Engineering and Urology Society

31th Annual Meeting

Saturday May 7, 2016

San Diego, CA

http://engineering-urology.org/
Following a long tradition, the Engineering and Urology Society holds its 31\textsuperscript{th} Annual Meeting during the first day of the American Urological Association Meeting. A unique collaboration between engineers and urologists, the EUS, has forested the path for new technical developments most especially for Endourology and Minimally Invasive surgery, both capital pillars of Urology. As a highly technology dependent specialty, Urology has profited from this collaboration and there is no doubt that clinical challenges have fuelled the engineering research while at the same time the later has been capital in improving patient care.

This year the meeting is organized and chaired by Dr. William W. Roberts from the University of Minnesota. Three sessions are scheduled in the morning followed by the award presentation. The first session focus on “High-impact technologies” in urological cancers and the value of the new 3-D printing technologies. Also improving lithotripsy and SWL performance will be discussed in this session.

The EAU Section of Uro-technology, is in charge of the second session. Moderated by Drs A. Breda, J. Rassweiler and the welcomed new ESUT chairman, Dr. E. Liatsikos will update the current scenario in training models for endourology and navigation systems to perform prostate biopsy; two timely subjects that will impact our future practice and that could not have been implemented without the heavy input of engineers. In the technology track the European experience in robotic living-donor surgery will be presented for the first time and novelties on laparoscopic suturing devices, laser stone disintegration and developments in ureteral stents will be exposed.

Interesting and useful is also the third session about clinical translation of medical devices at the University of Michigan. This is illustrated by a clinical example on how histotripsy has been developed, the different steps of the development process of a useful technical device from the initial idea, identification of opportunities and threats, bench design, testing and clinical implementation.

This year the Stent Working Group collaborates with industry to present the subject of the new drug eluting stents interspaced with the commercial hurdles. The Image Guided Working group will also discuss 3-D printing and MRI/US fusion for prostate biopsy, as well as new imaging and ablation techniques.

Two poseter sessions in the afternoon provide researchers with the opportunity to present their work and update the attendees on the progress on the field and latest innovations. The review of the abstracts for the poster sessions was performed online by a group of 52 reviewers from around the world. Each paper received between 15 and 19 reviews. We would like to thank the reviewers, listed at the end of this program book, for their essential contribution to the quality of the meeting and their constructive comments that they made for the research.

Based on the review scores, the Society presents two Best Paper Awards this year, listed at the end of this program book, together with the Top 10 abstracts, and Best Reviewer Awards. The authors of all awarded abstracts are invited to submit full length articles to the Journal of Endourology on the respective topics. We gratefully thank all reviewers for their hard work, objective scoring, and contribution to the success of the meeting.

We welcome all urologists, engineers, and scientists to join us for this unique cross-disciplinary experience. As always, we thank 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.

Stavros Gravas
Pilar Laguna
Dan Stoianovici
CONTINUING MEDICAL EDUCATION

AUA ACCREDITATION INFORMATION

Accreditation: The American Urological Association (AUA) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

Credit Designation: The American Urological Association designates this activity for a maximum of 8.0 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Non-physician Health Professionals: The AUA is not accredited to offer credit for non-physician health professionals. However, the AUA will issue documentation of participation that states that the activity was certified for AMA PRA Category 1 Credit™.

Evidence Based Content: It is the policy of the AUA to ensure that the content contained in this CME activity is valid, fair, balanced, scientifically rigorous, and free of commercial bias.

AUA Disclosure Policy: All persons in a position to control the content of an educational activity (i.e., activity planners, presenters, authors) participating in an educational activity provided by the AUA are required to disclose to the provider any relevant financial relationships with any commercial interest. The AUA must determine if the individual’s relationships may influence the educational content and resolve any conflicts of interest prior to the commencement of the educational activity. The intent of this disclosure is not to prevent individuals with relevant financial relationships from participating, but rather to provide learners information with which they can make their own judgments.

Resolution of Identified Conflict of Interest: All disclosures will be reviewed by the program/course directors or editors for identification of conflicts of interest. Peer reviewers, working with the program directors and/or editors, will document the mechanism(s) for management and resolution of the conflict of interest and final approval of the activity will be documented prior to implementation. Any of the mechanisms below can/will be used to resolve conflict of interest:

- Peer review for valid, evidence-based content of all materials associated with an educational activity by the course/program director, editor, and/or Education Content Review Committee or its subgroup.
- Limit content to evidence with no recommendations
- Introduction of a debate format with an unbiased moderator (point-counterpoint)
- Inclusion of moderated panel discussion
- Publication of a parallel or rebuttal article for an article that is felt to be biased
- Limit equipment representatives to providing logistics and operation support only in procedural demonstrations
- Divestiture of the relationship by faculty

Off-label or Unapproved Use of Drugs or Devices: It is the policy of the AUA to require the disclosure of all references to off-label or unapproved uses of drugs or devices prior to the presentation of educational content. The audience is advised that this continuing medical education activity may contain reference(s) to off-label or unapproved uses of drugs or devices. Please consult the prescribing information for full disclosure of approved uses.

Disclaimer: The opinions and recommendations expressed by faculty, authors and other experts whose input is included in this program are their own and do not necessarily represent the viewpoint of the AUA.

Consent to Use of Photographic Images: Attendance at or participation in AUA meetings and other activities constitutes an agreement by the registrant to AUA's use and distribution (both now and in the future) of the attendee's image or voice in photographs and electronic reproductions of such meetings and activities.

Audio, Video and Photographic Equipment: The use of audio, video and other photographic recording equipment by attendees is prohibited inside AUA meeting rooms.

Reproduction Permission: Reproduction of written materials developed for this AUA course is prohibited without the written permission from individual authors and the American Urological Association.

Special Assistance/Dietary Needs: The American Urological Association complies with the Americans with Disabilities Act §12112(a). If any participant is in need of special assistance or has any dietary restrictions, please see the registration desk.
CONTEMPORARY MEDICAL EDUCATION

FACULTY DISCLOSURES:

Baxley, John  Nothing to disclose
Best, Sara American Urological Association: Meeting Participant or Lecturer
Borofsky, Michael Nothing to disclose
Cadeddu, Jeffrey Titan Medical, Inc.: Investment Interest, Transenterix: Investment Interest
Challacombe, Ben Lilly: Meeting Participant or Lecturer, Takeda: Meeting Participant or Lecturer, Intuitive Surgical: Meeting Participant or Lecturer, Astellas: Meeting Participant or lecturer, GSK: Meeting Participant or Lecturer
Chang, Connie Nothing to disclose
Chew, Ben Boston Scientific: Consultant or Advisor, Cook Urological: Consultant or Advisor, Meeting Participant or Lecturer, Scientific Study or Trial, PercSys: Consultant or Advisor, Scientific Study or Trial, Olympus-ACMI: Consultant or Advisor, Poly-Med, Inc. Consultant or Advisor, Scientific Study or Trial, Urotech: Consultant or Advisor, Bard Medical: Consultant or Advisor, Meeting Participant or lecturer
Eliceiri, Kevin Nothing to disclose
Fiedler, Marcel Nothing to disclose
Gorin, Michael Nothing to disclose
Hall, Tim HistoSonics, Inc.: Consultant or Advisor, Owner, Product Development
Harrah, Tim Boston Scientific: Employee
Knoll, Thomas Schally: Consultant or Advisor, Richard Wolf: Meeting Participant or Lecturer, Cook Medical: Scientific Study or Trial, Boston Scientific: Consultant or Advisor, Meeting Participant or Lecturer, Karl Storz: Consultant or Advisor, Meeting Participant or Lecturer
Laguna Pes, Pilar Nothing to disclose
Lange, Dirk Cook Medical: Consultant or Advisor, Scientific Study or Trial, Olympus Surgical: Consultant or Advisor, Scientific Study or Trial, Bard Medical: Consultant or Advisor, Boston Scientific: Consultant or Advisor, Scientific Study or Trial, Urotech, Gmbh: Consultant or Advisor, Scientific Study or Trial
Liao, Joseph Nothing to disclose
Liatsikos, Evangelos Cook Urology: Consultant or Advisor, Meeting Participant or Lecturer, Boston Scientific: Meeting Participant or Lecturer, Karl Storz: Meeting Participant or Lecturer
Martin, Bradley Nothing to disclose
May, Philip Nothing to disclose
Maxwell, Adam Sonomition, Inc.: Consultant or Advisor, Investment Interest
Rassweiler, Jens Karl Storz Germany: Other
Roberts, William HistoSonics, Inc.: Consultant or Advisor, Scientific Study or Trial, Investment Interest, Owner, Product Development
Ryan, Walter Cook Incorporated: Leadership Position, Employee
Schade, George Nothing to disclose
Servoss, Jon Nothing to disclose
Stoianovici, Dan Samsung: Other
Thomas, Raju Journal of Urology: Health Publishing, Meeting Participant or Lecturer, Urology Gold Journal: Health Publishing, Meeting Participant or Lecturer, Gulf South Lithotripsy: Leadership Position, Investment Interest, AUA Annual CME Courses: Meeting Participant or Lecturer, Journal of Endourology: Health Publishing, Consultant or Advisor
Veneziano, Domenico Nothing to disclose
Zhao, Lee Boston Scientific: Consultant or Advisor
EXHIBITORS

**Boston Scientific – Urology**

Boston Scientific is a leading developer of less-invasive medical technologies. Products for the Urology/Women's Health division include devices for the diagnosis and treatment of kidney stones, BPH, female urinary incontinence, and pelvic floor reconstruction. Please visit our exhibit to learn about our newest technologies and our commitment to physician education.

**Cook Medical**

Cook Medical has been a leading supplier of medical devices for urologists for over 35 years. Offering interventional and Biodesign® technologies that support diagnostic and therapeutic procedures in adult and pediatric urology, Cook has placed particular emphasis on stone management as well as both male and female pelvic health.
7:15am  Registration Opens

7:25 - 7:30am  Welcome – Program Chairmen  
William Roberts

7:30 – 8:30am  SESSION 1: Emerging High-Impact Technologies  
Sara Best

7:30 - 7:40am  Second-Harmonic Generation Imaging for Cancer: Urologic Applications  
Kevin Elicieri

7:42 – 7:52am  Boiling Histotripsy for Ablation of Renal Cell Carcinoma: Can Tumor Characteristics Predict Success?  
George Schade

7:54 – 8:04am  3D Printing Surgical Tools  
Jeffrey Cadeddu

8:06 – 8:16am  Enhanced Lithotripsy Through Suppression of Cavitation Bubbles  
Tim Hall

8:18 – 8:28am  Burst Wave Lithotripsy: Noninvasive Stone Disintegration by Focused Ultrasound Without Shock Waves  
Adam Maxwell

8:30 – 9:30am  SESSION 2: EAU Section of Uro-Technology  
Evangelos Liatsikos

8:30 – 8:37am  New Training Models in Endourology  
Domenico Veneziano

8:40 – 8:47am  Robotic Living Donor-European Experience  
Michael Stoeckle

8:50 – 8:57am  Existing Systems for Navigation of Prostate Biopsy  
Marcel Fiedler

9:00 – 9:07am  New Laparoscopic Suturing Device  
Jens Rassweiler

9:10 – 9:17am  Laser Induced Stone Disintegration  
Thomas Knoll

9:20 – 9:27am  New Technology in Ureteral Stents  
Evangelos Liatsikos

9:30 - 11:30am  SESSION 3: Idea to Clinical Impact Workshop: The Medical Device Development Process at the University of Michigan  
William Roberts

9:30 – 9:45 am  A Story of Innovation: The Story of Histotripsy  
William Roberts

9:45 – 9:55 am  Market Trends and Paths to Commercialization  
Connie Chang

9:55 -10:15am  What Value Does Your Innovation Deliver?  
Brad Martin

10:15 – 10:55am  Exercise: Value Proposition Canvass  
Brad Martin

10:55 – 11:10am  Communicating Your Value Proposition  
Brad Martin

11:10 – 11:25am  The UM Model and Resources for You  
Connie Chang

11:25 – 11:30am  Closing Remarks  
William Roberts
11:30 – 12:00  AWARDS PRESENTATIONS
  11:30 – 11:40am  Awards  Dan Stoianovici
  11:40 – 11:50am  Increased Contrast of Stone Specific Ultrasound Imaging in Human Subjects  Philip C. May
  11:50 – 12:00pm  Prospective Evaluation of 99mTc-Sestamibi SPECT/CT for the Diagnosis of Renal Oncocytomas and Hybrid Oncocytic/Chromophobe Tumors  Michael Gorin

12:00 – 1:00pm  LUNCH BREAK

1:00 – 2:00pm  SESSION 4: Stent Working Group / FDA Panel Discussion
  1:00 – 1:15pm  Drug-Eluting Ureteral Stents – An Update  John Denstedt
  1:15 – 1:30pm  Working with the FDA in the realm of approval for drug eluting stents  Walter Ryan
  1:30 – 1:45pm  Delivering Innovation in Drug Eluting Ureteral Stents: An Industry Perspective  Tim Harrah
  1:45 – 2:00pm  FDA Regulation of Combination Products (The Dos and Don’ts)  John Baxley

2:00 – 3:00pm  SESSION 5: Imaged Guided Working Group
  2:00 – 2:10pm  The Evolving Role of Renal Endoscopy as a Diagnosis Toll for Patients with Nephrolithiasis  Michael Borofsky
  2:10 – 2:20pm  3D Printing in Urology  Raju Thomas
  2:20 – 2:30pm  New Applications of Confocal Laser Endomicroscopy in Urology  Joseph Liao
  2:30 – 2:40pm  Transperineal MRI/US Fusion Prostate Biopsy  Ben Challacombe
  2:40 – 2:50pm  Near-Infrared Fluorescence Imaging to Facilitate Robotic Reconstructive Surgery  Lee Zhao
  2:50 – 3:00pm  Irreversible Electroporation in Urology: Treatment and follow-up  Pilar Laguna

1:00–4:00PM  POSTER SESSIONS:
  1:00–2:30PM  Poster Session 1
    Room: Ballroom G  Jens Rassweiler
    Jeffrey Cadeddu
    Alan Priester

  3:00–4:30PM  Poster Session 2
    Room: Ballroom G  Louis Kavoussi
    Stephen Nakada
    Michael Gorin
<table>
<thead>
<tr>
<th>No</th>
<th>Title</th>
<th>Presenting Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>APPYING UROLITHIASIS TO BILIARY STONES: PERCUTANEOUS TRANSHEPATIC LITHOTRIPSY</td>
<td>Brett Johnson</td>
</tr>
<tr>
<td>2</td>
<td>EVALUATION OF CONTEMPORARY HOLMIUM LASER FIBERS FOR PERFORMANCE CHARACTERISTICS</td>
<td>Zhamshid Okhunov</td>
</tr>
<tr>
<td>3</td>
<td>OFFICE-BASED ULTRASOUND PERCUTANEOUS RENAL MASS BIOPSY</td>
<td>Zhamshid Okhunov</td>
</tr>
<tr>
<td>4</td>
<td>COMPARISON OF THE NEW ShockPulse™ INTRACORPOREAL LITHOTRIPTER TO THREE COMMERCIALY AVAILABLE ULTRASONIC LITHOTRIPTERS</td>
<td>Andre Matteliano</td>
</tr>
<tr>
<td>5</td>
<td>MR SAFE REMOTE CENTER OF MOTION NEEDLE-GUIDE ROBOT</td>
<td>Dan Stoianovici</td>
</tr>
<tr>
<td>6</td>
<td>A LONG-TERM CLINICAL COMPARISON IN CASES OF HIGH VOLUME BENIGN PROSTATIC OBSTRUCTION—BIPOLAR PLASMA ENUCLEATION VERSUS STANDARD PROSTATECTOMY</td>
<td>Bogdan Geavlete</td>
</tr>
<tr>
<td>7</td>
<td>ROBOTIC VERSUS CONVENTIONAL FLEXIBLE URETEROSCOPY IN RENAL STONES: EXPERIENCE OF 132 CASES</td>
<td>Petrisor Geavlete</td>
</tr>
<tr>
<td>8</td>
<td>DEVELOPMENT OF AN ADAPTIVE ROBOTIC-ASSISTED MR-HIFU SYSTEM: PRE-CLINICAL PROOF OF PRINCIPLE</td>
<td>Nicholas Ellens</td>
</tr>
<tr>
<td>9</td>
<td>VASCULAR-TARGETED PHOTODYNAMIC THERAPY IN UROTHELIAL CANCER: IMPROVED SURVIVAL EVEN WITH SUBTHERAPEUTIC PARAMETERS</td>
<td>Barak Rosenzweig</td>
</tr>
<tr>
<td>10</td>
<td>DISPOSABLE ITEM USE AND COST IN URETEROSCOPY</td>
<td>Wesley Ludwig</td>
</tr>
<tr>
<td>11</td>
<td>EVOLUTION OF PERCUTANEOUS RENAL MASS BIOPSY TECHNIQUES AND DIAGNOSTIC OUTCOMES AT JOHNS HOPKINS HOSPITAL</td>
<td>Sasha Druskin</td>
</tr>
<tr>
<td>12</td>
<td>A DEVICE FOR RARE CELL ISOLATION AND CHARACTERIZATION</td>
<td>Emma van der Toom</td>
</tr>
</tbody>
</table>

**TOP 10 ABSTRACT**
<p>| 13 | ABSORBABLE PERIRECTAL HYDROGEL SPACER INJECTION TO REDUCE RECTAL DOSE IN LOW DOSE RATE PROSTATE BRACHYTHERAPY | Harpreet Wadhwa |
| 14 | COMPUTATIONAL SIMULATION OF ENDOSCOPIC STONE SURGERY: THREE-DIMENSIONAL AND INTRA FLY THROUGH IMAGING IN UPPER URINARY TRACT | Yasushi Yoshino |
| 15 | ENDOSCOPIC MANAGEMENT OF VESICO-URETHRAL ANASTOMOTIC STRICTURES AFTER RADICAL PROSTATECTOMY IN LOCALLY ADVANCED PROSTATE CANCER PATIENTS | Christian Surcel |
| 16 | CONVERSION OF XENON LIGHT SOURCE FOR BLUE LIGHT CYSTOSCOPY IN THE DIAGNOSIS OF BLADDER CANCER | Raphael Gomes |
| 17 | NEW GENERATION SINGLE-PORT ROBOTIC PLATFORM: FEASIBILITY ASSESSMENT IN A CADAVERIC MODEL | Daniel Ramirez |
| 18 | A NOVEL ANTI-FOULING COATING THAT REPELS PROTEINS AND BACTERIA FROM THE SURFACE OF INDWELLING URINARY DEVICE MATERIALS | Dirk Lange |
| 19 | NOVEL ANTIMICROBIAL PEPTIDE-BASED COATINGS TO PREVENT INDWELLING URINARY DEVICE-ASSOCIATED URINARY TRACT INFECTIONS | Dirk Lange |
| 20 | THE EFFECT OF INHALED CARBON DIOXIDE ON KIDNEY STONE DETECTION WITH ULTRASOUND | Julianna Simon |
| 21 | EVALUATING THE IMAGE QUALITY OF A NOVEL SINGLE-USE DIGITAL FLEXIBLE URETEROSCOPE | Brian Eisner |
| 22 | INCREASED CONTRAST OF STONE SPECIFIC ULTRASOUND IMAGING IN HUMAN SUBJECTS | Bryan Cunitz |
| 23 | OPTIMIZING DAMAGE ESTIMATION FOR PROSTATE THERMAL THERAPY | Alan Priester |
| 24 | INITIAL RESULTS OF PHASE I TRIAL OF OFFICE-BASED FOCAL LASER ABLATION | Shyam Natarajan |
| 25 | AUTOMATIC DIAGNOSIS AND MONITORING OF LOWER URINARY TRACT ACTIVITY BY A NOVEL DEVICE IMPLEMENTED ON A SMARTPHONE PLATFORM: IN VITRO PILOT STUDY | Gil Hidas |
| 26 | DETERMINING OPTIMAL EXPOSURE DURATION FOR FOCAL LASER ABLATION | Rory Geoghegan |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>REDUCTION IN KIDNEY INJURY DURING SWL USING ACOUSTIC BUBBLE COALESCE</td>
<td>Steven Allen</td>
</tr>
<tr>
<td>28</td>
<td>THE SINGLE USE DIGITAL FLEXIBLE URETEROSCOPE: A NEW PARADIGM?</td>
<td>Brian Matlaga</td>
</tr>
<tr>
<td>29</td>
<td>THE APPLICATION OF AN INNOVATIVE SURFACE ELECTRODE SYSTEM IN EXTERNAL URETHRAL SPHINCTER ELECTROMYOGRAPHY TESTING IN RATS</td>
<td>Xiaoyi Yuan</td>
</tr>
<tr>
<td>30</td>
<td>SEMI-AUTOMATED ELECTRO-MECHANICAL WOUND-CLOSURE DEVICE</td>
<td>Chad Cunningham</td>
</tr>
<tr>
<td>31</td>
<td>PROSTATE MRI PRIOR TO RADICAL PROSTATECTOMY: EFFECTS ON NERVE SPARING AND PATHOLOGIC MARGIN STATUS</td>
<td>Sasha Druskin</td>
</tr>
<tr>
<td>32</td>
<td>IMAGING OF PROSTATIC CANCER BY NEWLY DEVELOPED LED-BASED WIDEBAND NEAR-INFRARED LIGHT SOURCE INCLUDING THE ABSORPTION BAND OF WATER WITH PSA: FIRST RESULTS</td>
<td>Tokunori Yamamoto</td>
</tr>
<tr>
<td>No</td>
<td>Title</td>
<td>Presenting Author</td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>33</td>
<td>DIFFERENCES IN SURGICAL OUTCOMES BETWEEN ROBOTIC-ASSISTED LAPAROSCOPIC AND OPEN RADICAL CYSTECTOMY AMONG HIGH-RISK PATIENTS</td>
<td>Andrew Leone</td>
</tr>
<tr>
<td>34</td>
<td>Withdrawn</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td><em>IN VITRO</em> MICROBIOLOGICAL EVALUATION OF INSUFFLATION FILTER PERFORMANCE</td>
<td>Renai Yoon</td>
</tr>
<tr>
<td>36</td>
<td>COMPARATIVE ANALYSIS OF LAPAROSCOPIC FOGGING PREVENTION TECHNIQUES</td>
<td>Austin Drysch</td>
</tr>
<tr>
<td>37</td>
<td>COST COMPARISONS BETWEEN DIFFERENT TECHNIQUES OF PERCUTANEOUS RENAL BIOPSY FOR SMALL RENAL CORTICAL NEOPLASMS</td>
<td>Rahul Dutta</td>
</tr>
<tr>
<td>38</td>
<td>PILOT STUDY: ASSESSMENT OF BULBAR CONJUNCTIVAL HEMODYNAMICS IN SUBJECTS WITH ERECTILE DYSFUNCTION</td>
<td>Harpreet Wadhwa</td>
</tr>
<tr>
<td>39</td>
<td>EFFECTS OF THE COMBINATION OF VASCULAR TARGETED PHOTODYNAMIC THERAPY AND ANTI-CTLA-4 IN A PRE-CLINICAL UROTHELIAL CARCINOMA MODEL</td>
<td>Renato Corradi</td>
</tr>
<tr>
<td>40</td>
<td>MARGIN ASSESSMENT IN RENAL SURGERY USING A HANDHELD OPTICAL COHERENCE TOMOGRAPHY PROBE</td>
<td>Wesley Ludwig</td>
</tr>
<tr>
<td>41</td>
<td>ROBOT-ASSISTED FALLOPIAN TUBE TRANSECTION-ANASTOMOSIS USING THE NEW REVO-I ROBOTIC SURGICAL SYSTEM: FEASIBILITY IN A CHRONIC PORCINE STUDY</td>
<td>Ali Abdel Raheim</td>
</tr>
<tr>
<td>42</td>
<td>EVALUATION OF A SINGLE-USE, FLEXIBLE 9 FR URETEROSCOPE WITH ARTICULATING TIP IN EVERYDAY UROLOGICAL PRACTICE</td>
<td>Joseph V. DiTrolio</td>
</tr>
<tr>
<td>43</td>
<td>STONE-MODE ULTRASOUND FOR THE IMAGING OF RENAL STONES</td>
<td>Philip May</td>
</tr>
<tr>
<td>44</td>
<td>CONSTRUCTION AND ASSESSMENT OF AN INNOVATIVE VIRTUAL FLUOROSCOPY PCNL SIMULATOR</td>
<td>Ashish Rawandale</td>
</tr>
<tr>
<td>No.</td>
<td>Title</td>
<td>Author</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>45</td>
<td>HYDROGEL SPACER (&quot;SPACEOAR&quot;) IN IMAGE GUIDED INTENSITY MODULATED RADIATION THERAPY (IMRT) FOR PROSTATE CANCER: A SINGLE INSTITUTION COMMUNITY-BASED EXPERIENCE</td>
<td>Harpreet Wadhwa</td>
</tr>
<tr>
<td>46</td>
<td>BODY WALL FORCES APPLIED DURING daVINCI INTRAOPERATIVE TABLE MOTION</td>
<td>Smita De</td>
</tr>
<tr>
<td>47</td>
<td>EVALUATING THE PercSac FOR CYSTOLITHOLAPAXY IN A PORCINE BLADDER</td>
<td>Aaron Lay</td>
</tr>
<tr>
<td>48</td>
<td>AUTONOMOUS CLOSED-LOOP GENITAL NERVE STIMULATION IDENTIFIES AND INHIBITS HYPER-REFLEXIC BLADDER CONTRACTIONS</td>
<td>Robert Karam</td>
</tr>
<tr>
<td>49</td>
<td>PROSPECTIVE EVALUATION OF $^{99m}$Tc-SESTAMIBI SPECT/CT FOR THE DIAGNOSIS OF RENAL ONCOCYTOMAS AND HYBRID ONCOCYTIC/CHROMOPHOB TUMORS</td>
<td>Michael Gorin</td>
</tr>
<tr>
<td>50</td>
<td>PILOT STUDY EVALUATING PSMA-TARGETED $^{18}$F-DCFpyL PET/CT IN PATIENTS WITH METASTATIC CLEAR CELL RENAL CELL CARCINOMA</td>
<td>Michael Gorin</td>
</tr>
<tr>
<td>51</td>
<td>PREVENTING OCCURRENCE OF METASTATIC PROSTATE CANCER IN RATS WITH LOCALLY ADVANCED PROSTATE CANCER BY IMMUNOMODULATION AND VASCULAR TARGETED</td>
<td>Uri Lindner</td>
</tr>
<tr>
<td>52</td>
<td>REDUCING BACTERIAL GROWTH USING A NOVEL INDWELLING URINARY CATHETER</td>
<td>Francisco Portela</td>
</tr>
<tr>
<td>53</td>
<td>BROADLY FOCUSED BEAM FOR IMPROVED REPOSITIONING OF STONE FRAGMENTS</td>
<td>Bryan Cunitz</td>
</tr>
<tr>
<td>54</td>
<td>DEVELOPMENT OF A RELIABLE SPOT-URINE “OXALOMETER”</td>
<td>John Lindsey</td>
</tr>
<tr>
<td>55</td>
<td>PROSTATE BIOPSY-SITE TRACKING: EFFECT OF NEEDLE DEFLECTION AND SEGMENTATION ERRORS</td>
<td>Layne Haber</td>
</tr>
<tr>
<td>56</td>
<td>ENHANCED SWL STONE COMMINUTION IN A PORCINE MODEL USING ACOUSTIC BUBBLE COALESCEENCE</td>
<td>Hedieh Tamaddoni</td>
</tr>
<tr>
<td>57</td>
<td>PATIENT SPECIFIC 3-D PRINTED PROSTATE WITH TISSUE AND ANATOMIC FIDELITY</td>
<td>Kaiyan Qiu</td>
</tr>
<tr>
<td>58</td>
<td>SIMILARITIES OF HARMONIC DOPPLER SIGNALS FROM KIDNEY STONES AND ULTRASOUND CONTRAST AGENTS</td>
<td>Matthew Bruce</td>
</tr>
<tr>
<td>59</td>
<td>AUGMENTED REALITY AND HAPTIC EXPLORATION OF EXCISED PROSTATES USING MAGNETIC RESONANCE ELASTOGRAPHY</td>
<td>David Zumba</td>
</tr>
<tr>
<td>60</td>
<td>INITIAL ASSESSMENT OF BOILING HISTOTRIPSY ABLATION OF <em>EX VIVO</em> HUMAN RENAL TUMORS VS. RENAL CORTEX</td>
<td>George Schade</td>
</tr>
<tr>
<td>61</td>
<td><em>EX VIVO</em> COMPARISON OF PORCINE RENAL MICROWAVE ABLATION AT 915 MHZ AND 2450 MHZ</td>
<td>Karli Peña</td>
</tr>
<tr>
<td>62</td>
<td>THREE-DIMENSIONAL COMPUTED TOMOGRAPHIC EVALUATION OF PELVICE ORGAN PROLAPSE SURGERY</td>
<td>Mayura Nakano</td>
</tr>
<tr>
<td>63</td>
<td>SYNTHETIC HUMAN MODEL FOR UROLOGY RESIDENCY TRAINING PROGRAM IN KIDNEY BIOPSY</td>
<td>Raphael Freitas</td>
</tr>
</tbody>
</table>
APPYING UROLITHIASIS TO BILIARY STONES: PERCUTANEOUS TRANSHEPATIC LITHOTRIPSY

