Welcome! The Engineering and Urology Society (EUS) is holding its 20th annual meeting on Saturday, May 21st 2005 in San Antonio, TX together with the annual meeting of the American Urological Association. The E&U is dedicated to providing a forum where the latest tools and cutting-edge technology can be presented, as they pertain to either immediate or ambitiously foreseen urologic applications. The meeting is also meant to serve as a vehicle to shape future urologic practice by facilitating interactions among clinicians, academia and industry scientists. With this in mind, several exciting discussions have been planned for this year’s meeting. The program will include invited presentations and podium discussions in the morning and two poster scientific sessions in the afternoon. A wide variety of topics related to applied engineering, advances in endoscopy, urodynamics, ablation techniques, modeling and simulation, robotics, laparoscopy and telemedicine will be addressed.

Several positive changes and additions have been made this year in the structure of the society. The most important is that the E&U Society is now affiliated with the Endourological Society under a common membership structure. This year we have also extended the web site of the E&U society at http://engineering-urology.org/ with several new features reflecting the new structure of the society. Among these, are the online membership application and individual member pages giving access to communication between members, posting of messages, job opportunities, direct access to the Journal of Endourology, and simplified registrations for meetings. The web-based paper submission and review site was also upgraded.

We are happy to report that this year a record number of 75 paper submissions were received by the initial deadline. The review of these papers was performed with a number of 1024 reviews performed in less then 2 weeks by 44 reviewers from around the world. Each paper was graded with at least 12 independent reviews. We would like to thank the reviewers, whose names are gratefully listed in this program, for their contributions to this meeting.

The review process has also allowed for selection of the “Best Paper" Awards for the submission with the highest scores. We are happy to announce that this year’s top award was won by the research team of Dr. William Roberts from the University of Michigan for their excellent work on a pulsed cavitation ultrasound therapy model and animal experiments. The 2nd place was awarded to Dr. Joseph Liao and his colleagues from UCLA for their work on a biofilter for the detection of pathogens. Congratulations!

The E&U abstracts will continue to be published in the Journal of Endourology. Last year’s abstracts can be found in the September 2004 issue of the journal: Vol. 18, No. 7, p: 691-706.

Dr. John Denstedt, the program chairman this year, has assembled a well esteemed group of specialists for the podium sessions in the morning. Among those are again present our colleagues from the European Society of Urology Technology.

The society welcomes all urologists, engineers, scientists from industry and academia to join us for this unique multi / interdisciplinary experience. It is through the sharing of many visions that our future will be shaped. Once again we are very thankful to Dr. George Nagamatsu, the founder and first president of the society for setting the basis on which we are meeting today.

Thank you for your continued scientific support,

Louis Kavoussi, MD
Dan Stoianovici, PhD
ENGINEERING AND UROLOGY SOCIETY

Saturday, May 21\textsuperscript{st}, 2005, HBG Convention Center, San Antonio, TX

Program Chair: John Denstedt, MD

7:00AM-7:30AM  
Registration

7:30AM-7:40AM  
Welcome and Awards  
Best Paper Awards  
Louis Kavoussi, MD  
Dan Stoianovici, PhD

7:40AM-8:00AM  
2005 Fellows Presentation  
Sompol Permpongkosol, MD

8:00AM-9:00AM  
Health Information Technology and Communications:  
Current and Future Applications  
Digital Communications in the OR and Clinic  
Ramsay Kuo, MD  
Telementoring and Telesurgery  
Prokar Dasgupta, MD  
The Medical Device Accelerator:  
Mr. Rick Geoffrion  
A Vehicle to Develop New Technology

9:00AM-10:00AM  
European Society of Urology Technology  
Jean de la Rosette, MD, PhD  
Image Guided Therapy  
Adrian Joyce, MD  
Advanced Diagnostics  
Rolf Muschter, MD  
Future Developments in Imaging  
Hessel Wijkstra, PhD

10:00AM-10:30AM  
Coffee Break

10:30AM-11:30AM  
Biotechnology Forum  
Laparoscopic Equipment and Devices:  
What’s New / What’s Coming  
Michael Moran, MD  
Advantages and Limitations When Using  
NiTi Alloy for Urological Applications  
Mr. Erik Othel-Jacobsen  
Tissue Engineering in Urology:  
Current State of the Art  
Tony Atala. MD

11:00AM-12:00PM  
E&U Plenary Session  
Robots and Micromotors:  
Alok Shrivastava, MD  
Star Wars Surgery 2005  
Michael Parfitt, MD  
Surgical Simulation and Training:  
A New Paradigm in Surgical Education  
Rob Sweet, MD  
What’s New in Stones:  
Manoj Monga, MD  
ESWL / Lasers and Devices  
Michael Bailey, MD

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Lunch Break
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Victor Leitao

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ABSTRACT 101

IMMUNE MEDIATED SURVIVAL ADVANTAGE AND PRIMARY TUMOR CONTROL OF CRYOABLATION COMPARED TO NEPHRECTOMY IN A MURINE MODEL OF ADVANCED RENAL CANCER

Sean P. Hedican, M.D., Eric R. Wilkinson, Thomas F. Warner, M.D., Fred T. Lee, M.D., Stephen Y. Nakada, M.D.

Madison, WI.

Introduction and Objective: We previously described a reproducible, non-debilitating murine model of renal tumor cryoablation utilizing small cryoprobes and intra-renal implants of Renca, a murine renal adenocarcinoma. We evaluated the impact of an intact immune system on the improved survival observed in mice with advanced renal cancer treated with cryoablation compared to nephrectomy.

Methods: Subcapsular left renal implantation of $1 \times 10^5$ Renca cells was performed in 42 BALB/c mice and 14 each were randomized to nephrectomy, cryoablation, or a sham operation on a day when progression to metastatic disease had previously been shown to be inevitable (11 days). Cryoablation to $-160^\circ C$ was performed of the observed renal tumors using specially designed 2-mm cryoprobes (Endocare Cryosurgery-Irvine, CA) and a standard argon-based cryosurgery unit. The last three groups of 6 animals were run parallel to three groups of BALB/c nude (T-suppressor cell deficient) mice. Mean survival analysis was performed using a standard T-test. To assess local control of the primary lesion, residual gross tumor volume in the implanted kidney ($4/3 \pi l w d$) at necroscopy was compared between cryoablation and sham treated animals. Significant residual tumor was defined as a volume encompassing $>10\%$ of the entire kidney. If no visible tumor was identified, microscopic confirmation was performed.

Results: Mean survival of immune-competent Renca implanted animals was 37, 30, and 29 days for those treated with cryoablation, sham surgery, and nephrectomy, respectively, versus 25, 25, and 24 days in similarly treated nude mice. Improvement in survival of animals with an intact immune system treated with cryoablation relative to nephrectomy was significant ($p=.03$) in this treatment model of advanced renal cancer. No significant survival advantage ($p=.76$) of cryoablation relative to nephrectomy was observed in the similarly treated nude mice. Significant residual tumor within the cryoablation treated kidneys was noted in only 27$\%$ of immune-competent and 38$\%$ of nude mice compared to 100$\%$ of sham treated animals. No gross tumor was identified in 53$\%$ of cryoablation treated kidneys in immune-competent mice with 38$\%$ of these animals having no evidence of microscopic tumor. Only 25$\%$ of the nude mice treated with cryoablation had no gross evidence of tumor with 50$\%$ of these demonstrating no microscopic tumor.

Conclusions: Our investigations suggest that cryoablative therapy of advanced renal cancer may provide survival advantages over nephrectomy in addition to local tumor control, which appears to be immune mediated.
ABSTRACT 102

SUPERIOR URINE PRODUCTION DURING LAPAROSCOPIC KIDNEY DONATION AND EQUIVALENT EARLY GRAFT FUNCTION RELATIVE TO OPEN DONATION USING OSMOTIC DIURETIC AND DOPAMINE INFUSIONS

Stefanie L. Bolte, M.D., Thomas L. Chin, M.D., Timothy D. Moon, M.D., Stephen Y. Nakada, M.D., David T. Uehling, M.D., Anthony M. D’Alessandro, M.D., Yolanda T. Becker, M.D., Sean P. Hedican, M.D.

Madison, WI.

Introduction and Objective: Intraoperative oliguria due to the prolonged pneumoperitoneum and its impact on immediate postoperative renal function have been expressed potential concerns of laparoscopic kidney donation. We evaluated our ability to maintain adequate diuresis during laparoscopic donor nephrectomy using continuous infusions of mannitol and dopamine and the ultimate impact on early graft function relative to open donation.

Methods: We performed a retrospective review of 98 consecutive laparoscopic donor nephrectomies and the most recent 80 open donor nephrectomies from 1999 to 2002. All laparoscopic donors received our protocol infusions of mannitol (.33 g/kg/hr) and renal dose dopamine (2-3.0 cg/kg/min) throughout the duration of the pneumoperitoneum. All of the open donors received a single dose of 12.5 g of mannitol. Multiple donor variables including age, weight, operative time, estimated blood loss, intraoperative fluids (cc/min), intraoperative urine production (cc/kg/hr), and change of creatinine at the time of discharge were compared between the two groups. Postoperative graft recipient data including initial 24-hour urine production, one week, and one month creatinine values among the two groups were also compared using Wilcoxon rank sum test.

Results: No significant differences were noted between the two groups with respect to age, weight, intraoperative fluids, or change of creatinine at the time of discharge. Mean intraoperative urine output was 5.2 cc/kg/hr for the laparoscopic and 2.4 cc/kg/hr for the open donors (p=0.0001). Mean estimated blood loss was significantly lower (p= 0.0001) for the laparoscopic (106.7 cc) versus the open donor patients (184.7 cc). No significant difference was noted in initial 24-hour urine production, and one week and one month creatinine values among patients receiving a kidney donated via a laparoscopic versus an open technique.

Conclusions: Laparoscopic harvest of a donor kidney utilizing osmotic diuretic and dopamine infusions produces superior intraoperative urine production in donor patients and equivalent early graft function in recipients compared to open donation.
DECREASED BACTERIAL ADVANCEMENT USING A NOVEL EVERTING ACCESS SHEATH

Jonathan N. Rubenstein M.D., Affonso H.L.A. Camargo M.D., Sinan Sozen M.D., Brent D. Ershoff B.S., Marshall L. Stoller M.D.
Department of Urology, University of California, San Francisco, CA

Introduction: A novel device (SLIP Introducer™ Sheath, Percutaneous Systems, Mountain View, CA) that deploys a urologic sheath in an everting manner to achieve urinary tract access has been developed. This design likely decreases complications associated with instrumentation compared to using no sheath or using a traditional access sheath. We created an in vitro urinary tract model to compare advancement of bacteria between instruments with and without this everting technology.

Methods: Blocks of sterile agar with 17-French tracts of three lengths (2.7, 5.5 and 11 cm) were created, and 5 ml of Luria-Bertani broth/ampicillin solution were placed in a well at the distal end of each tract. An 18-French everting SLIP Introducer™ Sheath and a non-everting instrument of the same diameter (18-French dilator, Cook Urological, Spencer, IN) were each dipped into a solution of ampicillin-resistant E. coli, and advanced through the agar tracts until the tip reached the center of the wells. After 10 seconds, 4 ml of the broth were collected from each well and cultured at 37ºC. Bacterial growth was compared by measuring the optical density (OD) of the broth after 6, 7, 8, 9, and 10 hours of incubation.

Results: The mean overall OD (range) of the broth was significantly lower (p<0.001) in the SLIP Introducer™ everting sheath cultures when compared to the non-everting control instrument for all advancements at all three tract lengths. (Table 1):

<table>
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<th>Time</th>
<th>2.7 cm length</th>
<th>5.5 cm</th>
<th>11 cm</th>
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<tr>
<td></td>
<td>SLIP</td>
<td>Control</td>
<td>SLIP</td>
</tr>
<tr>
<td>6 hr</td>
<td>0.12  (0.07-0.17)</td>
<td>0.73  (0.15-1.34)</td>
<td>0.01  (&lt;0.01-0.30)</td>
</tr>
<tr>
<td>7 hr</td>
<td>0.24  (0.12-0.33)</td>
<td>1.10  (0.35-1.75)</td>
<td>0.05  (&lt;0.01-0.56)</td>
</tr>
<tr>
<td>8 hr</td>
<td>0.41  (0.27-0.56)</td>
<td>1.46  (0.53-2.21)</td>
<td>0.02  (&lt;0.01-0.76)</td>
</tr>
<tr>
<td>9 hr</td>
<td>0.75  (0.50-0.89)</td>
<td>1.77  (0.86-2.31)</td>
<td>0.06  (&lt;0.01-0.47)</td>
</tr>
<tr>
<td>10 hr</td>
<td>1.14  (0.81-1.56)</td>
<td>2.33  (1.50-3.22)</td>
<td>0.13  (&lt;0.01-0.37)</td>
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Conclusion: The everting sheath design allows a substantial reduction in bacterial advancement through an artificial urinary tract when compared to a non-everting instrument. This finding, along with other advantages of an everting sheath, may reduce or eliminate many of the complications associated with urinary tract instrumentation.
ABSTRACT 104

A COMPARISON OF RESOLUTION, CONTRAST AND COLOR DIFFERENTIATION AMONG FIBEROPTIC AND DIGITAL FLEXIBLE CYSTOSCOPES

James F. Borin, Corollos S. Abdelshehid and Ralph V. Clayman
Department of Urology, University of California, Irvine, Orange, CA

Introduction and Objective: Advances in electro-optics continue to improve the urologist’s ability to perform minimally invasive endoscopic and laparoscopic procedures. While the development of fiberoptic endoscopes 20 years ago greatly impacted the practice of urology, distal sensor, digital technology may represent the next step in the evolution of endoscopy. We compared a new distal sensor, digital flexible cystoscope to two standard fiberoptic flexible cystoscopes.

Methods: We evaluated resolution, contrast, and color discrimination in a new ACMI-ICN distal sensor, digital cystoscope with >165,000 effective pixels in its clear aperture (viewing area), a new ACMI-ACN II fiberoptic cystoscope with <15,000 pixels in its clear aperture, and a Storz 1127 office fiberoptic cystoscope. The distal sensor, digital cystoscope had a self-contained white-light LED illumination while the fiberoptic cystoscopes were connected to a conventional 300 W Xenon external light source and a high-end, Storz Tricam SL, 3-chip camera. Five subjects, 3 urologists and 2 animal laboratory assistants familiar with cystoscopic equipment, compared each cystoscope across 13 test parameters.

