in MATLAB®.

Results: The assessment lines worked well in that they were invisible to the user during a suturing exercise (Figure 1a) and then appeared with sufficient brightness under UV light to be captured as an image (Figure 1b). Image processing techniques were determined to be useful in giving user feedback quantitatively through an overlap percentage value as well as by visually showing overlapped and non-overlapped regions of an image (Figure 2). A model for training laparoscopic pyeloplasty was also completed for demonstration of using BLAST for applications specific to urology (Figure 3). It was premiered at the AUA hands on laparoscopic training course.

Conclusion: Analysis of suturing skills is possible using assessment lines in tissue analog models using BLAST (2D and 3D) and image processing techniques (2D).

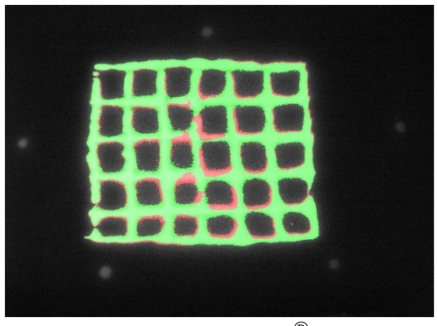


Figure 2. MATLAB®output image showing overlap between the unsutured and sutured image (green) and no overlap (red).

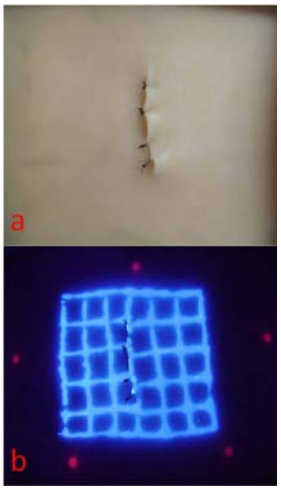


Figure 1. Sutured synthetic skin under (a) room lighting conditions and (b) UV light.

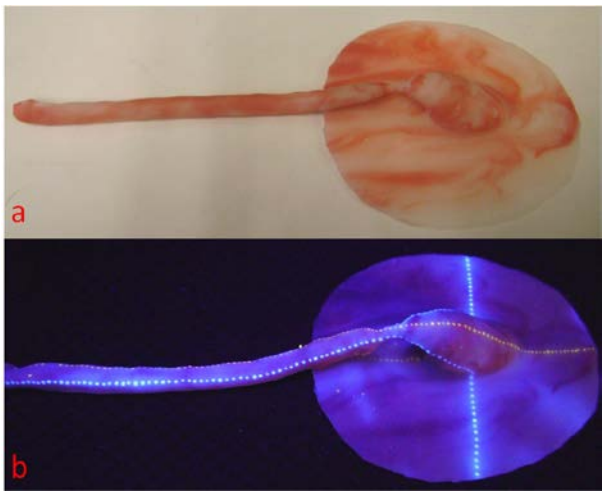


Figure 3. Pyeloplasty model under (a) room lighting conditions and (b) UV light.

ABSTRACT 57

THE XENX™ – A NEW DEVICE TO PREVENT STONE MIGRATION DURING LASER LITHOTRIPSY

Eugene Kramolowsky[1], Idan Tamir[2], Ofer Zigman[2], David Murphy[1], Isaac Koziol[1]

[1] Virginia Urology, Richmond, VA [2] Xenolith Medical, Kiryat-Gat, Israel

Introduction: Stone migration during ureteroscopic laser lithotripsy is a well-known phenomenon resulting in lengthened procedures and increased technical difficulty. Several stone retention devices are available commercially, but have various shortcomings, such as the need to introduce them in addition to a guide-wire and a tendency to disintegrate when exposed to the laser. We report here the results of clinical development and evaluation of the XenX (Xenolith Medical) - a novel stone retention device for proximal and distal stones during holmium laser lithotripsy. The XenX integrates into one device a self-expanding retention element, which fits itself to the ureter anatomy, and a guide wire. Moreover, due to its unique design, holmium laser lithotripsy may be conducted in close proximity to the retention element without compromising its ability to prevent stone migration.

Methods: Between January and March 2012, ten ureteroscopy procedures using the XenX device were performed by four board certified urologists. The device evaluation included deployment, positioning, stone entrapment, and urologist's perception of value. The mean patient age was 47 years (range 25-72). Seven patients had a single stone and the remainder had two or more. Stones were located in the distal (70%), mid (10%) or proximal (20%) ureter. Mean stone size was 53 mm^2 (range 16-81). Secondary endpoints were reduction in operation time, intraoperative complications, and stone migration. Patients were followed for 30 days post-operatively.

Results: The ureteroscopy and laser fragmentation was successfully completed in ten patients. The braided mesh that comprises the stone retention element was deployed between the stone and the kidney and effectively blocked retrograde stone migration during holmium laser lithotripsy while allowing free fluid flow in all cases. Stones fragmented to sub-mm size did not pass through the mesh and were removed or flushed into the bladder. The device allowed increased irrigation rates (300mm Hg pressurized system and employment of higher laser power settings, typically, 8J, 8Hz, 6.4W), and ease in stone engagement with the laser fiber. Initial clinical data indicated that friction between the device and both the cystoscope's working channel and the ureteroscope was too high, which resulted in device migration along the ureter. The XenX device was improved by coating both its core wire and outer layer of the overlay tube (which houses the self-expanding braid) with PTFE, resulting in significant reduction in both static and dynamic friction coefficients. Re-testing the device in the clinical setting indicated that device migration was no longer significant. No intra- or post-operative complications were encountered and all patients were stone-free 30 days post-operatively. Survey of operating surgeons revealed a perception of increased ease of performing the procedure and a decrease in procedure duration.

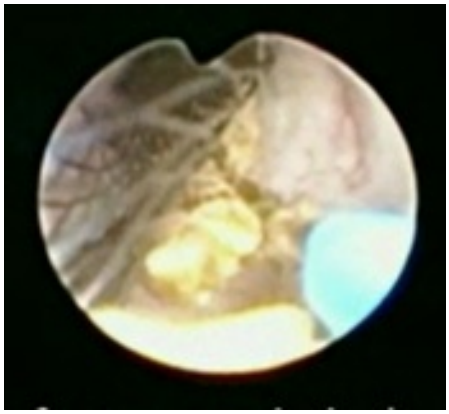


Figure: Visualization of stone using Xenolith device

Conclusion: The XenX device provides a significant improvement to holmium laser lithotripsy by effectively preventing retrograde stone migration, improving ureteroscopic visualization, and significantly reducing procedure complexity and apparent operative time. The device may also have application during percutaneous nephrolithotripsy to prevent stone efflux down the ureter.

ABSTRACT 58

IN VITRO AND *IN VIVO* COMPARISON OF OPTICS AND PERFORMANCE OF A DISTAL SENSOR URETEROSCOPE (STORZ FLEX-X^C) VS. A STANDARD FIBEROPTIC URETEROSCOPE (STORZ FLEX-X^2)

A. Lusch, C. Abdelshehid, J.A. Graversen, K. Osann, S. Olamendi, R. Alipanar,
E. McDougall, J. Landman
Department of Urology, University of California, Irvine, Orange CA 92868, USA

Purpose: Recent advances in distal sensor technologies have made distal sensor ureteroscopes commercially technically feasible. We evaluated the performance characteristics and optics of a new generation distal sensor (Flex-X^C, Karl Storz, Tuttlingen, Germany)(X^c) and a standard flexible fiberoptic ureteroscope (Flex-X^2, Karl Storz, Tuttlingen, Germany)(X^2).

Material and Methods: The two ureteroscopes were compared for active deflection, irrigation flow rates and optical characteristics. Each ureteroscope was evaluated with an empty working channel and with various accessories. Optical characteristics (resolution, grayscale imaging and color representation) were measured using USAF test targets. The ureteroscopes were tested *in vivo* in a porcine model using a HD monitor and an HD recording system. We digitally recorded a renal porcine ureteroscopy and laser ablation of a stone with the X^2 and with the X^C. Edited footage of the recorded procedure was shown to different surgeons (n=8) on a HD monitor for evaluation by questionnaire for image quality and performance.

Results: The X^C had a higher resolution than the X^2 at 20 and 10 mm 3.17 lines/mm vs. 1.41 lines/mm, 10.1 vs 3.56, respectively ($p=0.003$,$p=0.002$). Color representation was better in the X^C. There was no difference in contrast quality between the two ureterosopes. For each individual scope, the upward deflection was greater than the downward deflection both with and without accessories. When compared to the X^2, the X^C manifested superior deflection and irrigant flow ($p<0.0005$, $p<0.05$) with and without accessory present in the working channel. When an accessory was present, the X^2 demonstrated less diminishment of deflection compared to empty working channel deflection than the X^C ($p<0.0005$ for combined up and down deflection). Deflection (up/down) of both ureteroscopes was most impaired by a 3.2 Fr grasper (98.5%/99% reduction for the X^C and 99%/99% for the X^2) and least impaired by a 1.7 Fr Nitinol Stone Basket (48%/45% reduction for the X^C and 52%/55% for the X^2). Irrigation flow rate was also most impaired by a 3.2 Fr grasper (98.5% reduction for the X^C and 99% for the X^2) and least impaired by a 200 µm laser fiber (48% reduction for the X^C and 52% for the X^2). Observers deemed the distal sensor ureteroscope superior in visualization in clear and bloody fields, as well as for illumination. ($p=0.0005$, $p=0.002$, $p=0.0125$)

Conclusion: In this *in vitro* and porcine evaluation the distal sensor ureteroscope appears to provide significantly improved resolution and color representation as compared to a standard fiberoptic ureteroscope. The overall deflection was also better in the X^C and deflection, as well as flow rate, was less impaired by the various accessories.