Brett Johnson¹, John R Bell¹, John McDermott², Prasad Dalvie², Stephen Nakada¹
¹ University of Wisconsin Department of Urology
² University of Wisconsin Department of Radiology

Introduction: Choledocolithiasis is a significant problem that can lead to life threatening cholangitis. Endoscopic retrograde cholangiopancreatography (ERCP) is first-line treatment. However, this may be technically challenging or impossible with surgically altered anatomy or very large stone burden. Because of these limitations, we have been asked by our colleagues if we can apply our Urologic skills and technology to assist in this problem. We report our technique and outcomes from our 15 years of experience.

Methods: We use a percutaneous transhepatic approach utilizing the flexible ureteroscope and holmium laser to treat biliary stones. Indications for this procedure include very large stone burden, biliary strictures, or altered anatomy such as history of liver transplant, Roux-en-Y, or Whipple. Interventional radiology obtains percutaneous access to the biliary system via the hepatic duct. A 14 French ureteral access sheath is placed under fluoroscopic guidance into the common bile duct. A flexible ureteroscope is then guided through the access sheath into the biliary system. A holmium laser is used to fragment the stones. The stones can be retrieved or flushed into the intestinal tract.

Results: Since 2000, we have performed 20 procedures on 13 different patients at our institution. 62% were stone free after one procedure. 93% were stone free after a mean of 1.3 procedures. One episode of cholangitis was noted post-operatively. We have not observed injury to the biliary system, pancreatitis, or need for urgent re-intervention.

Conclusion: With a multidisciplinary approach and the correctly selected patient, percutaneous transhepatic biliary endoscopy with lithotripsy is a safe and effective intervention for complex biliary stones. Endourologic urolithiasis technology and engineering can play a role in the treatment of patients with choledocolithiasis not amenable to ERCP. This improves patient care by decreasing the need for invasive surgery in patients with complex anatomy, large stone burden, or when ERCP is ineffective.

Figure 1: Patient is supine with a ureteral access catheter inserted percutaneously into the common bile duct. The radiograph shows the location of the sheath (yellow arrow) and the ureteroscope in place.
EVALUATION OF CONTEMPORARY HOLMIUM LASER FIBERS FOR PERFORMANCE CHARACTERISTICS

Zhamshid Okhunov, Achim Lusch, Emon Heidari, Kathryn Osann, Jaime Landman
Department of Urology, University of California, Irvine

Introduction: We compared Holmium laser fibers (LF) with different core sizes for performance characteristics including energy transmission (ET), LF failure, LF flexibility, and core diameter.

Methods: Single use LF from Cook, Boston Scientific, and Storz were tested in small (200, 272/273 micron), medium (365 micron) and large (550 and 940/1000 micron) core sizes. LF were tested in straight and deflected configurations. We evaluated each LF in a fiberoptic ureteroscope [Storz X-2 Karl Storz, Tuttlingen, Germany]. All LF were evaluated for flexibility, true LF diameter, ET, and LF failure. For ET LF were tested (straight and bent) at a pulse energy of 1 J and a frequency of 10 Hz for 30 sec. ET was measured with an Ophir Star Link USB Sensor (Ophir, North Logan, USA). All tests were performed on a 30W Holmium Laser (Cook Medical, Bloomington, USA).

Results: Among the small core LF, Storz and Cook Smart Sync showed a significantly higher deflection whereas in the 550 micron group Boston Scientific Accumax and Cook Smart Sync were the most flexible LF. In the large and medium core groups, the Boston Scientific Accumax showed superior ET (p=0.007 and p=0.001, respectively) whereas in the small core group there was no difference among the LF, except for 272/3 micron. [Storz was inferior compared to the competitors (P<0.0005).] For LF failure Storz, Cook Optilite and BS AccuTrac completed all testing without failing (200 micron, bending radius <0.5 cm). In the 365 micron group Cook Optilite showed superior results, whereas in the large LF diameter group (550 micron) the Boston Scientific AccuMax was superior.

Conclusions: Performance characteristics differ significantly among different LF diameters and manufacturers, and LF choice should depend on specific surgical requirements. Small core LF should be considered for ureteroscopic applications as there is no difference in energy transmission among the different core sizes.
ABSTRACT 3

OFFICE-BASED ULTRASOUND GUIDED PERCUTANEOUS RENAL MASS BIOPSY

Zhamshid Okhunov¹, Ashleigh Menhadji¹, Simone L. Vernez¹, Vien Nguyen¹, Victor Huynh¹, Thomas Lee², and Jaime Landman¹

¹Department of Urology, University of California, Irvine
²Department of Pathology, University of California, Irvine

Introduction: We present our prospective experience regarding the feasibility, safety and efficacy of office-based, ultrasound-guided percutaneous renal biopsy (USGPRB) of a renal cortical mass.

Methods: Patients with posterior, lateral tumors in the mid or lower pole were selected to undergo office-based USGPRB. Patients were instructed to apply EMLA cream to the ipsilateral flank 2 hours before the procedure. Procedures were performed in a standard exam room with the patient in a prone position. After the flank was prepared and draped, a Hitachi-Aloka alpha 7 US device with a 2.5-5.5 MHz probe with facilitated ultrasound targeting (FUT) technology was used to visualize the tumor. The probe was positioned such that the tumor was in the virtual needle path as projected by the FUT technology on the US screen. After injection of 1% lidocaine, an 18G biopsy needle was inserted through a needle guide on the transducer probe and advanced toward the renal mass under US guidance; 3 to 5 cores were taken. US evaluation was then repeated one hour later to assess for a perirenal hematoma prior to discharge home. Patients completed an analog pain scale (0 = no pain, 10 = severe pain) before and immediately after the procedure, and one to 2 weeks later at their return office visit. Patient demographics, tumor characteristics, procedure time, complications, and histopathological diagnosis were recorded.

Results: A total of 28 patients with a mean age of 70 yrs (43-89) underwent USGPRB. Mean biopsy time was 11.5 minutes (3-47). There were 15 (53.5%) males and 13 (46.5%) females. The mean tumor size was 3.8 cm (1.8-7). The mean R.E.N.A.L. score was 6 (4-8). Twenty-two (80%) of the 28 biopsies were diagnostic. Diagnostic biopsies included 13 (59%) renal cell cancers and 9 (41%) (6 oncocytomas and 3 angiomyolipomas). The latter all elected for active surveillance. There were no complications during or after the biopsy procedure; no hematomas were noted on post-biopsy US assessment. None of the patients reported pain before the procedure. Mean pain score immediately after the procedure was 1.2/10(0-3) and 0.47/10(0-3) at one hour after the procedure and 0 at three week follow up (p=0.657).

Conclusions: USGPRB is feasible, safe, and diagnostic in 80% of patients. Of note, 32% of the biopsied tumors were benign, thereby precluding additional treatment.
ABSTRACTS

ABSTRACT 4

COMPARISON OF THE NEW ShockPulse™ INTRACORPOREAL LITHOTRIPTER TO THREE COMMERCIALLY AVAILABLE ULTRASONIC LITHOTRIPTERS

Andre Matteliano¹, Ryan Paterson², Thomas de los Reyes², Dirk Lange², Ben Chew²

¹Section of Urology, Department of Surgery, University of Manitoba
²Department of Urologic Sciences, University of British Columbia

Introduction: Ultrasonic intracorporeal lithotripters are used during percutaneous nephrolithotomy for stone fragmentation and removal. We performed standardized bench testing of the new ShockPulse™ Stone Eliminator against three commercially available systems to determine differences and nuances in performance against both hard and soft stones.

Methods: The new ShockPulse (Olympus) intracorporeal lithotripter was tested against the LUS-2™ (Olympus), Cyberwand™ (ACMI/Olympus) and EMS LithoClast™ in a standardized setting using hard (Utracal 30: U30) and soft (plaster of Paris: POP) stones. Using a rigid nephroscope, irrigation, camera and video screen; the time to fragment equally sized U30 and POP stones in a rubber kidney model was assessed by three surgeons. The time needed to fragment each stone into pluckable fragments was first recorded, followed by the time to fully eliminate all fragments with the lithotripter. To determine the efficacy of each system at various pressures, a hands-free apparatus was used to transmit 1, 1.5 and 2 pounds of fixed force to both solid cylindrical stones and groups of six smaller stone fragments. The time required to fragment the stones was recorded at each fixed force.

Results: The time to create pluckable fragments in the kidney model was similar among all four lithotripters for both POP stones (17-23s) and U30 stones (25-33s). The time to total fragmentation of free stones was similar for three of the lithotripters (45-66s), which were all significantly faster than the Cyberwand system (112s, p=0.046) for both U30 and POP stones (p=0.001). When fixed force testing was applied to solid cylindrical stones, the ShockPulse and Cyberwand were significantly faster at all fixed forces (p<0.0001). The LUS-2 was unable to fragment stones at 1 or 2 pounds of fixed force, and was only able to penetrate at 1.5 pounds of force. When fixed force testing was applied to the six smaller fragments, the ShockPulse was significantly faster than the other models at 1 pound (p<0.001) and 1.5 pounds (p<0.002). At 2 pounds, the Cyberwand was the slowest (p<0.0001), with no observed difference between the other three lithotripters (p=0.09).

Conclusion: The ShockPulse lithotripter is equally as effective as current commercially available lithotripters. It was significantly faster at fragmenting stones at lighter fixed forces, which are more in keeping with those pressures applied clinically. The ShockPulse also performed equally well at greater fixed forces.
MR SAFE REMOTE CENTER OF MOTION NEEDLE-GUIDE ROBOT

Dan Stoianovici¹, Changhan Jun¹, Sunghwan Lim¹, Doru Petrisor¹, Reza Monfaredi², Emmanuel Wilson², Axel Krieger², Stan Fricke², Karun Sharma², Kevin Cleary²

¹Robotics Laboratory, Urology Department, Johns Hopkins University, Baltimore, MD
²Sheikh Zayed Institute for Pediatric Surgical Innovation, Children's National Health System, Washington, DC

Introduction: A new MRI-Safe robot has been developed. The robot mounts on the MRI table and orients a needle-guide on target at a location specified by the physician from the images. Its kinematic architecture is optimized to orient the needle-guide about a skin-entry fulcrum point located distal to the mechanism, using an innovative Remote Center of Motion (RCM) parallelogram type mechanism. Numerous medical robots use RCM mechanisms, including the daVinci system (Intuitive Surgical). The novelty of the new robot is its MRI compatibility, compact structure, high stiffness, and accuracy that are required for image-guided (rather than surgeon-driven) interventions. Applications include general needle placement for diagnosis and therapy delivery, including bone biopsy and urologic interventions.

Methods: An MRI –Safe (ASTM F2503) robot with 3 degrees of freedom (DoF) has been developed (Figure below). All axes are actuated with two PneuStep motors coaxially located on the robot base. The needle is inserted manually through the guide. The depth of needle insertion is set by a third PneuStep motor located outside the MR gantry. Before the insertion, this pre-adjusts the location of a depth stop along the barrel of the needle.

The robot is electricity free, uses air pressure for actuation, light for the position sensors, and is entirely made of nonconductive, non-metallic, and nonmagnetic materials. Accordingly, the robot is MRI-Safe according to ASTM F2052, F2213, and F2182 based on the scientific rationale. The needle-guide, which comes in direct contact with the patient, is built of certified biocompatible material (ISO-10993). The bore of the needle-guide can be made to accommodate various needles. The figure shows the MRI-Conditional Invivo 15100 bone biopsy needle (Invivo, Philips Healthcare, The Netherlands).

Results: Bench tests of the robot have been completed for motion precision, accuracy, and structural stiffness. A Polaris optical tracker (NDI, Canada) was used to measure the actual location of a passive marker placed on a rod attached to the needle-guide. Under careful measurement conditions, the accuracy of this optical tracker is as low as 0.055 mm. Experimental results showed an angular accuracy of 0.177° and a precision of 0.077°. For a 50mm deep target, the positioning accuracy is 0.155mm and the precision is 0.067mm. The stiffness of the mechanical structure has been measured with a force gauge and a micrometer that showed a structural stiffness of 34.5N/mm at the needle-guide.

The robot includes high contrast MRI markers for registration (filled with MR-Spots contrast, Beekley, Bristol, CT). A custom image-to-model registration algorithm and image-guided control software was developed. Initial tests were conducted in a Siemens MAGNETOM Tim4G scanner. Images of a gelatin mock-up were acquired together with the robot. These initial tests showed no apparent image artifacts or problems in operating the robot within the MRI.

Conclusion: We present a new robotic assistant for percutaneous needle procedures. Laboratory experiments show that it is accurate, precise, and stiff. Comprehensive image-based targeting and image deterioration tests are in progress. The robot is MRI-Safe and initial imaging tests showed no mutual interference with the MRI. The next steps are to evaluate the MRI-based targeting accuracy and prepare for a clinical trial.

Acknowledgement: The project described is supported by award 1R01CA172244 from the NCI-NIH.
ABSTRACT 6

A LONG-TERM CLINICAL COMPARISON IN CASES OF HIGH VOLUME BENIGN PROSTATIC OBSTRUCTION—BIPOLAR PLASMA ENUCLEATION VERSUS STANDARD PROSTATECTOMY

P. Geavlete, C. Bulai, C. Ene, B. Geavlete
Department of Urology, “Saint John” Emergency Clinical Hospital, Bucharest, Romania

Objectives: This retrospective, long-term study was designed to compare safety and efficiency of the bipolar enucleation of the prostate (BPEP) and standard open prostatectomy (OP) in cases of high volume benign prostatic hyperplasia (BPH).

Methods: Between January 2013 and January 2016, a total of 140 patients underwent BPEP and OP in equal numbers and were followed by International Prostate Symptom Score (IPSS), Quality of Life score (QoL), maximum flow rate ($Q_{\text{max}}$), postvoiding residual urinary volume (PVR) and PSA level at 1, 3, 6, 12, 18 and 24 months after the initial intervention. The inclusion criteria consisted of prostate volume larger than 80 mL, IPSS higher than 19, and $Q_{\text{max}}$ smaller than 10 mL/s.

Results: Similar preoperative features were defined in the two study arms. Equivalent mean operating times and resected adenoma tissue weights were determined for BPEP and OP. The plasma-button enucleation provided the advantages of reduced mean hemoglobin level drop, catheterization period, and hospital stay. No major differences were described in terms of short as well as long-term adverse events. The two years’ follow-up revealed similar outcomes concerning symptom scores and voiding parameters in the two series.

Conclusions: The BPEP technique constitutes a feasible alternative of matching the conventional OP therapeutic efficiency while minimizing morbidity and reducing convalescence. This long-term evaluation confirmed the similar functional benefits of the two treatment alternatives.
ABSTRACTS

ABSTRACT 7

ROBOTIC VERSUS CONVENTIONAL FLEXIBLE URETEROSCOPY IN RENAL STONES: EXPERIENCE OF 132 CASES

Petrisor Geavlete\textsuperscript{a,d}, Remzi Saglam\textsuperscript{b}, Dragos Georgescu\textsuperscript{a,d}, Razvan Multescu\textsuperscript{a,d}, Valentin Iordache\textsuperscript{a}, Ahmet Sinan Kabakci\textsuperscript{c}, Cosmin Ene\textsuperscript{d}, Bogdan Geavlete\textsuperscript{a,d}

\textsuperscript{a}Sanador Hospital, Bucharest, Romania
\textsuperscript{b}Department of Urology, Medicana International Hospital, Ankara, Turkey
\textsuperscript{c}Department of Bioengineering, Hacettepe University, Ankara, Turkey
\textsuperscript{d}Department of Urology“St.John” Clinical Hospital of Emergency, Bucharest, Romania

Introduction and objectives: Roboflex Avicenna represents a new platform for flexible ureteroscopy, capable of providing a safer and more effective lithotripsy of renal calculi. The aim of the study was to compare the efficiency of the Avicenna robotic flexible ureteroscopy with classical flexible ureteroscopy.

Material and methods: The study was prospective and included 132 patients equally randomized who underwent standard flexible ureteroscopy (FUS) and robotic flexible ureteroscopy for renal calculi between July and December 2015. All the procedures were performed with a Storz SPIES type flexible ureteroscope in association with the Avicenna Roboflex. Stone fragmentation was performed using a Dornier Medilas 20H, Holmium Laser of 20 watt power and 2.1μm wavelength.

Results: The mean age was 48 years (range 26-77 years) and the mean stone size was 2.1 cm (range 1.1-3.6 cm) for the first group, while for the second group the mean age was 51 years (range 25-74 years) and the mean stone size was 2.4 cm (range 1.0-3.7 cm). Among the cases that underwent FURS and robotic FURS, 51 cases and 43 cases, respectfully, presented with a single stone, while 15 and 23 cases presented with multiple stones. The treatment time as well as fragmentation time of the stones (45 min versus 50 min and 35 min versus 39 min) was significantly better for robotic FURS. The number of cases that required retreatment was significantly lower for robotic FURS than for classical FURS (9.1% versus 15.1%). In 95.4% of cases and in 98.5% of patients with FURS and robotic FURS, respectively, were performed to complete stone disintegration. The stone-free rate after 3 months was 89.4% for FURS versus 92.4% for robotic FURS, thus representing a clear performance advantage of the robotic technique over the classical one.

Conclusions: Based on the present study, it can be stated that robotic-assisted flexible ureteroscopy represents a viable treatment method for kidney stones, as confirmed in the initial clinical outcomes.
DEVELOPMENT OF AN ADAPTIVE ROBOTIC-ASSISTED MR-HIFU SYSTEM: PRE-CLINICAL PROOF OF PRINCIPLE

Nicholas Ellens¹, Doru Petrisor¹, Changhan Jun¹, Sunghwan Lim¹, Keyvan Farahani¹,², Ari Partanen¹,³, Dan Stoianovici¹
¹ Johns Hopkins University School of Medicine, Baltimore, MD, USA
² National Cancer Institute, Bethesda, MD, USA
³ Philips, Andover, MA, USA

Introduction: Magnetic resonance-guided high intensity focused ultrasound (MR-HIFU) has been used for the treatment of a wide range of diseases and conditions. Juxtaposed to current clinical systems that are tailored to specific anatomical targets, we propose an adaptive, robotic-assisted MR-HIFU system consisting of a multi-element phased-array transducer mounted to a robotic arm with a large range of motion above a conventional MRI bed, suitable for use with many anatomical targets in the abdomen, particularly the liver and pancreas, extremities (primary and secondary bone cancers), and even in the brain. Such a system would require a robust method for coupling the transducer to the body with different orientations and integration with the MRI for targeting and sonication control.

As a precursor to a clinical system, this study presents preliminary results with an adaptive, pre-clinical system based on the integration of the Philips Sonalleve MR-HIFU software platform, a pre-clinical-specific transducer, and an MR-Safe robot.

Methods: A sealed, sonolucent membrane was attached across the face of a 5 cm, 3 MHz, 8-element sector vortex HIFU transducer (maximum power of 64 W electric). The membrane was filled with degassed water such that it formed a convex surface. The transducer case was mounted to an existing MRI-safe robot. The Sonalleve MR-HIFU planning software was modified to include a GUI overlay to represent the transducer which could be interactively placed on 3D MRI data sets to predict the HIFU focus prior to sonication and allow for adjustments in the transducer position. Based on the perceived transducer location, multi-planar MR thermometry slices were positioned to optimally capture the heating.

The system was evaluated for accuracy in a tissue-mimicking phantom by sonicating in a 15 mm grid with different powers and durations (4-32 W, 30-90 s, continuous wave) to assess the accuracy of the combined robot transducer system. Second, sonications were performed in a 10 mm grid on a fresh, excised pig leg (16 W, 120 s) to evaluate the targeting accuracy and the ability of the system to couple to the leg properly. The MRI SNR was also evaluated with and without the system in place.

Results: Preliminary integration appeared to be successful. The sonication accuracy in the tissue-mimicking phantom was 0.3 +/- 0.1 mm, smaller than the size of the ultrasound focus. The GUI overlay allowed the location of peak heating to 2.4 +/- 0.4 mm overall and 0.8 +/- 0.1 mm in both transverse directions. The MRI SNR was unchanged when the system was added to the MRI: 302 +/- 2 without the system and 306 +/- 4 with it.

Conclusion: This combined robot and transducer system provided excellent spatial accuracy for sonication and the software GUI made treatment planning straightforward and effective.
ABSTRACTS

ABSTRACT 9

TOP 10 ABSTRACT

VASCULAR-TARGETED PHOTODYNAMIC THERAPY IN UROTHELIAL CANCER: IMPROVED SURVIVAL EVEN WITH SUBTHERAPEUTIC PARAMETERS

Barak Rosenzweig¹, Alex Somma¹, Stephen La Rosa¹, Sylvia Jebiwott¹, Renato Beluco Corradi Fonseca¹, Sebastien Monette², Kwanghee Kim¹ and Jonathan A. Coleman¹

¹Urology Service, Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, NY
²Department of Pathology, Memorial Sloan Kettering Cancer Center, New York, NY

Introduction: Surgical resection (SR) is the gold standard for treatment of early stage urothelial cancer (UC). However, some patients may already harbor micro-metastatic disease at time of diagnosis while others may be too sick to undergo surgery. Vascular-targeted photodynamic (VTP) therapy is a novel focal therapy using intravascular photosensitizer activated by light to destroy tumors. Subtherapeutic VTP (sbVTP) allows for immune modulation that results in the development of an antitumor immune response. We aimed to evaluate whether sbVTP would be equivalent to no treatment, comparing both to SR in UC murine model.

Methods: MB49/luciferase UC cell line was subcutaneously implanted in 54 C57BL/6 male mice. Animals were allocated into 5 groups: control (no treatment), early SR (Surgery1), early VTP (VTP1), late SR (Surgery2), and late VTP (VTP2). VTP treatment utilized WST11, a palladium-bacteriochlorophyll derivative, administered intravenously (9 mg/kg) with subtherapeutic laser dose of 122 mW/cm. Procedures were performed 2 weeks (“early”) or 3 weeks (“late”) postimplantation. Survivals were re-challenged after 119 days using the same cell line. Tumor burden and lung metastases were assessed using validated bioluminescent imaging.

Results: All animals survived the initial intervention. The median tumor volume to be treated “late” was 583 mm³ resulting in partial tumor ablation (PTA). By 22 days after tumor implantation the VTP1 group showed tumor and lung fluorescent signal to be significantly lower than control but higher than Surgery1 (Figure 1). VTP2 group tumor radiance also demonstrated signal lower than control. Overall and metastasis-free survival was significantly longer in the VTP1 group than control, but shorter than Surgery1. VTP2 group failed to show advantage over control regarding these end points (Figure 2). sbVTP survivals did not develop tumors nor metastasis following re-challenge.