Results: There was no difference in the performance between the two fiberoptic cystoscopes. The ACMI distal sensor, digital cystoscope was statistically superior to one or both fiberoptic cystoscopes across 12 of 13 tests. Contrast—the distal sensor, digital cystoscope was better able to discern contrast differences along a 15-step grayscale gradient than the 1127 fiberoptic cystoscope (p<0.001). Resolution—the distal sensor, digital cystoscope was able to resolve an average of 3.5 lines/mm vs. 2.0 lines/mm for both fiberoptic cystoscopes at high, medium and low contrast at a distance of 20 mm from the target (p<0.04), and 7.52 lines/mm vs. 3.58 lines/mm at 10 mm distance (p<0.001). The ICN distal sensor, digital cystoscope was able to resolve a 1 mm target at a distance of 6.1 cm vs. 3.3 and 3.8 cm for the 1127 and ACN II fiberoptic cystoscopes, respectively (p<0.001). Color—the distal sensor, digital cystoscope was better able than either fiberoptic cystoscope to discern the difference between shades of dark red, but performed equally in the blue/green range.

Conclusions: The ICN distal sensor, all-digital cystoscope was clearly superior to two representative fiberoptic cystoscopes in vitro in terms of resolution, contrast discrimination and red color differentiation. In vivo performance remains to be assessed.
Objective: The mechanisms and factors for renal vascular trauma induced by extra-corporeal shockwave lithotripsy (ESWL) are still under discussion. An ex vivo tissue model (isolated, dye perfused pig kidney) was used, to evaluate the shockwave induced renal trauma. Four different electromagnetic shockwave sources (SIEMENS-System M, SIEMENS-System C + two experimental energy sources) have been tested with different physical parameters (energy density, total energy).

Methods: Porcine kidneys were harvested within ten minutes after death, flushed with cold saline solution and stored on crushed ice. The experiments have been performed with laser guided application of shock waves in a waterbath during arterial perfusion with Berliner Blau under constant pressure (80 mm Hg), followed by morphological and histo-pathological investigation of renal vascular damage. To quantify the renal tissue trauma, the localization and grade of tissue lesion, examined in histopathological investigation, were graduated and transferred into a score-system. The scores for localization (L0-L3) and grade of lesion (S0-S4) were multiplied, to form the „LesionScore“ (0-12), representing the total extend of renal tissue injury.

Results: The morphological and microscopical examination of “treated” kidneys showed typical vascular lesions (dye extravasation) in relation to applied SW-parameters (No. of shockwave, shockwave-energy). All experiments were carried out five times with a constant SW-parameter, to calculate an average lesion score. After completion of the experiments, the correlation between shockwave parameters and resulting LesionScore were analysed with the statistic tool of linear regression. Energy density (ED+) was the only shockwave parameter with a proven statistical correlation ($R^2 = 0,96$). Shockwave system specific parameters ($p^+$, $p^-$, focal geometry) played a minor role in regard to renal traumatization.

Conclusion: The evaluation of four different shockwave sources pointed out, that energy density (ED+) is the most important shockwave parameter in regard to renal vascular damage. This fact may invigorate the development of new shockwave systems, enabling high energy output with low energy density levels.
ABSTRACT 106

EFFICACY OF HIGH INTENSITY FOCUSED ULTRASOUND (HIFU) IN DIFFERENT RISK GROUPS OF LOCALIZED PROSTATE CANCER

S Thueroff , Ch Chaussy
Dep of Urology, Muenchen Harlaching, Germany

Objectives: Evaluation of >1000 cases of local HIFU treatment in localized PCa. 3 “risk groups”: high risk/locally advanced (A), low/intermediate risk (B) and unilateral, low grade + low volume PCa, treated partially (C).

Material and Methods: 557 patients (A), 412 patients (B) and 44 patients (C) treated for biopsy proven PCa by transrectal HIFU in a single center, using Ablatherm® HIFU device (EDAP SA, France).

Results:

<table>
<thead>
<tr>
<th>Patient groups</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>557</td>
<td>412</td>
<td>44</td>
</tr>
<tr>
<td>T</td>
<td>3-4</td>
<td>1-2 b</td>
<td>1-2 a</td>
</tr>
<tr>
<td>N / M</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gleason score (1-5)</td>
<td>4-5</td>
<td>1-3</td>
<td>1-4</td>
</tr>
<tr>
<td>number of + biopsies</td>
<td>&gt;3</td>
<td>1-3</td>
<td>1-3</td>
</tr>
<tr>
<td>PSA i</td>
<td>&gt;20</td>
<td>&lt;20</td>
<td>&lt;20</td>
</tr>
<tr>
<td>% of all HIFU patients</td>
<td>48,4</td>
<td>35,8</td>
<td>4,6</td>
</tr>
<tr>
<td>age (median)</td>
<td>70</td>
<td>68</td>
<td>66</td>
</tr>
<tr>
<td>treated prostatic vol</td>
<td>&gt;80</td>
<td>&gt;80</td>
<td>&lt;80</td>
</tr>
<tr>
<td>% Gleason 1-3</td>
<td>29</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>number of + biopsies</td>
<td>3,2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>prostate volume (cc)</td>
<td>25</td>
<td>35</td>
<td>21</td>
</tr>
<tr>
<td>potent before therapy</td>
<td>45</td>
<td>68</td>
<td>80</td>
</tr>
<tr>
<td>PSA Initially</td>
<td>11 / 28</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>PSA ng/ml</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...Nadir</td>
<td>0,0 / 0,1</td>
<td>0,0</td>
<td>0,5</td>
</tr>
<tr>
<td>time to Nadir (weeks)</td>
<td>9,2</td>
<td>10,3</td>
<td>x</td>
</tr>
<tr>
<td>...velocity (ng/year)</td>
<td>0,15 / 0,78</td>
<td>0,11</td>
<td>x</td>
</tr>
<tr>
<td>...stability (ASTRO)</td>
<td>73,2 / 23,1</td>
<td>80,7</td>
<td>83,3</td>
</tr>
<tr>
<td>... at last PSA test</td>
<td>0,7 / 2,7</td>
<td>0,4</td>
<td>2,1</td>
</tr>
<tr>
<td>negative biopsies</td>
<td>82</td>
<td>93,7</td>
<td>52</td>
</tr>
<tr>
<td>residual tumor vol</td>
<td>15</td>
<td>2</td>
<td>Ipside 38</td>
</tr>
<tr>
<td>additional Pca therapy</td>
<td>15 / 28</td>
<td>4,9</td>
<td>4,6</td>
</tr>
<tr>
<td>sev. complications</td>
<td>2,7</td>
<td>1,6</td>
<td>2</td>
</tr>
<tr>
<td>endoOR after HIFU</td>
<td>22</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>HIFU re X rate</td>
<td>x</td>
<td>7,7</td>
<td>23</td>
</tr>
<tr>
<td>FU (weeks med/max)</td>
<td>133 / 305</td>
<td>114 / 332</td>
<td>90 / 203</td>
</tr>
<tr>
<td>potent after HIFU</td>
<td>22</td>
<td>37</td>
<td>70</td>
</tr>
</tbody>
</table>

Conclusions: HIFU by Ablatherm® proved high local and biochemical efficacy in non surgical cases (high comorbidity (B) and local advanced PCa (A) with an acceptable balance between efficacy and morbidity. Partial treatment (C) with preservation of contra-lateral tissue showed higher risk of recurrence.
ABSTRACT 107

SIEMENS SHOCKWAVE SYSTEM U 11 - FIRST CLINICAL RESULTS WITH A NEW ELECTROMAGNETIC SHOCKWAVE SOURCE

S Thueroff, Th Bergsdorf, Ch Chaussy
Department of Urology, Krankenhaus Muenchen-Harlaching
Munich, Germany, urologie@khmh.de

Objective: ESWL as an established treatment option for stone therapy showed a lack of real innovation throughout the last decade and lost ground in comparison to endoscopic measures. There is a need for new shockwave systems, providing high performance (low retreatment rate) with low complications.

Material and Methods: Based on the findings of the experiments with the isolated, dye perfused kidney, that energy density is the key parameter for shockwave induced tissue trauma, a new electromagnetic shockwave system was developed. This ringshaped SW-system U 11 with an increased penetration depth of 160 mm provides high energy output at low energy density levels. The feasibility of inline localization with ultrasound or fluoroscopy guarantees a precise stone focusing. For a first clinical test, this shockwave system was mounted on the lithotripsy platform SIEMENS Lithostar Modularis.

Results: 75 patients with 85 radioopaque stones in all areas of the urinary system were treated between 03 – 08/2004. Average stone size was 10.9 mm (5 – 25 mm). All patients received one ESWL-session under i.v. analgesia. The fragmentation was evaluated with KUB and ultrasound after 24 h. 1.500 – 4.000 shockwaves (kidney: Ø 2795, ureter: Ø 2996) were performed in 15 - 55 minutes treatment time (kidney: Ø 35 min., ureter: Ø 38 min.). 20 pts. needed auxiliary procedures before ESWL because of severe colics or stones > 15 mm; only 1 pt. required the placement of a JJ-stent after treatment because of an infected hydronephrosis. One patient developed a small subcapsular hematoma after ESWL-treatment.

All stones showed fragmentation after one ESWL-session. 9,3 % of the pts. were stonefre after 24 h; 58,7 % presented with fragments < 3 mm, 26,7 % with fragments 3–5 mm. Only 5,3 % of the pts. had fragments bigger than 5 mm. Based on the 24 h follow-up, 14,7 % of the patients with fragments > 3 mm were judged to receive a second ESWL-treatment according our BOOSTER-strategy (retreatment after 3 days, if fragments > 3 mm).

Conclusion: The concept of wide focal spot, enabling high energy output with low energy density, realized in this new electromagnetic shockwave system U 11 showed a high performance with low rate of side effects. The reduction of retreatment rate without increasing patient’s discomfort and complications will furthermore strengthen the position of ESWL as therapy of first choice for urinary calculi.
MODEL TO CALCULATE PRESSURE TRANSMISSION BY A LAPAROSCOPIC BULLDOG CLAMP DURING LAPAROSCOPIC RADICAL PROSTATECTOMY

Sijo J. Parekattil and Inderbir S. Gill.
The Cleveland Clinic Foundation

Objective: During laparoscopic radical prostatectomy, we utilize an atraumatic 25mm bulldog clamp (CEV 565, MicroFrance Medtronic Xomed, Jacksonville, Fla. Figure 1 below) for the control of the lateral vascular pedicles to the prostate. Our goal was to design a model to calculate the pressure (in mmHg) transmitted to tissue between the jaws of this clamp. Such a model may promote our understanding of optimal clamp placement on the vascular pedicle.

Methods: A load cell linked to a voltage transducer was utilized to record the pressure generated between the clamp jaws (figure 2 below). Standardized weights were utilized to convert the voltage readings into gram weight equivalents. The area under the clamp jaws was calculated to be 77.2 mm². This was used to calculate pressure applied in mmHg. The pressure applied by the clamp was measured from a thickness of 0mm up to 10mm in 1mm increments. Readings were obtained on three runs and then the results were averaged. The results were then used to generate a line of best fit to calculate the pressure in mmHg at various thickness levels. The measurements were performed at two positions along the length of the clamp – at the tip and at the midpoint of the jaws. These readings were then synthesized to generate a linear model that would calculate the pressure applied by the clamp based on the thickness level and position along the length of the jaws.

Results: Best fit linear relationships were identified between pressure applied at the tip and midpoint along the jaws and at thicknesses from 0-10mm. A linear model was designed to calculate the actual pressure in mmHg at any thickness level and at any length along the jaws. A palm™ handheld version of the model is available as free shareware at: www.uroengineering.com.

Conclusion: This model calculates the least pressure in mmHg generated by the laparoscopic bulldog clamp at any specified length along the jaws and at any thickness level between 0-10mm. This model may provide insight for optimal clamp placement on the vascular pedicle during a laparoscopic radical prostatectomy.
MULTI-INSTITUTIONAL VALIDATION STUDY OF NEURAL NETWORKS TO PREDICT DURATION OF STAY AFTER LAPAROSCOPIC RADICAL/SIMPLE OR PARTIAL NEPHRECTOMY

Sijo J. Parekattil, Erik P. Castle, Scott V. Burgess, Melissa M. Walls, Raju Thomas, Udaya Kumar, Jody A. Purifoy, Christopher S. Ng, Young Kang, Gerhard J. Fuchs, Erik S. Weise, Howard N. Winfield, Costas Lallas, Paul E. Andrews, Inderbir S. Gill

Cleveland Clinic Foundation, Cleveland, OH, Tulane University Medical School, New Orleans, LA, University of Arkansas for Medical Sciences, Little Rock, AR, Cedars-Sinai Medical Center, Los Angeles, CA, University of Iowa, Iowa City, IA
Mayo Clinic, Scottsdale, AZ.

Purpose: To develop models to predict post laparoscopic radical or simple nephrectomy (LapNx) and post laparoscopic partial nephrectomy (LapPNx) hospital duration of stay (DOS).

Methods: Retrospective review (design group) of all 726 patients (July 1997 to April 2004) who underwent LapNx or LapPNx at the Cleveland Clinic Foundation (CCF). Preoperative findings were recorded. Neural network algorithms were designed to preoperatively predict the DOS. The models were then tested on a separate 252 patients from six different institutions: Tulane University Medical School (TUMS), University of Arkansas for Medical Sciences (UAMS), Cedars-Sinai Medical Center (CSMC), University of Iowa (UI), Mayo Clinic at Scottsdale (MCS) and CCF.

Results: In the CCF design groups, the LapNx model accuracy was 73-74%, and the LapPNx model 73-83%. Overall accuracy in the test groups at all six institutions was: 72% (area under ROC 0.6-0.7) for the LapNx model and 52-81% (ROC 0.5-0.7) for the LapPNx model. Palm™ and Windows™ versions of these models are available as shareware from: www.uroengineering.com. The figure below illustrates the Windows version screenshot.

Conclusions: The LapNx model provides 72% accuracy in predicting the DOS at all six institutions. The LapPNx model provided fair accuracy only at CCF and TUMS. These models may streamline the delivery of care and continued testing will allow for further refinement.
ABSTRACT 110

TECHNIQUE OF URETERAL LITHIASIS SUSPENSION DURING LASER LITHOTRIPSY

Gary W. Chien, Ashish R. Parekh, Ronald M. Yang, Hetal S. Patel, Ronald K. Loo
Kaiser Permanente Medical Center, Downey, California, USA

Objective: During laser lithotripsy with the ureteroscope, small ureteral calculi often prove difficult to pulverize. The force of the laser energy, in conjunction with pressurized irrigation makes small stones difficult to stabilize during lithotripsy. We herein present our technique of using sterilized surgical lubricant as a medium to stabilize small stones for laser lithotripsy.