ABSTRACT 59 **TOP 10 ABSTRACT**

PHANTOM STUDY OF A NOVEL STEREOTACTIC PROSTATE BIOPSY SYSTEM INTEGRATING PREINTERVENTIONAL MRI AND LIVE US FUSION

Timur H. Kuru[1], Matthias Roethke[2], Dogu Teber[1], Boris A. Hadaschik[1]*, Markus Hohenfellner[1]*

[1]Department of Urology, Heidelberg University Hospital, Heidelberg, Germany
[2]Department of Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

Introduction: To determine the targeting error of a novel stereotactic prostate biopsy system, which integrates preinterventional MRI with periinterventional ultrasound for perineal navigated prostate biopsies.

Methods: We performed stereotactic biopsies on 5 prostate phantoms (one CIRS 053-MM and four CIRS 066). Phantom 053-MM incorporates three MRI- and TRUS-visible lesions, while lesions within phantom 066 are only detectable on MRI. In both phantoms the 0.5cc volume lesions are randomly placed. The phantoms were examined by 3T-MRI preinterventionally. Then 3 stereotactic biopsies from one lesion in phantom 053-MM and from all ultrasound-invisible lesions in the 066 phantoms were taken under live-fusion-imaging guidance. During intervention a mix of blue ink and gadobutrol was injected into each biopsy channel. Afterwards 3T-MRI was obtained again. These MRI images were then fused again with the intraoperative TRUS-data. Thus, the targeting error (TE) between the planned and performed biopsy cores could be measured. Additionally, the procedural targeting error (PTE) between the virtually planned biopsy trajectory and the manually registered three-dimensional needle position of every single biopsy core taken was calculated.

Results: The overall targeting error (TE) of the 39 biopsy-cores taken was 0.83mm (SD: 0.48mm) with the highest TE in the sagittal plane (1.09±0.54mm), followed by the coronal (0.72±0.43mm) and axial (0.69±0.34mm) planes. The procedural targeting error, which is provided intraoperatively, was 0.26mm in average (SD: 0.46mm). Comparing PTE and TE, there was no statistically significant difference (p=0.39).

Conclusion: The targeting error of stereotactic biopsies using our novel perineal prostate biopsy system (BiopSee®, MedCom, Germany) is below 1mm and can be estimated *in vivo* by the automatically calculated procedural targeting error. Stereotactic prostate biopsies guided by the combination of MRI and ultrasound allow effective and precise examination of MRI-lesions.

ABSTRACT 60

VERSION 2-5 PART PERCUTANEOUS ACCESS NEEDLE WITH GLIDEWIRE (5-PANG): A MULTIUTILITY PUNCTURE SYSTEM FOR PERCUTANEOUS RENAL ACCESS

Rawandale-Patil AV, Kurane C S, Patni L G.

Institute of Urology Dhule, Maharastra, India 424001

Introduction: We describe and analyse our innovative 5-PANG (version 2) needle to make inital tract dilatation during PCNL. Also describe the other utilities of this puncture system.

Methods: The 5-PANG(version 2) needle (fig 1) (designed, fabricated, patented by our institute) consists of 5 parts allowing puncture and inital tract dilatation to 12 Fr during PCNL. Puncture is performed with the inner 2 parts. Part 1 is removed and a glide wire parked into the pelvicalyceal system. Parts 3,4 & 5 are telescoped over part 2. Part 2,3&4 removed. Safety wire/ balloon dilator/ Rigid telescopic dilator rod / flexible or rigid ureterorenoscope (4.5 Fr) can then be passed through part 5. Part 5 is then retained or removed depending on the procedure performed. Successively 364, "5-PANG PCNLs" were carried out. Advantages, disadvantages, safety, efficacy of the 5-PANG technique were prospectively evaluated.

Results: Of 40 renal accesses, 12 had history of previous renal surgeries. Average time from successful puncture to rod/balloon/ureteroscope placement was 51.32 secs with an average radiation time of 3.31 secs. No failure, limitations, early or late complications were observed. 4 cases with stone size of 1.5 cms underwent the 12 Fr 5-PANG miniperc

Conclusion: 5-PANG (version 2) needle makes initial tract dilatation during renal access easy, safe and cheap. It prevents extrarenal wire kinking and slippage, straightens curved puncture tracts, avoids extravasation of contrast, decreases procedure and radiation time required for initial tract creation; is cheap and reusable. It can also be used as a 12 Fr miniperc system and allows antegrade flexible ureterorenoscopy

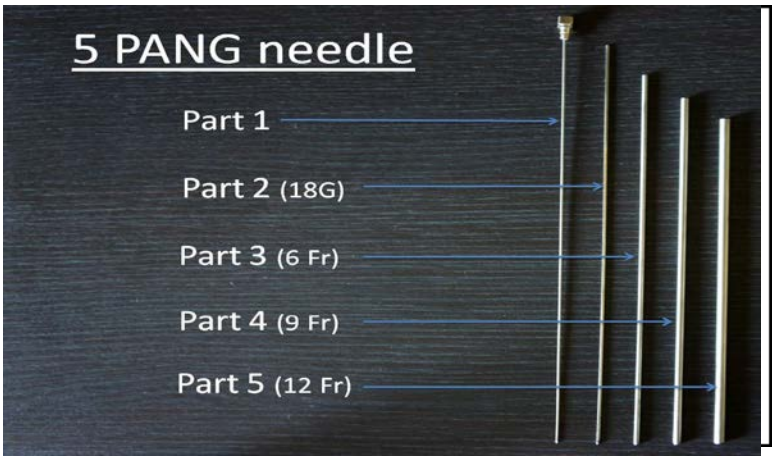


Figure: 5-PANG (version 2) Needle

ABSTRACT 61

AUTOMATED VOLUMETRIC ASSESSMENT BY NONCONTRAST COMPUTED TOMOGRAPHY IN THE SURVEILLANCE OF NEPHROLITHIASIS

Sutchin R Patel MD[1], Shane Wells MD[2], Julie Ruma MD[2], Scott King MD[2], Meghan Lubner MD[2], Stephen Y Nakada MD[1], Perry J Pickhardt MD[2]

[1] Department of Urology, [2] Department of Radiology
University of Wisconsin School of Medicine and Public Health, Madison WI

Introduction: Assessment of size and interval change of renal calculi via noncontrast computed tomography (NCCT) is generally performed using linear measurement in the axial plane in clinical practice. We evaluate the use of automated volumetric assessment for stone surveillance via NCCT and compare the results with manual linear measurement.

Methods: We retrospectively reviewed patients seen in our stone clinic that had undergone two NCCT scans without stone intervention during the interval between scans. Thirty patients met our inclusion criteria and underwent longitudinal assessment for urolithiasis via NCCT (mean interval:583.2 days; range:122-2,030 days). A total of 52 discrete calculi were analyzed. Three board-certified radiologists measured maximal linear stone size in the axial plane using electronic calipers on soft tissue (ST) and bone windows (BW). Automated stone volume was also obtained by each reader using a dedicated prototype software tool (Ziosoft, Redwood City, CA) for stone evaluation.

Results: Mean stone linear size and volume was 4.9±2.8mm(ST), 4.5±2.6mm(BW), and 116.2±194.6 mm^3(window independent), respectively. Mean inter-observer variability for linear size measurement was 16.4±10.5%(ST) and 20.3±13.8%(BW). Inter-observer variability for volumetric measurement was 0%. Of the 52 persistent stones, the mean % change in linear stone size between CT studies was 39.3±46.7%(ST) and 42.9±53.1%(BW) growth, compared with 171.4±320.1%(window independent) growth for automated volume measurement over a mean of 583.2 days. However, discordant results for increased vs. decreased interval size were seen between linear and volumetric assessment in 19/52 stones (36.5%).

Conclusion: Automated volumetric measurement of renal calculi via NCCT is independent of specific reader and window settings. Volumetric assessment amplifies smaller linear changes over time, while up to one-third of cases show linear-volume measurement discordance. Volumetric assessment is therefore preferable, particularly for longitudinal surveillance of renal calculi.