Conclusion: Early sbVTP treatment reduces lung metastases burden and improves survival compared to control and appears to provide immunity to tumor re-challenge. These data suggest therapeutic benefit even to PTA with sbVTP.

![Fig 1(Lt). Fluorescent signal from tumor and lungs of mice injected with MB49 tumor cell line for urothelial cancer, treated with surgery or VTP 2 weeks (Surgery1/VTP1) or 3 weeks (Surgery2/VTP2) after tumor implantation.](image1)

![Fig 2(Rt). Kaplan-Meier curves showing overall survival (a) and metastatic-free survival (b) of 54 mice injected with MB49 urothelial tumor cell line, treated with surgery or VTP at 2 weeks (Surgery1/VTP1) or 3 weeks (Surgery2/VTP2) after tumor implantation. P-values are shown in separate table.](image2)
ABSTRACT 10

DISPOSABLE ITEM USE AND COST IN URETEROSCOPY

Wesley W. Ludwig, Justin B. Ziemba, Sasha C. Druskin and Brian R. Matlaga
Johns Hopkins Hospital, Baltimore, MD

Introduction: Achieving high-value care for patients with stone disease requires an understanding of the interface between surgical outcomes and cost. Ureteroscopy (URS) is one of the most commonly performed treatments for renal and ureteral stones. Although operative outcomes are well described, our understanding of the procedure’s cost, particularly the costs associated with disposable items, is limited. Therefore, we performed an analysis of disposable item use during URS.

Methods: We retrospectively identified all URS performed by 10 surgeons at a single academic hospital during fiscal year 2014 (FY14) and 2015 (FY15). We extracted all disposables for each case, and excluded items for skin preparation, draping, irrigation, and positioning. The variable cost of each disposable item in US dollars ($) was the monthly average set by the hospital master charge list at the time of abstraction (9/2015). Disposable usage and cost was compared between surgeons and FY.

Results: A total of 231 and 281 cases were performed in FY14 and FY15, respectively. The median number of disposable items used per case was 9 (IQR: 7-11) in FY14 and 8 (IQR: 8-10) in FY15. The most commonly used item was a Sensor™ PTFE guidewire (220/231; 95%) at an aggregate cost of $9,560.76 in FY14 and (268/281; 95%) at an aggregate cost of $11,647.00 in FY15. The mean disposable item cost per procedure was $955.55 ± $863.18 in FY14 and $950.90 ± $843.84 in FY15. When comparing FY14 and FY15, there was no difference in per procedure cost (p=0.951) or number of DI (=0.091). However, when comparing our two highest volume surgeons (combined case total=222) in FY15, surgeon 1 with 10 years of experience had a lower mean DI cost per case as compared to surgeon 2 with 1 year of experience ($894.29 ± $777.95 v. $1168.80 ± $1105.45; p=0.03). This was unrelated to the number of DI used per case, which did not significantly differ between surgeons in FY15 (p=0.362).

Conclusions: URS requires a large number of disposable items at a significant cost per case. Surgeon experience appears to influence the disposable item cost per procedure. This may be related to provider preference without awareness of cost. Strategies incorporating feedback on individual provider disposable item choice can help to develop a high-value culture surrounding URS.

![Figure 1: Relationship between item usage and cost](image-url)
ABSTRACT 11

EVOLUTION OF PERCUTANEOUS RENAL MASS BIOPSY TECHNIQUES AND DIAGNOSTIC OUTCOMES AT JOHNS HOPKINS HOSPITAL

Sasha Druskin, Sara Wobker, Christopher VandenBussche, Mark Ball, Michael Gorin, Wesley Ludwig, Michael Johnson, Christian Pavlovich, Mohamad Allaf, Phillip Pierorazio

Johns Hopkins Medical Institutions

Introduction: Renal masses are being detected with greater frequency due to wide availability and use of cross-sectional imaging and are increasingly managed with observation or ablative techniques. In this setting, renal mass sampling may have a growing role in how these masses are managed. Percutaneous fine-needle aspiration (FNA) and core biopsy (CB) are techniques used for this purpose. We sought to assess how the diagnostic abilities of these techniques compared.

Methods: We retrospectively reviewed pathology reports of renal mass biopsies performed over the last 10 years. Overall diagnostic rates, as well as rates of RCC subtype and Fuhrman grade assignment were determined. Trends in the usage of FNA and CB over time, and the association of technique and diagnostic ability, were assessed.

Results: A total of 328 biopsies were identified. Of those, 100 were FNA alone and 228 were combined FNA and CB. In total, results were non-diagnostic 18.6% of the time. In those who had an FNA only, the non-diagnostic rate was 42%, compared to 8.3% in those who had a FNA with CB. In the FNA with CB and FNA alone groups, samples were diagnosed as RCC, other cancers, and benign in 54.4%, 15.4% and 21.9%, and 21%, 17% and 20% of cases, respectively. RCC diagnoses were accompanied with a subtype in 86.3% of FNA with CB and 71.4% of FNA alone cases, and Fuhrman grades were provided in 56.8% and 10% of cases, respectively. The most common RCC subtypes in both groups were clear cell and papillary. When breaking the cases up into tertiles, divided by date of biopsy, the earliest, middle, and latest tertile used FNA with CB 44%, 80.7%, and 83.6% of the time, respectively. Following this trend, the diagnostic rate also increased by tertile: 75.2%, 84.4% and 84.5%, respectively, as did the rate of reported Fuhrman grade (11.8%, 62.7% and 61.7%, respectively) and RCC subtype (58.8%, 92.2% and 91.7%, respectively).

Conclusion: FNA with CB, when compared with FNA alone, had higher diagnostic rates and RCC subtype and Fuhrman grade reporting rates. Throughout the duration of the study period, FNA was increasingly combined with CB; this was associated with an increase in diagnostic rates as well as reporting of RCC subtype and Fuhrman grade. Combined FNA and CB are increasingly used at our institution with reliable reporting of RCC subtype and Fuhrman grade.
ABSTRACT 12

A DEVICE FOR RARE CELL ISOLATION AND CHARACTERIZATION

Emma E. van der Toom\textsuperscript{1,2}, Michael A. Gorin\textsuperscript{1}, James E. Verdone\textsuperscript{1}, Changhan Jun\textsuperscript{1}, Doru Petrisor\textsuperscript{1}, Dan Stoianovici\textsuperscript{1}, Kenneth J. Pienta\textsuperscript{1}

\textsuperscript{1}The James Buchanan Brady Urological Institute, Johns Hopkins School of Medicine, Baltimore, MD, USA
\textsuperscript{2}VUmc School of Medical Sciences, VU University, Amsterdam, The Netherlands

Introduction: The efficient and cost-effective isolation and characterization of circulating and disseminated tumor cells (CTCs/DTCs) as a ‘real-time liquid biopsy’ continues to evade the scientific community. Existing macro-scale methods to isolate and analyze CTCs and DTCs require various transfer, wash, and staining steps, which are time consuming, expensive and risk the loss of rare cells. To overcome the limitations of existing CTC/DTC isolation strategies, we have developed a ‘lab on a chip’ device for the microscale enrichment, staining, and analysis of rare cell populations. This device utilizes immunomagnetic positive selection for the isolation of cells through an immiscible interface. The isolated cells can then be stained utilizing immunofluorescence or other downstream detection methods. We describe the construction and initial preclinical testing of the device.

Methods: The device is composed of a 500 \( \mu \)l sample well connected via a thin channel to an output well containing a 8.0 \( \mu \)m polycarbonate membrane filter (Figure a). The channel is filled with 10 \( \mu \)l of a high surface tension solution such as oil. The output well is filled with a washing solution such as phosphate buffered saline. A cell suspension derived from either blood or bone marrow is admixed with anti-EpCAM antibodies labeled with 4.5 \( \mu \)m paramagnetic Dynabeads (ThermoFisher Scientific, Waltham, MA). This solution is then pipetted into the input well and the magnet placed under this well. The magnetic field attracts the antibody-bound cells. With advancement of the magnet, bound cells of interest are displaced into the output well. A syringe is then used to extract the washing solution by passing it through the filter. The filter is chosen for a pore size that is capable of trapping the antibody-bound cells. Downstream processing steps such as immunofluorescence or fluorescence in situ hybridization can then be performed directly on the chip. Once these processes are complete, the filter is removed and mounted on a glass slide for microscopic imaging or other analysis.

Results: Initial tests of the device were performed using the LNCaP prostate cancer cell line. These tests showed that LNCaP cells could be reliably captured (Figure b) with an increase in recovery up to approximately 85\% using 50 \( \mu \)l of anti-EpCAM Dynabeads (Figure c). Anti-CD45 Dynabeads were also tested as a negative control to account for non-specific cell capture. This demonstrated a low rate of recovery across tested concentrations (Figure c).

Conclusion: Our novel device integrates rare cell isolation with downstream molecular detection methods in a single microscale platform. Initial tests suggest that the device may be well suited for the isolation of CTCs and DTCs. Processing on one device saves time and reagents and reduces the risk of sample loss. The device may allow the monitoring of cancer progression and the response to therapy over time.

Figure: a) Schematic diagram of the device, b) LNCaP prostate cancer cell captured and visualized on membrane. Red = magnetic beads, green = cytosol of the cell, and blue = nucleus. c) Percent recovery of LNCaP prostate cancer cells using different volumes of anti-EpCAM Dynabeads (n=3 per concentration)), as well as with a negative control using anti-CD45 Dynabeads (n=1 per concentration).
ABSTRACT 13

ABSORBABLE PERIRECTAL HYDROGEL SPACER INJECTION TO REDUCE RECTAL DOSE IN LOW DOSE RATE PROSTATE BRACHYTHERAPY

Jason Huang, BA1, Paul LeVan, JD, PhD2, William Andre, MS2, Harpreet Wadhwa, MD1, Peter Tsambarlis, MD3, Dan M Tauber3, Kalyan Latchamsetty, MD2,3, Parthiv Mehta, MD2, Paul Yonover, MD, FACS1,2

1Department of Urology, University of Illinois at Chicago College of Medicine, Chicago, IL
2Uropartners, LLC, Chicago, IL
3Rush University Medical Center, Chicago IL

Introduction: Rectal toxicity in prostate brachytherapy is a dreaded complication and is related to irradiation of the rectal wall. Absorbable perirectal hydrogel spacers have been shown to reduce rectal dose in IMRT patients, but experience with brachytherapy is quite limited. We report our single institution experience with the “SpaceOAR” hydrogel system (Augmenix) in low dose rate transrectal ultrasound-guided permanent prostate brachytherapy.

Methods: 11 men with Stage T1c-T2c prostate cancer scheduled to undergo I-125 brachytherapy received "SpaceOAR" transperineal absorbable hydrogel spacer injection concomitant to seed implantation. CT-based dosimetry was performed at 30 days. Five patients received 110Gy from brachytherapy as part of combination therapy and 6 patients received 145Gy as monotherapy. Dosimetry data for brachytherapy were analyzed for the prostate and organs at risk for each patient.

Results: The average prostate volume = 37.3 cc. The average prostate V100 (%volume that received 100% of the prescription dose) = 86.3% (71.6-95.7). The mean prostate D90= 95.23% (77.54-112.96). The RV100 (volume of rectum which received ≥ 100% of the prescription dose) was undetectable in 10/11 patients. Only one patient had a measurable RV100 = 0.33cc.

Conclusion: The American Brachytherapy Society consensus guidelines for brachytherapy recommends that the RV100 should be < 1.33cc by Day 30 on dosimetry. In all but one of our patients (10 of 11) who received hydrogel spacer, we were able to achieve an RV100 = 0cc. These results confirm that injection of absorbable perirectal hydrogel spacers can significantly reduce rectal dose during brachytherapy, often to undetectable levels.
COMPUTATIONAL SIMULATION OF ENDOSCOPIC STONE SURGERY: THREE-DIMENSIONAL AND INTRA FLY THROUGH IMAGING IN UPPER URINARY TRACT

Yasushi Yoshino¹, Tokunori Yamamoto¹, Chenglong Wang², Sho-hei Ishida¹, Yasuhito Funahashi¹, Masahiro Oda², Kensaku Mori², Momokazu Gotoh¹

¹ Nagoya University Graduate School of Medicine, Department of Urology, Nagoya, Japan
² Nagoya University Graduate School of Information Science, Nagoya, Japan

Introduction: We preliminarily established a new virtual imaging of ureterorenoscopy and laparoscopy using NewVES (Virtual Endoscopy Software using fast volume rendering) system that was produced by Nagoya University Information Science Technology Group. An image-processing algorithm in computational virtual ureteroscopy combined with nephrostomy was presented (Fig.1).

Methods: Preoperatively, three phases of enhanced abdominal CT images were captured and converted to DICOM data that were divided by every 0.5 to 1 mm slice. Three-dimensional (3D) images of renal artery, vein and ureter and renal pelvis were obtained and were given the different color in each (Fig.2). Excretory phase of images in upper urinary tract were also captured and fuse together with the arterial and venous phase (Fig.3). Optimal virtual picture line was draw through each renal calix along the center axis of funnel shaped renal calix. Then virtual puncture line was slightly arranged to avoid the vessel piercing and was projected onto the virtual pneumonic-abdominal wall (Extra fly through image). Three dimensional perspective ureteral images were constructed and a virtual scope eye was moved up- and downward while observing the cranial side. Virtual nephrostomy was made through an intersection point puncture and needle penetration was observed at the pelvic location of the scope eye (Intra fly through image).

Results: Two hours were required to complete the image preparation. Lithotripsy and kidney puncture for 58-year-old male with 2cm calculi was successfully treated under the preoperative simulation guidance (Fig.4).

Conclusion: Computational virtual ureteroscopy combined with nephrostomy made by 3D extra and intra fly through image might predict optimal puncture point, help the preoperative simulation, and lead to safer stone surgery.
ABSTRACT 15

ENDOSCOPIC MANAGEMENT OF VESICO-URETHRAL ANASTOMOTIC STRICTURES AFTER RADICAL PROSTATECTOMY IN LOCALLY ADVANCED PROSTATE CANCER PATIENTS

Surcel C1,2, Mirvald C1,2, Pavelescu C1, Mihai V1, Najjar S1, Gingu C1,2, Savu Carmen3, Sinescu I1,2

1 Centre of Uronephrology and Renal Transplantation, Fundeni Clinical Institute, Bucharest, Romania
2 “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania
3 Anestesiology and Intensive Care Unit, Fundeni Clinical Institute, Bucharest, Romania

Introduction: Currently, there is no universally accepted approach for management of anastomotic strictures after radical prostatectomy for prostate cancer. Cold knife incision is the most commonly used technique for the treatment of bladder neck contractures, however, it present a high recurrence rate. The aim of this study was to evaluate the efficiency of different endoscopic techniques for treatment of vesico-urethral anastomotic stricture (VUAS).

Methods: Between 2008-2015, 42 patients were diagnosed with anastomotic stricture after radical prostatectomy. Flowmetry, postvoid residual volume of urine (PVR) and urethroscopy were used to confirm the diagnosis. Data regarding surgical approach, staging, PSA, previous prostate surgery, systemic conditions such as diabetes, were also recorded. After exclusion of local recurrence and pts who received postoperative radiotherapy, 32 (76.19%) patients were divided in 3 groups: 1st group - 20 pts (62.5%) were subjected to cold knife incision; 2nd group – 8 pts (25%) were treated with plasma button vaporization (PBV) and 4 pts (12.5%) were treated using Ho:YAG laser. In all pts, the urethral catheter was removed after 7 days. The results were evaluated by measuring the maximum urinary flow (Qmax), PVR at 6 weeks and every 3 months. Plasma button vaporization was performed in case of recurrence. For statistical analysis, Wilcoxon rank-sum test was used and a P value <0.05 was considered significant.

Results: Mean follow-up period was 21 (6-36) months. Mean time to VUAS after surgery was 8.9 (6-32) months. Improvements in Qmax and PVR were present in all cohorts at 6 weeks. No perioperative complications and no deterioration of urinary continence were recorded. Mean values Qmax at 6 weeks for all groups were 8.9 mL/s, 12.1 mL/s and 13.3 mL/s (p=0.023), while PVR values were 46 mL, 25 mL, and 31 mL (p=0.043). VUAS recurrence was recorded in 19 pts (45.23%), 12 (60%) in the 1st group, 4 (33.33%) and 3 (37.5%) in the 2nd and 3rd cohort, respectively (p=0.031). Mean time to recurrence was significantly longer in the 2nd and 3rd group when compared to the 1st group, with no difference between PBV and laser treatments. Statistically significantly better results of Qmax at 6 and 12 months were recorded in the PBV and laser cohort (P < 0.001) when compared to cold knife incision.

Conclusion: Laser treatment and PBV technique provide good short- and long-term outcomes in the treatment of anastomotic stenosis after radical prostatectomy. Cold knife incision remains a viable option but with a higher long-term recurrence rate.

Figure:1 Cold knife incision of vesico-urethral anastomotic stricture
CONVERSION OF XENON LIGHT SOURCE FOR BLUE LIGHT CYSTOSCOPY IN THE DIAGNOSIS OF BLADDER CANCER


FACERES - Faculty of Medicine*, São José do Rio Preto, Brazil
Institute of Urology - Santa Virginia Hospital, São Paulo, Brazil.

**Introduction:** Bladder carcinoma is the common malignancy of the urinary tract. It is thought that photodynamic diagnosis, by the use of a photosensitizing drug and Blue Light Cystoscopy (BLC), can improve the detection and increase the cure of disease. It was achieved with development of the fiber optic applications, like high-end endoscopy, light sources with high luminance. Currently, short arc discharge lamps are being used. However, more and more LED solutions are trying to compete, but they cannot yet reach the performance obtainable by 300 Watts Xenon short arc discharge lamps. On the basis of this idea, a blue light source has been developed to match the performance of a state of the art 300 Watts Xenon Lamp System.

**Methods:** A light source Smith Nephew 300XL® was used to convert white light to blue light emission. A low cost light filter was used to converts the Xenon White Light Source into blue light and keeping the power of Xenon 300 W. The efficacy of the method was tested in patients with bladder cancer using hexaminolevulinate (Hexvix®) photosensitizing drug, compared to White Light Cystoscopy (WLC) and the light source changed to BLC. The images were analyzed by urologists with extensive experience in bladder cancer who evaluated whether there was an improvement and clarity in the diagnosis of affected sites by bladder tumor.

**Results:** Capture images of BLC showed up greater clarity and facility of being displayed in the affected areas by bladder cancer, because can identify the photosensitized area highlighted by the coloring a longer focal length when using the BLC method.

**Conclusions:** In this study was demonstrated to be possible, with low cost, adapt a Xenon Light Source to BLC method, keeping the luminous efficiency of the Xenon Light Source with the features of the Blue Light LED Source, thus facilitating the diagnosis of bladder tumors.
ABSTRACT 17

NEW GENERATION SINGLE-PORT ROBOTIC PLATFORM: FEASIBILITY ASSESSMENT IN A CADAVERIC MODEL

Daniel Ramirez, Matthew J. Maurice, Peter A. Caputo, Ryan J. Nelson, Jihad H. Kaouk
Cleveland Clinic Glickman Urological and Kidney Institute

Introduction: Robotic laparo-endoscopic single-site surgery (RLESS) has evolved over the last decade, and only recently has a purpose-built robotic platform been developed. We previously published our experience assessing the efficacy and safety using the 1st generation SP999 da Vinci SP platform (Intuitive Surgical, Sunnyvale, CA)[ PMID:25041850]. Since that time, a next-generation model has been developed. We sought to assess the feasibility of using this 3rd generation, single-port robotic platform in performing extraperitoneal abdominal and pelvic surgery in cadaveric model.

Methods: We utilized the next-generation SP1098 da Vinci SP robotic platform in performing retroperitoneal radical nephrectomy and perineal prostatectomy. The improvements in the next-generation device include enhanced unit arm control and better optics. Access was obtained using a novel, single-port robotic trocar with a diameter of 25 mm. This port accommodates an articulating camera and 3 double-jointed instruments 6 mm in diameter. An additional 12 mm assistant port was utilized in both cases for suction and introduction of suture. For the retroperitoneal radical nephrectomy, the single-port trocar was placed 2 cm inferior and posterior to the tip of the 12th rib. For the perineal radical prostatectomy a 2.5 cm semilunar incision overlying the perineal body was made to accommodate the single-port trocar.

Results: Operative time for the perineal radical prostatectomy was 180 minutes and 100 minutes for the retroperitoneal radical nephrectomy. Both procedures were performed successfully with no intraoperative complications or need for conversion to conventional techniques. Use of the SP1098 single-port robotic platform was feasible for retroperitoneal and perineal approaches in performing radical nephrectomy and radical prostatectomy, respectively.

Conclusion: We demonstrate that use of the next-generation SP1098 da Vinci SP robotic platform may be used in performing extra-peritoneal renal and prostatic surgery. Its application will continue to evolve among various surgical fields. Further clinical studies are needed to define the role of this technology when it becomes commercially available.
A NOVEL ANTIFOULING COATING THAT REPELS PROTEINS AND BACTERIA FROM THE SURFACE OF IN DwELLING URINARY DEVICE MATERIALS

Kai Yu1, Joey Lo2, Yan Mei1, Dirk Lange2, Jayachandran Kizhakkedathu1.

1Dept. of Pathology and Lab Medicine & Centre for Blood Research; 2Dept. of Urologic Sciences; University of British Columbia, Vancouver, BC, Canada

Introduction: Nosocomial (hospital-acquired) infections account for the 4th largest cause of death in the western world. Catheter-associated urinary tract infections (CAUTIs) account for a majority of these and are a significant burden on the health care system. Current methods used to provide marginal relief from CAUTI still rely on the use of antibiotics, however given the significant rise in antibiotic resistance among bacteria, their continued use is limited. Other approaches including silver-based coatings have met with limited success mainly due to their lack of broad spectrum antimicrobial activity, poor in vivo efficacy, modest biocompatibility, limited application to diverse materials and poor stability. In addition, conditioning film deposition provides pedestals for bacterial biofilm formation and renders novel coating or drug eluting technologies ineffective by forming a physical blockade.

Methods: In a typical coating process, substrate was placed in a buffer solution containing dopamine and ultra-high molecular weight hydrophilic synthetic polymers. The deposited coatings were characterized by ellipsometry, attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR), X-Ray photoelectron spectroscopy (XPS), static water contact angle measurements and atomic force microscopy (AFM). The formation of binary complexes was characterized using ultraviolet-visible spectroscopy (UV/Vis), dynamic light scattering (DLS) and transmission electron microscopy (TEM). The protein interaction and complement activation on surface were determined by fluorescent microscopy analysis. The platelet adhesion on the surface was determined using scanning electron microscopy (SEM). The bacterial adhesion (S. aureus and E. coli) on different coatings was determined by colony counting assay, Live/Dead bacterial viability assay and SEM. A novel in vivo mouse model of CAUTI was employed to evaluate the efficacy of the optimal coating.

Results: We developed a binary universal anti-adhesion coating on catheter materials by the co-assembly of PDA with a library of hydrophilic polymers with varying MWs. Using various in vitro biological assays, we identified a stable coating from this library composed of ultra-high MW PDMA and PDA. The optimized coating showed: (a) Exceptional in vitro anti-biofilm properties against both gram-negative and gram-positive bacteria (>99.3%) compared to pristine polypropylene (PP) film; (b) Excellent biocompatibility as demonstrated by reduction in protein adsorption (>95%), complement binding and platelet adhesion (>95%) compared to PP films; (c) Universality of the approach and stability of the binary coating as demonstrated by the formation coating on diverse materials; and (d) Exceptional in vivo anti-biofilm properties using a mouse model of CAUTI, dramatically reducing (99.7%) adherent bacteria and biofilm formation on the catheter surface compared to uncoated catheters when challenged with 10^8 CFU/mL bacteria over 7 days (Fig. 1A-C).

Conclusion: The described dopamine-assisted modification represents a simple and universal method for the development of a novel indwelling urinary device that repels proteins and bacteria in the urinary environment. Given the ease with which it is applied to varying materials, this coating has significant potential to decrease medical device-associated infections.
ABSTRACT 19

NOVEL ANTIMICROBIAL PEPTIDE-BASED COATINGS TO PREVENT INDWELLING URINARY DEVICE-ASSOCIATED URINARY TRACT INFECTIONS

Kai Yu1, Joey Lo2, Yan Mei1, Evan Haney3, Robert Hancock3, Dirk Lange2, Jayachandran Kizhakkedathu1.

1Dept. of Pathology and Lab Medicine & Centre for Blood Research; 2Dept. of Urologic Sciences; 3Dept. of Microbiology and Immunology; University of British Columbia, Vancouver, BC, Canada

Introduction: Catheter-associated urinary tract infection (CAUTI) is one of the leading causes for nosocomial infections resulting in significant patient morbidity and mortality worldwide. The scope of the problem is evidenced by the fact that 100% of urinary catheters indwelling for >7 days have a biofilm, significantly raising the potential for subsequent serious infection. Several attempts to change catheter biomaterial design to prevent CAUTI have failed, mostly due to the rise in antibiotic resistance, absence of broad spectrum antimicrobial activity, poor in vivo efficacy and modest biocompatibility, as well as the deposition of urinary components on the device surface facilitating bacterial biofilm formation and rendering novel antimicrobial technologies ineffective. Here we present the development of a novel antimicrobial peptide based coating that works away from the device surface and effectively prevents bacterial adhesion and biofilm formation on catheter material both in vitro and in vivo.