Material and Methods: Seven consecutive patients with ureteral calculi who underwent laser lithotripsy during ureteroscopy were enrolled in the study. Ureteroscopic laser lithotripsy was initially performed in our usual fashion: a safety wire was placed, ureteral access sheath advanced over the wire, and a ureteroscope was advanced into the access sheath up to the level of the stone. A laser fiber was then passed up to the stone, and laser lithotripsy was performed with pressurized irrigation under direct visualization. When the stones were ≤ 3mm, we injected the surgical lubricant into the ureteroscope to stabilize the small stone. Laser lithotripsy was then resumed. With the lubricant, small stones were easily fragmented and did not migrate away from the fiber, despite the energy of the laser or the force of pressurized irrigant (Figure a, b).

Results: Under direct visualization, all stones were pulverized to insignificant debris. A final complete inspection of the ureter was performed in all cases to verify that no stones remained.

Conclusions: With the thick and viscous medium created by the surgical lubricant, we were able to fragment small ureteral stones completely using the method described. A study is underway to compare three groups of patients who had laser lithotripsy with plain irrigant, with plain lubricant, or with lidocaine jelly.

Two examples (a,b) of small ureteral stones suspended in place with surgical lubricant, with laser fibers pointing at the stones. As laser lithotripsy commenced after lubricant injection, small stones were pulverized without migrating away from the laser fiber.

a) b)
ABSTRACT 111

STIFFNESS OF URETERAL STENTS UNDER UNIAXIAL TENSION

K Hendlin¹, C Horn¹, N Pshon², M Monga³
Departments of Biomedical Engineering¹, Statistics², and Urologic Surgery³,
University of Minnesota, Minneapolis, MN 55455

Objective: The stiffness of ureteral stents may contribute to patient comfort and varies with stent configuration and material. This study evaluates the variability of stiffness of ureteral stents under uniaxial tension.

Method: Stents of ten different commercially available ureteral stent models were tested under uniaxial tension using a MTS Micro Bionix Testing System placed on a vibration isolation table. Stents with different lot numbers were used when possible. Stents were held in place by hydraulic grips positioned 24 cm apart. Each stent was preconditioned prior to testing and then stretched at a rate of 5mm/sec for 1 sec. Data was collected using a 5 N load cell with computer data-acquisition utilizing Testworks II software. Stents were repositioned after every four tests in the same manner. Twelve trials in total were conducted for each stent. The Young’s Modulus, E, was calculated from each trial using the engineering stress.

Results: The Cook C-Flex stent was the stiffest (E=1472±196 KPa) and the Cook Black Silicone was the least stiff (E=122±18 KPa). Considerable variability was found between the lot numbers of each stent model using a two-tailed t-test (p<0.05). Stent models that demonstrated consistent E values among stents from different lots were the Circon Double J (E=183±8 KPa, p≥0.29), Bard In-lay (E=386±47 KPa, p≥0.39). Statistically, all stent models were significantly different in tensile strength.

Discussion: This study suggests that though material properties may play an important role in the overall mechanical functioning of ureteral stents, there is significant variation in the stress-strain curves with stents of the same model but different lot numbers. This presents an obstacle to comparisons of stents from different manufacturers. Future research is planned to evaluate this topic in more detail including viscoelastic behavior and failure strength testing. As such, the Cook Black Silicone is the softest ureteral stent and the Cook C-Flex is the stiffest.
COIL STRENGTH OF URETERAL STENTS: IMPACT OF URINE EXPOSURE

Manoj Monga², Kari Hendlin¹, Kelly Dockendorf¹, Jessica Roll¹
Departments of Biomedical Engineering¹ and Urologic Surgery²,
University of Minnesota, Minneapolis, MN 55455

Objective: The coil strength of ureteral stents impacts the likelihood of stent migration. This study evaluates the strength of stent coils before and after exposure to urine.

Method: Ureteral stents (6Fr) tested were the Surgitek Quadracoil, Microvasive Contour, Microvasive Percuflex Plus, Applied Medical Vertex, Circon Double Pigtail, Bard Lubricious, Bard In-Lay, Cook Double Pigtail, Cook Sof-Flex, Cook Endo-Sof AQ, Cook Black Silicone, and Cook C-Flex. All stents were tested before and after incubation in urine for one month. Each stent was passed over a 0.038” guidewire and then the top coil was inserted through a 5/64-inch hole drilled in a 12-ounce package of bologna with the outer plastic casing still in place, supported by two tables. The coil was allowed to reshape for 30 seconds. A handheld Force Five™ FDV force gauge was taped to the lower portion of the stent and used to pull the coil through the bologna. This procedure was repeated in triplicate using a different hole for each stent. Maximum force readings were recorded.

Results: Prior to urine exposure, the Cook Black Silicone and C-Flex stents had the strongest coil strengths (0.480±0lbs) and the Cook Sof-Flex had the weakest (0.158±0.015lbs). Post-urine coil strengths found the Cook Endo-Sof and the Surgitek Quadracoil to be the strongest (0.223±0.014lbs and 0.220±0.005lbs respectively) and the Applied Medical Vertex to be the weakest (0.088±0.008lbs). All stent coils weakened with exposure to urine. The stent that weakened the least was the Cook Sof-Flex (5.3%) while the Cook Black Silicone and C-Flex weakened the most (65.6% and 70.8% respectively).

Discussion: Stent coil strength is a critical element of ureteral stent design that prevents spontaneous proximal or distal migration of the stent. Changes in coil strength following exposure to urine suggest that certain stents may be better suited for long indwelling times than others.
ABSTRACT 113

A NEW METHODOLOGY AND APPARATUS FOR THE EVALUATION OF URETERAL STENTS

Maxim Kaplan, Ephraim Sparrow, Manoj Monga. Departments of Mechanical Engineering & Urologic Surgery, University of Minnesota, Minneapolis USA

Introduction: Ureteral stents are an established therapy for the alleviation of ureter blockage. The efficacy of a ureteral stent depends on both mechanical and biomedical factors. The mechanical issues include the resistance to urine flow caused by the presence of the stent and the pressure drop between the ends of the stent that is required to overcome this resistance. Biomedical issues relate to biofilm formation and encrustation deposits both within the bore of the stent and on its surface. The growth of these foulants is due both to chemical reactions and to the precipitation of particulates. Foulants tend to increase the resistance to urine flow and to slow the transfer of urine from the kidney to the bladder. These events lead to a timewise degradation in the performance of the stent. Models are needed to replicate in vivo conditions for the purpose of comparative testing.

Methods: To model the ureteral function, we developed an apparatus that provides a continuous and steady flow of urine throughout an extended period of time. These flow conditions are guaranteed by the use of a urine-filled vertical standpipe in which the level of the free surface is maintained at a precisely constant elevation. Emanating radially outward from the base of the standpipe is an assemblage of 24 simulated ureters, each fitted with a stent. The apparatus is situated within a temperature-controlled microclimate. Throughout the course of the experiments, it is expected that the temperature will be maintained at approximately 37°C.

Results: Urine flows into the simulated ureters from the standpipe, with the pressures at the inlets of the respective ureters being the same for all. The rate at which urine passes through each of the ureters is measured by an absolute method. The urine exiting the assemblage of ureters is collected in a reservoir, from which it is pumped back to the top of the standpipe.

Conclusions: The new methodology is firmly based on the principles of fluid mechanics. It enables as many as 24 stents to be simultaneously evaluated under precisely controlled conditions. Long-term evaluations of ureteral stents in a urine environment are readily accommodated.
ABSTRACT 114

A METHOD FOR EVALUATING THE MECHANICAL PROPERTIES OF GUIDE WIRES AND CATHETERS

Alexandru Patriciu, Doru Petrisor, Dumitru Mazilu, Dan Stoianovici, Louis Kavoussi
Brady Urological Institute, Johns Hopkins Medicine, Baltimore, MD

Introduction: Guide wires and catheters are invaluable tools in urologic practice. The performance of a wire in accessing the kidney and negotiating ureteral obstructions is directly related to its mechanical properties such as flexibility and friction coefficient. An objective test methodology based on mechanical evaluation was developed to test and quantify these characteristics in commercially available wires and catheters.

Methods: A test stand was purposely designed and built to provide consistent and repetitive quantitative measurements of insertion forces for allowing comparative evaluations of different wires. The model was designed to mimic the ureteral environment and included a tortuous path and an obstruction stage. The wire/catheter is advanced by a computer controlled motorized stage in sequential steps reproducing the alternating hand motion. After passing through a luer-lock adapter, the wire was fed through a silicone tube that was designed with 2 stages of a potential ureteral environment (obstructing stone, tortuous path). Four high sensitivity force transducers measured longitudinal force along the wire. A video camera simultaneously measured deformation and displacement of the tubing. A computer commanded the motion of the wire and recorded forces on each stage. Five types of wires (0.97 mm diameter) and catheters were tested: 1) Heavy Duty PTFE coated, 2) Bentson, PTFE coated, 3) Glidewire with straight tip, 4) Glidewire with angled tip wires, and 5) Everting film catheter. Once the wire was passed, a 5F angiographic catheter was inserted over each wire. Tests were performed in non-lubricated and lubricated conditions. Each wire was tested 5 times.

Results: The maximum forces exerted on the tortuous path ($F_G$) and the obstruction ($F_O$) are presented in the figure. The lowest wire force was recorded for the Glidewire with straight tip (3), and the evertong film catheter (5).

Conclusions: The proposed computerized test stand gives quantitative measurements of the longitudinal forces generated when advancing wires and catheters through the ureter to pass obstructions. This may help urologists in choosing wires for various applications and help manufacturers improve designs. Future studies assessing localized stress could be used to minimize the risk of perforation.

Acknowledgements: We gratefully acknowledge the partial support of this research by American Foundation for Urological Diseases and Percutaneous Systems Inc., CA.
INTRODUCTION: When choosing an access sheath, one must consider its physical properties. Inner diameter size and kink resistance may affect the ease of ureteroscope passage and size of retrieved stone fragments. Lubricity and buckling may determine the ease of insertion of the access sheath. The ‘perfect’ access sheath has yet to be designed. The objectives of this study were two-fold: first, to evaluate and compare the physical properties of different ureteral access sheaths in an in vitro setting; second, to make recommendations, based on our results, regarding the use of access sheaths in the clinical setting.

METHODS: Four access sheaths were compared: Applied Medical Forte® XE; Cook Urological Flexor®; Boston Scientific Microvasive Urology Navigator™; ACMI UroPass®. Physical properties tested included inner diameter size, lubricity, kink resistance and buckling. The inner diameter size was measured by determining the size of the largest steel ball capable of rolling through the access sheath in various positions, including: straight; 30 degrees; 60 degrees. Access sheath lubricity was tested by measuring the force required to pass each sheath through a silicone disc. Kink resistance was measured by wrapping the access sheath around a gauge pin and measuring the bend radius that resulted in kinking. Buckling was tested by applying incremental pressure at a point 25cm from the tip of the access sheath and measuring the peak pressure during buckling.

RESULTS: In the straight position and 30 degree bend positions, the Cook and ACMI access sheaths were found to have the greatest inner diameter, whereas in the 60 degree bend position, the ACMI and Applied Medical sheaths had the greatest inner diameter. The ACMI access sheath was found to have the highest lubricity, followed by the Boston Scientific and Cook sheaths. The ACMI and Applied Medical access sheaths were the most resistant to kinking. The ACMI access sheath had the greatest resistance to buckling, followed by the Cook sheath.

CONCLUSIONS: Physical properties that are important for a particular case must be considered when choosing an access sheath. When it is desired to remove larger stone fragments, the Cook and ACMI access sheaths are recommended. When outer lubricity for ease of access is important, the ACMI, Boston Scientific and Cook sheaths are recommended. If buckling is a problem while achieving access, the ACMI and Cook sheaths are recommended. Clinical trials are required in order to further validate our results.
ABSTRACT 116

COMPARISON OF BIOPSY SAMPLE WEIGHTS BETWEEN A NOVEL BENDABLE BIOPSY NEEDLE VERSUS THE INDUSTRY STANDARD

Travis L. Bullock, Jay S. Belani, Yan Yan and Gerald L. Andriole
Division of Urology, Washington University School of Medicine, St. Louis, MO.

Introduction and Objectives: The Envisioneering TargetScan® is a novel transrectal ultrasound (TRUS) device employing a 3D imaging and targeting system. This device allows the physician to generate a solid image of the prostate without moving the transducer probe. This greatly facilitates treatment planning (brachytherapy and cryotherapy) and systematic prostatic biopsies. This system employs a novel, specially designed 18 gauge (GA) x 20 centimeter (cm) 3-piece Nitinol Bendable Biopsy Needle (NBBN) to sample the prostate. The primary objective of this investigation is to compare the weights of a series of biopsy samples obtained using the NBBN and comparing the specimen yield to that obtained by a standard 18GA x 20cm biopsy needle used in current TRUS biopsy procedures.

Methods: 30 Envisioneering NBBN were fired into a pork loin 30 times each and resultant biopsy samples were weighed and recorded. 5 Manan Medical Products, Inc. Pro-Mag 18GA x 20cm biopsy needles were fired into the same pork loin tissue 30 times each and the specimens obtained were likewise weighed and recorded. Specimen weights retrieved using each needle were compared.

Results: The means and standard deviations are shown in table 1. The average specimen weight obtained using the Manan biopsy needles was 0.0050 grams (gm). The average specimen weight obtained using the Envisioneering NBBN was 0.0052 gm. The 4% greater yield using the NBBN was not statistically significant (p-value 0.43). No sample attempt for either needle failed to obtain tissue. There were no mechanical failures observed with either needle.

Conclusions: The Envisioneering Nitinol Bendable Biopsy Needle is at least comparable to the standard 18GA prostatic biopsy needle used to biopsy the prostate in most Urology practices. In addition no mechanical failure or failure in obtaining tissue was noted from the study needle. It seems plausible that the combination of the Envisioneering TargetScan® 3D imaging system with this novel Bendable Biopsy Needle will improve our ability to diagnose prostate cancer.