ABSTRACT 62

ROBOTIC-ASSISTED LAPAROSCOPIC PARTIAL NEPHRECTOMY IN PATIENTS WITH PREVIOUS ABDOMINAL AND PELVIC SURGERY

Isac WE, Autorino R, Rizkala E, Hillyer S, Laydner H, Long JA, Kassab A, Khalifeh A, Panumatrassamee K, Eyraud R, Haber GP, Stein RJ, Kaouk J

Glickman Urological and Kidney Institute, Cleveland Clinic, Cleveland, Ohio

Introduction: To assess the outcomes of robot assisted laparoscopic partial nephrectomy (RALPN) in patients with history of previous abdominal or pelvic surgery and to describe our access technique in this patient population

Methods: Retrospective review of our IRB approved database yielded 369 patients who underwent (RALPN) from June 2006 to August 2011. Patients were divided into those who had previous abdominal or pelvic surgery (PAS group) and with no previous abdominal surgery (NPAS). Perioperative outcomes were compared between the two groups. The access site was modified to be as far as possible from the previous abdominal scar and an open access was preferred in selected cases.

Results: Overall, two hundred and eleven patients had a history of previous abdominal surgery (57.1%). Of them, 97 (45%) had history of multiple abdominal surgeries. One hundred and twelve patients of the PAS group were females (53%) as compared to 46 patients (29.1%) (p= 0.0001). RENAL nephrometry score was significantly higher in the PAS group (7.2 versus 6.7) (p=0.04). Otherwise there was no significant difference between groups in terms of other baseline characteristics. Similarly, there was no difference in terms of operative time (p=0.6), estimated blood loss (p=0.8) and warm ischemia time (p=0.08). The surgical access was accomplished using Veress needle in 97.2% in the PAS group versus 97.4% in the non-PAS group (p=0.8). Intra-operative complications were comparable between both groups (p=0.9). No complications related to the use of the Veress needle to gain primary access were encountered.

Conclusion: By applying appropriate modifications to the access technique, RALPN results to be a safe and effective minimally invasive treatment option for the management of small renal masses in the setting of previous abdominal surgery.

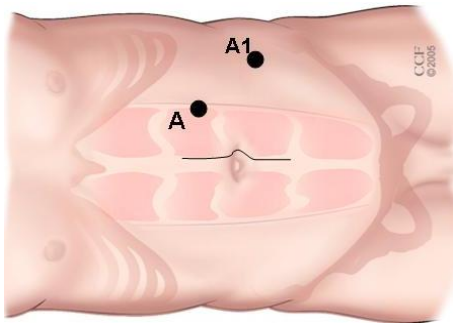


Figure: Drawing shows the usual initial access site (A), alternative access site in case of presence of previous abdominal surgery scar (A1)

ABSTRACT 63

ROBOTIC VERSUS OPEN URETERONEOCYSTOSTOMY: A SINGLE INSTITUTION COMPARATIVE OUTCOME ANALYSIS

Isac WE[1], Kaouk J[1], Altunrende F[2], Rizkala E[1], Autorino R[1], Hillyer S[1], Laydner H[1], Long JA[1], Kassab A[1], Khalifeh A[1], Panumatrassamee K[1], Eyraud R[1], Falcone T[3], Haber GP[1], Stein RJ[1]

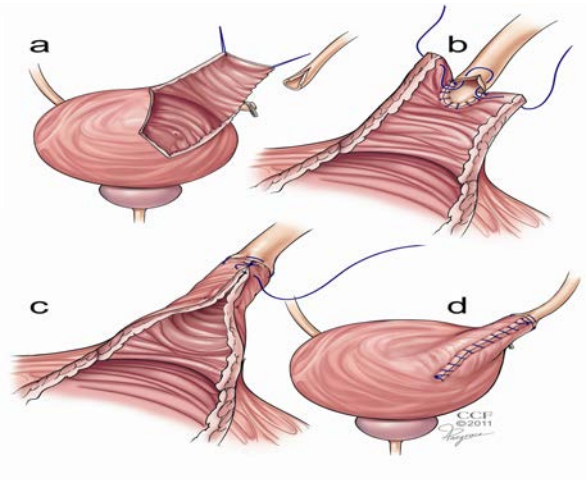
[1]Glickman Urological and Kidney institute, Center for Reproductive Medicine, Obstetrics and Gynecology and Women's Health Institute[3], Cleveland Clinic, Cleveland, Ohio, [2]Istanbul Bilim University Medical Faculty, Department of Urology

Introduction: Ureteroneocystosctomy is used for the treatment of a wide variety of ureteral diseases. Over the last decade, robotic surgery has become more commonly used as a minimally invasive approach for reconstructive upper urinary tract procedures. The aim of this study is to present our experience with robotic ureteroneocystosctomy (RUNC) and compare them to those of open ureteroneocystosctomy (OUNC) in a tertiary care institution.

Methods: Medical records of patients who underwent robotic (RUNC, 26 patients) and open (OUNC, 56 patients) ureteroneocystostomy at our institution between 2000 and 2010 were retrospectively analyzed. Main perioperative and postoperative data including patient demographics, surgical outcomes and clinical and radiographic findings at postoperative follow-up were considered in the comparative analysis.

Results: No significant differences were detected in terms of baseline patient characteristics between the two groups. The OUNC procedures were performed with a shorter median operative time (270 vs. 214 min., p=0.0005) whereas RUNC patients had a shorter hospital stay (median 3 versus 4, p=0.0007), less narcotics pain requirement (median morphine equivalent, mg 104.6 versus 279, p=0.0001) and less estimated blood loss (median 100 versus 150mg, p=<0.0001). The rate of reoperation was similar between the two groups, RUNC 2/26 (7.6 %), OUNC 5/56 (8.9 %).
Conclusion: RUNC provides excellent outcomes with shorter hospital stay and less narcotic pain requirement when compared to the open procedure. Advantages of the robotic platform for dissection and suturing can be useful for complex minimally invasive urologic reconstructive procedures.

Figure 1: Creation of the Boari Flap:
a: A bladder flap is developed.
b: the ureter is anastomosed to the tip of the flap .
c: Tubularization of the boari flap.
d: Completion of the procedure



ABSTRACT 64

REGISTRATION OF ULTRASOUND AND HISTOLOGY DATA FOR VALIDATION OF EMERGING PROSTATE CANCER IMAGING TECHNIQUES

M. Mischi[1], S. Schalk[1], M. Smeenge[2], F. Brughi[1], T. Saidov[1], M.J.P. Kuenen[1,2], R.P. Kuipers[2], M.P. Laguna Pes[2], J.J.C.M.H. De La Rosette[2], H. Wijkstra[1,2]

[1] *Eindhoven University of Technology, Dept. of Electrical Engineering, Eindhoven, the Netherlands*

[2] *Academic Medical Center, Urology, Amsterdam, the Netherlands*

Introduction: Several ultrasound (US) methods are emerging for prostate cancer imaging, aiming at enabling targeted biopsies as well as focal-therapy guidance. However, any of these methods, such as elastography and contrast-enhanced US, requires accurate validation prior to introduction in clinical practice. As the gold standard reference for prostate cancer detection remains histological Gleason scoring after radical prostatectomy, validation requires accurate mapping of the histology results on the imaging results. This task is complicated by misalignment between histology slices and US imaging planes, and by prostate deformations in the ultrasound image, due to insertion of the transrectal US (TRUS) probe, as well as in the histology, due to fixation processes. In addition, except for the prostate contour, US images do not provide reliable landmarks for accurate mapping. This abstract proposes a solution to these problems by a dedicated 3D elastic registration method.

Methods: A 3D US image of the prostate is reconstructed based on two 2D TRUS imaging sweeps, longitudinal and lateral. Also a 3D reconstruction of the histology results, including cancer location, is realized by integration and interpolation of 4-mm prostate slices. Two 3D triangulated meshes of the prostate surface are then realized on the reconstructed US and histology volumes. A combination of rigid and elastic registration is applied for 3D mapping of the histology on the US surface. The deformation of the inner volume is estimated on the basis of the surface deformation, without need for additional landmarks.

Results: *In vitro* validation was performed by a prostate mimicking phantom with inserted elastic wires. The proposed registration method was applied to estimate the wire displacement due to an externally-applied pressure. The resulting accuracy was 2.2 mm, smaller than the histology resolution (4 mm). The method feasibility was tested in two patients referred for radical prostatectomy. Figure 1 shows two registered planes with the contours of the US image and the corresponding mapped histology. Cancerous tissue, according to the histology, is depicted in red.