Methods: Polymer brushes containing, DMA:N,N-dimethylacrylamide, MPC:2-methacroyloxyethyl phosphorylcholine, MPDSAH:[3-(methacryloylamido)propyl]dimethyl(3-sulfopropyl)ammonium hydroxide), APMA: N-(3-Aminopropyl)methacrylamide, P(DMA-co-APMA), P(MPC-co-APMA) and P(MPDSAH-co-APMA), were attached to varying materials by surface initiated atom transfer radical polymerization. Two cathelicidin-derived peptides, E6 (RRWRIVVIRVRRC) or Tet20 (KRWRIRVRVIRKC), were conjugated to the brushes to construct different combinations of AMPs tethered polymer brush coatings. The effectiveness of the different polymer:peptide combinations was tested in vitro against Gram-positive (S. aureus) and Gram-negative bacteria (E. coli and P. aeruginosa) using CFU counts and fluorescence microscopy. The in vivo efficacy was tested over a 7-day period in a novel murine model of CAUTI using ultrasound guided introduction of peptide coated and uncoated catheter pieces into the bladder, followed by infection using the highly resistant P. aeruginosa.

Results: Successful grafting of polymer brushes onto the surfaces and conjugation of peptides were confirmed by FTIR spectra. In vitro testing of the antimicrobial activity of the different polymer:peptide combinations showed that E6 and Tet20 were more effective on PDMA brushes against E. coli, P. aeruginosa, and S. aureus in compared to PMPC or PMPDSAH brushes at similar AMP concentrations when tethered to various surfaces. Studying the interaction of peptides with biomembranes revealed that the mechanism of killing involves changes in the peptide secondary structure, consistent with their disruption of bacterial membranes. Subsequent testing of peptide coated catheter materials in a novel in vivo model of CAUTI showed a 99.9% decrease in both bacterial adhesion to the indwelling device surface (Fig.1A) and a 99.9% decrease in planktonic bacteria (Fig.1B&C).

Conclusion: The use of polymer brushes to tether antimicrobial peptides to indwelling urinary device materials results in a novel coating that acts away from the device surface and is highly effective at decreasing bacterial adhesion, biofilm formation and overall infection in vivo. This coating has the potential to significantly decrease the incidence of indwelling device associated infection in urology.
ABSTRACT 20

THE EFFECT OF INHALED CARBON DIOXIDE ON KIDNEY STONE DETECTION WITH ULTRASOUND

Julianna C. Simon\(^1\), Yak-Nam Wang\(^1\), Bryan W. Cunitz\(^1\), Jeffrey Thiel\(^1\), Frank Starr\(^1\), Ziyue Liu\(^2\), Michael R. Bailey\(^1\), Mathew D. Sorensen\(^3\)

\(^1\) Ctr. for Industrial and Medical Ultrasound, Applied Physics Lab., Univ. of Washington, Seattle, WA
\(^2\) Dept. of Biostatistics, Indiana Univ. Schools of Public Health and Medicine, Indianapolis, IN
\(^3\) Dept. of Urology, Dept. of Veteran Affairs Med. Ctr., Seattle, WA

Introduction: Dehydration, stasis, and bone demineralization put astronauts at an increased risk of forming kidney stones in space, and current ground technologies, such as computerized tomography are unsuitable for flight. The color-Doppler ultrasound “twinkling artifact”, which highlights kidney stones with rapidly changing color, can make kidney stones readily detectable with ultrasound; however our bench top results indicate twinkling is caused by tiny gas cavities on the stone which we postulate could be affected by the elevated levels of carbon dioxide (CO\(_2\)) found on the International Space Station.

Methods: Four pigs were implanted with \textit{ex vivo} human kidney stones via retrograde ureteroscopy. The implanted stones were imaged with a flexible ultrasound system while the anesthetic carrier gas was oscillated between oxygen (O\(_2\)) and air containing 0.8% CO\(_2\). Twinkling was monitored qualitatively during the study, and data were post-processed for quantification of twinkle power (magnitude of the Doppler ultrasound signal). Blood and urine samples were taken throughout the study for analysis.

Results: Upon exposing pigs to 0.8% CO\(_2\), twinkling was significantly reduced or eliminated in 9-25 minutes (Fig. 1 (left)). When the carrier gas was returned to O\(_2\), twinkling was restored. These trends repeated when pigs were again exposed to the increased CO\(_2\) followed by O\(_2\) (Fig. 1 (right)). Compared to the end of the first CO\(_2\) exposure, twinkling was significantly reduced from the initial twinkling on O\(_2\) \((p=0.017)\) and twinkling had significantly increased by the end of the first return to O\(_2\) \((p=0.009)\). The changes in twinkling tracked well with the changes in blood oxygenation levels.

Conclusion: These results continue to support the crevice bubble hypothesis of twinkling. The significant reduction or elimination of twinkling from exposure to 0.8% CO\(_2\) has significant implications for using the ultrasound twinkling artifact to detect kidney stones in the current spaceflight environment.

Work supported by the National Space Biomedical Research Institute through NASA NCC 9-58 and NIH NIDDK grants DK043881 and DK092197; this material is the result of work supported by resources from the VA Puget Sound Health Care System, Seattle, WA.
EVALUATING THE IMAGE QUALITY OF A NOVEL SINGLE-USE DIGITAL FLEXIBLE URETEROSCOPE


Purpose: To compare image quality between a novel single-use digital flexible ureteroscope and commonly used fiber optic and digital flexible ureteroscopes.

Methods: Flexible ureteroscopy using saline irrigation was performed on 3 ex-vivo porcine kidneys and images of 2 to 3 renal papilla per kidney were obtained using a MediCapture Device. A novel single-use digital flexible ureteroscope (LithoVue™ Single-use Digital Flexible Ureteroscope, Boston Scientific Corporation, Marlborough, MA, not yet commercially available) was compared with the following commonly used flexible ureteroscopes: Storz Flex-X2, Storz Flex-Xc, Olympus URF-P5, Olympus URF-P6, Olympus URF-V2, Wolf Cobra, and Wolf Boa. Image quality was rated by 13 endourologists on a scale of 1 to 5 (1=poor, 2=below average, 3=average, 4=above average, 5=excellent). All endourologists were blinded to the model of the ureteroscope used to acquire each image, and all images were cropped to a uniform circular shape.

Results: The demographics of the 13 endourologists who participated in the study were as follows: mean age 46.9 (SD 9.5), mean years in practice 14.5 (SD 10.2), mean # flexible ureteroscopies per year 235 (SD 83). LithoVue (mean image quality = 4.59, SD = 0.6) demonstrated superior image quality to the Storz Flex-X2 (mean image quality = 1.87, SD = 0.8), Storz Flex-Xc (mean image quality 4.25, SD 0.8), Olympus URF-P5 (mean image quality 1.69, SD 0.8), Olympus URF-P6 (mean image quality 3.08, SD 1.0), Olympus URF-V2 (mean image quality 3.51, SD 1.0), and Wolf Cobra (mean image quality 1.92, SD 0.8; p-value ≤ 0.001 for all comparisons). LithoVue FlexScope demonstrated similar image quality to the Wolf Boa (mean image quality 4.53, SD 0.7, p = 0.6).

<table>
<thead>
<tr>
<th>Ureteroscope</th>
<th>Scope Type</th>
<th>Mean Image Quality</th>
<th>Standard Deviation (SD)</th>
<th>p-value versus LithoVue</th>
</tr>
</thead>
<tbody>
<tr>
<td>LithoVue</td>
<td>Digital</td>
<td>4.59</td>
<td>0.6</td>
<td>N/A</td>
</tr>
<tr>
<td>Storz Flex-X2</td>
<td>Fiber Optic</td>
<td>1.87</td>
<td>0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Storz Flex-Xc</td>
<td>Digital</td>
<td>4.25</td>
<td>0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Olympus URF-P5</td>
<td>Fiber Optic</td>
<td>1.69</td>
<td>0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Olympus URF-P6</td>
<td>Digital</td>
<td>3.08</td>
<td>1.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Olympus URF-V2</td>
<td>Digital</td>
<td>3.51</td>
<td>1.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Wolf Cobra</td>
<td>Fiber Optic</td>
<td>1.92</td>
<td>0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Wolf Boa</td>
<td>Digital</td>
<td>4.53</td>
<td>0.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Conclusions: In this blinded study by experienced endourologists, the Boston Scientific LithoVue, demonstrated statistically significant superior image quality to most commonly used digital and fiber optic scopes and similar image quality to the Wolf Boa.
ABSTRACT 22

INCREASED CONTRAST OF STONE SPECIFIC ULTRASOUND IMAGING IN HUMAN SUBJECTS

Bryan W. Cunitz MS,1 Barbrina Dunmire MS,1 Yasser Haider MD,1 Julianna Simon,1 PhD, Oleg Sapozhnikov, DSc,1,2 Michael R Bailey PhD,1,3 Jeff Thiel,4 Adam D. Maxwell, PhD, Philip C. May, MD,3 Mathew D. Sorensen MD MS,5 and Jonathan D. Harper MD3

1Center for Industrial and Medical Ultrasound, Applied Physics Laboratory, University of Washington, 2Dept. of Acoustics, Physics Faculty, Moscow State Univ., Leninskie Gory, Moscow 119991, Russia 3Department of Urology and 4Department of Radiology, University of Washington School of Medicine, 5Div. of Urology, Dept. of Veteran Affairs Medical Center, Seattle, WA 98108

Introduction: For patients presenting with an acute stone episode the AUA guidelines report ultrasound (US) has a low sensitivity of 61%. In particular, it is difficult to distinguish a bright stone from other bright structures in a standard US B-mode (gray scale) image. The twinkling artifact is the appearance of a mosaic of color in a Doppler ultrasound image in the region of a stone due to the presence of tiny bubbles on the stone surface. We are working to optimize the transmit and receive processing to make a stone specific imaging mode, S-mode, from a combination of enhanced gray scale and Doppler imaging. The goal of this paper is to compare B-mode and S-mode data collected from human subjects, specifically the contrast of the signal associated with a kidney stone, to the signal associated with surrounding kidney tissue.

Methods: Thirty-nine data sets from 14 subjects containing both stone B-mode and twinkling data were collected using a Philips HDI C5-2 imaging probe and Verasonics research ultrasound system. S-mode allows for imaging kidney stones over the entire image unrestricted by a Doppler imaging box. In S-mode, a refined and filtered color map is overlaid on B-mode, and the brightest objects in both maps are displayed. This is different from a color Doppler display where color is added to dark areas in the B-mode. For both B-mode and S-mode raw data, we calculate a signal-to-noise ratio (SNR) of the magnitude (brightness) of the stone signal compared to the second highest magnitude in the image.

Results: Average size stone with twinkling 6.1 ± 3.5. The mean and standard deviation of the SNR was 1.5 ± 0.3 for B-mode and 15 ± 21 for S-mode, with 1 being the stone is equally bright as, and difficult to distinguish from, background. The SNR for S-mode was never less than 1, i.e., in S-mode, the stone signal was always greater than background. In S-mode, 72% of the stones and 0% of false positives had an SNR greater than 3.5.

Conclusion: We have developed S-mode to improve the sensitivity and specificity of ultrasound in detecting kidney stones. In this human study the stones appeared over 15 times brighter than background and with over 10 times the contrast to background seen in B-mode.

Figure: 2D ultrasound image (12 cm depth) showing the B-mode (left) and S-mode (right).

Acknowledgement: This work was supported by NIH NIDDK grants DK043881 and DK092197, and the National Space Biomedical Research Institute through NASA NCC 9-58. This material is also the result of work supported by resources from the VA Puget Sound Health Care System, Seattle, Washington.
ABSTRACTS

ABSTRACT 23

OPTIMIZING DAMAGE ESTIMATION FOR PROSTATE THERMAL THERAPY

Alan Priester1, Rory Geoghegan1, Layne Haber1, James Garritano2, John Lipiz3, Daniel Margolis4, Steven Raman4, Warren Grundfest1, Leonard Marks5, Shyam Natarajan1,5

1 University of California Los Angeles, Department of Bioengineering
2 Yale School of Medicine
3 Case Western Reserve University, School of Medicine
4 David Geffen School of Medicine, Department of Radiological Sciences
5 David Geffen School of Medicine, Department of Urology

Introduction: The Arrhenius equation has been proposed as a means of estimating prostate tissue damage during thermal therapy. However, Arrhenius coefficients published for prostate cell death are highly dissimilar ($E_a$ 160 to 625 kJ/mol, $A$ 10$^{22}$ to 10$^{98}$), and they were determined solely via simulations, ex vivo human tissue, and animal studies. To find the optimal values in living human tissue, we evaluated MR data from men undergoing focal laser ablation (FLA) of prostate cancer.

Methods: 8 patients with biopsy-confirmed prostate cancer received FLA as part of an IRB-approved Phase I trial. For each case, the MR thermometry images (Fig A) were co-registered, interpolated, and merged into 4D datasets. Using the best available data from 5 prior publications (Fig D), the Arrhenius damage integral was applied to each voxel to produce a damage estimate. During post-procedure contrast-enhanced MRI (Fig B), thermal damage was evidenced by non-perfused tissue (NPT), which was contoured and registered to the damage estimate (Fig C). Lastly, the optimal Arrhenius coefficients were calculated in order to minimize volume error between the damage estimate and NPT.

Results: The mean NPT volume was 3.98 CCs. The coefficients employed by Jacques et al. were most accurate, with 0.55 CC mean volumetric error. When optimized, the best possible Arrhenius coefficients had a mean error of 0.50 CC ($E_a$ 175 kJ/mol, $A$ 2.59x10$^{25}$). Using a Wilcoxon signed-rank test, the accuracy of Jacques et al. and Skinner et al. was not significantly different from the coefficients optimized to our dataset. Both had statistically lower error (p < 0.05) than the other published values.

Conclusion: Many coefficients proposed for Arrhenius estimation of prostate cell death are not accurate when applied to a clinical dataset, including one (Stafford et al.) that is used in a commercial system (Visualase). However, the coefficients used by Jacques et al. are nearly optimal, and can be used to predict prostate tissue damage with mean volumetric error <15%. Future FLA trials could use this technique to estimate tissue damage in real time, providing vital feedback to monitor treatment progress.

![Fig A (left), MRI thermometry during treatment; Fig B (middle-left), DCE MRI with contoured non-perfused tissue (green); Fig C (middle-right), non-perfused tissue model (green) registered to Arrhenius damage estimate (red); Fig D (right), mean error of damage volume estimated using Arrhenius values from 5 publications, and using coefficients optimized to our dataset.](image-url)
INITIAL RESULTS OF PHASE I TRIAL OF OFFICE-BASED FOCAL LASER ABLATION

Shyam Natarajan¹,³, Alan Priester¹, Rory Geoghegan¹, Patricia Lieu², Maria Luz Macairan², Daniel Margolis³, Warren Grundfest¹, Allan Pantuck², Leonard Marks²

¹ University of California Los Angeles, Department of Bioengineering
² David Geffen School of Medicine, Department of Urology
³ David Geffen School of Medicine, Department of Radiological Sciences

Introduction: Focal laser ablation (FLA) has been used to safely treat prostate cancer (CaP) under real-time MRI guidance but is cumbersome, lengthy, resource-intensive, and a radiological procedure. We used an extensive targeted biopsy experience to provide the basis for performing FLA in a urology clinic under MRI/US fusion guidance.

Methods: Working under an Investigational Device Exemption (IDE) from the U.S. FDA, a clinical trial housed in the UCLA Urology Clinic was opened in October 2015 (NCT02357121). Patients enrolled in the study were men with biopsy-confirmed intermediate risk (Gleason 3+4) CaP in a single MR-visible lesion. FLA was performed transrectally under MRI/US fusion guidance (Artemis) using a 980-nm, 15 W water-cooled laser (Visualase). A peri-prostatic block was supplemented by intravenous midazolam. Custom software was created to monitor treatment temperatures in real-time using four interstitial thermal probes. At least one probe was placed adjacent to the rectal wall to assess safety, and one was placed parallel to the laser fiber to monitor the temperature at laser tip. Multi-parametric MRI, including dynamic contrast enhancement (DCE) was performed following treatment.

Results: FLA was successfully performed in ten of eleven patients without incident or serious adverse events. In one patient, the procedure was aborted prior to treatment due to difficulties in placing the laser fiber. In each patient, two or three laser applications of 3 minutes each were used. Total procedure time, from initial ultrasound scan to probe removal, averaged 93 minutes (71-105 min), and patients were discharged within 4 hours of treatment. Ablation volumes, seen on post-treatment DCE MRI (Figure), were 4.3 cc on average (2.1-6.0 cc). The thermal probe adjacent to the laser tip recorded a temperature exceeding 50 C in every case, and the rectal wall temperature did not exceed 42 C in any patient.

Conclusion: FLA in a urologic clinic setting, under MRI/US fusion guidance, is feasible and was safely performed in ten men. Thermal probe recordings proved reliable and convenient, demonstrating the ability to replace MRI thermometry for FLA. A potential for focal therapy of prostate cancer to remain a urological procedure was demonstrated.
ABSTRACT 25

AUTOMATIC DIAGNOSIS AND MONITORING OF LOWER URINARY TRACT ACTIVITY BY A NOVEL DEVICE IMPLEMENTED ON A SMARTPHONE PLATFORM: IN VITRO PILOT STUDY

Gil Hidas\(^1\), Yuval Hidas\(^1\), Guy Hidas MD\(^2\)

\(^1\) Kesem Health, Melbourne, Australia
\(^2\) Pediatric Urology Hadassah and Hebrew University Medical Center, Jerusalem, Israel

Introduction:
Voiding diary is an important diagnostic tool assisting physicians to better understand the type and severity of Lower Urinary Tract Symptoms (LUTS). Performing a voiding diary is an enormous burden to the patient. In many cases, voiding diaries are inaccurate, incomplete and low in compliance. These can result in a negative experience to the patient and potential misdiagnosis. The iUFlow is a device that placed over the toilet bowl and connects to the patient’s smartphone, enabling automated and continuous capturing and recording of patient’s urinary flow, frequency and volumes at home. The smartphone software is configured for processing sensor(s) signals to determine the total volume voided by the subject as well as total intake, max volume, median leakage, median urgency, first morning urination, night frequency and total night volume. This is done by an arrangement of sensors under a urine container producing acoustics signals that can be recorded, processed and analyzed via the mobile device microphone. Additionally, the iUFlow utilizes a HIPPA complaint cloud service for the storage and retrieval of clinical data.

Methods: An independent 3\(^{rd}\) party company (Mettler Toledo [1]) was asked to test the repeatability and accuracy of the iUFlow device. A calibrated balance was placed under the outlet of the iUFlow, an empty collecting beaker was sat on top of the measuring pan and the balance was tared. Purified water was delivered into the iUFlow device. The water passed through the iUFlow and was collected in the collecting beaker. An attached iPhone displayed the unrounded total volume. This volume was recorded along with the mass indicated on the balance.

Results: Volumes of 49ml, 102ml, 254ml and 514ml were repeated three times. Mean volumes reported of the iUFlow device were 56ml, 114ml, 263ml and 518ml. Mean difference between the mass of water and iUFlow reported volumes was 8.5ml with a standard deviation of ±2.8ml.

Conclusion: The iUFlow device demonstrated strong repeatability and accuracy with clinically insignificant deviation. Further studies should be conducted using urine, as well as clinical studies in order to validate the importance and usability of the iUFlow device in the management of LUTS patients.

![Figure 1: iUFlow (indicated volume) repeatability and accuracy testing](image1)

![Figure 2: iUFlow Fully Automated Voiding Diary Digital Health Solution](image2)
ABSTRACT 26

DETERMINING OPTIMAL EXPOSURE DURATION FOR FOCAL LASER ABLATION

Rory Geoghegan\textsuperscript{1}, Alan Priester\textsuperscript{1}, Patricia Lieu\textsuperscript{2}, Maria Luz Macarian\textsuperscript{2}, Allan Pantuck\textsuperscript{2}, Warren Grundfest\textsuperscript{1}, Leonard S. Marks\textsuperscript{2}, Shyam Natarajan\textsuperscript{1,2}

\textsuperscript{1}University of California Los Angeles, Department of Bioengineering  
\textsuperscript{2}David Geffen School of Medicine, Department of Urology

Introduction: The exposure duration used during focal laser ablation (FLA) of the prostate is an important factor in achieving target ablation while minimizing damage to surrounding structures. Determining the appropriate exposure duration has proven elusive due to difficulty replicating the in vivo environment. The objective of this study is to determine in vivo the exposure duration needed to achieve a 16mm diameter thermal damage zone using a 980nm laser at 13.75W.

Methods: Ten men received FLA under ultrasound guidance in an IRB-approved phase 1 clinical trial. The average number of laser activations per patient was 4.3, all at 13.75W. The procedure was monitored via interstitial thermal probes, one of which was placed at a radial distance of 8mm from the tip of the laser in every case. A damage estimate was calculated using these data in conjunction with the Arrhenius damage integral. The Arrhenius coefficients, $E_a=187$ (kJ/mol) and $A=2.08E+27$ (1/s), determined by Jacques et al (1993), were used.

Results: 7 laser activations produced a damage estimate of at least 63.2% in untreated tissue. This was considered sufficient to induce cellular necrosis throughout the region. Rapid cooling was noted to occur immediately after laser deactivation (Fig. 1). As a result mean damage during laser activation accounted for 93.07% of the total damage. Thus by using a damage threshold of 58.82%, the optimal exposure duration was found for these 7 ablations. The optimal exposure duration was also found for ablations that failed to reach the requisite threshold but produced a damage estimate of at least 35%. For these ablations, a second order polynomial was fit to the data to enable calculation of the optimal exposure duration via extrapolation. Fig. 2 shows the optimized ablation time in each case with a mean of 145.8s and standard deviation of 37s. Significant inter-prostate and intra-prostate variability was also observed.

Conclusion: Optimal exposure duration during FLA has previously been estimated only from simulations, due to the challenge of replicating in vivo conditions. In this study, we use in vivo data to characterize the relationship between laser exposure duration and induced thermal damage in human prostate. The mean optimized ablation time was found to be 145.8s with a standard deviation of 37s. These results may provide insight into appropriate ablation parameters and can be used to further validate simulations. Furthermore, given the variability found between patients, an optimal approach to FLA may require patient-specific treatment planning or real-time estimation of damage accumulation.

---

**Fig. 1:** Interstitial probe temperature vs time for patient B

**Fig. 2:** Optimal laser ablation duration for selected patients
ABSTRACT 27

REDUCTION IN KIDNEY INJURY DURING SWL USING ACOUSTIC BUBBLE COALESCEENCE

Steven P Allen¹, Hedieh Tamaddoni¹, William W Roberts¹,², Timothy L Hall¹
¹ Biomedical Engineering, University of Michigan, Ann Arbor, MI, USA.
² Urology, University of Michigan, Ann Arbor, MI, USA.

Introduction: Coalescence of remnant bubble nuclei using long duration low amplitude acoustic pulses has been shown to significantly enhance stone fragmentation during shock wave lithotripsy (SWL) in vitro [PMC3880900]. Remnant bubbles distributed along the acoustic propagation path can block subsequent shockwaves, reducing stone comminution. We hypothesize that these bubbles could also act as sites of cavitation activity. Subsequent shocks could excite these bubbles and inflict injury to the kidney. In this study we investigate whether coalescing remnant bubbles can reduce the volume of hemorrhage and hematoma introduced by SWL.

Methods: The lower pole of the right kidney in ten, 45-50 kg anesthetized porcine subjects was treated with 2500 shockwaves using a laboratory electro-hydraulic lithotripter at 2 Hz. For five subjects, the shockwaves were interleaved with bubble consolidation acoustic sequences of 16 millisecond duration produced at an amplitude of 1 MPa and at a frequency of 500 kHz by a ring of eight supplemental transducers mounted around the lithotripter reflector. The other five subjects were subjected to an identical sequence with the bubble consolidation sequence turned off. After treatment, the kidneys were harvested, sliced in half and the collecting system was surgically removed. The kidneys were then fixed in 10% buffered formalin for 2 weeks and imaged using a 7T MRI system using a spin-echo, multi-echo sequence with the imaging parameters tuned to maximize image contrast between hemorrhage and the kidney parenchyma. MR acquisition parameters are TR/TE: 5s, 15,30,60 ms; spectral width: 50 kHz; field of view: 14 x 10 cm; matrix size: 140 x 100 x 40; resolution: 1 mm isotropic.

Hemorrhage and hematoma induced during treatment appeared as dark pixels on the T2-weighted, MR scans. An image segmentation algorithm was able to separate hemorrhage from nominal parenchyma. The volume of hemorrhage was computed by summing the number of image pixels in a sample that had been identified as hemorrhage and then multiplying by the volume represented by an image pixel.

Results: Figure 1 displays an example MR image of a kidney slice. Hemorrhage and hematoma appeared dark compared to the kidney parenchyma, allowing straightforward image segmentation. The mean and standard deviation of the estimated total volume of hemorrhage for kidneys subjected to the control treatment were 3.6±1.9 cm³. For the treatment with bubble consolidation, they were 1.8±2.0 cm³.

Conclusion: The bubble consolidation sequence resulted, on average, in less hemorrhage and hematoma in the kidney parenchyma. We conclude that use of bubble consolidation has the potential to reduce kidney injury during SWL.

Figure 1: Example MR image slice of a kidney treated with SWL. Hemorrhage causes a readily apparent loss in image signal (right half of image).
THE SINGLE USE DIGITAL FLEXIBLE URETEROSCOPE: A NEW PARADIGM?

Brian R. Matlaga, Wilson Molina, Brian H. Eisner
Johns Hopkins University, Urology Department

Introduction: Flexible ureteroscopy is the most rapidly growing intervention for patients requiring treatment of upper urinary tract calculi. One of the greatest limitations to a more widespread adoption of this modality is the fragility and finite lifespan of present-day, reusable flexible ureteroscopes. To date, disposable flexible ureteroscopes have not offered performance characteristics and image quality comparable to reusable flexible ureteroscopes, which has limited their utility. We performed an evaluation of a novel, disposable, digital flexible ureteroscope in a porcine model, and compared it to a conventional fiber-optic flexible ureteroscope.

Methods: The Boston Scientific LithoVue disposable, digital flexible ureteroscope and the Olympus URF-P5 were both assessed in a porcine model by three experienced endourologists. Once the pigs were adequately anesthetized, flexible ureteroscopy was performed with an access sheath, without an access sheath, and finally a laser papillotomy was executed. The two ureteroscopes were assessed for their ability to navigate the upper urinary tract as well as their optical characteristics.