<table>
<thead>
<tr>
<th>Needle type</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manan Pro-Mag</td>
<td>0.0050 gm</td>
<td>0.00065</td>
<td>0.43</td>
</tr>
<tr>
<td>Envisioneering bendable needle</td>
<td>0.0052 gm</td>
<td>0.00082</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Mean and standard deviation of specimen weights (gm = grams)
ABSTRACTS – Session 1

ABSTRACT 117

FLEXGUARD® – A LASER INSERTION SHEATH AS A NEW DEVICE TO PROTECT THE WORKING CHANNEL OF FLEXIBLE URETEROSCOPIES

Herrmann TRW, Teichmann HO, Gross AJ

Introduction: With the miniaturization of flexible ureteroscopes, the high cost of purchase and repair and with the broadening of indications for flexible ureteroscopy, the durability of these instruments has become a major issue. Loss of active tip deflection was the primary problem however, reports from each of the four major ureteroscope manufacturers suggested that upward of 70% of all ureteroscope failures are the result of damage to the working channel, with most of these incidents resulting from incorrect use of the holmium laser during introduction of the laser fiber. We introduce a new device to prevent this problem.

Material and methods: We used the FlexGuard (LISA laser products) safeguard sheath with 2.7 F (0.9 mm) outside diameter and 2.1 F (0.7 mm) luminal diameter. The laser fiber (FlexiFib, 271 µm optical core, LISA laser products) could be slid inside the sheath without a problem up to a position approximately 5 mm distal from the end of the sheath. Then the sheath containing the fiber was pushed effortlessly through the working channel of the flexible ureteroscopes with the flexible ureteroscope in its extreme deflection. Not until the sheath was visible outside the working channel, was the fiber advanced until 2 mm protruded outside the sheath. Once the laser fiber was in position, then the FlexGuard was removed.

The influence of the safeguard-sheath containing the fiber on the curvature of the flexible ureteroscope in its extreme deflection has been investigated. The smallest achievable radius of curvature (ROC) of the unloaded flexible ureteroscope was compared to the laser fiber loaded only and to the laser fiber-safeguard-sheath loaded.

Results: Measured radius of curvature of the flexible ureteroscopes:

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Type</th>
<th>Radius of curvature (ROC)</th>
<th>ROC after loading with fiber-safeguard-sheath and fiber</th>
<th>ROC after removal of safeguard-sheath loaded with fiber only</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACMI</td>
<td>DUR-8 elite</td>
<td>22 mm</td>
<td>24 mm</td>
<td>22 mm</td>
</tr>
<tr>
<td>Olympus</td>
<td>URF P3</td>
<td>13 mm</td>
<td>15 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>Karl Storz</td>
<td>Flex-X u</td>
<td>24 mm</td>
<td>24 mm</td>
<td>24 mm</td>
</tr>
<tr>
<td></td>
<td>Flex-X d</td>
<td>17 mm</td>
<td>17 mm</td>
<td>18 mm</td>
</tr>
<tr>
<td>Richard Wolf</td>
<td>7325071</td>
<td>23 mm</td>
<td>24 mm</td>
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</tr>
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</table>

In all procedures the new laser insertion sheath could be brought into the working position without scratching the inner coating of the working channel. A subsequent insertion of the laser fiber after insertion of the safeguard sheath alone was not possible. After the FlexGuard has been removed, ROC returned to its initial position.

Discussion:
1. It was not our intention to compare various instruments, but to demonstrate that the use of FlexGuard is possible in all flexible ureteroscopes on the market.
2. Cost projections demonstrate the ureteroscope durability and repair costs result in variability in the overall costs of performing ureteroscopy. Lesions resulting from incorrect use of the holmium laser is a major problem in this respect. The new FlexGuard protection catheter helps to avoid such incidents.
ABSTRACT 118

ROBOTICS IN UROLOGY- THE INEVITABLE HERITAGE OF HELLENISM

Farzeen Firoozi, Michael E. Moran, Seth Capello, James Belarmino, Efrossini Kolios, Michael Perrotti
Albany, NY USA

Introduction and Objective: Robots have fascinated mankind since the dawn of recorded history. Homer detailed the Greek interest in mechanical beings with Hephaestus’ Talos, the robotic warder of Crete and Daedalus’ innovative mechanized statues. These will later inspire classic engineers such as Ctesibius, Philon, and Heron to devise sophisticated automata. These Hellenistic legacies will affect new generations from da Vinci, de Vaucanson and Phil Green to explore technology’s capacity to augment human endeavors.

Methods: Detailed exploration from ancient mythology into our era of Intelligent Technologies reveals mankind’s fascination with automated machines. Now with Moore’s Law resulting in the rapid transformation of technologies in less than a decade, a collective society holds it’s breadth as our futures change in a historical heartbeat. We review the history of automata. From detailed reading and annotations, timelines regarding two phases of technology could be constructed showing a virtual overlay of exponential growth in both basic technology and robotics.

Results: Historical accounts of primordial automata show a Hellenistic legacy of fascination with humanoid mechanisms. da Vinci devised a humanoid robot in 1469. The Frenchman, de Vaucanson perfected these to astounding degrees of sophistication by 1737. Later he went to work on mechanized surgical simulators and presented to the first society of surgeons. von Kempellen tried to automate human intelligence with his android, the “Turk,” a chess-playing device. Charles Babbage devised and built the first computer in 1834. Capek coined the term robot from the Czech word for “forced labor” in his 1921 play R.U.R. Isaac Asimov in 1939 constructed the modern science fiction genre of robotics in his short story, Strange Playfellow, but altered our methods of thinking of robots in Runaround in 1942 by formulating the Three Laws. “Artificial Intelligence” found its way into our vocabulary from a 1956 Dartmouth College study group. In 1989, Phil Green presents on “telepresence” surgery and Col. R. Satava becomes interested. Berners-Lee releases a language called HTML for CERN in Geneva and by 1994 the WWW emerged. Fred Moll arranges a team from MIT, SRI and IBM to license patents and forms Intuitive Surgical Corp. in 1995. A computer (Deep Blue) defeated Gary Kasparov, the world chess champion in 1997, computers outsold TVs in the U.S. for the first time, and the first autonomous robotic rover bounces onto the surface of Mars. There is no doubt that the technology of robotics is linked directly to computing power, and that the technology is poised to rapidly accelerate similar to Moore’s Law in electronic processing.

Conclusions: Unlike popular beliefs that robotic technology is new to medicine, there is in fact, quite a long pedigree of applied technology to emulate human/surgical endeavor. The current da Vinci Surgical System™ has a very long, Hellenistic tradition that is almost as amazing as the technology itself.
AN ORIENTAL CULTURE OF ROBOTICS - THE COMING MAELSTROM

James Belarmino, Michael E. Moran, Farzeen Firoozi, Seth Capello
Efrossini A. Kolios, Michael Perrotti
Albany, NY USA

Introduction and Objective: There is little doubt that the ancient Chinese were culturally adept and developed many technologic wonders. Mechanical engineering was advanced in this civilization as early as the Empire of King Wu (976-922 BC) of the Western Zhou Dynasty. Japan’s current interest in robotic technologies is only comparable to the U.S.’s investment in our Space Program and the financial and technologic effort placed by N.A.S.A. to put a man on the moon. The Japanese government is expected to fund 30 billion yen (about $258 million dollars) annually on a 30 year program to develop humanoid robots. This investigation is spurred by the potential this technology could have on our current age.

Methods: We have been able via the Internet and textbooks to investigate the earliest mechanizations of this Eastern historical heritage. The Chinese and Japanese perceptions of technology and robots in particularly are fundamentally different than those of Western societies. This is perhaps secondary to their earliest exposure to advanced mechanized technologies in a non-threatening fashion. In addition, we augmented this knowledge with a rapid rise in robotic technologies presented at the Japanese Robodex annually.

Results: The first known mechanized device in ancient China is a humanoid that could dance, by Yan Shi. Another account states that Daifeng Ma, designed odometers and mechanized birds used to measure wind. He also built a mechanized dresser for the imperial wife of the Emperor. Technologies continued into the Tang Dynasty. A humanoid robotic server is described that would serve drinks. A mechanized boat that had animated miniature humanoids was also made for the Emperor. Yin Wenliang is said to have created a musical android that could play the sheng (Chinese pipe). Yang Wulian created a wooden monk in Qinzhou City that could lift its arm for alms and speak a single sentence, “Alms solicited!” The Japanese likewise have a significant heritage with Karakuri (meaning mechanical devices). There are 3 categories of these; Butai are puppets used to entertain people in theaters, Zashiki were small automatons used to entertain people in private groups, and Dashi were on movable wooden floats and were much larger. There are several museums in Japan with extensive collections of the Karakuri such as Arashiyama Orgel Museum outside of Kyoto. Most of these were built in the 17th century.

Conclusions: The cultural heritage in the East is significantly different than the West and most of these automated devices were perceived as gifts to the people and in no way threatening. This is reflected in the Japanese cultural infatuation of a cartoon character of the 1950s, the Mighty Atom, or better known in the U.S. as “Astroboy.” This is a robot who struggles with his human interactions and his robotic capabilities. The first robotic company to begin manufacturing industrial robots in Japan was Kawasaki. The International Federation of Robotics currently estimates that Japan has 3X the number of industrial robots than the U.S. The World Fact Book 2002 states that Japan possesses 410,000 of the world’s 720,000 working robots. Support for this technology in the East is rapidly bearing fruit, at the ROBODEX 2003 (April 3-6), 66,264 people watched in awe as 24 vendors and 13 universities displayed 90 types of robots- most of which were humanoid.
ABSTRACT 120

HOLLYWOOD STEREOTYPES AND ROBOTIC SURGERY

Seth Capello, Michael E. Moran, James Belarmino, Farzeen Firoozi
Efrossini Kolios, Michael Perrotti
Albany, NY USA

Introduction and Objective: The evolution and incorporation of advanced digital technologies is just beginning to have an impact upon the practice of urology. The rapid expansion of the da Vinci Surgical System™ represents a fundamental incursion into the urologic surgical realm by advanced intelligent systems. Our Western traditional thoughts are heavily influenced by literature (fiction and science fiction), theater (Rossum’s Universal Robots) and in the United States particularly by the Hollywood stereotype. Hollywood imagery has influenced our American lifestyle for over 4 decades now, and the depiction of robotic technology has always been a Hollywood theme.

Methods: This is a retrospective investigation of the influence of Hollywood’s impressions of robotic technologies on our society. It involved a critical review of Hollywood dramatization of robots and specifically looking into 28 movies from 1926 till the present. We summarize them and their effect upon our perceptions of these intelligent technologies interacting with in three perceived stereotypes (beneficial, neutral, or hostile).

Results: The Hollywood stereotype of the “typical” robotic-human interaction is a very negative one. There are exceptions, for instance, in the Star Wars epics; both R2D2 and C3PO have a beneficent stereotype. Most of the 28 films reviewed here clearly show that robots have hostile intentions in view of humanity; 29% are neutral, and only 25% are beneficial. Also, the stereotypes depend upon the decade that they were filmed; prior to 70’s 67% had hostile robots, in the 70’s 29% hostile, 80’s 60% hostile, 90’s 67% hostile, and currently 75% films depict hostile robots.

Conclusions: Though Hollywood’s stereotypes do have some impact upon society’s views of technology or perhaps reflect society’s views of technology, there is no current data on whether these perceptions are favorable to patients undergoing advanced technologic procedures such as a da Vinci prostatectomy. The majority of Western, Hollywood stereotypes though are negative, and currently it is at the most polar negative extreme in the brief history of robotic cinematography.
ABSTRACT 121

A NEW SLING FOR THE TREATMENT OF MALE URINARY INCONTINENCE


Department of Urology, Universidade Estadual de Campinas, Brazil

Introduction: Male urinary incontinence is one of the most bothersome complications after radical prostatectomy. The use of artificial sphincter (AS) provides satisfactory results, but has a high cost, what is paramount in urological practice nowadays. Many male slings were developed, but none of them have better results than AS. The objective of this study is to demonstrate a new male sling that can be used in incontinent patients after prostate cancer surgery.

Material and methods: Seven patients with urinary incontinence secondary to surgical treatment of localized prostate cancer were offered treatment with sling. Their age ranged from 54 to 73 (mean 64.3 years). They received the new Promedon™ male sling, which is made of a silicone foam pad with two columns of sequential silicone beads in small conical shape and a pair of washers to maintain the sling traction (Fig.1).

The International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF) was performed before and three months after the surgery. The subjective improvement was also evaluated asking the patients how much they felt improving.

Results: The follow up ranged from 22 months (mean 12.6 months). Their pre-operative ICIQ-SF questionnaire values ranged from 17 to 21 (median 19) and 3 months after the surgery ranged from 0 to 20 (median 11), with subjective improvement of 60% (range from 0 to 100%). There were 2 patients that presented complete failure because of extrusion, one patient was diabetic and developed urinary and wound infection and the other had extrusion secondary to excess of tension, in order to correct a severe incontinence. One patient presented post-operative urinary retention and the sling was readjusted, loosing the washers, with satisfactory results and continence.

Conclusion: This new silicon sling offers a 60% continence satisfaction, with 71.4% of continence improvement or cure. The main advantage is the possibility of readjustment due to the conical shape of the columns and the use of washers. Although a small number of patients have been treated, it may be an alternative for post-prostatectomy incontinence with lower cost.
ABSTRACT 122

ARTIFICIAL INTELLIGENCE PROSTATE CANCER MANAGEMENT ASSISTANT

Sijo J. Parekattil, M.D., Igor Frank, M.D., Nicholas J. Hegarty, M.D., Inderbir S. Gill, M.D., Eric A. Klein, M.D.
Cleveland Clinic Foundation, Cleveland, OH.

Introduction and Objective: The evaluation and management of prostate cancer patients can be challenging. There is abundant literature regarding various treatment options. Our goal was to develop an artificial neural network (ANN) model to assist urologists with the management of these patients. Although previous models based on patient expectations and quality of life indices exist, our model uses a different approach and incorporates literature citations. The model derives conclusions from a urologic oncologist’s perspective based on the citations.

Methods: Currently published prostate cancer evaluation and treatment guidelines were employed to generate six ANNs, each designed to argue for a specific therapy: radical prostatectomy, external beam radiation therapy, brachytherapy, cryotherapy, hormonal therapy, and watchful waiting. The network inputs were the patient’s demographics, PSA levels, Gleason score, prostate size, baseline patient characteristics, and past medical history. The outputs from these networks were then integrated utilizing a logic-based algorithm to generate management recommendations and cite up to 16 references for each specific argument. The program was developed in two stages: 1) model training on 50 prostate cancer patient encounters and 2) prospective model testing on 30 consecutive prostate cancer patients encounters.

Results: The program has a user friendly data entry interface and instantly provides a suggested plan of action with supporting citations for each treatment modality. The figure below illustrates a screenshot of the program. During the testing phase, the diagnostic accuracy was 83% with only minor errors compared to the actual treatment plan. These errors were then corrected to further refine the model.