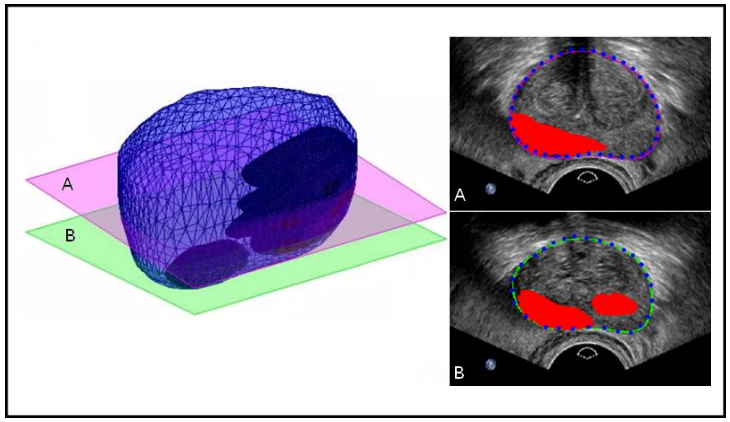


Figure: Mapping of two registered planes from histology to US.

ABSTRACT 65

MULTI-INSTITUTIONAL ANALYSIS OF ROBOTIC PARTIAL NEPHRECTOMY FOR SOLITARY KIDNEY

Shahab P. Hillyer[1], Sam B. Bhayani[2], Mohamad E. Allaf[3], Craig G. Rogers[4], Michael D. Stifelman[5], Youssef Tanagho[2], Jeffrey K. Mullins[3], Yichun Chiu[5], Bartosz F. Kaczmarek[4], and Jihad H Kaouk[1]

[1] *The Glickman Urological Institute, Cleveland Clinic, Cleveland, OH*
[2] *Division of Urologic Surgery, Washington University School of Medicine, Saint Louis, MO*
[3] *James Buchanan Brady Urological Institute, Johns Hopkins Medical Institutions, Baltimore, MD*
[4] *Vattikuti Urology Institute, Henry Ford Hospital, Detroit, MI*
[5] *Department of Urology, New York University, Langone Medical Center, New York, NY*

OBJECTIVE: We evaluated the outcomes of robot-assisted partial nephrectomy (RPN) for solitary kidney in a large multicenter series.

MATERIALS AND METHODS: A retrospective review of 887 consecutive patients who underwent RPN for a renal mass at five academic institutions from June 2006 to November 2011. A total of 22 patients with a solitary kidney were identified. Data was collected prospectively in an IRB approved protocol with all cases being performed by experienced robotic surgeons. Patient demographics, functional, peri-operative and early oncological outcomes of RPN in a solitary kidney were analyzed.

RESULTS: Demographics demonstrated a median body mass index of 31 (IQR 28.8, 34.1), American society of anesthesiologist score of 3 (IQR 2, 3), Charleston comorbidity index 4 (IQR 2.75, 4), nephrometry score 4.5 (IQR 5, 7) and median tumor size was 3.7 cm (IQR 2.9, 5). Peri-operative outcomes included a median blood loss 100 ml (IQR 100, 313), warm ischemia time 17 minutes (IQR 11, 18), operative time 166 minutes (IQR 1125, 234) and hospital stay of 2 days (IQR 2, 3.5). Intra-operative complications were 2 blood transfusions along with 1 renal vein injury that was repaired intra-operatively without sequela and an injury to an aortic vessel. There were 3 post-operative complications (13.6%), which included a urinary leak requiring stenting, atelectasis requiring oxygen, and significant increase creatinine not requiring dialysis. Pre-operative median creatinine of 1.2 (IQR 0.9, 1.6) and glomerular filtration rate (GFR) of 58.9 (45.9, 77.4). Last follow-up median creatinine and GFR were 1.7 (IQR 1.2, 2.1) and 43.9 (IQR 37.1, 58.7) respectively. The percent change in GFR was -15.8% (p=0.13). No patients required dialysis. Positive margins occurred in 1 patient (5.5%) with 68% of patients having either papillary or clear cell carcinoma. Two solitary kidneys had multiple tumors (n= 2). There was 1 (4.5%) recurrence of disease from malignant ascites one year after partial nephrectomy. Fourteen patients (64%) had solitary kidneys secondary to previous malignancy. Median follow-up was 6 months (IQR 5-9.7).

CONCLUSION: RPN offers a safe alternative to treatment of small renal masses in patients with a solitary kidney. Functional decline was comparable to previous open partial nephrectomy series. This represents the largest multi-institutional series in the literature regarding RPN in solitary kidney.

ABSTRACT 66

SYSTEMIC PROSTATE BIOPSIES MAY DETECT MORE INSIGNIFICANT CANCER THAN MRI LESION TARGET PROSTATE BIOPSIES

Coffin G[1,2], Chevreau G[1], Renard-Penna R[3], Comperat E[4], Vitrani MA[2], Torterotot C[2], Conort P[1], Bitker MO[1], Mozer P[1,2]

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Introduction: We wanted to compare pathological characteristics of biopsy cores among patient undergoing a first round prostate biopsy, between MRI lesion-targeted cores and systematic cores.
Methods: We retrospectively reviewed 80 patients who came at our department for a first round of transrectal ultrasound guided prostate biopsy and who were at risk of localized prostate cancer.
Exclusion criteria were: history of prostate cancer, previous prostate biopsy, local advanced (≥T3a TNM stage) or metastatic prostate cancer at examination (digital rectal and clinical examination, PSA serum level>20ng/mL, prostate MRI staging ≥T3a).
Inclusion criteria were: prostate multiparametric MRI showing suspicious intra-prostatic lesion.
MRI/TRUS fusion and lesion targeting was performed using Urostation® system (Koelis, France).
For each patient, 12 cores were taken from systematic sampling, then 2 to 3 additional cores were taken in the index MRI lesion.
Positive core was defined by the presence of prostate cancer from histological examination.
Cancer was insignificant if it responded to all of the following criteria:

- Maximum cancer length by core ≤ 5mm
- Maximum Gleason score by core ≤ 6
- Number of positive cores by patient ≤ 2

Results:

	MRI targeted biopsy -	MRI targeted biopsy +	Total
Systematic biopsy -	34	**3**	37
Systematic biopsy +	**8**	35	43
Total	42	38	80

Table 1. Cross-relation of pathological outcomes between MRI lesion targeted and systematic biopsy

	Significant cancer	No or insignificant cancer		Total
MRI +	37	**1 (33% out of 3)**	PPV=97.4%	38
MRI -	3	39	NPV=92.8%	42
	Se=92.5%	**Sp=97.5%**		
STD +	39	**4 (50% out of 8)**	PPV=90.7%	43
STD -	1	36	NPV=97.3%	37
	Se=97.5%	**Sp=90%**		
Total	40	40		80

Table 2. Effectiveness of systematic (STD +/-) and MRI targeted (MRI +/-) biopsy.

Systematic biopsy may be more sensitive than MRI targeted biopsy but it may detect more insignificant prostate cancer. However we could not show significant differences because of the too small number of patient.

Conclusion:
MRI lesion-targeted biopsies tend to detect significant lesions more specifically than systematic biopsy, however the study must be continued on a larger number of patients.

ABSTRACT 67

LONG-TERM OUCOMES OF INTRA-RENAL BCG/IFN FOR BIOPSY-PROVEN UPPER TRACT CARCINOMA IN SITU

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Introduction: Isolated carcinoma-in-situ (CIS) of the upper-tract is a relatively rare disease. While nephroureterectomy remains the gold-standard treatment for upper-tract CIS (UT-CIS), it may be unnecessarily aggressive in comparison to the treatment of bladder CIS. Upper-tract administration of BCG has shown promise for UT-CIS, but with limited reports and varied results. We report our experience using a novel technique to directly instill BCG with Interferon-α2B (BCG/IFN) into the upper-tract in patients with UT-CIS.

Methods: Following biopsy evidence of UT-CIS, patients received a 6-week induction course of BCG/IFN, administered under low pressure gravity drip via an open-ended ureteral catheter. Initial follow-up was scheduled one month following the completion of the intra-renal therapy, and consisted of flexible ureteroscopy, selective urinary cytology, retrograde pyelography, and re-biopsy of the upper-tract. Complete response (CR) was defined as the absence of visualized lesions on ureteroscopy, negative selective cytology, and absence of clinical progression. Absence of visualized lesions with persistently positive cytology was a partial response (PR), while persistence of lesions after induction was a non-response (NR). New upper-tract lesions after an initial CR were considered recurrences. Patients with a CR were placed on maintenance therapy for 2 years. Surveillance was performed every 3 months with ureteroscopy, selective cytology, and imaging.

Results: Eight patients (mean age = 75 years) were followed for a median of 35.8 months. Five patients (63%) had an initial CR, 2 (25%) had a PR, and 1 (12%) had NR. Both patients with a PR underwent a second induction course, and while 1 had a CR, the other had a recurrence 7 months later. Total kidney-preservation rate was 88% (7/8). There were no treatment related adverse events.

Conclusion: This study demonstrates the safety and efficacy of intra-renal BCG/IFN for patients with UT-CIS. Unlike other mechanisms of delivery, including percutaneous administration or reflux via double pigtail stents, this office-based technique spares the morbidity of a chronically indwelling nephrostomy tube or ureteral stent.