Results: Three renal units were inspected with each ureteroscope. No significant differences were noted in the ability to advance and manipulate the two ureteroscopes within the upper urinary tract. The image quality of the LithoVue was rated as superior to that of the Olympus URF-P5. Figures 1 and 2 are representative images captured by the LithoVue.

Conclusions: The disposable LithoVue ureteroscope exhibited comparable performance characteristics and superior image quality to that of a reusable fiber-optic ureteroscope.
ABSTRACT 29

THE APPLICATION OF AN INNOVATIVE SURFACE ELECTRODE SYSTEM IN EXTERNAL URETHRAL SPHINCTER ELECTROMYOGRAPHY TESTING IN RATS

X. Yuan 1,2,5, B.W. Hanzlicek 2, D. Lin 2, S.J.A. Majerus 3, M. S. Damaser 1,3,4
1Dept of BME, Lerner Research Institute, Cleveland, OH 44106
2Research Service, L. Stokes Cleveland VAMC, Cleveland, OH 44106
3APT Center, L. Stokes Cleveland VAMC, Cleveland, OH 44106
4Glickman Uro. And Kidney Inst., Cleveland Clinic Foundation, Cleveland, OH 44106
5Dept of Urology, Tongji Hospital, Huazhong Univ. of Sci. and Tech., Wuhan, China 430030

Introduction: Surface electrodes have been widely used in external urethral sphincter (EUS) electromyography (EMG) recordings of rat urodynamic studies for many years. However, when performing leak point pressure (LPP) testing at the same time as EMG recordings, conventional rigid mounted surface electrodes can easily disconnect or place too much pressure on the surface of the EUS, since pressing on the bladder to perform LPPs can cause the urethra to move slightly and lose contact with the electrode. Firmly pressing the electrode into the EUS can help ameliorate the situation but this can damage the tissue or cause obstruction of the urethra. These issues can lead to lower quality EMG and LPP results and/or longer recording times. In this study, we have developed and tested an innovative surface electrode system which remains in contact with same spot of the EUS at all the times during EMG recording and is able to move with the urethra as it shifts position during LPP testing.

Methods: The new electrode system consists of three main parts: (1) a small, weak compression spring (k factor: 0.0066) made of fine stainless steel wire (A-M Systems, Inc. Cat No.791600) to maintain constant, but gentle, contact with the EUS. (2) A custom-shaped electrode holder (inner maximum angle of inclination: 30°), which allows the electrode rotational movement but not translational movement. To ensure the exact size and shape of the holder, we made it using a 3D printer (Project 3510) with 3D design software (SolidWorks). (3) Extension wires from the electrode to the amplifier made of soft, fine, coated stainless steel wires (A-M Systems, Inc. Cat No.793400) that reduces the weight of the electrode. These wires were attached directly to the electrode without connectors (Fig.1). We then performed EUS EMG with LPP recordings in rats using both the conventional and new electrodes.

Result: Three rats were tested using both conventional and new electrodes sequentially. No significant difference was found in EMG amplitude or frequency between the electrodes. However, through the whole recording period, the new electrode maintained contact with the EUS while the conventional electrode disconnected multiple times (Fig.2).

Conclusion: The EUS EMG amplitude and firing rate of new and old electrodes are comparable. The new electrode system is easy to set up and makes more consistent contact with the EUS during EMG recordings, without placing excess pressure on the urethra, leading to more consistent and usable EMG data.
ABSTRACT 30

SEMI-AUTOMATED ELECTRO-MECHANICAL WOUND-CLOSURE DEVICE

Chad D. Cunningham\textsuperscript{1}, Pierre LLanos\textsuperscript{1}, Kevin C. Craig\textsuperscript{2}, Seth R. Rosenberg\textsuperscript{2}, Louis R. Kavoussi\textsuperscript{3}, Sina Y. Rabbany\textsuperscript{1}

\textsuperscript{1}Bioengineering Program, School of Engineering and Applied Science, Hofstra University
\textsuperscript{2}Mechanical Engineering Program, School of Engineering and Applied Science, Hofstra University
\textsuperscript{3}Smith Institute for Urology, Hofstra Northwell School of Medicine

Introduction: Tissue reapproximation is a fundamental aspect of reconstructive surgery. Currently this is performed in a free-hand manor and is dependent upon the skill of the operating surgeon. As such, variability exists in the process. As a first step in creating an autonomous system for reapproximating tissue, a semi-automated, motorized system has been designed to optimize controlled skin-edge closure.

Methods: A brushed motor is employed to drive a lead screw to bring the arms of the reapproximation mechanism (two stainless steel plates attached at one end) together. Disposable shoe end effectors, lined with biocompatible adhesive, are 3-D printed to interface with the skin. The mechanism motor closes the wound, while actively measuring the space created in between the arms with a capacitive sensor to terminate the motor. Once the wound closed it is held in position by automatically applied fasteners.

Results: Preliminary data is collected through LabVIEW, which is used as a control system, while allowing for precise movement of the end effector. This allows fine adjustment to be made during the alignment of the wound and results in a minimal (< 1mm) gap distance between each tissue edge. A capacitive sensor is employed in the arms of the mechanism, allowing a quantitative way to monitor the closure.

Conclusion: Our design offers a consistent and efficacious approach to primary wound closure. This is the first step in developing true fully autonomous reconstructive surgical robots.
ABSTRACTS

PROSTATE MRI PRIOR TO RADICAL PROSTATECTOMY:
EFFECTS ON NERVE SPARING AND PATHOLOGIC MARGIN STATUS

Sasha Druskin¹, Jen-Jane Liu², Allen Young¹, Zhaoyong Feng¹, Seyed Dianat¹, Wesley Ludwig¹, Elizabeth Humphreys¹, Misop Han¹, Katarzyna Macura¹, Bruce Trock¹, Christian Pavlovich¹

¹Johns Hopkins Medical Institutions
²Oregon Health & Science University

Introduction: Multiparametric MRI (mpMRI) is increasingly used for staging prior to radical prostatectomy (RP). It has modest performance in detecting non-focal extracapsular extension (nfECE), which increases the risk of leaving a positive surgical margin (PSM). Thus, MRI may improve surgical planning of the peri-prostatic dissection to optimize oncologic control (namely, minimize PSM) and nerve sparing (NS). To this effect, we assessed PSM and NS rates in patients who underwent mpMRI prior to RP and compared them to matched, non-imaged control RP patients.

Methods: We identified 204 men that received prostate MRI within 60 days of RP at our institution between 2006-2015, and compared them (1:1) to a non-MRI-scanned control group matched by surgeon, age, race, BMI, PSA, pathologic Gleason score, prostate specimen weight and year of RP.

Results: Rates of nfECE on final pathology were similar in the MRI and control groups (23.0% and 22.1%, respectively (p=0.906)). The MRI group trended towards a lower PSM rate (13.7%) than the control group (19.3%; p=0.143). MRI group patients with nfECE on final pathology also trended towards a lower rate of PSM than controls with nfECE (27.7% vs 39.5%; p=0.268), though neither difference was statistically significant. Rates of NS were equivalent between the MRI and control groups (any NS and optimal NS on at least one side had rates of 89.7% and 84.7% vs. 91.5% and 88.1%; p-values both >0.05). In the MRI group, 54 (26.5%) of patients had an MRI showing concern for nfECE; they had a statistically similar though higher rate of PSM than patients with an MRI not showing concern for nfECE (20.4% (of which, 64% were on the same side as the nfECE seen on MRI) vs. 11.3%; p=0.110), but a lower rate of NS. This was the case for any NS and optimal NS on at least one side (79.6% and 70.4% vs. 93.3% and 89.9%; p-values both <0.01). MRI detected nfECE with a sensitivity of 33.9%, specificity of 89.0%, PPV of 35.6% and NPV of 88.2%.

Conclusion: With the added information afforded by MRI, one would expect lower PSM than a matched, oncologically similar, non-imaged comparison group. While that trend was observed, it was not statistically significant, including in the subset of patients with nfECE on final pathology, who we expect would benefit the most from having had an MRI. This suggests that even wider resection is necessary in patients with MRIs suggesting advanced disease. Source of Funding: NIH SPORE grant P50CA58236.
IMAGING OF PROSTATIC CANCER BY NEWLY DEVELOPED LED-BASED WIDEBAND NEAR-INFRARED LIGHT SOURCE INCLUDING THE ABSORPTION BAND OF WATER WITH PSA: FIRST RESULTS

Tokunori Yamamoto¹, Hideki Mizuno¹, Yasuto Funahashi¹, Yoshihisa Mastukawa¹, Yasushi Yoshino¹, Shingo Fuchi² and Momokazu Gotoh¹

¹ University of Nagoya, Department of Urology
² Aoyamagakuin University, Department of Engineering

Introduction: Despite the technical advances in many areas of medical diagnostics, techniques for non-invasive detection and imaging of human prostatic cancer remain inadequate. Here, we newly developed an compact LED-based wideband near-infrared (CLWNI) light source device (JP2011 – 274984) to detect the structure of the prostate.

Methods: We imaged nodular prostatic cancer(NPca) and benign prostatic hyperplasia (NBPH) and peripheral zone of prostate as control in the prostatectomy specimens ex vivo using a newly developed CLWNI light source and the arteries of the fingers by power Doppler. CLWNI images were compared with histological images, preoperative magnetic resonance images (MRI), and contrast-enhanced transrectal ultrasound findings, to identify the corresponding structures.

Results: The CLWNI images clearly revealed the finger arteries in-vivo, corresponding to the power Doppler findings. CLWNI images of the Pca specimens also correlated with the MRI and histological findings. CLWNI imaging provides good image contrast, with the Pca and BPH-to-the normal tissue, for the prostatectomy specimens. The light permeability of the Pca specimens was lower than that of the BPH specimens, while the microvascular density in the Pca specimens was significantly higher than that in the BPH specimens. Additionally, the time to contrast enhanced peak of the Pca was shorter than that of the BPH. Ex-vivo imaging of nodular prostatic cancer with a compact LED-based wideband near-infrared light source including the absorption band of water and PSA.

Conclusion: CLWNI imaging is a new optical imaging technique to visualize Pca in real time, and allows detection of the precise characterization of microvasculature of the nodular Pca. Thus, CLWNI imaging similar to MRI may provide complementary diagnostic information to prostatic biopsy at the bedside.
DIFFERENCES IN SURGICAL OUTCOMES BETWEEN ROBOTIC-ASSISTED LAPAROSCOPIC AND OPEN RADICAL CYSTECTOMY AMONG HIGH-RISK PATIENTS

Andrew Leone1, Pranav Sharma, MD1, Kamran Zargar-Shoshtari, MD1, Michael A Poch, MD1, Julio M Pow-Sang, MD1, Wade J Sexton, MD1, Philippe E Spiess, MD1, Scott M Gilbert, MD, MS1,2

1Department of Genitourinary Oncology, Moffitt Cancer Center, Tampa, FL
2Health Outcomes and Behavior Program, H. Lee Moffitt Cancer Center & Research Institute, Tampa, FL

Introduction: Although many surgeons have extended robotic-assisted surgery to bladder cancer, the benefits of robotic-assisted laparoscopic cystectomy are still not fully defined. Comparative studies between robotic-assisted laparoscopic cystectomy and open radical cystectomy are relatively limited, and few have focused on high risk groups (e.g., advanced stage disease). We sought to evaluate postoperative and pathological outcomes of robotic-assisted laparoscopic and open radical cystectomy, focusing on high-risk patients as an example of one patient group who may or may not benefit from a robotic approach.

Methods: We retrospectively identified patients who underwent robotic assisted laparoscopic cystectomy or open radical cystectomy for bladder cancer at our institution from January 2010 - September 2014. Clinical and demographic factors, postoperative complications and pathological outcomes were compared between surgical approaches. Complications were classified using the Clavien grading system. Pathologic outcomes were abstracted from the cystectomy pathology report. Logistic regression was used to identify predictors of 30-day complications, prolonged length of stay (LOS), and positive soft-tissue surgical margins (STSMs) in high-risk cases.

Results: Sixty-five (13.8%) patients underwent robotic assisted laparoscopic cystectomy and 407 (86.2%) underwent open radical cystectomy. A total of 215 (45.6%) cases were classified as high-risk disease defined by pathologic stage T3/T4 disease. Robotic cystectomy patients were more likely to be male (96.9 vs. 73.2%, p<0.01), have better performance status (ECOG 0 78.5 vs. 59.7%, p=0.03), and less likely to receive neoadjuvant chemotherapy (21.5 vs. 39.3%, p<0.01) compared to patients treated with open cystectomy. Overall (52.3 vs. 59.7%, p=0.26) and high-grade (13.8 vs. 19.7%, p=0.27) complications were similar between groups. Surgical margin rates between robotic and open cystectomy were similar across the cohort. In adjusted models, prior radiation (OR 4.78, 95% CI 2.16-10.57) and advanced tumor stage (OR 3.06, 95% CI 1.56-6.03) were independently associated with positive margins, but robotic surgical approach was not (OR 0.81, 95% CI 0.29-2.30).

Conclusion: Robotic cystectomy had similar short-term post-operative and pathological outcomes compared to open cystectomy in this study. Larger studies with extended follow-up are necessary to better determine the benefit of RARC.
ABSTRACTS

ABSTRACT 35

IN VITRO MICROBIOLOGICAL EVALUATION OF INSUFFLATION FILTER PERFORMANCE

Renai Yoon, Cyrus Khoilar, Austin Drysh, Harwood Garland, Jaime Landman, Ralph Clayman
Department of Urology, University of California, Irvine

Introduction: In an effort to decrease the expense while increasing the accuracy and availability of flexible cystoscopy world-wide, we sought to replace standard sterile fluid irrigant and irrigation tubing (cost of $9.00) with a novel air irrigant system using a bacterial filter and a manual non-disposable, nonsterile squeeze bulb. As a first step in this process, we performed a microbiological evaluation of the filter’s integrity and durability in an in vitro study.

Methods: We constructed an air pump using a sterile Prime Flo insufflation tube with filter (Cardinal Health, Placentia, CA) (cost of $6.89). The tubing was cut to a length of 10 cm on either side of the filter and a 40 ml rubber bulb was attached to one end. We then prepared 200 ml of Lennox Luria Broth (LB) (tryptone, NaCl, yeast extract, distilled water) in an Erlenmeyer flask. This solution was autoclaved following standard procedure. After sterilization the supply end of the air pump was inserted into the Erlenmeyer flask containing LB and air was pumped 100, 500 or 1000 times. The solution was placed in a shaker at 37 °C at 220 rpm for 12 hours. Afterwards, a sample of the solution was read three times by a SmartSpec Plus spectrophotometer (Bio-Rad Laboratories, Hercules, CA) to measure absorbance at 600 nm. 300 µl of the grown LB solution was transferred onto LB-Agar plates using sterile technique and incubated at 37 °C for 24 hours. The total number of colony forming units was recorded for each plate after the incubation period. This procedure was repeated a total of ten times for each of the 100, 500 and 1000 pump groups with new, sterile filter and tubing.

Results: All samples obtained for the 100 and 500 pump groups showed OD600 values much lower than 0.1 (Table 1); for the 1000 pump group in one case the OD600 exceeded 0.15. No visible growth was seen in the LB broth or LB-agar plates for the 100 and 500 pump groups. Colony forming units were observed on two LB-agar plates in the 1000 pump group (2 cfu, 8 cfu).

Conclusion: The filter provides for a safe inexpensive alternative compared to standard sterile irrigant and tubing. Air cystoscopy in this manner may provide a less expensive and more globally available alternative to standard bagged sterile irrigant and one time use irrigation tubing.

<table>
<thead>
<tr>
<th>100 Pump</th>
<th>500 Pump</th>
<th>1000 Pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean OD600</td>
<td>Mean cfu/ml</td>
<td>Mean OD600</td>
</tr>
<tr>
<td>.010</td>
<td>(No growth)</td>
<td>.002</td>
</tr>
</tbody>
</table>

Table 1. Spectrophotometer and LB-agar plate growth data.
COMPARATIVE ANALYSIS OF LAPAROSCOPIC FOGGING PREVENTION TECHNIQUES

Austin Drysch, Kenneth Schmitt, Brittany Uribe, Renai Yoon, Zhamshid Okhunov, Christina Hwang, Ralph Clayman, and Jaime Landman

Department of Urology, University of California, Irvine

Introduction: Despite decades of laparoscopic surgery and much technological advancement, laparoscopic lens fogging remains a salient issue in urologic practice. LLF obstructs the surgeon's view, resulting in increased surgery duration and makes dissection more difficult. Herein we evaluated the efficiency and efficacy of two common and commercially available methods to resolve lens fogging: a heated sterile water bath (Fluid Warming System, O.R. Solutions, Chantilly, VA) and the Clearify Visualization System (Covidien, Mansfield, MA).

Methods: Forty patients undergoing a laparoscopic renal procedure were prospectively evaluated for either the fluid warming system (20 cases) or the Clearify (20 cases). We used the Clearify according to company instructions, while the Fluid Warming System was used to heat the laparoscope for a minimum of 30 seconds prior to surgery. For each procedure we documented the etiology of each episode of visual obstruction, procedure type, number of trocars placed, surgery duration and cost analysis. Insufflator type (Airseal System, SurgiQuest, Milford, CT) and insufflator location were held constant.

Results: All forty patients completed the study protocol without incident. The fluid warming system resulted in statistically fewer fogging events (Table 1).

Conclusion: In this pilot study, the Fluid Warming System was found to be superior to the Clearify Visualization System with regards preventing fogging of the laparoscopic view. There was minimal cost difference.

<table>
<thead>
<tr>
<th></th>
<th>Fluid Warming System (n=20)</th>
<th>Clearify Visualization System (n=20)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Fogging Events per Hour</td>
<td>0.700</td>
<td>1.41</td>
<td>0.045</td>
</tr>
<tr>
<td>Mean Surgery Time (hr:min)</td>
<td>1:42</td>
<td>1:45</td>
<td>0.593</td>
</tr>
<tr>
<td>Cost/Procedure</td>
<td>$36.50*</td>
<td>$41.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Fogging events, surgery time, cost; *Omits one-time purchase of Fluid Warming System
ABSTRACT 37

ABSTRACTS

COST COMPARISONS BETWEEN DIFFERENT TECHNIQUES OF PERCUTANEOUS RENAL BIOPSY FOR SMALL RENAL CORTICAL NEOPLASMS

Rahul Dutta¹, Zhamshid Okhunov¹, Simone L. Vernez¹, Ramy Youssef¹, Kari Nelson², Yair Lotan³, Jaime Landman¹
1. Department of Urology, University of California, Irvine
2. Department of Radiology, University of California, Irvine
3. Department of Urology, University of Texas Southwestern

Introduction and Objectives: Advances in cross-sectional imaging have dramatically increased the detection rate of renal cortical neoplasms (RCN). However, imaging is largely unable to distinguish tumor histopathology. The use of percutaneous renal biopsy (PRB) plays an important role in diagnosis of RCN. PRB is most often performed using computed tomography guidance (CTG); however, new techniques have been developed for ultrasound-guided office-based (UGOB) PRB, and ultrasound-guided hospital based (UGHB) biopsy. Herein we analyze the costs associated with different techniques in PRB.

Methods: PRB for RCN procedures between May 2012 and June 2015 were retrospectively analyzed. Patient demographics and tumor characteristics were compared. All patients were seen in the urology office prior to biopsy; selected anatomically favorable (exophytic, posteriorly located) were chosen for UGOB biopsy, while others were referred to interventional radiology for CTG or UGHB biopsy. Costs were also

Results: We used a total of 19 UGHB, 31 CTG, and 28 UGOB biopsies in our analysis. There were no differences between age at diagnosis (p=0.131). Mean tumor size was 3.8, 3.4, and 3.9 for the UGHB, CTG, and UGOB groups, respectively (p=0.603). Mean RENAL Nephrometry score was highest in UGHB (7.3) compared to CTG (7.1) and UGOB (6.0) (p=0.008). There were no differences in diagnostic rates among UGHB, CTG, and UGOB biopsy (79%, 84%, and 79%, respectively) (p=0.852). Only 2 minor complications (Clavien I-II), both in the CTG group, were observed. The average total cost for UGOB ($2,129) was lower than that of UGHB ($4,598) and CTG ($4,470) (p<0.0001).

Conclusions: There remains a role for all three biopsy strategies. However, ultrasound-guided office-based biopsy is a viable and cheaper alternative for selected exophytic, posteriorly located RCN.

Table 1: Demographics, tumor characteristics, and costs

<table>
<thead>
<tr>
<th></th>
<th>UGHB</th>
<th>CTG</th>
<th>UGOB</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>19</td>
<td>31</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Age at diagnosis (years)</td>
<td>67 (51-83)</td>
<td>65 (35-87)</td>
<td>70 (43-89)</td>
<td>0.131</td>
</tr>
<tr>
<td>Size (cm)</td>
<td>3.8 (1.4-8.9)</td>
<td>3.4 (1.8-5.6)</td>
<td>3.9 (1.8-7.0)</td>
<td>0.603</td>
</tr>
<tr>
<td>Mean RENAL Nephrometry</td>
<td>7.3 (4-11)</td>
<td>7.1 (4-11)</td>
<td>6.0 (4-8)</td>
<td>0.008</td>
</tr>
<tr>
<td>Diagnostic percentage</td>
<td>79%</td>
<td>84%</td>
<td>79%</td>
<td>0.852</td>
</tr>
<tr>
<td>Mean total cost</td>
<td>$4,598</td>
<td>$4,470</td>
<td>$2,129</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>
PILOT STUDY: ASSESSMENT OF BULBAR CONJUNCTIVAL HEMODYNAMICS IN SUBJECTS WITH ERECTILE DYSFUNCTION

Harpreet Wadhwa1, James Hotaling2, Ali Kord Valeshabad3, Nikita Abhayankar1, Mahnaz Shahidi3, Ervin Kočjancič1
1University of Illinois at Chicago – Department of Urology
2University of Utah – Division of Urology
3University of Illinois at Chicago, Department of Ophthalmology

Introduction: Cardiovascular disease is an established risk factor for erectile dysfunction (ED). As shown by prior studies, abnormalities in conjunctival microvascular hemodynamics can signify systemic vascular pathology. We hypothesized that conjunctival blood velocity is altered in subjects with advanced stages of ED and thus changes in conjunctival blood velocity may potentially serve as a surrogate biomarker in identifying severe ED.

Methods: Adult men diagnosed with ED and healthy controls were studied. Subjects with ocular/neurologic pathologies or history of pelvic surgery were excluded. Subjects with ED completed the International Index of Erectile Function (IIEF) questionnaire. All subjects underwent conjunctival microcirculation imaging with the use of the EyeFlow device. Mean arteriole and venule diameter, velocity, and blood flow was calculated in each subject.

Results: A total of 7 healthy control and 10 ED subjects participated in this study. Four subjects had ED severe that required penile prosthesis placement. Results are summarized in Table 1. Mean arteriole diameter, venule velocity and blood flow were higher in ED subjects as compared to controls.

Conclusion: In this pilot study, we found alterations in microvascular caliber and blood flow due to ED. Thus, EyeFlow can potentially identify patients with ED of vascular origin. Our group will study the possibility of stratifying ED by severity and correlate with microvascular alteration in patients.
EFFECTS OF THE COMBINATION OF VASCULAR TARGETED PHOTODYNAMIC THERAPY AND ANTI-CTLA-4 IN A PRE-CLINICAL UROTHELIAL CARCINOMA MODEL

Renato B. Corradi¹, Stephen La Rosa², Sylvia Jebiwott², Katie Murray¹, Barak Rosenzweig¹, Alex Somma², Avigdor Scherz³, Kwanghee Kim², Jonathan A. Coleman¹

¹ Department of Surgery, Division of Urology, Memorial Sloan Kettering Cancer Center, New York, NY
² Department of Surgery, Sloan-Kettering Institute, Memorial Sloan Kettering Cancer Center, New York, NY
³ Department of Plant Sciences, Weizmann Institute of Science, Rehovot, Israel Institution

Urothelial carcinoma (UC) is a common malignancy of the bladder or upper urinary tract which usually presents in non-muscle-invasive form at diagnosis. Yet we lack conservative treatment options for patients for whom bacillus Calmette-Guerin (BCG) immunotherapy has failed or is not indicated. To address this lack, we investigated the effectiveness of combination treatment using vascular targeted photodynamic therapy (VTP) and anti-CTLA-4 immunotherapy in a mouse model of UC. C57BL/6 mice injected with murine bladder 49 (MB-49) cell line were allocated into 4 treatment groups: VTP only, anti-CTLA-4 only, combination therapy, and control. We monitored tumor growth and development of lung metastases using bioluminescent imaging. Tumor cell population was studied with flow cytometry, and survival was evaluated with Kaplan-Meier curves. The combination treatment group had significantly lower tumor signal than the other three groups (p<0.0001), as well as decreased lung signal uptake compared to the control (p<0.0001), VTP only (p<0.0001), and anti-CTLA-4 only (p=0.002) groups. Combination therapy provided prolonged survival (p<0.0001). We also rechallenged tumors in previously treated mice and compared tumor growth to that of a group of naïve mice, finding that mice previously treated with VTP only or combination therapy did not present tumor growth after rechallenge. The combination of VTP with anti-CTLA-4 was shown to be an effective therapy in an UC syngeneic mouse model. Our results suggest this therapy as a potential treatment option for both bladder and upper tract tumors in future clinical trials.
ABSTRACT 40

MARGIN ASSESSMENT IN RENAL SURGERY USING A HANDHELD OPTICAL COHERENCE TOMOGRAPHY PROBE

Wesley W. Ludwig¹, Sara E. Wobker¹, Michael A. Gorin¹, Mark W. Ball¹, Adam M. Zysk², Philip M. Pierorazio¹, Mohamad E. Allaf³
¹Johns Hopkins Hospital, Baltimore, MD ²Diagnostic Photonics, Chicago, IL

Introduction: Optical coherence tomography (OCT) uses near-infrared light to visualize cross-sectional tissue morphology with a resolution of < 20 µm. The goal of partial nephrectomy (PN) is to complete tumor excision while maximizing preservation of renal parenchyma. In this study, we assessed margin detection and measurement with a handheld OCT probe suitable for surgical use.