Conclusions: This program illustrates the ability to create a tool to facilitate prostate cancer evaluation and management using artificial intelligence methods. A high concordance with actual clinical practice can be achieved. Further testing and training will enhance the model. The model may provide a useful adjunct for urologists in practice and residents in training.
ABSTRACTS – Session 1

ABSTRACT 123

IN VITRO EVALUATION OF A NOVEL SELF-ANCHORING SUTURE MATERIAL FOR KNOTLESS TISSUE APPROXIMATION

Gregory Hruby, Stephen Dryer, Kyle J. Weld, Caroline D. Ames, and Jaime Landman
St. Louis, MO

Introduction and Objective: Reconstructive laparoscopic procedures are limited by technical challenges such as the difficulties currently associated with intracorporeal suturing. As such, we evaluated a novel prototype self-anchoring suture (SAS) material that incorporates unidirectional “barbs” designed to grip tissue and obviate the need for knot tying during laparoscopic tissue approximation.

Methods: Porcine tissue samples were approximated in vitro with either a running 0 SAS without knot tying or with a standard running or interrupted polydioxanone monofilament 0 suture with standard knot tying. Tissues were stratified into two categories: thin tissues (ureter, small bowel, colon) and thick tissues (bladder, stomach, uterus). Anastomotic failure strength was recorded with a Chatillon Tensometer (Model LG100N, Greensboro, NC) by loading tissues perpendicular to the sutured approximation. Statistical analysis was performed using the chi-squared test for independence.

Results:

<table>
<thead>
<tr>
<th>Average Tissue Failure Force</th>
<th>SAS</th>
<th>Interrupted</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin</td>
<td>7.88</td>
<td>8.05</td>
<td>0.087</td>
</tr>
<tr>
<td>Thick</td>
<td>18.5</td>
<td>18.67</td>
<td>0.316</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Tissue Failure Force</th>
<th>SAS</th>
<th>Running</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>Thin</td>
<td>7.88</td>
<td>8.67</td>
<td>0.363</td>
</tr>
<tr>
<td>Thick</td>
<td>18.5</td>
<td>20.72</td>
<td>0.073</td>
</tr>
</tbody>
</table>

The SAS failure force did not statistically differ from the failure force of the standard running or interrupted suture techniques. Approximation failure was the consequence of SAS slippage in 66.7% of the trials. Tissue fracture was the cause of failure in the remaining SAS trials and all of the standard suture trials. The high percentage of SAS slippage may have resulted from tissue thinning with the increased force applied; the suture barbs were no longer effective at gripping tissue. Credence is lent to this rationale as the thin tissues tested were much more likely to fail by suture slippage than the thicker tissues.

Conclusions: This preliminary in vitro evaluation demonstrates that SAS without knots secures tissue approximations at loads equivalent to those with standard tied suture. The novel suture tested may facilitate laparoscopic reconstructive procedures by eliminating the need for intracorporeal knot tying. In vivo evaluation is in progress to further characterize the utility of SAS for laparoscopic reconstructive procedures.

ABSTRACTS – Session 1

ABSTRACT 124

A COMPARISON OF SINGLE USE AND REUSABLE SMALL CORE SIZED HOLMIUM: YAG LASER FIBERS: IS THERE A DIFFERENCE IN THE RISK OF FIBER FAILURE?

Ohio State University, University of Western Ontario, University of Texas Health Science Center at San Antonio, University of British Columbia

Introduction: Prior studies show that holmium:YAG laser fibers are susceptible to failure when energy is transmitted in a deflected fiber, as occurs during lower pole flexible ureteroureteroscopy. It is unknown whether failure is due to mechanical stress from fiber deflection, sterilization effects on the fiber, or propagation of laser energy into cladding at the deflection site. This study was designed to determine the contribution of these factors to fiber failure, as well as to identify differences in the risk of fiber fracture with single use and reusable small core sized (200-272 µm) holmium laser fibers.

Methods: Single use and reusable small core-sized holmium laser fibers were tested. Single use fibers included the Dornier Lightguide Super 200, Optical Integrity Scopesafe 272, IQinc. LLF200TG-D, and IQinc. LLF273TG-D. Reusable fibers included the Lumenis Slimline 200, Sharplan 200, Laser Peripherals RBLF-200, IQinc. LFT273NT, and Convergent Optiview SMH1020F. A Coherent VersaPulse 100 watt holmium laser was used. Fibers were bent to 180 degrees at a diameter of 1.5 cm. The laser was fired at 1.5J, 10Hz for 30 minutes or until fiber fracture. Reusable fibers were sterilized for twenty cycles using the manufacturers’ specifications. These fibers were retested after every five sterilization cycles. All testing was done with the fiber submerged in water.

Results: No fiber fractured with bending alone. Two of three Dornier Super 200 fibers tested fractured repeatedly within several laser pulses. The Laser Peripherals RBLF-200 fiber fractured during initial testing. Repeat testing and sterilization did not result in further fractures. Fibers fractured at the point of maximum bend and only after the laser was discharged. The remaining fibers did not fracture during initial testing. The reusable fibers did not fracture following repeated testing after 5, 10, 15, and 20 sterilization cycles.

Conclusion: The Dornier Super 200 holmium laser fiber was the only fiber to fracture repeatedly. Use of this fiber during lower pole flexible nephroscopy may risk endoscope damage. The Laser Peripherals RBLF-200 fractured during initial testing but this result was not reproducible. Twenty cycles of steam sterilization did not cause any of the reusable fibers to fracture during repeat testing. The data implies that the cause of failure for the Dornier Super 200 fiber is propagation of laser energy into the cladding. Prior studies showed similar patterns of fiber failure, suggesting limitations of the ability of fibers to transmit laser energy in a deflected configuration. Future work will addresses other causes of fiber failure.
ABSTRACT 125

COMPARISON OF MECHANICAL AND IN VIVO PERFORMANCE OF NEW AND REPROCESSED HARMONIC SCALPELS

Stephen Dryer, Gregory Hruby, Kyle J. Weld, Caroline D. Ames, Ramakrishna Venkatesh, Jaime Landman

Introduction and Objective: Recently, there is a trend toward instrument reprocessing; re-sterilization and refurbishment of surgical instrumentation designed for one time use. The efficacy and safety of reprocessed equipment has undergone limited evaluation. As such, we compared new and reprocessed Harmonic scalpels (HS) both mechanically and in vivo in a porcine model.

Methods: Eighty-nine reprocessed HS (LCS-C5s) were compared to 90 new HS. Instruments were subjected to visual inspection, destructive testing, and non-destructive mechanical testing. For in vivo testing, new HS, randomly selected reprocessed HS, and selected reprocessed HS with identified abnormalities were evaluated in a porcine model and then implemented in vitro on excised psoas muscle until failure. Each HS trial was videotaped and the performance of the HS groups in vivo was graded by 14 surgeons who were blinded to the type of HS being evaluated. Surgeons graded the harmonic scalpel performances on criteria including grasping, hemostasis, efficiency, and tissue effects.

Results: Visual inspection of the HS discriminated between new and reprocessed instruments in 11/12 (92%) cases (p < 0.02). In vitro mechanical testing revealed higher clamp arm dislodge forces for new HS (p < 0.01) and higher midshaft temperatures for reprocessed HS (p < 0.01). Overall, 65/89 (73%) of reprocessed and 7/90 (7.8%) new HS had gross abnormalities noted on inspection and mechanical evaluation (p < 0.01). The surgeons’ evaluation of instruments during in vivo testing demonstrated that new instruments manifested significantly greater hemostatic control compared to randomly selected reprocessed HS (p = 0.01) and reprocessed HS with obvious defects (p = 0.04). Additionally, new HS performed better than reprocessed HS with obvious defects for tissue sticking (p = 0.01), tissue transection (p = 0.02), tissue dissection (p < 0.01), and grasping (p < 0.01). Premature instrument failure was noted in 16.7% of the randomly selected reprocessed instruments and 66.7% of the reprocessed instruments with defects.

Conclusions: In vitro and in vivo data demonstrate significantly greater performance of new HS compared to reprocessed HS. Visual inspection and mechanical testing of reprocessed HS cannot adequately distinguish which HS will result in decreased performance. These findings raise important issues of clinical safety in the contemporary quest for cost-effectiveness.


20th E&U Annual Meeting, May 21, 2005, San Antonio, TX
PULSED CAVITATIONAL ULTRASOUND THERAPY: A NONINVASIVE NONTHERMAL MODALITY FOR CONTROLLED TISSUE ABLATION IN THE RABBIT KIDNEY

William W. Roberts, Timothy L. Hall, Binh C. Tran, J. Stuart Wolf Jr., J. Brian Fowlkes, Charles A. Cain

Current therapeutic technologies for minimally invasive ablation of renal masses (radiofrequency ablation, cryotherapy, and HIFU) rely on thermal mechanisms for tissue destruction. As such, creation of precise lesions is limited by inhomogeneous heating due to tissue variability, heat sink effects, and tissue charring. High Energy Shock Wave Therapy (HESW), developed a decade ago, represented the extension of ESWL to tissue applications. Although innovative, this technology was abandoned, presumably due to difficulty in controlling the tissue destruction from cavitation. We hypothesize that an optimal cavitative environment can be produced using a large number (1000 – 10000) of less intense pulses whereby tissue in the focal volume can be progressively homogenized in a controlled fashion with predictable results. Additionally, ultrasound imaging used in conjunction with cavitation may simplify pretreatment focal localization, and evaluation of tissue damage during and after treatment.

We have developed and tested an annular array pulsed ultrasound system capable of delivering high intensity (>20 kW/cm²), short pulses (15 cycles = 20 microsec) at 100 Hz repetition frequency resulting in low time-averaged power (~5 W total acoustic output). Following approval from the Institutional Animal Care and Use Committee, a series of experiments were performed on the normal kidneys of ten rabbits. Gross and histological characterization of lesions created with varying numbers of pulses from 10 to 10000 was performed.

Lesions produced with a small numbers of pulses (10 or 100) produced scattered areas of damage across the focal region. The damage was characterized by focal hemorrhage and areas of cellular injury. Lesions created from larger numbers of pulses (1000 or 10000) produced complete destruction of the focal region. On gross examination, these lesions contained a liquefied core with smooth walls and sharply demarcated boundaries. Histological examination of these lesions demonstrated extensive areas of acellular debris surrounded by a narrow margin of cellular injury.

Pulsed cavitative ultrasound therapy (PCUT) is a promising transcutaneous therapy that utilizes cavitation to precisely homogenize tissue in the focal zone while minimizing thermal effects. Multiple sites (or a larger lesion) could be treated with use of an electronically steerable ultrasound phased array. Future work to establish the non-viability of the liquefied material within the cavities, and optimize spatial-temporal scanning parameters for treating larger volumes is currently underway.
ABSTRACT 127

IN VITRO ASSESSMENT OF THE CYBERWAND INTRACORPOREAL LITHOTRIPTOR

Samuel C. Kim, Brian R. Matlaga, Molly E. Jackson, Ramsay L. Kuo, James C. Williams, James A. McAteer, James E. Lingeman

Methodist Hospital / Clarian Health Partners
Indiana University School of Medicine
Indianapolis, Indiana

Introduction and Objectives: The Cyberwand (Cybersonics, Erie, PA) is a novel intracorporeal lithotriptor that incorporates two concentric probes driven at different frequencies by a single ultrasonic hand piece. We performed a study to compare this device to the Lithoclast Ultra (Boston Scientific, Natick, MA), which we have previously demonstrated in vitro to be the most efficient commercially available device (J Urol 170:1101-1104, 2003).

Methods: An in vitro test system was used to assess the efficiency of stone penetration for the Cyberwand and the Lithoclast Ultra. The devices were mounted upright (probe tip up) in a modified irrigation sheath. A gypsum artificial stone was centered on the probe tip, and a mass was placed atop the stone to provide constant force. Output of the Cyberwand was pre-set by the manufacturer. For the Lithoclast Ultra, we used a pneumatic frequency of 12 Hz with an ultrasonic power setting of 100%, optimal settings as determined from previous in vitro tests (J Endourol, 18:153-156, 2004). The time required for complete stone penetration was assessed. Differences in mean stone penetration times were compared using ANOVA.

Results: The mean penetration time for the Cyberwand was significantly less than for the Lithoclast Ultra (4.77 seconds, SD 0.63 vs. 8.09 seconds, SD 0.55, p<0.0001). Neither device exhibited any difficulties with overheating, occlusion, or other malfunction.

Conclusions: Initial assessment using our “hands-free” in vitro test system – in which stone penetration time is not affected by operator bias – suggests that the Cyberwand is a very efficient lithotrite. These promising in vitro results open the door for in vivo testing using stones implanted in the kidney (J Urol 168:2211-2215, 2002).
PRELIMINARY REPORT ON LAPAROSCOPIC BLADDER AUTOAUGMENTATION: AN EXPERIMENTAL STUDY


Division of Urology, Universidade Estadual de Campinas – UNICAMP, Campinas São Paulo, Brazil.

Introduction: Bladder autoaugmentation is a surgical option to improve bladder capacity and compliance, avoiding the morbidity related to enterocystoplasty. However, results are controversial and few studies have addressed the feasibility in performing a videolaparoscopic technique.

Materials and Methods: Laparoscopic bladder autoaugmentation was performed in five male mongrel dogs, weighting 15-20 kg. The procedure was performed using four trocars, one 10mm for the camera placed at the umbilicus and three 5mm for the graspers placed at the lower quadrant of the abdomen. Urodynamic evaluation was performed in all dogs preoperatively and in postoperative days 30, 60 and 90, under general anesthesia. In postoperative day 90 the bladder was removed under general anesthesia and sent to pathological evaluation.

Results: All procedures were completed successfully in less than 60 minutes. A great diverticulum was created at the anterior bladder wall by blunt dissection of detrusor fibers with two delicate graspers. With respect to urodynamic results, three dogs had a dramatic decrease in capacity and compliance through the postoperative period and two dogs had great increase in capacity and improvement in compliance (tables 1 and 2). Pathologic evaluation showed intense fibrosis at the diverticulum site in bladders that had decrease in capacity and compliance. In the two bladders that became more compliant and with greater capacity, healing was uniform and fibrosis slight.