ABSTRACT 68

PROSTATIC SWELLING AND SHIFT OF INTRA-PROSTATIC TARGET DURING HIFU: IMPLICATION FOR TARGETED FOCAL THERAPY

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USC Institute of Urology, Hillard and Roclyn Herzog Center for Prostate Cancer Focal Therapy, Keck School of Medicine, University of Southern California, Los Angeles, CA

Introduction: Prostatic swelling during high-intensity focused ultrasound (HIFU) during whole gland therapy can be intra-operatively observed, but has not been quantitatively documented. The objective of our study is to quantify (a) intra-operative swelling of the prostate and (b) shift of intra-prostatic targeted points during HIFU.

Methods: Forty-four patients with clinically localized prostate cancer (without neoadjuvant hormonal therapy or transurethral resection) underwent whole gland HIFU (Sonablate 500®, version 4 or TCM, Focus Surgery, IN, USA). Whole gland HIFU consisted of 3 consecutive treatment sessions to focus initially on the anterior zone, followed by the middle zone, and finally on the posterior zone of the prostate. Three-dimensional (3D) models of the prostate were reconstructed from the routinely acquired 3-mm step-sectional images of the intra-operative transrectal ultrasound (TRUS) before and after each of the treatment sessions. The 3D models were compared to identify changes in prostate volume and any positional change of identical intra-prostatic calcifications. Inter-observer variability of prostate volume measurements was assessed in 20 cases using a Cohen's kappa statistics. An agreement >0.81 was defined as a significant correlation.

Results: Mean prostate volume significantly increased from 30 ml to 36 ml (20% increase) during the anterior zone treatment ($p<0.001$), from 40 ml to 41 ml (2.5% increase) during the middle zone treatment ($p=0.027$), and from 41 ml to 43 ml (5% increase) during the posterior zone treatment ($p<0.001$). The volume of transition zone (TZ) during the anterior zone treatment significantly increased from 16 ml to 20 ml (25% increase) ($p<0.001$), while the peripheral zone (PZ) did not change during the posterior zone treatment ($p=0.5$). The mean shift of the identical targeting point measured 3.6 mm in the transition zone (n=88), and 4.1 mm in the peripheral zone (n=102) ($p=0.2$). Detailed vector (distance and direction) shifts of the identical targeting points in each quadrant of the TZ and PZ are demonstrated in the Figure1. Inter-observer variability demonstrated a Cohen's kappa value of 0.839 indicating significant agreement.

Conclusion: Comparative analysis of reconstructed 3D prostate models from step-sectional TRUS images during HIFU demonstrated significant intra-operative swelling of the prostate and definitive shifts of the intra-prostatic points. Our findings suggest a need for intra-operative adjustment of the treatment plan during energy-based targeted ablative treatment of the prostate such as focal HIFU therapy. Adjustment of the treatment plan can be facilitated by the quantitative prediction and real-time image-based monitoring of intra-operative swelling and target shifts.

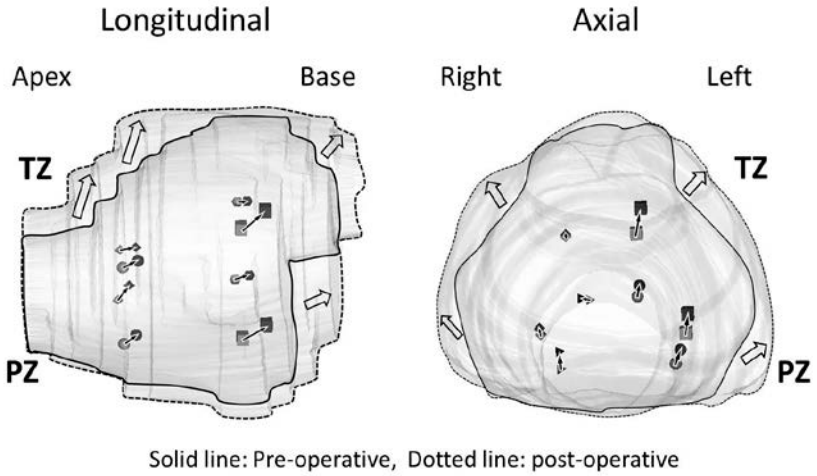

Figure: Change in prostate volume (⇨) and vector (distance and direction) shifts of the identical target (→).

ABSTRACT 69

NOVEL MICRO-ULTRASOUND PROBE TO IDENTIFY MICROVESSELS IN THE SPERMATIC CORD

Ahmet Gudeloglu, Jamin Brahmbhatt, Karen Priola, Sijo Parekattil.
Winter Haven Hospital & University of Florida

Introduction: Previous studies have shown the benefit of real-time intra-operative audio flow Doppler identification of testicular arteries during microscopic subinguinal varicocelectomy. This prevents inadvertent testicular artery injury during such microsurgical procedures. This study evaluates the use of a novel micro-ultrasound probe for the localization of the testicular arteries during such procedures.

Methods: A new micro-ultrasound probe (Aloka-Hitachi Ltd., Tokyo, Japan) was utilized during three robotic assisted sub-inguinal microsurgical varicocelectomy procedures, to localize the testicular arteries real-time during the procedure. The ultrasound image was fed into the TilePro (Intuitive Surgical, Sunnyvale, CA) robotic surgical console software system to provide three simultaneous real-time video images to the microsurgeon during the procedure: 1) a 12-15x 3D image via the HD robotic camera, 2) a 16-18x optical high magnification view via the VITOM camera (Karl Storz Inc, Tuttlingen, Germany) and 3) a real time visual ultrasound image from the new micro-ultrasound probe (Figure 1). Localization of the testicular arteries was validated against the current gold standard, which is audio flow Doppler mapping using a micro Doppler probe (Vascular Technology Inc, Nashua, NH).

Results: The new ultrasound probe was able to identify all arteries in the spermatic cord (testicular artery & deferential artery). The probe also allowed visualization of small veins (1-5 mm diameter) in the spermatic cord to aid in identification of posterior varicose veins. The location of the arteries was verified with the audio Doppler probe. No arteries where missed by the micro-ultrasound probe based on the additional Doppler scanning.

Conclusion: Accurate localization of the arteries in the spermatic cord vessel is critical to minimize inadvertent injury during microsurgical varicocelectomy. The new micro-ultrasound probe appears to be effective in micro-vessel localization in this preliminary study.

ABSTRACT 70

NEUROPROTECTIVE WRAP FOR THE SPERMATIC CORD AFTER DENERVATION PROCEDURES

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Winter Haven Hospital & University of Florida

Introduction: Previous studies have shown that microsurgical denervation of the spermatic cord is a possible treatment option for chronic orchialgia with success rates in the 75-85% range. Recurrent or persistent pain after such procedures is very disappointing for these patients. One cause for this phenomenon could be neuroma formation or irritation of the ligated ends of the nerve fibers in the spermatic cord. Neuroprotective wraps have been safely and successfully utilized by microsurgeons in peripheral nerve repair procedures to minimize such neuroma or scar formation. This study evaluates the impact of a neuroprotective wrap placed around the spermatic cord after the denervation procedure.

Methods: We reviewed a prospectively maintained database of six patients with bilateral chronic orchialgia who underwent bilateral robotic assisted microsurgical denervation of the spermatic cord by a single microsurgeon from March to July 2010. A neuroprotective wrap (bio-inert matrix derived from porcine gut: Axoguard, Axogen Inc., Gainesville, FL) was placed on one side of each patient around the spermatic cord after completion of the denervation procedure (side was randomly selected). The contra-lateral side (with no wrap) was the control for each patient. Pain was assessed preoperatively and post-operatively at 1, 3, 6 and 12 months using an externally validated pain impact questionnaire (PIQ-6, QualityMetric Inc, Lincoln, RI).

Results: The median pain impact scores were less on both sides after surgery compared to pre-op (median pre-op score = 77). Median PIQ-6 scores on the wrap side were: 52, 40, 50 and 59 at 1, 3, 6 and 12 months post-op respectively. The median scores on the non-wrap side were: 59, 56, 60 and 68 respectively (Figure 1). The median pain scores on the side with the wrap were significantly less than the non-wrap side (a score difference of 5 indicates a p value of <0.05).

Conclusion: This study, despite its small sample size, seems to indicate a possible benefit to using a neuroprotective wrap around the spermatic cord after denervation procedures for chronic orchialgia. Further evaluation and longer follow-up is needed.

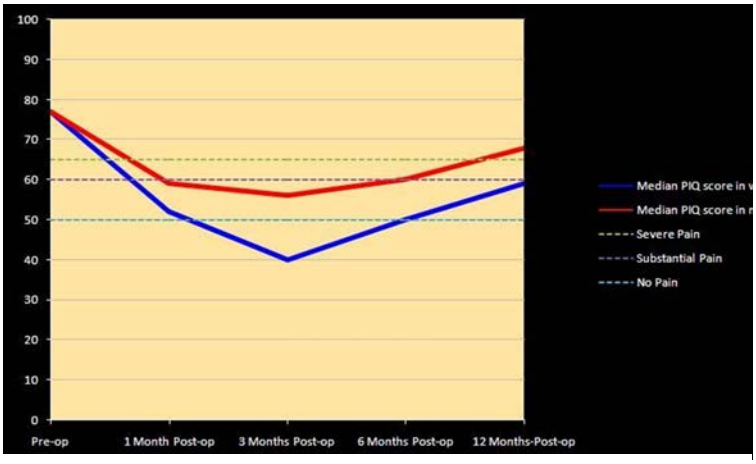

Figure: Pre-op and post-op median PIQ scores in the both sides.