Methods: Following radical nephrectomy, a 9-cm clear cell carcinoma was sectioned into 19 total samples with grossly 0 mm (positive), grossly 1 mm, and grossly 2 mm margins. The margin status of each sample was assessed with a handheld OCT probe employing an interferometric synthetic aperture microscopy algorithm (Diagnostic Photonics). Additionally, prospective assessment of 4 PN specimens was performed to determine margin widths and attenuation coefficients (AC) – a measurement of light scatter that can differentiate between tissue types.

Results: The average OCT margin measurement was 0±0 mm for samples with positive margins (n=8), 1.3±0.9 mm for 1 mm samples (n=6), and 2.4±0.5 mm for 2 mm samples (n=5) (Fig. 1). The difference between OCT measurements from 1- and 2-mm margins was statistically significant (p=.03). The sensitivity and specificity for identifying positive margins were 100%. All 4 clear-cell PN specimens were found to have negative margins by OCT and confirmed on final pathology (Fig. 2). The difference in margin measurement between OCT and pathology was 0.5±0.3mm. AC for carcinoma and renal parenchyma were 4.7±0.3 mm⁻¹ and 3.1±0.3 mm⁻¹, respectively.

Conclusion: A handheld OCT probe can be used to visualize tumor tissue and measure renal surgical margins. With further investigation, OCT may obviate the need for intraoperative frozen section and aid in minimizing parenchymal excision.

Fig 1: Tumor to left of dotted line, margin to right. A) Gross sample with 2 mm margin. B) H & E of same sample. C) OCT en face image of region within box.

Fig 2: A) Contrast-enhanced MRI, with mas circled. B) Gross image of enucleated tumor. C) OCT en face image of region within box, thin margin to left of line.
ABSTRACT 41

ROBOT-ASSISTED FALLOPIAN TUBE TRANSECTION-ANASTOMOSIS USING THE NEW REVO-I ROBOTIC SURGICAL SYSTEM: FEASIBILITY IN A CHRONIC PORCINE STUDY

Ali Abdel Raheem1, Irela Soto Troya1, Dae Keun Kim2, Ibrahim Alabdulaali1, Glen Denmer Santok, Lawrence HC Kim, Park Dong Won3, Koon Ho Rha1
1 Department of Urology and Urological Science Institute, Yonsei University College of Medicine, Seoul
2 Department of Urology, CHA Seoul Station Medical Center, CHA University Medical School, Seoul
3 Meere company Inc, Pangyo Techno Valley, Seongnam, Republic of Korea

Introduction: The efficiency of the new Korean REVO-I robotic surgical system needs to be evaluated prior to its application in humans. The current study test the feasibility and safety of the REVO-I platform by performing fallopian tube transection-anastomosis in a live porcine model.

Methods: A prospective chronic animal study was done with Crossed Breed female pigs in our Animal Medicine Laboratory (Avison Bio-Medical Research Center). The primary outcome was to assess the pigs’ 2-week survival. The secondary outcomes were the intraoperative parameters and the complications or difficulties when using the REVO-I. Simple descriptive analyses were performed using the IBM SPSS version 23 statistical package (SPSS Inc., Chicago, IL).

Results: The procedure was successfully performed in 4 porcine models. The mean operative time was 66 min (range: 46-104 min), the mean docking time was 22.25 min (range: 14–53 min) and the mean console time was 18 min (range: 13–20 min). The REVO-I robotic system functioned appropriately, with no technical problems or difficulties noted during the procedures. Both the surgeon and the bed-side assistant reported ease of use and better performance with subsequent procedures. All pigs were alive 2 weeks after surgery, with no perioperative complications related to the use of the robot.

Conclusion: The current pre-clinical chronic animal study revealed that the REVO-I robotic surgical system is a feasible and safe robotic instrument that can be used by surgeons to perform robotic procedures in porcine models. Our next objective is to demonstrate its safety in humans.

Figure: REVO-I robotic surgical system (2011); Meerecompany (Inc. Seongnam, Republic of Korea)
ABSTRACT 42

EVALUATION OF A SINGLE-USE, FLEXIBLE 9 FR URETEROSCOPE WITH ARTICULATING TIP IN EVERYDAY UROLOGICAL PRACTICE

Joseph V. DiTrolio, M.D. 1, Kyle Blum, B.S. 2, Michael D. LaSalle, M.D. 3
1Rutgers New Jersey Medical School, Department of Urology, Newark, NJ
2St. George’s University; 3St. Barnabas Medical Center, Livingston, NJ

Introduction: Endoscopic procedures are an integral part of urological practice. With the cost of maintaining flexible endoscopic equipment increasing dramatically, compounded by a risk of cross-contamination and an inherently destructive sterilization process, a more sustainable solution to current standards of practice must be investigated. With the recent trends in healthcare pressing for quality care at less cost, there is an increasing need for a single-use flexible ureteroscope that is affordable for the future of healthcare.

Methods: A 9FR rounded-tip single-use flexible ureteroscope with 8FR shaft and 3.6FR (1.2mm) working channel was evaluated in a laboratory setting. Using a high definition LCD monitor, video processor, and LED light source, we were able to power the all fiber-optic distal light source and chip-on-the-tip 250 x 250, 2,500 pixel CMOS sensor camera. The single-use ureteroscope was evaluated based on its focal length, outer diameters, angular tip deflection, and practical function through its compatibility with current introductory ureteroscope sheaths. At the time of utilization, proper function of the ureteroscope required only the following:

1. Single-use, flexible 9FR articulating tip ureteroscope
2. LED light source/video processor with monitor

Results: This 9FR single-use, flexible, articulating tip ureteroscope was evaluated in laboratory conditions and found to have an optimal focal length of 5mm – 50mm. The single-use ureteroscope has an 8FR shaft that ends in a rounded 9FR tip, which incorporates a 3.6FR working channel that is fully capable of both irrigation and laser utilization for intended use within the renal pelvis. Integration with current equipment was satisfactory, with the 9FR ureteroscope easily inserted into standard introductory sheaths that had inside diameters of 10FR, or greater. The flexible articulating tip ureteroscope had a maximum tip deflection angle of 270° in one plane of flex, and an impressive 360° in the opposite flex. The deflection diameter while flexed at 270° and 360° was measured as 25mm and 19mm, respectively.

Conclusion: Financial expenditure related to the maintenance and sterilization of endoscopic equipment has steadily increased over time. Recent technologies have now allowed for single-use high-tech endoscopic equipment to become more affordable than reprocessing reusable instruments. The potential value of single-use equipment has additional benefits in light of the ever-increasing development of resistant organisms by completely eliminating the risk of cross-contamination. With this consideration in mind, paired with the increasing cost of a destructive sterilization process, a single-use ureteroscope appears to be a low-cost, low-risk alternative that warrants further investigation.
ABSTRACT 43

STONE-MODE ULTRASOUND FOR THE IMAGING OF RENAL STONES
Philip C May 1, Yasser Haider 2, Barbrina Dunmire 2, Bryan W Cunitz 2, Jeff Thiel 2, Ziyue Liu 3, Michael R Bailey 1,2, Mathew D Sorensen 1, and Jonathan D Harper 1

1 University of Washington Department of Urology and 2 Center for Industrial and Medical Ultrasound  
3 Indiana University Department of Biostatistics

Introduction: Ultrasound (US) is an inexpensive and safe modality for imaging renal stones, but is limited in sensitivity and stone sizing accuracy. The purpose of this study is to assess the accuracy of stone specific ultrasound algorithms for the detection and sizing of renal stones in human subjects, both in comparison to a computed tomography (CT) standard as well as a commercial US system.

Methods: Adult subjects were prospectively recruited with a diagnosis of renal stones and a CT scan of the kidneys within 100 days of evaluation. All subjects had a dedicated US with a research-based system with customized grayscale imaging optimized to image stones. Higher ray line density was utilized to improve resolution. No spatial compounding, speckle reduction, or smoothing algorithms were utilized in order to improve stone to tissue-edge contrast. Additional subjects were scanned with a modern commercial US imaging system for comparison.

Results: Twenty-nine subjects with 94 renal stones were included. Overall, 85% of stones identified on CT were visualized on ultrasound (Figure 1). Seventy-five percent of stones were within the same size category (<5 mm, 5-10 mm, >10 mm) on CT and US. The mean absolute difference in stone size between CT and US was 1.4 ± 1.4 mm for all stones. There was no statistically significant difference in size of stone on CT or US for stones < 10 mm. Only four (5%) stone measurements on US were greater than 3 mm discrepant from CT. Four subjects with 16 renal stones were scanned with the commercial US system; mean absolute difference was 1.6 mm versus 0.5 mm with the research system (p = 0.05).

Conclusion: Stone-mode ultrasound offers improved detection and sizing of renal stones based on a CT size standard, both in comparison to published series and direct comparison to a commercial US system.

Figure 1: Correlation of stone size measurement between US and CT. Each measurement is color-coded based on the absolute difference (error), with the CT size used as the reference measurement. The solid black line represents a 1:1 correspondence between the US and CT measurements. The dashed line represents the correlation between the US and CT measurements.

R² = 0.49

Acknowledgement: Funding provided from NSBRI through NASA NCC 9-58, NIH NIDDK grants DK043881 and DK092197, and VA Puget Sound Health Care System, Seattle, Washington.
CONSTRUCTION AND ASSESSMENT OF AN INNOVATIVE VIRTUAL FLUOROSCOPY PCNL SIMULATOR

Ashish Rawandale, Lokesh Patni, Yasser Dar, Gautam Ladumor, Institute of Urology Dhule. India

Introduction: PCNL has a significant learning curve. Commercial simulators have prohibitive pitfalls. We describe and validate our active mannequin, portable virtual fluoroscopy PCNL simulator. It uses visible light to reproduce images similar to that of the fluoroscopy machine.

Methods: A portable virtual fluoroscopy PCNL simulator was designed using CAD (Fig 1), patented and constructed (Fig 2) using an acrylic patient torso, an isocentric C-arm with a 12 volt bright light source at the lower end and an HD camera at the upper. The torso has a window fitted with a translucent interface (paper / thin white cloth). A metallic pelvi-calyceal system is suspended at the point of isocentricity. This produces a shadow on the translucent screen that is captured by the camera and reproduced on the monitor. An initial puncture needle is used to approach the kidney against the light through the translucent interface which resembles skin. The lamp and camera are operated with an on/off foot switch alike a fluoroscopy machine. An electronic beep sounds on the IPN touching the PCS. CCTVs inside the caricature and side inspectory windows help access accuracy of the puncture. Respiratory kidney excursions are replicated by a motorized CAM arrangement. Evaluation using a 3 step test, GRS score and trainee feedback was analyzed using Spearman rank order correlations and paired test.

Results: 10 urology trainees and 2 experts participated in the study. Face and content validity demonstrated a satisfactory resemblance of the virtual fluoroscopy image to an actual fluoroscopy machine image. The simulator could differentiate the novices from experts. All subjects demonstrated statistically significant betterment in their GRS scores, total task time, fluoroscopic time and puncture attempts. Measured parameters of most trainees showed a shift, towards the control though they were significantly slower than the controls. Progress when plotted against time, demonstrated the potential to quantify the training hours mandatory for individual trainee to reach the desired expertise. Subjective simulator assessment of the trainees indicated a high degree of satisfaction.

Conclusion: Our portable virtual fluoroscopy (radiation free) PCNL simulator, reproduces fluoroscopy like images. Uses the usual initial puncture needle, allows any access technique and simulates respiration. The end of task alarm and CCTVs help facilitate training. Evaluation and supervised, repetitive tailored learning in a controlled, low stress environment. It has low initial and maintenance cost and is a viable alternative to the expensive VR systems. The concept may open up newer avenues in PCNL simulation.
HYDROGEL SPACER ("SPACEOAR") IN IMAGE GUIDED INTENSITY MODULATED RADIATION THERAPY (IMRT) FOR PROSTATE CANCER: A SINGLE INSTITUTION COMMUNITY-BASED EXPERIENCE

Jason Huang, BA1, Paul LeVan, JD, PhD2, William Andre2, Harpreet Wadhwa, MD1, Peter Tsambarlis, MD3, Dan M Tauber3, Kaylan Latchamsetty, MD2,3, Parthiv Mehta, MD2, Paul Yonover, MD, FACS1,2
1 Department of Urology, University of Illinois at Chicago College of Medicine, Chicago, IL
2 Uropartners, LLC, Chicago, IL
3 Rush University Medical Center, Chicago IL

Introduction: Rectal irradiation during radiotherapy for prostate cancer is a source of significant toxicity. Absorbable perirectal hydrogel spacers have been shown to reduce incidental rectal dose. We report a single institution community-based experience with transperineal perirectal hydrogel spacer injection ("SpaceOAR" System, Augmenix) prior to prostate cancer intensity modulated radiation therapy (IMRT).

Methods: Sixty-five men with stage T1c-T2c prostate cancer scheduled to undergo IMRT monotherapy (81 Gy, 45 fractions) received transperineal hydrogel spacer injection. Dose volume histograms (DVHs) were calculated and analyzed. We compared our results to a large multicenter published trial of hydrogel spacer [http://dx.doi.org/10.1016/j.ijrobp.2015.04.030] and to established Quantitative Analyses of Normal Tissue Effects in the Clinic (QUANTEC) guidelines.

Results: In our series, 100% of treatment plans met rectal dose constraints. The mean rectal V70 (rV70) = 1.55% ± 1.94 (0-8.30); the average mean penile bulb dose = 8.79 Gy (3.08–25.84). These compared quite favorably to both the rV70 of the published control arm (12.4% vs 1.55%) and the hydrogel spacer arm (3.3% vs 1.55%) of the hydrogel published trial. Our mean penile bulb dose was also considerably lower (22.8 Gy vs 8.79 Gy). Our reported rV70 represents an 87.5% reduction in rectal dose compared to the published control arm and a 92.25% reduction in rectal dose compared to QUANTEC rV70 guidelines (20% vs 1.55%).

Conclusion: Transperineal perirectal hydrogel spacer injection is a safe, reproducible, and effective procedure performable in a community setting and considerably reduces rectal irradiation during prostate cancer radiotherapy.
BODY WALL FORCES APPLIED DURING daVinci INTRAOPERATIVE TABLE MOTION

Smita De, M.D., Ph.D.¹, Brett Page, B.S.², Samana Ghimire, M.S. ², Amy Kerdok, Ph.D.²
¹ Department of Urology, Stanford University Hospital, Stanford, CA, USA
² Intuitive Surgical Operations, Inc., Sunnyvale, CA, USA

Introduction: Minimally invasive surgical (MIS) techniques provide numerous patient benefits. Surgical robots, such as the da Vinci® surgical systems (Intuitive Surgical, Inc., Sunnyvale, CA), provide additional advantages and capabilities over traditional MIS instruments, though one limitation is the inability to move the operating table once the robot has been docked. The new TruSystem® 7000dV (Trumpf Medical, Ditzingen, Germany) is an operating table that is in communication with the da Vinci® Xi™ and allows for integrated table motion (ITM). During ITM, the TruSystem operating table is able to move similar to a standard operating, allowing for dynamic patient positioning for optimal surgical exposure and/or improved patient relief from extreme positions without undocking the robot. We have previously described studies to measure the forces applied at the body wall during MIS procedures. Here, we utilize a similar methodology to perform a preliminary study on body wall forces during simple maneuvers with ITM.

Methods: We used a sensorized cannula that was specifically constructed to directly measure in vivo body wall forces during MIS procedures. To create the sensorized cannula, a standard long length robotic cannula was modified with an overtube designed to contact the body wall and deflect like a cantilever beam. Standard strain gauges (force sensors) were then fixed to the proximal end of the overtube. This design added minimal width to the standard cannula and was easily waterproofed. The sensorized cannula was calibrated and validated using standard force gauges. The cannula was then used for in vivo porcine experiments using the da Vinci® Xi™ Surgical System and the TruSystem® OR table. Surgeons test subjects performed simple maneuvers during various OR table movements such as ‘level to 20 degrees Trendelenberg’ or ‘10 degrees roll.’ Maneuvers included activation of instruments without manipulation of tissues as well as retraction of specific organs, such as the bladder and uterus. We continuously recorded the force applied in the plane of the body wall and then measured the change in resultant force magnitude (delta force) for each maneuver.

Results: The overall range of mean delta forces measured during these simple maneuvers was 5.4-10.3 N. Mean delta forces during 20 degrees of Trendelenberg and reverse Trendelenberg to and from level without tissue manipulation ranged from 5.4–9.1 N. During active pelvic organ retraction with ITM, mean forces ranged from 7.6-8.8 N. Rolling the OR table 10 degrees to the left or right with no tissue manipulation resulted in mean delta forces ranging from 7.0-10.3 N. A mean delta force of 7.0 N was observed during rolling of the table while retracting the liver.

Conclusion: The new TruSystem® OR table allows for increased intraoperative capabilities with real-time table motion with the da Vinci® Xi™. Mean changes in body wall forces during ITM ranged from 5.4-10.3 N during basic maneuvers which is well within the range of our prior studies that reported mean changes in body wall forces up to 12.8 N during pelvic tasks without ITM. It was also observed that the angle of the cannula compared to the body wall may play a role in the force applied suggesting that this concept should be further evaluated. Future work with more complex surgical maneuvers and other surgical platforms may help better characterize the body wall forces during MIS and identify potential relationships between body wall forces and port site complications.

Sensorized cannula with obturator
ABSTRACTS

ABSTRACT 47

EVALUATING THE PercSac FOR CYSTOLITHOLAPAXY IN A PORCINE BLADDER

Aaron H. Lay¹, Noah E. Canvasser¹, Nicholas Kavoussi¹, Steeve Doizi¹, Ersin Koseoglu¹, Heather Beardsley², Margaret S. Pearle¹, Jeffrey A. Cadeddu¹, Jodi A. Antonelli¹

¹ Department of Urology, University of Texas Southwestern Medical Center, Dallas, TX, USA
² Department of Mechanical Engineering, University of Texas at Arlington, Arlington, TX, USA

Introduction: Up to 50% of patients with residual fragments after percutaneous nephrolithotomy (PCNL) experience a stone-related event. We previously developed a polyethylene sack (the PercSac) that fits over the shaft of a rigid nephroscope and is deployed in the collecting system to capture a stone during PCNL (Figure 1), thereby containing the fragments to allow for efficient and complete removal. Herein we utilize the porcine bladder to evaluate the feasibility and performance of the PercSac for cystolitholapaxy in an animal model.

Methods: A female Yorkshire pig was sacrificed and the bladder was exposed in an open fashion. A Bego® stone made in spherical molds of 1.8cm diameter was then placed in the bladder, followed by a 30Fr Amplatz working sheath secured in place by a silk suture (Figure 2). Each stone was then fragmented using a 24Fr rigid nephroscope and an ultrasonic lithotripter, 3 trials with the PercSac and 3 trials without the PercSac were performed. The time for stone fragmentation with ultrasonic lithotripter, total time for stone clearance from the bladder, gross assessment of stone-free status, and gross assessment of urothelial damage were recorded.

Results: The mean stone weight was 6.62g. The average time needed for fragmentation was significantly shorter in the PercSac group compared to control (900 sec ± 59.2 sec vs. 1,158 sec ± 33.1 sec, p=0.02). In addition, there were no residual fragments in all trials with the PercSac compared to residual fragments in all trials in the control group. There was also no gross evidence of bladder mucosal damage in either group.

Conclusion: The PercSac is safe and effective in improving efficiency and outcomes during cystolitholapaxy in a porcine bladder. Further testing for use in a kidney may improve stone-free rates during PCNL.

Figure 1. Nephroscope fitted with PercSac

Figure 2. 30Fr Amplatz sheath placed in porcine bladder for cystolitholapaxy
AUTONOMOUS CLOSED-LOOP GENITAL NERVE STIMULATION IDENTIFIES AND INHIBITS HYPER-REFLEXIC BLADDER CONTRACTIONS

R. Karam¹,², S.J.A. Majerus², S. Bhunia¹, S.W. Brose³, M.S. Damaser²,⁴,⁵, D. Bourbeau³

¹ Dept of ECE, University of Florida, Gainesville, FL 32608
² Advanced Platform Technology Center, L. Stokes Cleveland VAMC, Cleveland, OH 44106
³ Functional Electrical Stimulation Center, L. Stokes Cleveland VAMC, Cleveland, OH 44106
⁴ Dept of Biomedical Engineering, Lerner Research Institute, Cleveland, OH 44106
⁵ Glickman Urology And Kidney Inst., Cleveland Clinic Foundation, Cleveland, OH 44106

Introduction: Neuromodulation of lower urinary tract nerves, such as genital nerve stimulation (GNS), can be used to inhibit hyper-reflexic bladder contractions for individuals with idiopathic or neurogenic bladder overactivity. Triggering inhibitory stimulation on condition of the onset of a bladder contraction has been investigated as a possible improvement to the currently available open-loop stimulation systems. However, conditional stimulation requires a robust, adaptive, and noise-tolerant method of classifying bladder function from real-time bladder pressure measurements.

Methods: We have previously shown that Context-Aware Thresholding (CAT) can identify bladder contractions on pre-recorded urodynamic data with a single contraction [1]. In this work, we present real-time detection of multiple serial bladder contractions using 58 cystometrogram (CMG) recordings from 15 human subjects with neurogenic detrusor overactivity. We then conducted a live test of closed-loop GNS triggered by the CAT algorithm in a 62-year-old male subject with neurogenic detrusor overactivity. We completed, in randomized order, 3 CMGs without GNS and 3 CMGs with closed-loop GNS using a clinical urodynamics system at a fill rate of 50 mL/min.

Results: On pre-recorded data, the CAT algorithm demonstrated a high degree of accuracy and noise tolerance, with a mean accuracy of 92% and average false positive rate of 0.3 false positives per contraction. Analysis of event detection latencies showed that the CAT algorithm identified and responded to events 1.4 seconds faster than a human experimenter. In our live test of the CAT algorithm, autonomous closed-loop GNS successfully inhibited unwanted bladder contractions, which strongly diminished the subject’s feelings of urgency and significantly increased bladder capacity by 200 mL (Figure). The subject reported no physical or psychological discomfort in response to algorithm-controlled stimulation.

Conclusion: The CAT algorithm can identify multiple serial contractions using only bladder pressure data and does not require a second sensor to monitor abdominal data. Closed-loop electrical stimulation using the CAT algorithm can efficiently and effectively inhibit hyper-reflexic bladder contractions without increasing the cognitive load on the user. The CAT algorithm can also be used for automated long-term urodynamic analysis for clinical bladder diagnosis. Event driven modulation has the potential to allow a more effective means of clinical management of neurogenic detrusor overactivity in persons with SCI. Further work investigating this approach in persons with SCI is indicated.
ABSTRACTS

PROSPECTIVE EVALUATION OF $^{99m}$Tc-SESTAMIBI SPECT/CT FOR THE DIAGNOSIS OF RENAL ONCOCYTOMAS AND HYBRID ONCOCYTIC/CHROMOPHOBE TUMORS

Michael A. Gorin, M.D.\textsuperscript{1}, Steven P. Rowe, M.D., Ph.D.\textsuperscript{2}, Alex S. Baras, M.D., Ph.D.\textsuperscript{3}, Lilja B. Solnes, M.D.\textsuperscript{2}, Mark W. Ball M.D.\textsuperscript{1}, Phillip M. Pierorazio, M.D.\textsuperscript{1}, Christian P. Pavlovich, M.D.\textsuperscript{1}, Jonathan I, Epstein, M.D.\textsuperscript{3}, Mehrbod S. Javadi, M.D.\textsuperscript{2}, Mohamad E. Allaf, M.D.\textsuperscript{1}

\textsuperscript{1}The James Buchanan Brady Urological Institute and Department of Urology
\textsuperscript{2}The Russell H. Morgan Department of Radiology and Radiological Science
\textsuperscript{3}Department of Pathology
Johns Hopkins University, School of Medicine, Baltimore, MD, USA

Introduction: Benign renal oncocytomas and hybrid oncocytic/chromophobe tumors (HOCTs) are uniquely comprised of cells with densely packed mitochondria. Previously, we have reported that the mitochondrial imaging agent $^{99m}$Tc-sestamibi can aid in the differentiation of these tumors apart from other renal tumor histologies. Relatively small patient numbers, however, limit these data. Herein, we report the results of an expanded cohort of patients enrolled in a prospective study aimed at determining the accuracy of $^{99m}$Tc-sestamibi single photon emission computed tomography/x-ray computed tomography (SPECT/CT) for the diagnosis of renal oncocytomas and HOCTs (ClinicalTrials.gov identifier NCT02160925).

Methods: Patients with a clinical T1 renal mass electing to undergo surgical resection were imaged with $^{99m}$Tc-sestamibi SPECT/CT prior to surgery. Preoperative SPECT/CT scans were reviewed by two blinded readers and their results were compared to centrally reviewed surgical pathology data. Measures of diagnostic performance including sensitivity, specificity, positive predictive value and negative predictive value were then calculated.

Results: 71 patients with a median tumor diameter of 3.1 cm (IQR 2.4-4.7 cm) participated in this study. On final surgical pathology, 9 (12.7%) tumors were classified as renal oncocytomas and 2 (2.8%) as HOCTs. With the exception of 1 (1.4%) angiomyolipoma, all other tumors were renal cell carcinomas (83.1%). Analysis of intra- and inter-observer agreement of the first 50 imaged tumors demonstrated excellent agreement for all comparisons (range of kappa values 0.93-1.00). $^{99m}$Tc-sestamibi SPECT/CT correctly identified 8 of 9 (88.9%) oncocytomas and 2 of 2 (100%) HOCTs, resulting in an overall sensitivity of 90.1% (95% CI 57.1-99.5%). Only 2 tumors were falsely positive on SPECT/CT, resulting in a specificity of 96.7% (95% CI 87.4-99.4%). Interestingly, both false positive tumors were the eosinophilic variant of chromophobe renal cell carcinoma. Values of positive and negative predictive accuracy were 83.3% (95% CI 50.9-97.0%) and 98.3% (95% CI 89.7-99.9%), respectively.