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<thead>
<tr>
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Conclusions: Laparoscopic bladder autoaugmentation is feasible in the canine model. Pathological evaluation shows that healing at the diverticulum site is not similar in all animals and fibrosis with shrinkage of the diverticulum area is not the rule. Urodynamic results are poor in those who develop intense fibrosis.
VALIDATION OF AN ELECTROCHEMICAL MICROSENSOR ARRAY WITH FEMTOMOLAR SENSITIVITY FOR RAPID MOLECULAR DETECTION OF UROPATHOGENS

Joseph C. Liao¹, Mitra Mastali², Vincent Gau³, David A. Haake², Bernard M. Churchill¹
¹Department of Urology, David Geffen School of Medicine at UCLA, Los Angeles, California
²Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, California
³GeneFluidics Inc., Monterey Park, California

Introduction: Recent advances in sensors based on micromachining technology have led to an intense interest in the development of their biomedical applications. Microsensors are well suited to detect biological molecules of interest such as nucleic acids with nanoscale precision. We describe the validation of a novel electrochemical DNA microsensor array for rapid detection of uropathogens.

Methods: The GeneFluidics microsensor array with 16 electrochemical sensors was used. The gold sensor surface was functionalized with DNA capture probes through a streptavidin monolayer. A rapid sample preparation protocol was developed in which raw uropathogen lysates containing target 16S rRNA hybridized to a sequence-specific DNA detector probe were deposited on the sensor surface, forming a DNA sandwich. The hybridization was detected through a horseradish peroxidase (HRP)-conjugated antibody recognizing the detector probe. The hybridization signal was enzymatically amplified with addition of HRP substrates at fixed voltage potential and the resultant electro-reduction current was measured amperometrically.

Results: Sequence specific detection of target uropathogen 16S rRNA was demonstrated within 40 minutes after bacterial lysis. No further nucleic acid purification and amplification was needed. An uropathogenic *E. coli* was inoculated into clean urine from a healthy volunteer and grown to log phase (2 x 10⁷ bacterial/cc). Serial dilution of the inoculated urine specimen was tested with the sensor. A sensitivity of 1500 bacteria, or femtomolar (1.9 x 10⁻¹⁶ M) sensitivity of the target 16S rRNA molecules was achieved. The positive signal was relative to the negative control background signal in which no uropathogens were used (P < 0.01).

Conclusion: We have validated a novel electrochemical microsensor array for direct, robust detection of uropathogens in urine specimens with femtomolar sensitivity. A rapid detection protocol was developed consisted of single step bacterial lysis without nucleic acid purification or amplification steps such as polymerase chain reaction. The sensor array may be used as the basis of a point-of-care device for rapid uropathogen detection.
ABSTRACTS – Session 1

ABSTRACT 130

RETRIEVAL DEVICES IN URETEROSCOPY FOR UROLITHIASIS: ANALYSIS OF MECHANICAL FAILURES & MALFUNCTION

Prabhakar Pandey¹, Cheryl D. Marsh¹ and Chandrasekhar Thamire²

¹Urology Clinic of Cumberland, Western Maryland Health System, Cumberland, MD
²Department of Mechanical Engineering, University of Maryland, College Park, MD

Introduction: Advances in instrumentation have enabled ureteroscopy to be an effective alternative for management of upper urinary tract stone. This retrospective study was aimed to analyze the use of various retrieval devices and their outcome during such procedures.

Materials & Method: Charts of ureteroscopic procedures for upper tract stones and use of retrieval devices during September 2003 till March 9, 2005 were reviewed in retrospective manner. Information on use of retrieval devices and its failure rates were assessed.

Results: 112 retrieval devices were utilized during 61 ureteroscopic procedures. 61(54.5%), 30(26.8%) and 13(11.6%) devices were used in first, second and third round of use. The retrieval devices were categorized as Helical basket (23), 4-Wire 2.4 Fr. 0-tip Nitinol basket (45), 1.9Fr.0-tip Nitinol basket (3), 12-Wire basket (31), 6-Wire 0-tip Nitinol basket (4) and other (6).

11(9.8%) mechanical malfunctions were categorized in to (a) failure of terminal end – 7(63.6%), (b) failure of handle end – 3(27.2%) and (c) wire disruption – 1. These malfunctions were noted in 12-Wire basket (6), 4-Wire 2.4 Fr. 0-tip Nitinol basket (3) and 1.9 Fr. 0-tip Nitinol basket (2)

Conclusion: Retrieval devices in current clinical use present mechanical malfunction in a small but significant percentage of cases. Further analysis of these mechanical failures will be needed to improve the overall quality and effectiveness of these instruments.
CASCA - ADJUSTABLE SUBURETHRAL SLING FOR FEMALE STRESS URINARY INCONTINENCE

O.M. Schlarp, W. A. Hübner, H. Gallistl
Department of Urology, Humanis Clinic Lower Austria
Wiener Ring 3-5, 2100 Korneuburg, Austria

Introduction: Suburethral slings are now the most often offered treatment option for female stress urinary incontinence. Although surgical complications are rare, postoperative complications are reported. Among those, urinary retention or high post voiding residual urine is the most relevant. Furthermore we don’t know about the long term effects (i.e. over 30 years) using alloplastic meshes, which are not adjustable.

Methods: We report of one case in which a modified adjustable sling was used. The device was build using the silicone cuff of an AUS (AMS 800™), a TVT™ tape and a porth a cath system. The cuff was secured on the tape and acts like a pad. The tape is positioned like in a conventional TVT™ implanting procedure beyond the proximal urethra after anterior colpotomia. The difference is that the urethra is now supported not only by the mesh but additionally by the cuff. The tape is put in place tension free. A second incision is made in the lower abdomen over the symphysis and the rectus abdominis muscle is exposed. The porth a cath is fixed on the fascia and connected to the tube of the cuff. The system is filled with contrast and can now be adjusted percutaneously if necessary.

Results: We implanted this system in a 42 year old farmer’s wife with a stress urinary incontinence grade 3 according to the Stamey score. She used 25 daily protective pads per day. Routine examination with cystometry, direct visual stress test and pelvic floor examination was done. After surgery she was dry and had no more signs of a hypermobile urethra. After three months she complained about little leakage during heavy exercises. She was cured in an outpatient procedure by an adjustment of additional 0.25 mL of contrast in local anaesthesia.

Conclusion: The adjustability of a suburethral sling offers many advantages. Retention due to weak detrusor function or too tight mesh as well as recurrent leakage could be avoided in the postoperative period using this system.
IMPROVING ULTRASONOGRAPHY OF RENAL MASSES USING CONTRAST PULSE SEQUENCE IMAGING, A PILOT STUDY

Margot H. Wink, Hessel Wijkstra, M. Pilar Laguna, Brunolf W. Lagerveld, Jean J.M.C.H. de la Rosette
Academic Medical Center, Amsterdam, the Netherlands

Introduction and Objectives: Ultrasound (US) contrast agents consist of encapsulated gas bubbles smaller than erythrocytes. These microbubbles enhance reflectivity of blood flow and enable visualization of flow even in capillaries. Alterations in perfusion which occur in tumors due to rapid growth can be visualized using contrast enhanced ultrasound (CE-US). A new imaging technique, Contrast Pulse Sequencing (CPS), allows exclusive detection of the signal reflected by the contrast agent. It recognizes the nonlinear fundamental responses and the higher order harmonics reflected by the contrast agent, by means of transmitting a sequence of pulses with different amplitude and/or phase. The reflections of the pulses are summed in such a way that tissue components are cancelled out, whereas nonlinear contrast signals add to form a stronger signal. This enables real time simultaneous viewing of tissue-only and contrast-only images. The purpose of this pilot study was to determine the value of CPS imaging in the diagnosis of renal masses and establish the possible additional value in the diagnostic process.

Methods: 18 patients with 20 renal masses, detected either on US or CT, were evaluated using CE-US. A Siemens ACUSON Sequoia system with CPS imaging was used and a maximum of 2 boluses of 2.4 milliliter Sonovue (Bracco) was injected intravenously. Each kidney was investigated using both grayscale and CE-US and studies were stored digitally. Off-line evaluations by two urologists were compared to CT reports as a gold standard.

Results: On CT, 15 renal cell cancers (RCC), 1 angiomyolipoma, 2 uncomplicated cysts, 1 complicated cyst and 1 mass of unknown origin were determined. Subjectively, CPS imaging was considered to be of very high quality and the contrast-only images showed additional value. Distinct benign lesions could all be identified using CPS (3/3). Beside one mass characterized as a small RCC on CT which was not seen, all probable malignant lesions were identified as such by the most experienced urologist (14/15). The other urologist correctly identified 2/3 benign and 6/15 malignant masses, which indicates the importance of experience in renal ultrasound. On CT it was concluded that the complicated cyst was probably a hemorrhagic cyst. On CPS imaging no enhancement inside the cyst was seen, confirming this diagnosis without difficulty (figure 1).

Conclusions: From this pilot study it can be concluded that CE-US using CPS is a promising imaging technique that offers additional value in the characterization of renal masses. Based on these preliminary results, it can be concluded that the use of CPS as first line imaging modality has the potential to decrease the number of CT scans necessary for a correct diagnosis of renal masses. Furthermore, it can certainly provide additional clinical value in patients in whom the use of iodine-containing contrast media for CT is not possible.
TRANSURETHRAL ADENOMA RESECTION (TURP) IN COMBINATION WITH HIGH INTENSITY FOCUSED ULTRASOUND (HIFU)

Ch Chaussy, S Thueroff;
Dep. of Urology Muenchen Harlaching
Germany
urologie@khmh.de

Objectives: Transrectal HIFU has a high efficacy in regard to negative follow up biopsy rate, PSA Nadir and -stability. Postoperative necrotic debris of the coagulated adenoma shows frequently postoperative side effects as obstruction and infection causing urgency and incontinence symptoms. In this study the impact of neoadjuvant TURP on patients inducing postoperative morbidity was evaluated.

Material: Inclusion criteria: Patients with histological proven PCa, T1-2, Nx-N0, M0, not suitable for surgery, treated with HIFU at 3 MHz and 5 sec lesions were included. Prospective analysis of 500 patients, 51,6% only HIFU-, 48.4% treated with HIFU + neoadjuvant TURP of the adenoma in one session. Treatment strategies, -parameters and side effect rate were analysed.

Results: In patients with combined treatment resection weight was median 12gr (2- 82gr, chips cancer free in 54%). In both groups, HIFU dose (median of 570 lesions) and total treatment time (median 165min/168min) were similar. Urethral catheter were removed within 24 hours. Suprapubic catheter remained median 35 days in “HIFU only” and 8 days in “HIFU+TURP” cases. Incontinence symptoms were reduced from 14,8% without TURP to 5,0% with TURP. Infection rate decreased from 38,3% to 13,6%. IPSS (score: 0-35) after HIFU showed to be lower with the combined TURP (median score: 2/35) than with HIFU only (median score: 5/35).

Conclusions: HIFU+TURP as combination treatment in one session proved to be favourable. Higher invasiveness or longer hospitalisation time has to be judged against advantages, as there are: better adaptation of every prostate size to HIFU, penetration depth, identical overall treatment, shorter suprapubic catheter time, lower infection-, incontinence- and morbidity rate. Postoperative percource of patients treated with the combination of HIFU + TURP showed to be comparable to a classical TURP.
ABSTRACTS – Session 2

POSTER 204

LAPAROSCOPIC VIDEOTAPE MENTORING AS PART OF A SKILLS-BASED LEARNING COURSE LEADS TO INCREASED LAPAROSCOPIC CASELOAD AND CLINICAL LAPAROSCOPIC SUTURING

Gyan Pareek, MD¹, Sean P Hedican, MD¹, Jay T Bishoff, Lackland Afb, TX; Steven J Shichman, Avon, CT; J. Stuart Wolf, Jr, Ann Arbor, MI; Stephen Y Nakada, MD¹

¹Division of Urology, University of Wisconsin Medical School, Madison, WI

Introduction and Objective: Previously, learning laparoscopy, particularly suturing, has required laparoscopic fellowship training. Today, many urologists without fellowship training practice laparoscopic urology, yet do not advance their skills beyond hand-assisted, extirpative laparoscopy. We sought to evaluate the impact of the American Urological Association (AUA) Hands on Laparoscopy (HOL) course on the clinical practices of HOL alumni.

Methods: Sixty-eight urologists, ages 31-61 (mean, 46.6 years) participated in the one of 4 courses between August 2002 and March 2004. All participants took a 2 day course which included performing standardized tasks under expert videotape analysis and participation in a porcine and an extended pelvic trainer laboratory session. Follow-up surveys were sent regular mail and e-mailed in September 2004 to assess the impact of the course on the participants' clinical practices. Mean follow up was 15.2 months (7 to 25 months). Questions addressed the number of laparoscopic cases performed and whether the laparoscopic practice of each participant expanded. Specific questions included whether any laparoscopic suturing was done after the course, whether the video mentoring during the course was helpful and whether any participants purchased and used a pelvic trainer following the course.

Results: Of the 68 surveys mailed, 52 were returned (76%). The majority of respondents described themselves in a private practice and had experience with extirpative laparoscopy prior to the course. Thirty-nine of 52 alumni (75%) responded that there laparoscopic practice had expanded after taking the course with 34% performing at least 2 cases per month. Thirty-one of 52 respondents (60%) reported to have sutured laparoscopically after taking the course, with 35% having sutured a bleeding vessel. Eighty-four percent of the participants reported that the video mentoring during the course was helpful. Ninety percent of those who purchased a pelvic trainer reported practicing on it regularly.

Conclusions: Our skills-based hands on course proved to be an effective means for practicing urologists with laparoscopic experience to expand their laparoscopic practices. Experience gained from a skills-based lecture format, videotape mentoring on pelvic trainers and a mentored porcine laboratory resulted in laparoscopic suturing for the majority (60%) of participants.
RAPID DETECTION OF BLADDER CANCER RECURRENT WITH NMP22® BLADDERCHEK™ TEST IN COMPARISON TO VOIDED URINE CYTOLOGY

Ilya A. Volkson¹, Alexandra Sawczuk², Debra Fromer², Ravi Munver²
Richard A. Watson², Ihor S. Sawczuk²

¹ Department of Urology, UMDNJ-Newark, Newark, NJ
² Department of Urology, Hackensack University Medical Center, Hackensack, NJ

Introduction: Levels of nuclear matrix protein 22 (NMP 22) are elevated in the urine of patients with bladder cancer. The NMP22® BladderChek™ test (NMP22-BC) (Matritech, Inc., Newton, MA) is a point of service assay developed for the detection of bladder cancer recurrence. This study evaluated the utility of NMP22-BC in the monitoring of bladder cancer patients alone and combined with voided urine cytology (VUC).