ABSTRACT 71

ROBOTIC-ASSISTED PARTIAL NEPHRECTOMY IN PATIENTS WITHOUT HILAR CLAMPING—A MULTI-INSTITUTIONAL STUDY

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Introduction: Ongoing efforts are focused on minimizing or eliminating renal ischemia during robot-assisted partial nephrectomy (RPN). We evaluate the outcomes of RPN without hilar clamping using data from a large multi-center series.

Methods: We performed a multi-institutional analysis of prospectively maintained databases of RPN performed by high-volume surgeons across 5 academic institutions. Our series combined operative data of 886 RPN collected between 2007-2011. A total of 66 patients who underwent RPN without hilar clamping were identified and retrospectively analyzed. Patient demographics, perioperative, functional, and early oncological outcomes of RPN without hilar clamping were assessed.

Results: Mean patient age was 60 years (18-88). Mean Charlson Comorbidity Index was 3.5 (SD=1.99) and mean ASA score was 2.5 (SD=0.68). Mean tumor size was 2.5 cm (range 0.7-11) and eight patients (12%) had tumors over 4cm in size. Mean nephrometry score was 5.3 (range 4-10) with 30 tumors (45%) >50% exophytic and 45 (68%) tumors in a polar location. Indications for an off-clamp approach included eGFR≤60 in 13 patients (20%), solitary kidney in 4 patients (6%), and multiple or bilateral tumors in 2 patients (3%). Perioperative outcomes included a median blood loss of 150 ml (IQR 50-300), mean operative time 157min (range 59-267), and hospital stay of 2 days (SD 1.8). There were no intraoperative complications. There were 8 postoperative Clavien I-II complications (12%) but no Clavien III-V complications. Preoperative mean eGFR was 81 (20-119). The mean postoperative change in eGFR was 0.4% and no patients required dialysis. Positive surgical margins occurred in two patients (3%). There were no disease recurrences at a mean followup of 21 months.

Conclusion: Off-clamp RPN is safe and feasible in appropriately selected patients and with surgeon experience. Off-clamp RPN may help optimize renal function by eliminating renal ischemia. This represents the largest multi-institutional series in the literature regarding off-clamp RPN.

ABSTRACT 72

APPLICATIONS OF SPIDER IN UROLOGY
THE UNIVERSITY OF MIAMI EXPERIENCE

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Introduction: The use of the Single Port Instrument Delivery Extended Reach (SPIDER) surgical system (Transenterix, Durham NC) in conjunction with Laparoendoscopic Single Site Surgery (LESS) is an emerging alternative in the field of minimally invasive surgery. In the past few years institutions with centers of excellence for laparoscopy and minimally invasive surgery have explored its use in Urology (1,2,3). Its intuitive design that affords good triangulation and avoids instrument collision endemic in single port surgeries have been documented in recent publications (3,4). We present our cumulative experience of its different applications in Urology.

Methods: We performed SPIDER-LESS surgery on 6 patients. The procedures were: 2 simple nephrectomies, 2 decortication of cysts, 1 Pyeloplasty and 1 radical nephrectomy. Both the first and second generation SPIDER along with its long flexible instruments were used. Use of an accessory port for retraction was required in two cases. The extirpative and reconstructive surgeries were performed by two experienced laparoscopists while a surgical resident was given a major role in one of the SPIDER-LESS decortication of cysts.

Results: The radical nephrectomy and one simple nephrectomy were converted to hand-assisted laparoscopy. These were done so because of dense adhesions and because of failure to progress. The need to use an extra 5 mm port was encountered in 2 cases: in the pyeloplasty where we found the extra port necessary to facilitate suture insertion and in 1 of the cyst decortication where it was necessary to use a 3mm Karl Storz rigid dissector grasper to facilitate retraction of the flaccid cyst wall. The comparable operative times between the resident and the experienced surgeon performing SPIDER-LESS decortication of cysts points to the intuitive design of the device which facilitates ease of use and rapid learning regardless of laparoscopic skill or experience. Figure 1 shows the second generation SPIDER mounted on its docking station.

Conclusion: Our experience demonstrates the utility of the SPIDER in laparoendeoscopic single site urologic surgery. SPIDER-LESS surgery is feasible in extirpative surgery of benign lesions and even in challenging reconstructive procedures. Its use however, in cancer cases remains to be proven. Our experience points to the need to strictly screen patients to undergo this challenging procedure. It is through sound patient selection that the success of this minimally invasive surgery hinges on. The relative concurrence of surgical variables between novice and experienced surgeon in the conduct of SPIDER-LESS decortication of cysts points to the operator-friendly nature of this device. As for future directions: there is a need to conduct prospective studies to truly document the advantages of this device compared to standard multi-port laparoscopy and also when compared to other single port access devices. It is only through these further studies that we can conclusively say that SPIDER surgery is truly less.

Figure: Second generation SPIDER mounted on its dock

ABSTRACT 73

ABSTRACTS

DEVELOPMENT AND VALIDATION OF A RAPID CIRCUMCISION DEVICE TO FACILITATE DISSEMINATION OF SAFE ADULT MALE CIRCUMCISION AMONG U.S. VETERANS

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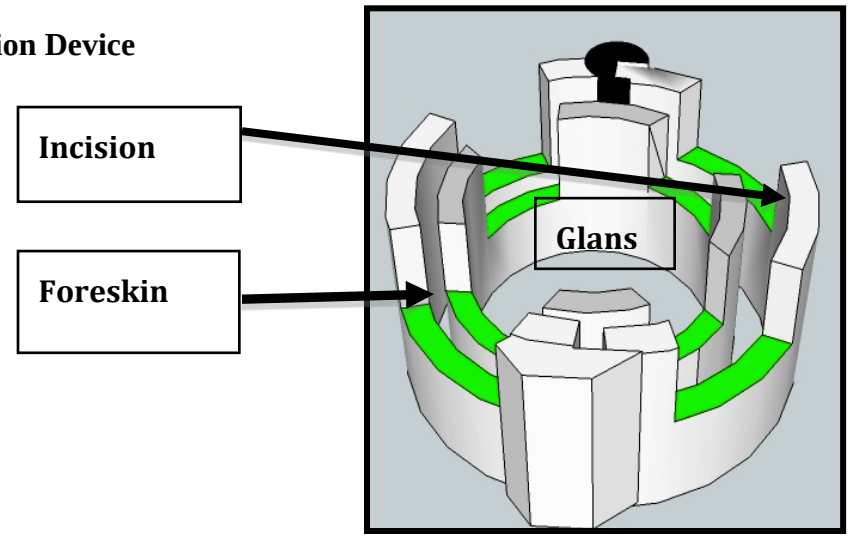
Introduction: The purpose of this study is to evaluate a new device to simplify adult male circumcision procedures. Male circumcision rates are lower in the VA population than in many other US populations. Circumcision offers a number of health benefits including lower rates of urinary tract infection, several sexually transmitted diseases and penile cancer. Medical circumcision is indicated for treatment of certain penile malignancies and other urological conditions such as balanitis, phimosis and paraphimosis. Recently circumcision has been proven in three large randomized controlled trials to reduce the rate of HIV transmission by roughly 65%.

Methods: We have developed a circumcision device that can be used in a single procedure. Following IRB approved protocols, we will pilot this proprietary device, formulated to US standards in eight consenting VAPSHCS patients who have indications for circumcision. This device was developed in conjunction with UW urologists following a landscape review of available devices. In contrast to other adult male circumcision devices undergoing evaluation this device may allow a non-surgeon to perform adult male circumcision under local anesthesia with the device being removed at the end of the procedure.

Results: Standardized evaluation forms will be deployed to validate the device for procedural complications, pain and patient satisfaction.

Conclusion: Successful completion of this pilot project is required to support applications to other funding agencies for comparative studies to increase acceptability and availability of male circumcision in VA populations as well as scale up of circumcision efforts to reduce HIV transmission. Work supported by the UW Institute of Translational Health Sciences.