Conclusions: $^{99m}$Tc-sestamibi SPECT/CT is an accurate imaging test for the non-invasive differentiation of renal oncocytomas and HOCTs from other tumor histologies. Future work aims to confirm these findings in a large multicenter study.
PILOT STUDY EVALUATING PSMA-TARGETED $^{18}$F-DCFPyL PET/CT IN PATIENTS WITH METASTATIC CLEAR CELL RENAL CELL CARCINOMA

Michael A. Gorin, M.D.\textsuperscript{1}, Steven P. Rowe, M.D., Ph.D.\textsuperscript{2}, Jody E. Hooper, M.D.\textsuperscript{3}, Hans-Joerg Hammers M.D., Ph.D.\textsuperscript{4}, Mehrbod S. Javadi M.D.\textsuperscript{2}, Hazem Hawasli, M.D.\textsuperscript{2}, Zsolt Szabo M.D., Ph.D.\textsuperscript{2}, Martin G. Pomper M.D., Ph.D.\textsuperscript{2} and Mohamad E. Allaf M.D.\textsuperscript{1}

\textsuperscript{1}The James Buchanan Brady Urological Institute and Department of Urology
\textsuperscript{2}The Russell H. Morgan Department of Radiology and Radiological Science
\textsuperscript{3}Department of Pathology
\textsuperscript{4}Department of Medical Oncology, Sidney Kimmel Comprehensive Cancer Center
Johns Hopkins University School of Medicine, Baltimore, MD, USA

Introduction: Despite the specificity implied by its name, prostate-specific membrane antigen (PSMA) is expressed within the neovasculature of a number of solid malignancies. Owing to frequent loss of the \textit{VHL} gene, the clear cell subtype of renal cell carcinoma (ccRCC) is characterized by a high degree of neovascularization. In this study, we tested the feasibility of imaging metastatic clear cell RCC (ccRCC) using $^{18}$F-DCFPyL, a novel small molecule radiotracer targeting PSMA.

Methods: Six patients with untreated metastatic ccRCC were imaged with $^{18}$F-DCFPyL positron emission computed tomography/x-ray computed tomography (PET/CT). $^{18}$F-DCFPyL PET/CT scans were collaboratively reviewed by two experienced readers blinded to findings on conventional imaging. Conventional imaging studies were similarly reviewed by a third reader blinded to findings on $^{18}$F-DCFPyL PET/CT. Scan results were then compared for concordance. Additionally, to evaluate the specificity of the radiotracer, a seventh patient with progressive ccRCC was imaged shortly prior to death and a rapid autopsy was performed allowing for the histological assessment of PET positive sites that were occult on conventional imaging.

Results: In the 6 patients with untreated ccRCC, conventional imaging identified 19 sites of metastatic ccRCC (range 1-9 per patient). In contrast, $^{18}$F-DCFPyL PET/CT identified 29 foci of abnormal radiotracer uptake (range 1-14 per patient). Sites of abnormal radiotracer uptake had maximum standardized uptake values ranging from 1.6 to 19.3. Of the 19 sites of disease identified on conventional imaging, 18 (94.7\%) were also identified on $^{18}$F-DCFPyL PET/CT. Two of these lesions were resected and found to be metastatic ccRCC. In the seventh patient with progressive ccRCC imaged prior to passing, 65 discrete sites of radiotracer uptake were identified. This included 12 (18.5\%) sites that were positive on $^{18}$F-DCFPyL PET/CT but negative on conventional imaging. Of these sites, 8 were readily accessible at the time of rapid autopsy and 7 (87.5\%) were confirmed to be metastatic ccRCC.

Conclusions: $^{18}$F-DCFPyL PET/CT allowed for the sensitive and specific detection of sites of metastatic ccRCC. Future work aims to more precisely define the sensitivity of this imaging test as well as to determine its clinical utility in patients with ccRCC.
ABSTRACT 51

PREVENTING OCCURRENCE OF METASTATIC PROSTATE CANCER IN RATS WITH LOCALLY ADVANCED PROSTATE CANCER BY IMMUNOMODULATION AND VASCULAR TARGETED


1Urology Department, Kaplan Medical Center, Rehovot, Israel
2Department of Plant and Environmental Sciences & 3Department Biological Regulation, The Weizmann Institute of Science, Rehovot, Israel.
4Department of Surgery, Memorial Sloan-Kettering Cancer Center, New York, New York, USA
*Equal Contribution

Introduction & Objectives: Vascular targeted photodynamic (VTP) therapy using WST11 has been clinically investigated as a focal therapy for localized Prostate Cancer (PCa). Preclinical studies showed that WST11-VTP creates a strong antitumor immune reaction by exposing tumor antigens and danger associated molecular patterns, hastening immune cells to the ablated area and more. We set out to evaluate if treatment with cyclophosphamide (CTX) as an immune modulator prior to VTP might reduce/prevent metastatic disease in an orthotopic animal model of locally advanced aggressive PCa.

Materials & Methods: These experiments consisted of two stages, Stage 1: luciferin transfected PCa androgen insensitive cells with propensity to metastasize (Mat- Lu) were grafted into immunocompetent Copenhagen rats. Cells were implanted orthotopically and 8-13 days later the prostate was removed. In the following 2-3 months animals were continuously monitored for the development of metastasis. In the second stage PCa was implanted orthotopically, 7 days after implantation the rats were randomly treated by CTX or saline. Three days after treatment all animals underwent WST11-VTP. Three days later the prostate gland was surgically removed. Whole body metastatic growth was monitored clinically and by emission of Mat-Lu bioluminescence. Animals not exhibiting metastatic disease were sacrificed after 60 day and subjected to a histological evaluation.

Results: In stage 1, metastases were observed in 18 and 46% of the animals that underwent surgical removal of the prostate at day 8 (N=11) and 10 (N=13) post PCa implantation respectively. Prostate removal was not technically feasible at day 13 due to locally advanced disease and animals did not survive the procedure, hence, day 10 was selected for the first treatment intervention. 15 male rats underwent immunomodulation with CTX followed by VTP and prostate removal, 12 rats had VTP and prostate removal alone. 1 animal (7%) in the immunomodulation group developed metastatic disease whereas in the control group 6 animals (50%) developed metastatic disease (p=0.02).

Conclusion: Immunomodulation with CTX synchronized with WST11-VTP prior to prostatic surgical removal at the early dissemination stage, reduced/prevented the development of metastatic disease in the PCa rat model. Surgery or VTP combined with surgery resulted in a 46%, 50% metastatic rate. Our data suggest that WST11-VTP initiates an immune response that upon augmentation by pre-treatment with CTX, results in the prevention of metastasis and a high cure rate. This finding warrants further evaluation in clinical settings.
ABSTRACT 52

REDUCING BACTERIAL GROWTH USING A NOVEL INDWELLING URINARY CATHETER

Francisco Portela¹, R.N., Kenneth Kim¹, M.S., Gyan Pareek¹,², M.D., Joseph Renzulli II¹,², M.D.

¹Portela Soni Medical LLC
²Section of Minimally Invasive Urology, Brown Medical School

Introduction. Catheter-associated urinary tract infections (CAUTIs) make up 40% of all nosocomial infections. A major cause of CAUTI is bacterial growth and biofilm formation between the urethral membrane and outer catheter surface. We have hypothesized that a redesigned indwelling urinary catheter with a urethral flushing mechanism can reduce the risk of CAUTI by reducing bacterial growth. This flushing mechanism recapitulates the homeostatic function that normally prevents urinary tract infection. A controlled in vitro experiment was performed to evaluate this hypothesis.

Methods. A prototype flushing catheter was constructed by modifying a 16 French silicone elastomer catheter. A sterile urethral model was inoculated with Escherichia Coli K12 then flushed using the prototype catheter. The urethral model was swabbed for bacterial growth pre-inoculation, post-inoculation and post-urethral flush. This process was repeated twice with the prototype catheter and once with a standard Foley 16 french silicone elastomer catheter. The swabs were then plated on Luria Bertani (LB) agar and incubated for 24 hours. Colony Forming Units (CFUs) were then counted to determine relative bacterial concentrations.

Results. The pre-inoculation results across all three tests produced 0% growth, demonstrating that urethral model was sterile prior to inoculation. In Prototype Trial 1 (PT-1) there was a 74.8% CFU reduction following the urethral flush. In Prototype Trial 2 (PT-2) there was an 88.2% CFU reduction following the urethral flush. Following the removal of the control catheter (no flush), there was a 6.2% CFU reduction.

Conclusions. These preliminary results suggest that the urethral flushing mechanism can significantly reduce bacterial growth in the urinary tract. That said, a redesigned urinary catheter that incorporates this flushing mechanism may have a significantly reduced risk of CAUTI.
ABSTRACT 53

BROADLY FOCUSED BEAM FOR IMPROVED REPOSITIONING OF STONE FRAGMENTS

Bryan W. Cunitz MS,1 Adam D. Maxwell, PhD,2 Barbrina Dunmire MS,1 Brian MacConaghy, MS,1 Michael R Bailey PhD,1,2 Doug Corl, PhD,3 Oren Levy, PhD,3 Philip C. May MD,2 Jonathan D. Harper MD,2 and Mathew D. Sorensen MD MS4
1Center for Industrial and Medical Ultrasound, Applied Physics Laboratory, University of Washington, 2Department of Urology University of Washington School of Medicine, Seattle WA 3SonoMotion, Inc. San Francisco, CA 4Division of Urology, Dept. of Veteran Affairs Medical Center, Seattle, WA

Introduction: Ultrasonic Propulsion (UP) is a new therapeutic application of medical ultrasound in which focused bursts of ultrasound generate acoustic radiation force to non-invasively reposition renal calculi. A clinical feasibility study has shown UP to be safe and particularly effective at expelling post-lithotripsy fragments. The original design of the system focused on manipulating single, <5 mm stones, one at a time (using a narrow focal beam). This configuration made clearing clusters of fragments time consuming. In this study we evaluated three different methods of broadening the beam to accelerate repositioning of clusters of residual fragments.

Methods: Three methods of widening the beam were implemented: exciting all 128 elements on the current probe (Philips HDI C5-2) with a pattern to broaden the beam, exciting only 40 elements of the current probe, and a separate single element probe with a different aperture and frequency. The beams were modeled using an acoustic simulation software package, FIELD II and measured using a hydrophone in a water bath. The capability of each method to lift targets in a pipette was measured and filmed. Targets included a single 8-mm calcium oxalate monohydrate (COM) stone, and clusters of 1-2 mm and 3-4 mm COM fragments. Motion was filmed and the sum of the product of fragment area and distance moved was calculated. The mean and standard deviation (N=10) for each method and target were compared by standard statistics.

Results: All methods resulted in a broader beam compared to the original design. Measured and modeled beams were in good agreement. For the same peak pressure, the wider beams lifted greater target mass than the original narrow beam. With 1-2 mm fragments, improvement with the 3 methods was 10%, 14%, and 502%. For 3-4 mm, improvement was 15%, 45%, and 178%.

Conclusion: We have demonstrated the ability to move stones non-invasively and facilitate passage of stones using ultrasonic propulsion. These results show the system can be further optimized based on the application of UP. Specifically, the beam width was broadened to provide radiation force over a larger area to move clusters of fragments versus a single intact stone. Though effective, the focal width alone does not determine the overall efficacy of stone motion and additional studies will be conducted on the push pulse parameters, such as pressure, duty cycle, and duration, as well as the various potential applications of UP, including moving single small stones, clusters of fragments, large, possibly obstructing, stones, and attached stones. Work support by NIH NIDDK grants DK043881, DK107094, and DK092197, and the National Space Biomedical Research Institute through NASA NCC 9-58. This material is the result of work supported by resources from the VA Puget Sound Health Care System.

Figure: Simulated beam widths of the three methods
DEVELOPMENT OF A RELIABLE SPOT-URINE “OXALOMETER”

John P. Lindsey II MEng\textsuperscript{1}, Arun Wanchoo PhD\textsuperscript{2}, Cuong Nguyen PhD\textsuperscript{2}, Ammon B. Peck PhD\textsuperscript{2}, Benjamin K. Canales MD, MPH\textsuperscript{1}

\textsuperscript{1}Department of Urology, College of Medicine, University of Florida
\textsuperscript{2}Department of Microbiology, College of Veterinary Medicine, University of Florida

\textbf{Introduction:} Calcium oxalate is the prominent mineral found in human urine and kidney stones. Oxalate is an endogenous bi-product of carbohydrate metabolism and an exogenous plant-derivative absorbed by the gut. High urinary oxalate levels pose substantial risk for urolith formation. Current methods to detect urinary oxalate content are time consuming and require centrifugation and spectrophotometry found mainly in laboratory settings.

\textbf{Methods:} In order to measure urinary oxalate, urinary proteases must be removed to prevent inactivation of oxalate detection enzymes. This can be accomplished with activated charcoal filtration. Utilizing Google Sketchup and the Form1 Stereo Lithography Apparatus (SLA) 3D printer, we produced several prototypes of a removable filtration column pre-loaded with activated charcoal. These prototypes were then tested using a patented system of oxalate enzymes and markers. Oxalate color changes within the column were first measured using a visual scale and then by spectrophotometry. Detection time was recorded to ensure the device could produce prompt results. Lastly, oxalometer results were compared to a similar aliquot of urine run through the standard urinary oxalate assay.

\textbf{Results:} Typical filtration columns use centrifuges or vacuum manifolds to draw fluid through a filtration medium. To avoid the need for a centrifuge or vacuum, we trialed two passive flow column designs: a single-faceted and a double-faceted oblique design. We found that narrow, longitudinal slits in a column cap with a slanted face allowed the filtrate to be advanced by gravity and capillary action, reducing the energy and time needed in drop formation compared to a center-drip style column. Color resolution between standard concentrations of oxalate were achieved in approximately two minutes utilizing this filtration column and urinary oxalate levels were approximated without the need of a laboratory instrument.

\textbf{Conclusion:} We used SLA 3D printing to create a urinary filtration column that allows for rapid filtration of urine through activated charcoal in one easy step while avoiding the need for spectroscopy and centrifugation. Current technical issues are the even distribution of activated charcoal powder within the removable cap and reliance on visual color change scale for oxalate determination. Further work using color detection smart phone applications are underway along with validation in stone forming cohorts.

Figure: Single-faceted (left) and double-faceted (right) passive flow column designs in front of an assembled, 3D printed oxalometer with high oxalate-containing urinary sample (violet).
ABSTRACT 55

PROSTATE BIOPSY-SITE TRACKING:
EFFECT OF NEEDLE DEFLECTION AND SEGMENTATION ERRORS

Layne Haber¹, Alan Priester², Nima Nassiri³, Leonard Marks³, Shyam Natarajan²,³
¹ University of California, Los Angeles Department of Chemistry
² University of California, Los Angeles Department of Bioengineering
³ David Geffen School of Medicine, Department of Urology

Introduction: The ability to record a prostate biopsy site and resample it accurately ('tracking') is an advantage of image-fusion technology. The tracking function of the Artemis device was FDA-approved in 2008 and has been extensively used in men followed for low-risk prostate cancer. However, needle deflection and needle segmentation, which are major potential error sources in this process, have been little studied. We developed customized software to evaluate the presence and magnitude of such errors in an active surveillance program.

Methods: 30 patients from the UCLA targeted prostate biopsy database were randomly selected for assessment of biopsy accuracy, using 492 tracked biopsy sites as study material. Custom software was written to automatically query these cases, which included 3D core locations and US images from each of the biopsy locations. For each US image the true biopsy core location was manually annotated (Fig A), and it was then compared to the recorded core location in order to determine needle segmentation error. Needle deflection error was calculated by comparing the true biopsy location to the intended biopsy location, as defined by the geometry of the needle guide.

Results: The distribution of deflection errors and segmentation errors for the needle tip can be found in Figures B and C. Mean deflection errors, deflection angles, and segmentation errors are listed in Figure D. Assuming that the deflection and segmentation errors are uncorrelated, their sum in quadrature yields the average needle tip placement error when returning to a previous targeted biopsy location. Therefore, needle placement accuracy when attempting to re-sample a biopsy site is 3.2 ± 3.0 mm.

Conclusion: Deflection and segmentation errors of the biopsy needle tip follow approximately normal single-tailed distributions about zero, with average values of 1.8 and 2.7 mm respectively. Segmentation errors of the needle base had a distinct 2-peaked distribution, which suggests an infrequent but sizable operator error. The average error when attempting to re-sample a biopsy site would be 3.2 mm, which has important implications for tracking the status of cancer in men undergoing active surveillance. To re-sample a biopsy site accurately, especially one with a small apparent cancer focus, several well-spaced cores may be necessary to compensate for these inherent errors.

Fig A, US image with intended needle path (green), segmentation (red), and true location (orange); Fig B, histogram of segmentation errors for needle tip (red) and base (yellow); Fig C, histogram of deflection errors for needle tip; Fig D, mean deflection and segmentation errors relative to true core location.
ENHANCED SWL STONE COMMINUTION IN A PORCINE MODEL USING ACOUSTIC BUBBLE COALESCENCE

Hedieh Tamaddoni$^1$, Steven Allen$^1$, William Roberts$^{1,2}$, Timothy Hall$^1$
$^1$Biomedical Engineering, University of Michigan, Ann Arbor, USA
$^2$Department of Urology, University of Michigan, Ann Arbor, USA

Introduction: Cavitation plays a significant role in the efficacy of stone comminution during shock wave lithotripsy (SWL). Although cavitation on the surface of urinary stones helps to fragment the stone faster, residual bubble nuclei along the propagation path can shield or block subsequent shockwaves and potentially induce collateral tissue damage. We have previously shown in in-vitro studies that by applying low amplitude acoustic waves after each shockwave, we can force bubble coalescence to remove nuclei and enhance SWL efficacy [PMC3880900]. In this study, we investigated the feasibility of using bubble coalescence in an in vivo model.

Methods: A total of ten 45 to 50 kg female pigs were used for these experiments. Model stones were percutaneously implanted under ultrasound guidance in the mid or lower pole of the right kidney of each subject. Stones were on average 280 mg, cylindrical shape with 6 mm diameter, and about 7 mm height, made by a mixture of BegoStone plaster, albumin, and deionized water. A laboratory electrohydraulic lithotripter was used to apply 2500 shocks at pulse repetition rate (PRF) of 2 Hz for all treatments. Bubble coalescence acoustic sequences were applied in five of the ten treatments interleaved with each shockwave by an annular array of eight 500 kHz transducers surrounding the lithotripter reflector. These consisted of alternating tone bursts from each transducer with an amplitude of 1 MPa for a total duration of 16 ms. After each treatment, kidneys were harvested and the stone fragments in the collecting system were filtered, dried, and weighed.

Results: A comparison of the results of stone comminution, suggest an improvement in the stone fragmentation process when bubble coalescing pulses were applied. Figure (a) shows an example of the remaining stone fragments in a kidney that was treated with SWL only where a large stone fragment was left. In figure (b), only fine fragments remained when SWL was applied with bubble coalescence. Figure (c) summarizes the results from all ten treatments. On average only about 25% of the mass of the initial stone were eroded to fragments smaller than 2mm size in case of EHL only, and this fraction was increased to 75% when bubble coalescing pulses were applied.

Conclusion: This study demonstrates the feasibility of a bubble coalescence acoustic sequence to significantly improve the fragmentation of model kidney stones during SWL.
ABSTRACTS

ABSTRACT 57

PATIENT SPECIFIC 3-D PRINTED PROSTATE WITH TISSUE AND ANATOMIC FIDELITY

Kaiyan Qiu1, Zichen Zhao2, Lauren Poniatowski2, Shuang-Zhuang Guo1, Mingyu He3, Jayme Lee2, Luis Morales Tenorio4, Daniel Burke2, Paari Murugan5, Troy Reihsen2, Chih-Chang Chu3, Badrinath R. Konety2, Michael C. McAlpine1, Robert M. Sweet6

1Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN
2Department of Urology, University of Minnesota, Minneapolis, MN
3Fiber Science & Biomedical Engineering Programs, Cornell University, Ithaca, NY
4Department of Biomedical Engineering, University of Minnesota, Minneapolis, MN
5Department of Laboratory Medicine and Pathology, University of Minnesota, Minneapolis, MN
6Department of Urology, University of Washington, Seattle, WA

Introduction: The development of new materials and methods for fabrication of phantoms that accurately represent the properties of human tissue may be of value if we are ever going to move from use of 3D printing from surgical planning to patient-specific rehearsal. All previous work in this area has focused on anatomic fidelity. We attempt to address optical and mechanical fidelity. We address this challenge by creating a model that utilizes novel polymeric inks synthesized to match mechanical and optical properties derived from prostate ex-vivo, combined with MRI anatomic reference data. We chose the prostate given its fairly homogenous architecture and structure as a good organ for this proof of concept.

Methods: First, mechanical and optical properties of human prostate tissue were collected immediately following radical prostatectomy before going to pathology. The optical property of the outer surface for the prostate tissue was obtained using Ocean Optics Fiber-Optic equipment with the wavelength range of 340-1000 nm. The Fiber-Optics equipment accurately captured the transmittance and reflectance light on and through the tissue. Compression-relaxation testing was performed using ElectroForce® 5500 System with 20% strain with 0.5 mm/s speed. The specimens were compression tested while being placed on the platen after pathology divided the specimen. The indentation, unconfined compression method was utilized for these tests. Following collection of optical and compression mechanical data, the data were used as a reference for development of lab-synthesized solvent-free polymeric inks that were specifically developed based on the human tissue mechanical and optical reference data. The mechanical, optical and printable properties of the synthesized polymeric inks were adjusted with the use of reaction materials/conditions, molecular weights, functional groups, and types and amounts of additives. A state-of-the-art customized dual-head 3D printer was utilized to print the human tissue-simulated prostate model and its temporary support structure using the polymeric inks and patient specific MRI data of the prostate. The properties of printed prostate models were tested and compared using the same protocols for human prostate tissue.

Results: The 3D printed human tissue-simulated prostate model was fabricated via 3D printing under guidance of MRI data from human prostate. Tissue property and anatomic likeness were verified.

Conclusion: A 3D printed human tissue-simulated prostate model was developed using lab-synthesized polymeric inks and human prostate tissue characterization data. This approach has many advantages over traditional casting techniques due to its ability to allow for accurate representation of anatomic, optical and mechanical properties of human tissue in the form of phantoms. We have demonstrated proof of concept for prostate, and this approach deserves exploration for more complex tissue structures.
ABSTRACT 58

SIMILARITIES OF HARMONIC DOPPLER SIGNALS FROM KIDNEY STONES AND ULTRASOUND CONTRAST AGENTS

Matthew Bruce PhD,1 Bryan Cunitz MS,1 Barbrina Dunmire MS,1 Julianna Simon,1 PhD, Oleg Sapozhnikov, DSc,1,2 Michael R Bailey PhD,1,3 Jeff Thiel,4 Philip C. May, MD,3 Mathew D. Sorensen MD MS,5 and Jonathan D. Harper MD3

1 Center for Industrial and Medical Ultrasound, Applied Physics Laboratory, University of Washington, 2 Dept. of Acoustics, Physics Faculty, Moscow State Univ., Moscow, Russia, 3 Department of Urology and 4 Department of Radiology, University of Washington School of Medicine, 5 Div. of Urology, Dept. of Veteran Affairs Medical Center, Seattle

Introduction: A broadband Doppler signal specific to kidney stones has been observed since the 1990’s and is commonly referred to as the twinkling artifact (TA). This artifact is often used clinically to improve the sensitivity and specificity of B-mode ultrasound. The twinkling artifact has a high positive predictive value, but is not present or specific enough on its own to greatly improve the diagnostic performance of ultrasound. Our group has found evidence the TA is due to small microbubbles trapped in the crevices of the stone surface. We present further evidence for this hypothesis in demonstrating similar harmonic Doppler echoes from kidney stones and microbubbles used for ultrasound contrast agents. These harmonic Doppler signals are specific to kidney stones relative to surrounding tissue and could potentially be used to improve the clinical performance of ultrasound to detect kidney stones.

Methods: In vitro and in vivo data from kidney stones was collected using a Philips C5-2 imaging probe and Verasonics ultrasound research system. A pulse-inversion Doppler ensemble consisting of 256 pulses was programmed for the acquisitions. Pulse-inversion acquisitions enable separation of harmonic components. Acquisitions for both kidney stones and microbubbles were acquired with increasing transmit pressure. The resulting 2D Doppler-RF spectra were compared. Color flow acquisitions of increasing frequency and transmit pressure on a 2mm kidney stone were also acquired.

Results: Coherent harmonic signals were observed from in-vitro kidney stones, similar to those from microbubbles. As the transmit pressure was increased, similar Doppler spectral broadening around the fundamental frequency grew both for kidney stones and flowing microbubbles. Doppler spectral broadening was observed on an in-vivo stone both at the fundamental and harmonic frequencies. A difference of 9dB in power was observed between 2.5 and 4 MHz transmit frequencies with the color flow acquisitions (Fig 1).

Conclusion: We have observed similar harmonic Doppler signals originating from both kidney stones and microbubbles. These observations lend further support to the hypothesis that the origin of the TA is associated with bubble activity and could lead to improvements of kidney stone detection. Work support by NIH NIDDK grants DK043881 and DK092197, and the National Space Biomedical Research Institute through NASA NCC 9-58.