Methods: 67 patients with a history of bladder cancer were sequentially monitored for recurrence with 112 NMP22-BC, VUC and cystoscopy events. NMP22-BC was performed with 4 drops of urine according to the package insert and read within 30 minutes. Cytology was considered positive when read as positive or suspicious for malignancy; results took an average of 48 hours.

Results: 27 pathologically confirmed recurrences were detected of the 112 monitored events (24%). 13 were low grade and 14 were high grade tumors. 15 tumors were stage Ta; 5 stage T2; 1 stage T3; 1 stage T4, and 5 were carcinoma in situ (CIS). The overall sensitivity of NMP22-BC was 33%; specificity 92%; positive predictive value 60% and negative predictive value of 81%. VUC alone was 37%; 99%; 91% and 83%. Combination was 46%, 92%, 68% and 84%. NMP22-BC alone detected 3/13 (23%) low grade lesions and 7/14 (50%) high grade lesions. VUC detected 4/13 (31%) low grade and 6/14 (43%) high grade tumors. In combination 9/14 (64%) high grade tumors were detected. Results of detection for each stage are summarized in the table below.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Total Number of recurrences</th>
<th>NMP22-BC</th>
<th>VUC</th>
<th>Combination NMP22-BC &amp; VUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIS</td>
<td>5</td>
<td>2/5 (40%)</td>
<td>2/5 (40%)</td>
<td>3/5 (60%)</td>
</tr>
<tr>
<td>Ta</td>
<td>15</td>
<td>3/15 (20%)</td>
<td>4/15 (27%)</td>
<td>5/15 (33%)</td>
</tr>
<tr>
<td>T2</td>
<td>5</td>
<td>3/5 (60%)</td>
<td>3/5 (60%)</td>
<td>4/5 (80%)</td>
</tr>
<tr>
<td>T3</td>
<td>1</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>T4</td>
<td>1</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
</tr>
</tbody>
</table>

Conclusion: Overall, the addition of VUC did not significantly improve the detection rate. However, combination of NMP22-BC and VUC improved significantly the detection of high grade tumors as well as stage 2 and CIS lesions. Therefore, NMP22-BC is a valuable addition to VUC for detection of high risk lesions. Furthermore, the NMP22-BC assay offered an accurate result comparable to VUC, but more immediate and at the point of service.
POSTER 206

CRYOABLATION OF RENAL MASSES AND RENAL SALVAGE IN PATIENTS SOLITARY KIDNEY

Salvatore A. Lombardo, Newark, NJ; Vladislav G. Bargman, Indianapolis, IN; Ravi Munver, Ihor S. Sawczuk, Hackensack, NJ

Introduction and Objective: Cryoablative therapy may be a useful technique for the treatment of renal masses in patients with solitary kidneys or renal insufficiency. The purpose of this study was to evaluate the role of cryoablation in patients with solitary kidneys with the goal of tumor destruction or removal, and maximal renal parenchymal preservation.

Methods: 9 patients with single tumors were treated, of which 7 patients had solitary kidneys, 1 had a nonfunctioning contralateral kidney, and 1 had renal insufficiency. Seven tumors were treated with in-situ cryoablation and 2 tumors were treated with cryo-assisted partial nephrectomy. All masses were biopsied prior to freezing. Procedures were performed under real-time intraoperative sonographic guidance. In each case, tumor was easily discernable ultrasonographically, allowing for precise placement of cryoprobes. After cryprobe placement, tumor masses were treated with 2 freeze cycles (-40 degrees Celsius for 15 minutes per cycle) separated by an active thaw process. 7 tumors were left in situ and 2 were resected with a scalpel by tracing the edge of the ice ball.

Results: Cryoablation was well tolerated by all patients without any perioperative complications. Mean patient age was 62.1 years (range 49-79), and the tumor location included: 4 (upper pole), 2 (mid-kidney), 3 (lower pole).

<table>
<thead>
<tr>
<th>Mean Values (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Tumor Size in (cm)</td>
</tr>
<tr>
<td>Mean Pre-op HCT (%)</td>
</tr>
<tr>
<td>2.7 (1.2-4.3)</td>
</tr>
<tr>
<td>41.0 (34-46.1)</td>
</tr>
</tbody>
</table>

Mean hospitalization was 4.6 days (range 4-8). The patients that underwent cryo-assisted partial nephrectomy had negative margins. Seven patients received an MRI for a minimum of 5 months to a maximum of 30 months post-procedure, follow up. In six patients, postoperative imaging has revealed no evidence of tumor recurrence. One patient had an enhancing area that is indeterminate for recurrence. Mean post-operative Cr was 1.57 (range 1.3-2.1) at a mean of 17 months post-procedure.

Conclusions: Intermediate-term results of renal cryoablation suggest that this technique may offer an advantage for patients that require a maximal nephron-sparing effort. Our results demonstrate preservation of renal function with minimal risk of tumor recurrence.
High Energy Tumt Approaching TURP in Outcome Efficacy: A Meta-Analysis of Published Results

Michael C. Ost M.D., Gopal H. Badlani, M.D., Benjamin R. Lee M.D., Arthur D. Smith, M.D.

Introduction: Minimally invasive treatments for BPH (MIT-BPH) are currently challenging the traditional surgical and medical management of symptomatic BPH. We conducted a meta-analysis of published randomized controlled trials comparing high energy transurethral microwave thermotherapy (HE-TUMT) to transurethral resection of the prostate (TURP) to compare subjective and objective outcomes.

Methods: A literature search using Pub-Med was conducted to obtain all published data on HE-TUMT and all randomized controlled trials comparing HE-TUMT to TURP. Data was analyzed focusing on the pre and post treatment endpoints of IPSS, Qmax, and PVR. A meta-analysis was conducted and data was stratified with respect to the type of HE-TUMT machinery used.

Results: Differences in IPSS, Qmax, and PVR from current trials comparing TURP and HE-TUMT are best evaluated at 1 year follow up. At this time point, changes in Qmax (p<0.001), IPSS (p=0.01), and PVR (p=0.02) are more significant if TURP is the mode of treatment. HE-TUMT with the CoreTherm (previously Prostalund) device demonstrates the most significant improvements in subjective and objective criteria approximating outcomes with TURP (Figures).

Conclusions: A meta-analysis of current randomized controlled trials comparing TURP to HE-TUMT demonstrate more significant changes in Qmax, IPSS, and PVR when TURP is used to treat symptomatic BPH. Despite these statistical differences, stratified data demonstrate that current day HE-TUMT machinery is more efficacious than previously used lower energy based machinery, especially at objective endpoints. This is most evident when the Prostalund device is used. These findings coupled with the decreased costs and morbidity associated with HE-TUMT place this treatment at the forefront of MIT-BPH.
T-SLING FOR THE TREATMENT OF STRESS URINARY INCONTINENCE

Arnaldo F. Trabucco, MD, FACS, Jeffrey Blitstein, MD,

1Department of Urologic Surgery, Columbus Regional Hospital, Columbus, IN
2Department of Urology, SUNY Downstate Medical School, Brooklyn, NY

Objectives: The optimal treatment of stress urinary incontinence (SUI) remains a challenge, in part because of disappointing long-term results for percutaneous needle suspension and other sling substitutes whose application has resulted in the recurrence of urethral hypermobility or the creation of urethral obstruction. The purpose of this study was to test the effectiveness of a mesh that was designed for the surgical correction of stress urinary incontinence (SUI) using a new surgical synthetic composite sling. The sling was designed to prevent the inherent complications of chronic retention and urethral erosion, associated with traditional synthetic polypropylene slings and to provide the urologic surgeon with a minimally invasive user-friendly approach.

Methods: A retrospective study was performed on 55 patients with urethral hypermobility SUI who were treated with the T-Sling. The sling, composed of both absorbable and non-absorbable components, is implanted using a modified Stamey approach. Follow-up was for 17 to 79 months. All terms and definitions concur with those of the International Continence Society.

Results: 54 patients (98.2%) operated on had cure of incontinence. Irritative voiding symptoms improved in all patients. No morbidity or complications were seen.

Conclusion: We describe here the use of a novel sling, designed to reduce the occurrence of complications found with other synthetic slings, for treatment of SUI. The procedure is minimally invasive, involves a short hospital stay, and is technically simple.
ABSTRACTS – Session 2

POSTER 209

A NEW METHOD TO EVALUATE HUMAN-ROBOT PERFORMANCE AND ITS APPLICATION TO UROLOGICAL ROBOTICS

K Rose, G Rodriguez, P Dasgupta
Guys Hospital and GKT School of Medicine, London
Jet Propulsion Laboratory, California Institute of Technology, Pasadena

Introduction: With the introduction of sophisticated master-slave systems we urologists seem to be heading towards a digital future. However these robots are very expensive and rigorous scientific evaluation is necessary to establish their role in clinical practice.

Methods: This work sets out to apply a new analytical method first developed for space robotics to quantitatively evaluate the performance of the da Vinci robot during robotic prostatectomy and compare it to laparoscopic and radical retropubic prostatectomy for localised prostate cancer.

Results: Each of the main functions of the robotic system is referred to as a functional "primitive" which are:

1. Prostatic dissection
2. Suturing of dorsal venous complex
3. Reduction of bleeding
4. Sparing of neuro-vascular bundles
5. Urethro-vesical anastomosis

The performance of system $m$ for primitive $k$ is characterized by the symbol $p(k,m)$. This quantifies how well the system does each primitive function. For each system, there are also a set of parameters that reflect the resources the system needs. A performance to resource ratio and finally a composite score can be derived from this:

$$S = (1/2) \log \Sigma p^2(k,m)$$

Conclusions: Such composite scores are essential to mathematically evaluate human-robotic performance for given resources and truly compare robotics with traditional methods of performing urological surgery.
ROBOTIC ASSISTED RETROPERITONEOSCOPIC NEPHRECTOMY - INITIAL EXPERIENCE WITH THE HYBRID PORT TECHNIQUE

K Rose, P Dasgupta
Guy’s & St Thomas’ Hospital and GKT School of Medicine, London.

Introduction: Robotic assisted nephrectomy with the Zeus system has been described using the transperitoneal approach. To our knowledge we report the first two robotic nephroureterectomies and the first retroperitoneoscopic robotic nephrectomy/nephroureterectomies using the Da Vinci™ Surgical System in the UK.

Patients and Methods: After retroperitoneal balloon dissection, four ports are carefully placed. Using the “hybrid port technique”, with a robotic port through a standard laproscopic port the procedures could be completed much faster. The hybrid port can accommodate the instruments used by the third surgical arm of the robot, and also allows the assistant easy access for vascular stapling.

Results: The median operating time was 185min with a median robot docking time of 4min and estimated blood loss was 116ml (50-200ml). Median hospital stay was 10 days. Margins were clear. One patient had post operative bleeding.

Conclusions: The first reported results of a novel technique indicate that retroperitoneal robotic renal surgery is feasible. Short-term outcomes are comparable to those of open or laparoscopic techniques.
ROBOTIC RADICAL CYSTOPROSTATECTOMY AND ILEAL CONDUIT DIVERSION - FIRST UK EXPERIENCE

K Rose, AK Hemal, D Cahill, P Rimington, MS Khan, P Dasgupta
Guy's & St Thomas’ Hospital and GKT School of Medicine, Vattikuti Institute, East Sussex Hospital,

Introduction: Open cystectomy / cystoprostatectomy has significant morbidity with most patients needing blood transfusion, long hospital stay and prolonged recovery. Only around 20 robotic cystectomies have been reported worldwide.

Patients and Methods: We report the first UK experience of robotic cystectomy using the Da Vinci system in three patients (2 male, 1 female). Ileal conduit diversion was performed through a 5 cm appendix / midline incision.

Results: The two cystoprostatectomies (one nerve-sparing) were performed for muscle invasive bladder cancer, the third being for CIS. The median operating time was 420 min, median cystectomy time 225 min and median robot docking time of 7min. Estimated blood loss was 125 ml (100-150 ml). None required blood transfusion. Bowel function returned on day 1. Mean hospital stay was 12 days. One patient had a superficial wound infection. Margins were clear in all patients and one has assisted erections.

Conclusions: Although operative times are long, short-term results of robotic cystectomy, compared to open and even laparoscopic cystectomy are favorable.
ROBOTIC UROLOGY IN UK: KEY STEPS, GOVERNANCE AND SCIENTIFIC EVALUATION

KE Rose, AK Hemal, I Mushtaq, P Dasgupta
on behalf of the Guy’s and St Thomas’ Robotics Steering Group
Guy’s & St Thomas’ Hospital and GKT School of Medicine, London

Introduction: Development of an NHS robotic program must be supported by evidence showing it to be more effective than traditional open surgery. Establishment of our structured robotic urology program involved five key steps: funding, basic science, training, governance/clinical experience and evaluation.

Materials: Funding for the Da Vinci™ robot was obtained as a competitive project grant from the Charitable Foundation for its purchase and scientific evaluation.

Basic Science: To our knowledge we performed the only randomised-controlled trial of robotics in urology which showed the RCM robot to be slower but more accurate than humans.

Training: The robotic group were trained in a Da Vinci™ "dry-lab" and "cadaveric-lab". An observership was conducted in the Vatikutti Institute, Detroit.

Results: Mentored surgery was commenced after clearance from the local clinical governance committee, which reports to NICE.

<table>
<thead>
<tr>
<th>Procedures</th>
<th>No.</th>
<th>Mean time (min)</th>
<th>Mean blood loss</th>
<th>Early outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radical prostatectomy</td>
<td>4</td>
<td>1205</td>
<td>300ml</td>
<td>Gleason3+3; margins-ve</td>
</tr>
<tr>
<td>Radical Cystectomy</td>
<td>4</td>
<td>436</td>
<td>150ml</td>
<td>Margins-ve</td>
</tr>
<tr>
<td>Radical Nephrectomy</td>
<td>1</td>
<td>345</td>
<td>200ml</td>
<td>Full recovery 2 weeks</td>
</tr>
<tr>
<td>Nephroureterectomy</td>
<td>2</td>
<td>180</td>
<td>75ml</td>
<td>Full recovery 4 weeks</td>
</tr>
<tr>
<td>Colposuspension</td>
<td>2</td>
<td>145</td>
<td>15ml</td>
<td>Continent</td>
</tr>
</tbody>
</table>

Conclusion: Surgical outcomes, quality of life and patient attitudes to robotics are being evaluated prospectively, along with health economics, ergonomics and analytical sciences.
ROBOTIC PROSTATECTOMY - PATIENT PERCEPTIONS OF TECHNOLOGY

Seth Capello, Michael E. Moran, Efrossini A. Kolios, Farzeen Firoozi, James Belarmino, Michael Perrotti
Albany, NY USA

Introduction and Objective: Technology has always been perceived with a mixture of trepidation and awe. Some actually fear the unknown implications. The most radical example of such powerful negative response was the Luddite movement in response to the early Industrial Revolution. There currently are no studies on the patient’s perspective regarding robotic surgery. This is a prospective evaluation by questionnaire in our first 25 patients for robotic prostatectomy.