Figure: Adult Circumcision Device



ABSTRACT 74

FIBER OPTIC SUCTION AND PULLING OF URINARY STONE PHANTOMS USING A HIGH PULSE RATE THULIUM FIBER LASER

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Introduction: Previous investigators have transiently observed attraction of urinary stones to the fiber optic tip during Holmium:YAG laser lithotripsy procedures. This effect, if reproducible, could potentially be exploited to suction and pull small stone fragments inside the urinary tract without insertion of a mechanical grasping tool, thus saving the urologist time and space in the working channel of the flexible ureteroscope. Our laboratory is studying the Thulium fiber laser (TFL) (λ=1908 nm) as a potential alternative lithotripter to that of the conventional Holmium:YAG laser (λ=2120 nm). The TFL has a number of potential advantages over the Holmium laser including a lower stone ablation threshold, an improved spatial beam profile for transmission of higher laser powers through smaller optical fibers, and more flexible laser parameters (e.g. variable pulse duration, pulse rate, and duty cycle). In this study, we take advantage of the TFL's high pulse rate/low pulse energy operation mode to provide a rapid and repetitive chain of vapor bubble explosion and implosion events to promote attraction of the stone to the fiber tip while simultaneously minimizing undesirable retropulsion effects.

Methods: A Thulium fiber laser (TLR-110, IPG Photonics, Oxford, MA) with a wavelength of 1908 nm, pulse energy of 35 mJ, and pulse duration of 500 μs was used with a 270-μm-core silica fiber. Spherical Plaster-of-Paris (PoP) stone phantoms of ~4 mm diameter and ~40 mg mass (similar to human calcium oxalate monohydrate urinary stones) were used for all studies. The TFL pulse rate was adjusted from 10-350 Hz. The fiber optic tip was applied in non-contact mode in close proximity to the stone submerged in a saline bath. Stone drag speed was calculated by recording distance moved per unit time with a camera and video. At least 5 samples were tested for each set of laser parameters.

Results: The drag speed increased between 10-150 Hz, and then began to plateau and decrease at higher pulse rates between 150-350 Hz, possibly due to the retropulsion force dominating the attractive force. Figure 1 summarizes the results plotting the drag speed as a function of laser pulse repetition rate for 4-mm-diameter PoP stone phantoms.

Conclusion: This preliminary study demonstrates that it is feasible in an idealized setting to use the fiber optic tip to attract and pull urinary stone phantoms. Thulium fiber laser operation at higher pulse rates (~150 Hz) than typical Holmium lasers (~10 Hz) increases stone drag speed. This technique may potentially be used in the clinic to manipulate stone fragments in the urinary tract. Future studies will explore the effects of varying other parameters (e.g. pulse energy, pulse duration, fiber diameter, and stone size) on this phenomenon for both PoP and human urinary stone samples.

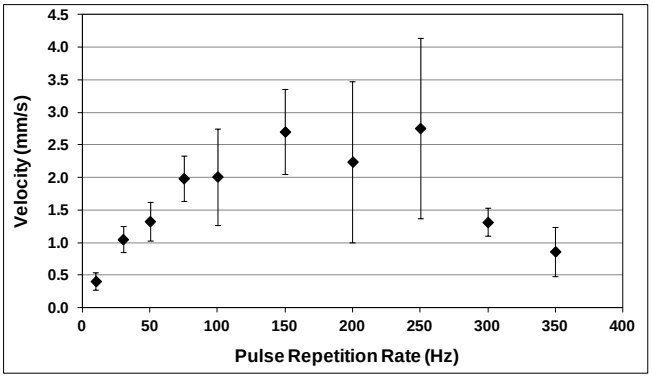

Figure: Drag speed as a function of laser pulse repetition rate for 4-mm-diameter Plaster-of-Paris stone phantoms. Thulium fiber laser irradiation was performed through a 270-μm-core fiber optic tip in near contact mode at 35 mJ, 500 μs, and 10-350 Hz.

ABSTRACT 75

ROBOTIC ASSISTED LEGO® CONSTRUCTION AS A MODEL FOR ROBOTIC MICROSURGERY SKILLS TRAINING

Ahmet Gudeloglu, Jamin Brahmbhatt, Karen Priola, Sijo Parekattil.
Winter Haven Hospital & University of Florida

Introduction: The application of robotic assisted microsurgery has been expanding over the last few years. However, there are limited structured training protocols for robotic microsurgical skill development. The existing microsurgical training models (rodent and cadaver models) are also quite tedious and expensive. Our goal was to assess the use of robotic assisted Lego® construction for robotic microsurgical skills training and compare it to our current standard.

Methods: 10 trainees (6 medical students and 4 urology residents) were enrolled in the study (all where robotic surgery naïve). The trainees where randomized into two arms: 1) a test group and 2) a control group. The test group performed 5 sessions: 1 robotic assisted microsurgical vasovasostomy on a biosynthetic vas deferens model (anastomosis with 4 double armed 10-0 nylon sutures using microdot technique) – this was the pre-training test procedure, 3 training sessions where the trainee built a 77 piece Empire State Building Lego® set to completion with robotic assistance using all 3 instrument arms, and then a final test session vasovasostomy on the vas deferens model. The control group also performed 5 sessions: they performed 5 repetitive robotic assisted vasovasostomy procedures on the vas deferens model – an initial pre-training test anastomosis, 3 training vasovasostomy sessions and then a final test anastomosis. The pre-training vasovasostomy was then compared to the post-training vasovasostomy for all trainees: duration, number of sutures used, suture breaks, needle bends, distance between suture placement and microdot where compared (a scoring methodology was developed).

Results: The mean pre-training vasovasostomy measures did not differ significantly between the Lego® and control arms. Mean duration of the anastomosis before and after training was 64.5min and 28.3min (Lego® test group); 88.5min and 34min (control group), respectively. Mean number of sutures used, needle bends and suture breaks significantly decreased after training in both arms. The mean quantitative scores of the first test anastomosis were 2 (Lego® group) and 0.5 (control group). These scores improved after training to 10.25 (Lego® group) and 5.5 (control group). The score improvement after training did not differ significantly between the Lego group and the control group ($p = 0.25$).

Conclusion: Although this is a small sample size, this preliminary study appears to indicate that robotic assisted Lego® construction may provide a comparable training model to develop robotic assisted microsurgical skills.

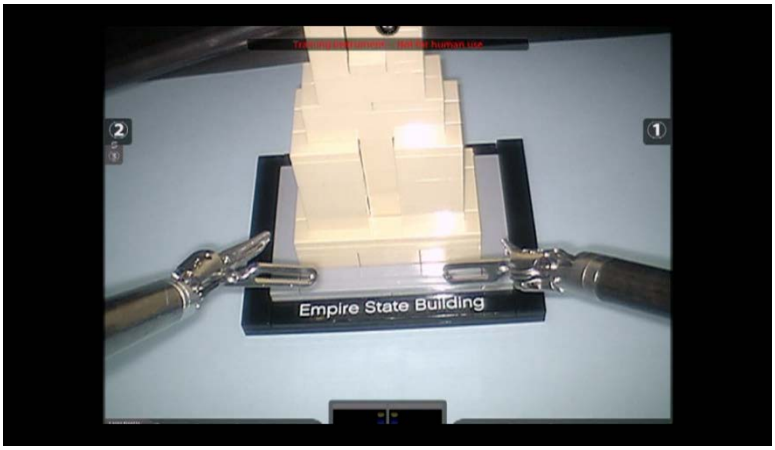

Figure: Robotic Assisted Lego® Construction Training

ABSTRACT 76 **TOP 10 ABSTRACT**

RAPID DETERMINATION OF SYSTEMIC LEVELS OF OXALATE USING A NEWLY DEVELOPED OXOMETER

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Department of Urology[1], Chemistry[2], and Pathology, Immunology and Laboratory Medicine[3]
University of Florida, Gainesville, FL

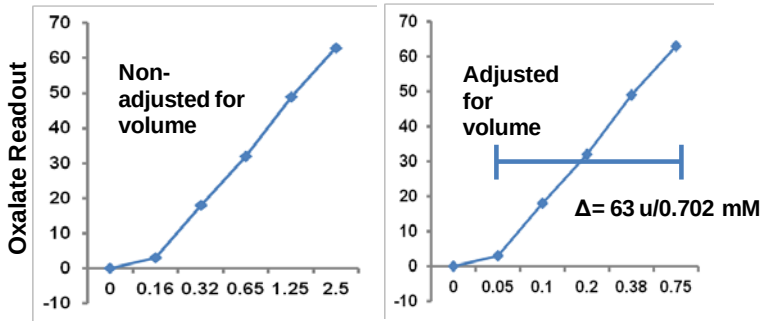
Introduction: Increased levels of oxalate are associated with multiple disease states, including renal disease, urolithiasis, malabsorption, hepatic dysfunction, and even some neurological conditions. Because no standardized test exists for measuring blood oxalate, patients with these conditions monitor their systemic oxalate levels in the form of 24 hour urine collections. We sought to develop a user-friendly, point-of-care device that would permit rapid determination of blood or urine oxalate at home.

Methods: Based on technology similar to the glucometer, we designed and impregnated blood glucose test strips with the enzyme oxalate oxidase (from *Hordeum vulgare*). An enzyme electrode was created to measure the production of hydrogen perioxide from the reaction, and human blood, spiked with various amounts of sodium-oxalate, was placed onto the strip.