Figure: Left: 2D ultrasound. Right: Twinkling power vs transmit voltage for different frequencies.
AUGMENTED REALITY AND HAPTIC EXPLORATION OF EXCISED PROSTATES USING MAGNETIC RESONANCE ELASTOGRAPHY

D. Zumba¹, S. Crivellaro⁴, S. Kearney², H. Wadhwa⁴, D. Klatt¹, A. Kajdacsy-Balla⁵, T. Royston¹,², C. Luciano¹,³

¹Dept. of Bioengineering, ²Dept. of Mechanical and Industrial Engineering, ³Dept. of Biomedical and Health Information Sciences, ⁴Dept. of Urology, ⁵Dept. of Pathology
University of Illinois at Chicago

Introduction: Quantitative viscoelastic properties obtained from magnetic resonance elastography (MRE) offer the potential for improved differentiation of pathological and healthy tissue and tumor localization. We developed an MRE-based augmented reality application to allow Urology surgeons to visualize the anatomy of excised prostates and determine tumor location and size with haptic feedback.

Methods: MRE of 5 excised prostates were obtained with a modified 9.4 T ultra-high field pre-clinical scanner using SampLe Interval Modulation (SLIM-MRE). The resulting volumetric data of shear modulus maps (SMM), determined from the MRE scans, were smoothed by a median filter and then used to create virtual 3D representations of the ex-vivo prostates. A haptic device (3DSystems Touch X) tracks the 3D position and orientation of the haptic stylus mapped to a virtual needle. The surgeon is able feel the prostate tissues with the virtual needle in one hand and manipulate a virtual clipping tool with the other hand (Figure 1). The surgeon can also rotate and move the 3D holographic prostate to interactively explore its anatomy from any angle, and use the virtual cutting tool to cut the virtual prostates and determine the tumor locations in the augmented reality environment. Haptic properties of the virtual prostate tissues were computed by: 1) a volume haptics rendering algorithm that defines a transfer function providing different stiffness, viscosity, as well as static and dynamic friction to different ranges of the SMM; 2) a mass-spring-damper model that provides a variable haptic viscosity effect that is proportional to the SMM value of the voxel located at the tip of the virtual needle.

Results: A preliminary pilot study was conducted by an experienced Urology surgeon that was requested to analyze the 3D anatomy of the 5 holographic prostates and determine the location and size of the tumors by visual and haptic feedback. The urologist declared that the haptic and augmented reality exploration provided a much more useful method for studying the prostates and finding the tumors than just visualizing the color-coded MRE 2D slices. Moreover, preliminary results indicate that the surgeon was able to corroborate the findings in the pathology reports of the 5 excised prostates.

Conclusions: The preliminary experiment has shown the potential of the developed augmented reality and haptic application to serve as a tool for prostate cancer diagnosis and pre-surgical planning. A more comprehensive validation study involving a cadre of expert urologists will be conducted in future.

Figure 2: Augmented reality and haptic interface for exploration of holographic prostates using MRE. Arrow indicates the direction and magnitude of the force feedback while touching the cancerous tissue with the virtual needle.
ABSTRACT 60

INITIAL ASSESSMENT OF BOILING HISTOTRIPSY ABLATION OF EX VIVO HUMAN RENAL TUMORS VS. RENAL CORTEX

George R. Schade¹, Tatiana D. Khokhlova², Yak-Nam Wang³, Philip C. May¹, Adam D. Maxwell¹, Daniel W. Lin¹, Michael R. Bailey³, Vera A. Khokhlova³
University of Washington, ¹Department of Urology, ²Department of Gastroenterology, ³Applied Physics Lab

Introduction: Boiling histotripsy (BH) is a pulsed focused ultrasound (FUS) technology that mechanically disrupts targeted tissue without thermal effects. BH utilizes millisecond-long FUS pulses to create bubbles at the focus via rapid shock-induced boiling and is distinct from “cavitation-cloud” histotripsy. Interaction between subsequent pulses and the bubbles mechanically homogenizes tissue into micron-sized debris. Our group has been developing BH as a novel non-invasive treatment for small renal masses, with promising ex vivo and in vivo preliminary data. We aimed to evaluate the responsiveness of fresh ex vivo human renal masses to the effects of BH compared to cortex.

Methods: Freshly excised human renal tissue (portions of masses and renal cortex) was obtained from patients (n=6) undergoing radical nephrectomy from an IRB approved procurement program. Renal masses included clear cell renal carcinoma (RCC, n=4), papillary RCC (n=1) and oncocytoma (n=1). All specimens were acquired <2 hours from nephrectomy. Tissue samples were degassed for >30 minutes in phosphate buffered saline (PBS) and then embedded in low melting point agarose gel. Embedded tissue was then submerged in a holder in degassed PBS. Under ultrasound image guidance, BH pulses (10 ms duration, 1 Hz pulse repetition frequency, peak focal pressures of p+≈88 MPa, p−≈17 MPa, shock amplitude of 98 MPa, 3-60 pulses/focus, 1-13 foci/tissue piece) were delivered to foci within the cortical or tumor tissue using a 1-MHz 7-element FUS transducer. Following treatment, tissue was evaluated grossly and/or formalin-fixed for histologic assessment with H&E and Masson’s trichrome staining.

Results: BH produced the expected hyperechoic bubbles at the focus in all treated tissue. As treatment progressed hypoechoic cavities became apparent between pulses consistent with mechanical tissue homogenization that was confirmed on gross and histologic assessment. In all cases, tumor was more sensitive to the effects of BH than renal cortex, with hypoechoic foci apparent on US in as few as 2-3 pulses in tumor vs >10 pulses in cortex. Histologically, clear cell and papillary tumors were completely or nearly completely homogenized in all cases with 10 pulses/focus (see Figure). Conversely, a minimum of 15 pulses/focus was required to produce any evidence of treatment in cortex, with complete homogenization requiring >120 pulses/focus. The oncocytoma tissue fragment was small and permitted only a single focus of treatment (45 pulses) with erosion of the lesion to the surface suggesting complete homogenization.

Conclusion: This data represents the first application of histotripsy to malignant human tissue of any type and suggests that mechanical ablation of human renal tumors with BH is feasible. The greater sensitivity of ex vivo human renal tumors compared to renal cortex, if confirmed in vivo, suggests preferential ablation of tumor tissue over benign parenchyma is possible and may assist in preservation of renal function and improve safety.

Funding: NIH R01 EB7643, K01 EB 015745, NSBRI through NASA NCC 9-58, and The Urology Care Foundation

Figure: Histologic appearance of nearly completely homogenized (+) clear cell RCC treated with 10 BH pulses and sparsely homogenized (*) renal cortex with intact glomeruli and tubules treated with 15 pulses.
ABSTRACT 61

EX-VIVO COMPARISON OF PORCINE RENAL MICROWAVE ABLATION AT 915 MHZ AND 2450 MHZ

Karli Peña¹, Sean Bartholomew¹, Nelson Salas PhD¹,⁲, Govindarajan Narayanan², Raymond Leveillee³
¹Biomedical Optics & Laser Laboratory, Biomedical Engineering, University of Miami, Coral Gables, FL
²Interventional Oncology & Robotics Laboratory, Division of Vascular & Interventional Radiology, Department of Radiology, University of Miami Miller School of Medicine, Miami, FL
³Center for Advanced Robotics & Urologic Care, Bethesda Hospital East, Boynton Beach, FL

Introduction: Microwave ablation (MWA) is becoming more frequently used as a minimally-invasive thermal treatment modality for solid tumors. The microwave penetration depth achieved during MWA depends on the relative permittivity of the tissue, which can vary with frequency, temperature, and water content. It is theorized that 915 MHz has a larger penetration depth than 2450 MHz, which may enable more controllable heating environment for larger sized ablations. Larger microwave reflection loss at 2450 MHz can be combated by use of higher output powers, resulting in steep temperature gradients and rapid increases in temperature. The objective of this study was to measure and compare the temperature and coagulation effects of MWA by a 915 MHz system and a 2450 MHz system when operated at similar output powers in a controlled ex-vivo environment.

Methods: Two ablations per ex-vivo porcine kidney were performed using either the Medwaves AveCure 902-928 MHz System (San Diego, CA) in power mode with a single 16 G probe or the HS Amica 2450 MHz System (Asprilla, Italy) with a saline-cooled 16 G probe. The probe was inserted 4.0 cm into the kidney at the upper or lower pole, between the surface and the collecting system boundary. The AveCure system was operated at an output power of 24 W with the threshold temperature at either 96°C or 106°C. Each ablation was performed for either 3 or 5 minutes. Amica system ablations were conducted at a constant output power of either 25 W or 30 W at 100°C for 5 minutes. Five trials per parameter set were completed. Temperatures were measured using eight fiber optic thermal sensor placed 5 and 15 mm from emitting region of the probe axis. Gross coagulation dimensions, maximum temperatures, and the time to reach maximum temperatures were recorded. Curve fitting of the initial 10 seconds of ablation and statistical analysis (ANOVA p<0.05) were completed using Origin 8 (Northampton, MA).

Results: Temperature changes within the first 10 seconds were best fit to a power equation having the form $T=a*t^b$, where “$T$” is temperature change ($°C$), “$t$” is the time into ablation (s), and “$a$” and “$b$” are parameters. The average values of each of the results are provided in the tables below. There were no significant differences between the systems in maximum temperatures, time to reach the maximum temperatures, and coagulation length and width. Significant differences between the coagulation depth measurements occurred between several of the AveCure and Amica experiments. Significant differences were observed between the curve fitting equation parameters obtained from both systems. This can be attributed to differences in energy absorption at different frequencies and rate of heat diffusion. Temperatures increased more rapidly near the probe tip when using the Amica 2450 MHz system.

Conclusion: Under similar output powers and irradiation times, there are few differences between the temperatures and coagulation dimensions achieved using these 915 MHz and 2450 MHz systems under their operating algorithms. Additional studies are required to further determine specifically the differences between the two wavelengths.

---

**Table 1.** Averaged experimental data from ex-vivo porcine kidneys irradiated using the Medwaves AveCure 915 MHz MWA system operated in power mode at 12 W output power and temperature settings.

<table>
<thead>
<tr>
<th>Coagulation Dimensions</th>
<th>Curve Fit Equation Parameters</th>
<th>$R^2$-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp. Length (cm)</td>
<td>Width (cm)</td>
<td>Depth (cm)</td>
</tr>
<tr>
<td>1</td>
<td>2.5±0.5</td>
<td>1.5±0.3</td>
</tr>
<tr>
<td>2</td>
<td>3.1±0.7</td>
<td>2.3±0.7</td>
</tr>
<tr>
<td>3</td>
<td>3.1±0.5</td>
<td>2.1±0.4</td>
</tr>
<tr>
<td>4</td>
<td>2.8±0.3</td>
<td>2.5±0.2</td>
</tr>
</tbody>
</table>

**Table 2.** Averaged experimental data from ex-vivo porcine kidneys irradiated using the HS Amica 2450 MHz MWA system operated at 25 W and 30 W for 5 minutes.

<table>
<thead>
<tr>
<th>Coagulation Dimensions</th>
<th>Curve Fit Equation Parameters</th>
<th>$R^2$-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp. Length (cm)</td>
<td>Width (cm)</td>
<td>Depth (cm)</td>
</tr>
<tr>
<td>1</td>
<td>2.0±0.6</td>
<td>2.5±0.7</td>
</tr>
<tr>
<td>2</td>
<td>3.1±0.6</td>
<td>2.3±0.2</td>
</tr>
</tbody>
</table>

(Experiment legend: 1: 25 W; 5 min; 2: 30 W; 5 min)
THREE-DIMENSIONAL COMPUTED TOMOGRAPHIC EVALUATION OF PELVICE ORGAN PROLAPSE SURGERY

Mayura Nakano1, Sunao Shoji1, Taro Higure1, Masayoshi Kawakami1,Toshiro Terachi2, Hikaru Tomoe3,Uchida Toyoaki1
1 Department of Urology, Tokai University Hachioji Hospital, Japan
2 Department of Urology, Tokai University School of medicine, Isehara, Japan
3 Department of Pelvic Reconstructive Surgery

Introduction: In patients with pelvic organ prolapse it is important to evaluate the posterior urethrovesical angle (PUVA), the distance between the urethra and the pubic bone, and the pelvic arterial anatomy in relation to the pelvic bone. We assessed the effectiveness of using three-dimensional (3D) computed tomography (CT) for such an evaluation before and after surgery for pelvic organ prolapse.

Methods: 3D CT examinations were performed in four women with pelvic organ prolapse between May 2015 and August 2015. We assessed three-dimensionally the changes in the pelvic organ and pelvic arterial anatomy, and evaluated the clinical efficacy of 3D CT for this condition.

Results: The mean age of the patients was 69 years (range, 65–74). Cystocele was present in three patients and uterine prolapse in one. Tension-free vaginal mesh (TVM) repair was performed in three patients and anteroposterior TVM repair in one. On chain urethrocystography (UCG), the median PUVA was 110° (range, 85–110°); however, when measured by 3D CT the median PUVA was 127° (range, 108–161°). On chain UCG the median distance between the urethra and the pubic bone was 12 mm (range, 3.7–18), whereas this distance was 7.15 mm (range, 3.6–10.3) as measured by 3D CT. A significantly widened PUVA (from 112° to 138°) was recognized in one patient with de novo stress urinary incontinence. The 3D change in positional relations between the urethra and bladder was more remarkable here than in the other cases. Delineation of the pelvic arterial anatomy obtained by 3D CT helped us to reorganize the relationship between the site of the needle puncture and the pelvic arteries.

Conclusion: In the present study, 3D images showed more detailed information than 2D images as well as minute changes in the relationships within the pelvic structures. Therefore, 3D CT evaluation of the pelvis is a potentially useful tool for pelvic organ prolapse surgery. Future comparison studies of surgical outcomes of patients assessed with and without 3D CT are warranted.
SYNTHETIC HUMAN MODEL FOR UROLOGY RESIDENCY TRAINING PROGRAM IN KIDNEY BIOPSY


FACERES - Medicine School*, São José do Rio Preto, Brazil
Institute of Urology - Santa Virginia Hospital, São Paulo, Brazil.

Introduction: The development of Urology is related to the improvement of the urologist in diagnostic techniques. Then, learning in ultrasound is very important, currently many urological conferences already have training courses in urological ultrasound. Renal biopsy directed by ultrasound is a very requested procedure by nephrologists, and the most of urologists have no training for this procedure, constituting a major challenge in the professional life of the urologist, mainly because this renal biopsy training also helps in punctures to nephrostomies. Therefore, we decided to develop an artificial model for training of the renal biopsy.

Methods: A model of the human body was built to the dimensions of the human body, kidney, ureter and ribs. We use ballistic gelatin (glycerin, collagen and water) molded in the human dummy. The kidney and ureter were constructed with different density silicon. The model was tested for resident training in percutaneous renal biopsy with ultrasound guided renal puncture.

Results: The model was constructed to simulate the dimensions and densities of the human body. All stages of renal biopsy were simulated with similarity to the real procedure. The training allowed locate the kidney by ultrasound, cutaneous path of the needle was visualized to the kidney, with the removal of the model fragments.

Conclusion: There was ease in building the model with great reality simulation in kidney biopsy guided by ultrasound, providing training for all stages of the procedure. Thus, the urology residents were able to assimilate all the technical steps, getting familiar with ultrasonography. This reduces the learning curve and brings greater security to the patient; furthermore, this model can be developed and adapted to other urological conditions, such as training in nephrostomy or extracorporeal lithotripsy.
SOCIETY OFFICERS:

PRESIDENTS
Stavros Gravas
Bodo Knudsen
Pilar Laguna

VICE-PRESIDENTS
Peter Schulam
Jean Zheng

TREASURER
John Denstedt

COUNCILOR
Louis Kavoussi

EXECUTIVE DIRECTOR
Dan Stoianovici

ADVISORY BOARD
Jeffrey Cadeddu
Ralph Clayman
Jean de la Rosette
Misop Han
Pilar Laguna
Thomas Lawson
Manoj Monga
Pierre Mozer
Stephen Nakada
Jens Rassweiler
Koon Ho Rha
William Roberts
Arthur Smith
Li-Ming Su
Gerald Timm
Hessel Wijkstra
Kevin Zorn
AWARDS:
BEST PAPER AWARDS:

INCREASED CONTRAST OF STONE SPECIFIC ULTRASOUND IMAGING IN HUMAN SUBJECTS. Bryan W. Cunitz MS,1 Barbrina Dunmire MS,1 Yasser Haider MD,1 Julianna Simon,1 PhD, Oleg Sapozhnikov, DSc,1,2 Michael R Bailey PhD,1,3 Jeff Thiel,4 Adam D. Maxwell, PhD,3 Philip C. May, MD,3 Mathew D. Sorensen MD MS,5 and Jonathan D. Harper MD.1 1Center for Industrial and Medical Ultrasound, Applied Physics Laboratory, University of Washington, 2Dept. of Acoustics, Physics Faculty, Moscow State Univ., Leninskie Gory, Moscow 119991, Russia, 3Department of Urology and 4Department of Radiology, University of Washington School of Medicine, 5 Div. of Urology, Dept. of Veteran Affairs Medical Center, Seattle, WA 98108

PROSPECTIVE EVALUATION OF 99mTc-SESTAMIBI SPECT/CT FOR THE DIAGNOSIS OF RENAL ONCOCYTOMAS AND HYBRID ONCOCYTIC/CHROMOPHobe TUMORS. Michael A. Gorin, M.D.1, Steven P. Rowe, M.D., Ph.D.2, Alex S. Baras, M.D., Ph.D.3, Lilja B. Solnes, M.D.2, Mark W. Ball M.D.1, Phillip M. Pierorazio, M.D.4, Christian P. Pavlovich, M.D.1, Jonathan I. Epstein, M.D.3, Mehrbod S. Javadi, M.D.2, Mohamad E. Allaf, M.D.1. 1The James Buchanan Brady Urological Institute and Department of Urology, 2The Russell H. Morgan Department of Radiology and Radiological Science, 3Department of Pathology, Johns Hopkins University, School of Medicine, Baltimore, MD

TOP 10 ABSTRACTS:

MRI-SAFE REMOTE CENTER OF MOTION NEEDLE-GUIDE ROBOT. Dan Stoianovici1, Changhan Jun1, Sunghwan Lim1, Doru Petrisor1, Reza Monfaredi2, Emmanuel Wilson2, Axel Krieger2, Stan Fricke2, Karun Sharma2, Kevin Cleary2. 1Robotics Laboratory, Urology Department, Johns Hopkins University, Baltimore, MD; 2Sheikh Zayed Institute for Pediatric Surgical Innovation, Children's National Health System, Washington, DC

A DEVICE FOR RARE CELL ISOLATION AND CHARACTERIZATION. Emma E. van der Toom1,2, Michael A. Gorin1, James E. Verdone1, Changhan Jun1, Doru Petrisor1, Dan Stoianovici1, Kenneth J. Pienta1. 1The James Buchanan Brady Urological Institute, Johns Hopkins School of Medicine, Baltimore, MD, USA; 2VUmc School of Medical Sciences, VU University, Amsterdam, The Netherlands

A NOVEL ANTIFOULING COATING THAT REPELTS PROTEINS AND BACTERIA FROM THE SURFACE OF INDEWILLING URINARY DEVICE MATERIALS. Kai Yu1, Joey Lo2, Yan Mei3, Dirk Lange4, Jayachandran Kizhakkedathu1. 1Dept. of Pathology and Lab Medicine & Centre for Blood Research; 2Dept. of Urologic Sciences; University of British Columbia, Vancouver, BC, Canada

DEVELOPMENT OF A RELIABLE SPOT-URINE “OXALOMETER”. John P. Lindsey II MEng1, Arun Wanchoo PhD2, Cuong Nguyen PhD2, Ammon B. Peck PhD2, Benjamin K. Canales MD, MPH1. 1 Department of Urology, University of Florida; 2Department of Microbiology, College of Veterinary Medicine, University of Florida

IMAGING OF PROSTATIC CANCER BY NEWLY DEVELOPED LED-BASED WIDEBAND NEAR-INFRARED LIGHT SOURCE INCLUDING THE ABSORPTION BAND OF WATER WITH PSA: FIRST RESULTS. Tokunori Yamamoto1, Hideki Mizuno1,Yasuto Funahashi1, Yoshihisa Mastukawa1, Yasushi Yoshino1,Shingo Fuchi1 and Momokazu Gotoh1. 1 University of Nagoya, Department of Urology; 2 AoyamaGakuin University, Department of Engineering

BROADLY FOCUSED BEAM FOR IMPROVED REPOSITIONING OF STONE FRAGMENTS. Bryan W. Cunitz MS,1 Adam D. Maxwell, PhD,2 Barbrina Dunmire MS,1 Brian MacConaghy, MS,1 Michael R Bailey PhD,1,2 Doug Corl, PhD,3 Oren Levy, PhD,3 Philip C. May MD,2 Jonathan D. Harper MD,2 and Mathew D. Sorensen MD MS. 1Center for Industrial and Medical Ultrasound, Applied Physics Laboratory, University of Washington, 2Department of Urology University of Washington School of Medicine, Seattle WA, 3SonoMotion, Inc. San Francisco, CA, 4Division of Urology, Dept. of Veteran Affairs Medical Center, Seattle, WA

VASCULAR-TARGETED PHOTODYNAMIC THERAPY IN UROTHELIAL CANCER: IMPROVED SURVIVAL EVEN WITH SUBTHERAPEUTIC PARAMETERS. Barak Rosenzweig1, Alex Somma1, Stephen La Rosa1, Sylvia Jebiwott1, Renato Beluco Corradi Fonseca1, Sebastien Monette2, Kwanghee Kim1 and Jonathan A. Coleman1. 1 Urology Service, Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, NY; 2 Division of Pathology, Memorial Sloan Kettering Cancer Center, New York, NY

MARGIN ASSESSMENT IN RENAL SURGERY USING A HANDHELD OPTICAL COHERENCE TOMOGRAPHY PROBE. Wesley W. Ludwig1, Sara E. Wobker1, Michael A. Gorin1, Mark W. Ball1, Adam M. Zysk2, Philip M. Pierorazio1, Mohamad E. Allaf1, Johns Hopkins Hospital, Baltimore, MD; 2 Diagnostic Photonics, Chicago, IL

31th EUS Annual Meeting, May 7, 2016, San Diego, CA
<table>
<thead>
<tr>
<th>Name</th>
<th>Award Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ernesto III Arada</td>
<td>☼</td>
</tr>
<tr>
<td>Riccardo Autorino</td>
<td>☼</td>
</tr>
<tr>
<td>Thorsten Bach</td>
<td>☼</td>
</tr>
<tr>
<td>Jeffrey Cadeddu</td>
<td>☼</td>
</tr>
<tr>
<td>Haixin Chen</td>
<td>☼</td>
</tr>
<tr>
<td>Ben H. Chew</td>
<td>☼</td>
</tr>
<tr>
<td>Mahesh Desai</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Mohamed Elkoushy</td>
<td>☼ ☼ ☼</td>
</tr>
<tr>
<td>Cosmin Ene</td>
<td>☼</td>
</tr>
<tr>
<td>Oscar Fugita</td>
<td>☼</td>
</tr>
<tr>
<td>Arvind Ganpule</td>
<td>☼ ☼ ☼</td>
</tr>
<tr>
<td>Petrisor Geavlete</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Michael Gorin</td>
<td>☼</td>
</tr>
<tr>
<td>Louis Kavoussi</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Bodo Knudsen</td>
<td>☼</td>
</tr>
<tr>
<td>Thomas Lawson</td>
<td>☼ ☼ ☼</td>
</tr>
<tr>
<td>Wesley Ludwig</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Cristian Mirvald</td>
<td>☼</td>
</tr>
<tr>
<td>Razvan Multescu</td>
<td>☼</td>
</tr>
<tr>
<td>Kamol Panumatrasamee</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Sutchin Patel</td>
<td>☼ ☼ ☼</td>
</tr>
<tr>
<td>Arnoud Postema</td>
<td>☼</td>
</tr>
<tr>
<td>Alan Priester</td>
<td>☼</td>
</tr>
<tr>
<td>Koon Ho Rha</td>
<td>☼</td>
</tr>
<tr>
<td>Ioanel Sinescu</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Mathew Sorensen</td>
<td>☼</td>
</tr>
<tr>
<td>Govindarajan Srimathveeravalli</td>
<td>☼</td>
</tr>
<tr>
<td>Cristian Surcel</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Hessel Wijkstra</td>
<td>☼ ☼</td>
</tr>
<tr>
<td>Chong Xue</td>
<td>☼</td>
</tr>
</tbody>
</table>
The active review committee comprises 72 reviewers from around the world. We gratefully acknowledge their contribution to the success of the meeting and thank them for taking the time to promote the best science.

Enrico Andrade
Caio Andrade
Ernesto III Arada
Mark Ball
Alex Baras
Timothy Brand
Jeremy Cepek
Haixin Chen
Ben H. Chew
Peter Choyke
Sasha Druskin
Mohamed Elkousy
Nicholas Ellens
Cosmin Ene
Luis Florencio
Bogdan Geavlete
Petrisor Geavlete

Dragos Georgescu
Raphael Gomes
Michael Gorin
Ryan Hutchinson
Eduardo Iared
Changhan Jun
Amy Kerdok
Thomas Lawson
Aaron Lay
Andrew Leone
Chiye Li
Wesley Ludwig
Salvatore Micali
Cristian Mirvald
Pierre Mozer
Razvan Multescu
Katie Murray
Shyam Natarajan

Yasser Noureldin
Cervando Ortiz-Vanderdys
Sutchin Patel
Karli Pena
Kenneth Pienta
Thomas Polascik
Wayne Poll
Alan Priester
William Roberts
Georgios Sakas
Raphael Santos
George Schade
Ioanel Sinescu
Dan Stoianovici
Cristian Surel
Nithin Theckumparampil
Sara Wobker
THANKS:

Dr. George Nagamatsu, Engineering and Urology Society Founder (1985)

Dr. Jack Vitenson, Society Treasurer (1985)

Special thanks to Dr. Thomas Lawson for his help formatting this program.

We thank Michelle Paoli and Debra Caridi for organizing the Annual Meeting.