Results: Oxalate levels in blood specimens exhibited a linear correlation over significantly large concentration ranges (Figure). Spotting the test strips with increasing levels of oxalate-degrading enzyme (defined as IU of activity) resulted in incrementally shorter measurement times.

Conclusion: A first generation oxometer that rapidly determines oxalate levels in biological fluid has been developed for use as a point-of-care device for both physicians and patients. Its design, similar to latest generation glucometers, permits one to closely follow temporal levels of systemic oxalate as a means to initiate remediation in a more rapid and practical manner than a 24 hour urine specimen. Further development of this system and clinical testing are now planned.

Oxalate levels in blood serum specimens using the LifeScan glucometer (Values minus glucose levels)



**** Oxalate oxidase enzyme (5 µL / reaction) added to 7.5 µL of stated oxalate solution (1 min), mixed with 12.5 µL blood specimen, one drop then placed on meter strip.**

ABSTRACT 77

PROSPECTIVE EVALUATION OF REFURBISHED FLEXIBLE URETEROSCOPE DURABILITY SEEN IN A LARGE PUBLIC TERTIARY CARE CENTER WITH MULTIPLE SURGEONS

Robert I. Carey, Christopher J. Martin, Marco Ferrara, Jacob Knego

Florida State University College of Medicine, Sarasota Campus, Sarasota, FL

Purpose: Poor durability of flexible ureteroscopes results in significant maintenance and repair costs. The frequency, cause, and cost of ureteroscope damage in our facility was assessed prospectively.

Methods and Materials: Ureteroscope usage and repair was prospectively recorded over a 365 day period at an 865 bed public tertiary care center. Cases were performed by 14 different board certified urologists using refurbished DUR-8 and DUR-8 Elite ureteroscopes. Retrograde cases involving calculi, urothelial carcinoma, stricture, and diagnostic evaluations were included. Ureteroscope repairs were performed by a single out-sourced repair vendor, not the original manufacturer.

Results: A total of 501 ureteroscopic cases involving 550 ureteroscope uses were performed over a 365 day period. Semi-rigid ureteroscopes were used for 281 (56.1%) cases, refurbished flexible ureteroscopes for 220 (43.9%). The reason for the ureteroscopy was calculi in 386 (77.0%) cases, urothelial carcinoma in 32 (6.4%), stricture in 36 (7.2%), and diagnostic in 47 (9.4%). No repairs were needed during this time period for semi-rigid scopes. Ureteral access sheaths were employed in 82 (37.7%) of the flexible ureteroscope cases. A total of 32 instances of catastrophic flexible ureteroscope breakage requiring send out for full repair was documented, thus indicating an average of 6.9 usages of a newly refurbished ureteroscope were obtained prior to incurring yet further catastrophic damage and requiring repair.

Conclusions: Refurbished flexible ureteroscopes that have undergone comprehensive repair are extremely fragile in the setting of multiple surgeon users in a large public tertiary care center that uses central processing for sterilization and storage. The high frequency of damage and repair seen in this study results in significant administrative inconvenience and cost. The durability of flexible ureteroscopes and cost of repair must be considered as well as the initial purchase cost.

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AWARDS:

Best Paper Award:

PRECLINICAL SAFETY AND EFFICACY OF ULTRASONIC PROPULSION OF KIDNEY STONES

Mathew Sorensen[1], Jonathan Harper[1], Ryan Hsi[1], Bryan Cunitz[2], Julianna Simon[2], Yak-Nam Wang[2], Marla Paun[2], Frank Starr[2], Wei Lu[2], Andrew Evan[3], Michael Bailey[2]

[1] *Department of Urology, University of Washington School of Medicine*

[2] *Center for Industrial and Medical Ultrasound, Applied Physics Laboratory, University of Washington*

[3] *Department of Anatomy and Cell Biology, Indiana University School of Medicine*

Outstanding Paper Award:

ROBOT-ASSISTED DIRECT MRI-TARGETED TRANSRECTAL PROSTATE BIOPSY

Chunwoo Kim[1], Govindarajan Srimathveeravalli[2], Peter Sebrechts[1], Doru Petrisor[1], Paula Ezell[2], Jonathan Coleman[2], Stephen B. Solomon[2], Hedvig Hricak[2], Dan Stoianovici[1]

[1] *Urology Robotics Lab, Johns Hopkins University, Baltimore, MD*

[2] *Radiology Department, Memorial Sloan Kettering Cancer Center, New York, NY*

Top 10 Abstracts:

3. **PRELIMINARY TESTING OF A TRANSURETHRAL DEXTEROUS ROBOTIC SYSTEM FOR BLADDER RESECTION,** Ryan B. Pickens, Andrea Bajo, Nabil Simaan, Duke Herrell; *Vanderbilt University Departments of Mechanical Engineering and Biomedical Engineering; Vanderbilt University Medical Center, Department of Urologic Surgery; Vanderbilt Initiative in Surgery and Engineering (VISE)*
4. **PHANTOM STUDY OF A NOVEL STEREOTACTIC PROSTATE BIOPSY SYSTEM INTEGRATING PREINTERVENTIONAL MRI AND LIVE US FUSION,** Timur H. Kuru, Matthias Roethke, Dogu Teber, Boris A. Hadaschik, Markus Hohenfellner; *Department of Urology, Heidelberg University Hospital, Heidelberg, Germany; Department of Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany.*
5. **SURGTRAK: EVOLUTION OF A MULTI-STREAM SURGICAL PERFORMANCE DATA CAPTURE SYSTEM FOR THE DA VINCI SURGICAL ROBOT**, Lee W White, Timothy M Kowalewski, Blake Hannaford, Thomas S Lendvay; *BioEngineering Department, University of Washington; Electrical Engineering Department, University of Washington; Department of Urology, University of Washington.*
6. **QUALITY MEASUREMENT OF SYSTEMATIC TRANSRECTAL PROSTATE BIOPSY: AN IN-VITRO STUDY**, Doyoung Chang, Chunwoo Kim, Doru Petrisor, Bruce Trock, Alan W. Partin, Ronald Rodriguez, H. Ballentine Carter, Mohamad Allaf, Misop Han, Dan Stoianovici; *Department of Urology, Johns Hopkins University*.
7. **3D-HOLOSCOPIC IMAGING: A NEW DIMENSION TO ENHANCE IMAGING IN MINIMALLY INVASIVE THERAPY IN UROLOGICAL ONCOLOGY**, Makanjuola JK, Aggoun A, Swash M, Grange P, Challacombe BJ, Dasgupta P; *Department of Urology, Guys and St Thomas Hospital, London, UK; Visual Information Engineering (3D VIE) Research Group, School of Engineering and Design, Brunel University, UK; Department of Urology, Kings College Hospital, London, UK; MRC Centre for Transplantation, NIHR Biomedical Research Centre, King's Health Partners Guys Hospital, London, UK.*
8. **RAPID DETERMINATION OF SYSTEMIC LEVELS OF OXALATE USING A NEWLY DEVELOPED OXOMETER**, Benjamin K. Canales, Nigel Richards, Ammon Peck; *Department of Urology, Chemistry, and Pathology, Immunology and Laboratory Medicine, University of Florida, Gainesville, FL.*
9. **DESIGN OF AN AUTOMATED CYSTOSCOPE FOR BLADDER CANCER SURVEILLANCE**, Xianming Ye, W. Jong Yoon; *Department of Mechanical and Industrial Engineering, Qatar University, Doha, Qatar*.
10. **LIVE ROBOTIC SURGERY: ARE OUTCOMES COMPROMISED?** Jeffrey K. Mullins, Michael S. Borofsky, Mohamad E. Allaf, Sam Bhayani, Jihad H. Kaouk, Craig C. Rogers, Shahab P. Hillyer, Bartosz F. Kaczmarek, Youssef S. Tanagho, and Michael D. Stifelman; *Department of Urology, New York University, Langone Medical Center, New York, NY; Brady Urological Institute, Johns Hopkins Medical Institutions, Baltimore, MD; Division of Urologic Surgery, Washington University School of Medicine, Saint Louis, MO; The Glickman Urological Institute, Cleveland Clinic, Cleveland, OH; Vattikuti Urology Institute, Henry Ford Hospital, Detroit, MI.*

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The paper review committee has been assembled by e-mail solicitation. Eighty-five reviewers from around the world participated. We gratefully acknowledge their contribution to the success of the meeting and thank them for taking the time to help the society.

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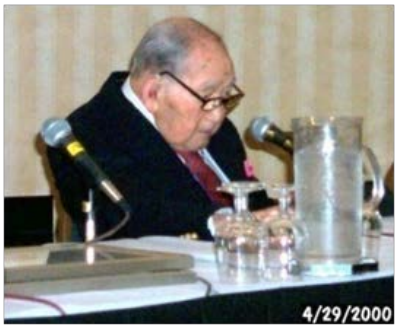

George Nagamatsu, M.D.
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