Methods: The first 25 consecutive patients presenting for robotic radical prostatectomy were given a questionnaire regarding intelligent, digital technologies during their discussion about robotic prostatectomy. All patient’s data such as age, race, level of education were all available with the data from the survey. Questions regarding patient familiarity with intelligent technologies and their consideration of its impact upon themselves were devised. Knowledge regarding robots were explored with an attempt to separate science fiction (Hollywood stereotypes) from science reality.

Results: All patients were eager to participate in the data collection regarding intelligent technologies. Our average age was 60.2 (range 41-71). All but three patients had a college degree (88%) and 11 (44%) had post graduate educations. Amazingly 28% felt that technology was progressing faster than society could comfortably cope with it. All but 3 had at least one computer in their households and a majority (68%) favored further space exploration and the Mars efforts. Surprisingly, five patients favoring a robotic-surgical approach (20%) could name no Hollywood robots, but most knew of R2D2(52%). Despite the degree of education in this initial population, only 2 patients new they had operational lasers in their households (ave. American has 4).

Conclusions: Almost nothing is known about a patient’s perception regarding the technology of surgery, add to this, advanced intelligent technologies and this gap will most likely widen. There is little doubt that the coming age of robots will transform our society and that the da Vinci Surgical System™ represents one such intelligent system. Surgeons must not lose sight of our patient’s understanding of the mechanisms we utilize on their behalf.
Introduction and Objective: Nikola Tesla is perhaps the least known geniuses of our era, yet during his own time, he was singled-out as perhaps the sentinel minds by his peers. He is the inventor of many of the electronic systems currently in use throughout the world. He formatted the AC current, patented the first AC engine, dynamo, turbine, and a host of purely electrical apparatus. He was the first to investigate plasmas, particle-beam weapons, radio communication, electromechanical propagation, terrestrial heating and power generators, oceanic thermal conversion, X-rays and others things. One of his least known devices was a remote-controlled, electronic robotic underwater submersible usable in armed conflicts. This is an investigation into Tesla and his unique robotic device.

Methods: Tesla was an incredibly secretive individual but there exists extensive writing by and about him. We were able to gather extensive details including photos of Tesla and his intriguing radio-controlled robot. This, plus his patent are readily available for students of robotics to investigate.

Results: Tesla was much influenced by war torn Yugoslavia, his homeland and had a significant interest in electronic instruments that might remove humanity from the risks of injury during war. Tesla had exhaustively prepared for the first Electrical Exhibition at Madison Square Garden, but the proceedings were overshadowed by the onset of the Spanish-American War. On that fateful day in 1898, Tesla demonstrated more than the public could possibly absorb. His first two radio-controlled devices were boats, one that could subsurface. In one afternoon, Tesla had demonstrated the future of modern guided weapons, vehicles, the automated industrial manufacturing, and robotry but no one present understood any of these concepts.

Conclusions: In biographies about Tesla, Commander E.J. Quinby, USN Retired is quoted as follows: “I was there with my father, quite fascinated, but also quite unaware that I was witnessing the dawn of space navigation to be realized later, in the following century.” The inventor did not disclose more than his fundamental idea in his patent No. 613,809, a technique he had developed to protect his ideas from his competitors, especially Edison. His robotic submarine was entirely autonomous, it included six 14-foot torpedoes which were arrayed vertically in two rows so that as one discharged, another would fall into place. In Tesla’s own words, he claimed that “such a ship attack and destroy a whole armada—destroy it utterly in an hour, and the enemy would never have a sight of their antagonists or know what power destroyed them.”
THE DA VINCI ROBOT

Seth Capello, Michael E. Moran, James Belarmino, Farzeen Firoozi
Efrossini A. Kolios, Michael Perrotti
Albany, NY USA

Introduction and Objective: One might safely assume that by the title of this abstract, we might be discussing the nuances of a very complex mechanical robot, and this would be correct. On the other hand, the date of the design and possible construction of this robot was 1495, a little over 5 Centuries ago. The key point in the title is the lack of a trade mark name, as Leonardo was the designer of this sophisticated system. His notes from the Codex Altanticus represent the foundation of this report.

Methods: English translations of da Vinci’s notebooks are currently widely available. Beginning in the 1960s, investigators at the University of California had begun to ponder the significance of some of da Vinci’s markings on what appeared to be technical drawings. They also occur in his Codex Atlanticus (the largest single collection of da Vinci’s sheets consisting of 1119 separate pages) along with a large number of other easily perceived mechanical devices. Continuing research at the Instituto e Museo di Storia della Scienza in Florence has resulted in a great deal of information on Leonardo’s intentions with his mechanical knight.

Results: It is now known that the appearance of da Vinci’s robot would have the outer appearance of a Germanic knight. It had a complex core of mechanical devices that was probably human powered. This mechanical knight could sit up, wave it’s arms, and move it’s neck while opening and closing it’s anatomically correct jaw. It made sounds to the accompaniment of drums. The robot had two independent operating systems. The first had 3 degree-of-freedom legs, ankles, knees and hips. The second had 4 degree-of-freedom in the arms with articulated shoulders, elbows, wrists, and hands. A mechanical analog-programmable controller within the chest provided the power and control for the arms. The legs were powered by an external crank arrangement driving the cable, which connected to key locations near each lower extremities’ joints. da Vinci also is known to have devised a programmable, front wheel-drive automobile with rack-and-pinion suspension mechanisms using whale baleen at age 26. He would recall this device again, when at age 40 he is thought to have built a programmable, automated lion but by then he had produced his own metal springs as well as drum containing springs called tambours. He positions his fusee to a stationary rotating power output shaft that will be used to power his programmable automaton.

Conclusions: Part the obscurity of da Vinci’s robot comes from difficulties interpreting Leonardo’s markings. His designs precede any formal method of blueprint designing. The technical aspects had to be deciphered before anyone could even attempt to reproduce his intended device. This robotic device fits together with other pieces of evidence that link 15th century automatons to da Vinci’s design, namely the automated Tea Servers from Spain. As with many things from da Vinci, looking backwards at this master leaves one with a pronounced sense of awe at his prescient view of the world.
BIAXIAL PASSIVE MECHANICAL PROPERTIES OF DIABETIC BLADDER WALL

Chung Cheng Wang1,4, Michael S. Sacks2,3, K. Khashayar Toosi2,3, Jiro Nagatomi2,3, Naoki Yoshimura1, Michael B. Chancellor1,3

1Department of Urology, University of Pittsburgh, Pittsburgh, PA
2Department of Bioengineering, University of Pittsburgh, Pittsburgh, PA
3McGowan Institute for Regenerative Medicine, University of Pittsburgh, Pittsburgh, PA
4Department of Urology, En Chu Kong Hospital and Department of Biomedical Engineering of Chung Yuan Christian University, Taiwan

Introduction: We investigated the time-course changes of mechanical properties of diabetic and diuretic rat bladders using biaxial mechanical testing.

Methods: Diabetes was induced in adult female Sprague-Dawley rats by a single intraperitoneal injection (65mg/kg body weight) of Streptozotocin. Chronic diuresis was induced by feeding 5% sucrose in water. Whole bladders were harvested at 2-week, 4-week and 8-week post-treatment. Mechanical properties of 10 mm square tissues obtained from the bladder body were tested using planar biaxial testing, in which a maximal 100 kPa stress was applied in the circumferential and longitudinal (base-apex) directions, and resulting axial strains were measured.

Results: The bladders exhibited a non-linear stress-strain relationship, mechanical anisotropy and asymmetric mechanical coupling. Both axes showed rapidly increasing stresses at higher stretches. Under maximal equi-biaxial stress, the stretch in the circumferential axis was greater than that in the longitudinal axis. The maximal stretch in the circumferential axis and areal strain continued increased in both treated rats over the 4-week period. In 8-week diabetic rats, the areal strain showed a further increase compared with 4-week diabetic rats (0.64 ± 0.11 versus 0.46 ± 0.09, p=0.01). However, the areal strain was similar in 4-week and 8-week diuretic rats (0.47 ± 0.12 versus 0.48 ± 0.12, p=0.98).

Conclusion: Both diabetes and diuresis changed the mechanical properties of the bladders. We suggested that the “early” changes (up to 4-week treated) of mechanical properties were mainly induced by diuresis and the “late” changes (8-week treated) were induced by other diabetic effects. These data may be used in computational simulations of the bladder to predict the effects of diabetes and further treatment.
TELEMENTORED HAND-ASSISTED LAPAROSCOPIC LIVE DONOR NEPHRECTOMY: AN EASIER ROUTE TO INDEPENDENT PRACTICE

Ben Challacombe, Shamim Khan, Raja Kandaswamy, Matthew Bultitude
Prokar Dasgupta, Nizam Mamode.

Departments of Transplantation and Urology, Guy’s Hospital, London and Department of Surgery
University of Minnesota, Minneapolis, USA.

Laparoscopic live donor nephrectomy is a major advance but a challenging procedure to learn even after laparoscopic training. It requires significant previous training in both laparoscopic and transplant surgery. Telementoring has been shown to reduce the laparoscopic learning curve in other fields. Of six cases of hand-assisted laparoscopic (HAL) live donor nephrectomy at our institution, an on-site mentor supervised the initial two. We present the subsequent four cases as the first documented examples of telementored HAL live donor nephrectomy.

Telelink was established with a Comstation (Zydacron, UK) incorporating a Z360 telementoring codec and 4 ISDN lines (512kb/sec) with time delay of 500msec for both audio and video. The remote surgeon in Minnesota, USA could change independently between the laparoscopic and external views. The operating surgeons were able to look at the mentor and converse with him throughout. Total cost was approximately $14,000.

| Results: Trans-Atlantic telementored hand-assisted laparoscopic live donor nephrectomy |
|-----------------------------------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| Donor-Recipient | Op time (mins) | Warm ischemic time (sec) | Estimated blood loss (mls) | Donor Total morphine dose (mg) | Donor Creat pre-op | Donor Creat day 1 |
| Son-Mother | 125 | 146 | 28 | 4 | 94 | 165 | 2 |
| Wife-Husband | 170 | 185 | 287 | 1 | 66 | 120 | 3 |
| Father-Son | 296 | 245 | 185 | 5 | 83 | 136 | 4 |
| Father-Son | 240 | 178 | 100 | 6 | 118 | 176 | 3 |
| Mean | 208 | 189 | 150 | 4 | 90 | 149 | 3 |

There were no adverse events in recipients and graft function was excellent.

Telementoring for laparoscopic donor nephrectomy is feasible, effective and is likely to aid independent practice by providing continued supervision and reducing the learning period. It may have implications for living donor transplantation programmes and other surgical specialities. Telementoring networks may allow rapid transfer of complex skills between regional centres.
DEVELOPMENT AND CONSTRUCTION OF AN ICE-SLUSH GENERATOR AND DEPLOYMENT END-EFFECTOR FOR LAPAROSCOPIC PARENCHYMAL HYPOTHERMIA

Stephen Dryer, Gregory Hruby, Ramakrishna Venkatesh, Kyle J. Weld, Kevin Morrissey, Kelley Foyil, Tabitha Shen, Caroline D. Ames, Salvatore P. Sutera, Jaime Landman
St. Louis, MO

Introduction and Objective: We designed and constructed a device to create and deploy an iced saline slush laparoscopically to order to induce laparoscopic organ parenchymal hypothermia.

Methods: A method for creating a fine consistency slush was developed, using a Bunn Ultra 2 (Bunn-O-Matic, Springfield, IL) ice-slush creating machine and a Cobe parastaltic roller pump (Cobe Cardiovascular, Arvada, CO) to move the ice slush through 3/8 inch Tygon (Saint-Gobain Performance Plastics Corporation, Akron, Ohio) tubing. A laparoscopic administration device, a 10 mm end-effector, was designed and built to minimize rough edges and step-downs in tubing diameter, and allow for a recycle pathway which would maintain the ice-slush at an ideal consistency for optimal deployment through the system. These design features help prevent aggregation of ice crystals and plug formation. The end-effector was tested in a laboratory setting evenly and reliably metering a fine consistency slush without stop-ups or excessive volumes of run-off saline. Sterility testing was performed to confirm the creation of sterile ice-slush with this system.

Conclusions: We designed and constructed an efficient means of generating, directing, and controlling a fine consistency ice-slush that can be easily deployed via a standard laparoscopic trocar for organ parenchymal hypothermia.


Explanation of how slush pump works

20th E&U Annual Meeting, May 21, 2005, San Antonio, TX
POSTER 219

3-D VIRTUAL REALITY MODELING OF RENAL STONE PATIENTS: PROOF OF CONCEPT

Bodo E. Knudsen, Ben H. Chew, Gord Campbell, David Perry
Stephen E. Pautler, John D. Denstedt
Ohio State University, University of Western Ontario, National Research Council of Canada

Introduction: Successful renal percutaneous access requires a fundamental understanding of renal anatomy in three dimensions. Fluoroscopic imaging in the operating room provides two dimensional imaging only. We present our initial experience developing a technique to create interactive 3-D virtual reality (VR) models of the renal units of patients with renal calculi. Ultimately this should facilitate preoperative surgical planning and improve outcomes in patients undergoing percutaneous renal access procedures.

Methods: Two patients with renal stone disease were selected. Patient A had a right-sided staghorn calculus. Patient B had a stone material contained within a diverticulum in the left kidney. Unprocessed CT data in DICOM format was imported into Amira (TGS Inc., San Diego, CA) running on a desktop PC and the 3D VR model was created. A Silicon Graphics Monster Onyx 2 running Linux was used to display the 3-D stereo model in a VR theatre called the CAVE (FakeSpace Systems Inc., Marshalltown, Iowa) or on a specialized desk called the Immersadesk (FakeSpace Systems Inc.). The 3-D (non-VR) model was also viewed on a desktop PC running Windows XP.

Results: 3-D VR models of the kidney of two patients with renal stone disease were created. They were successfully viewed in both an interactive 3-D virtual reality environment and in a non-VR environment utilizing a desktop PC.

Conclusion: This proof of concept study demonstrates that interactive 3-D VR models of renal units with stone disease can be successfully created. VR imaging is a promising technology that may be used in the future to facilitate renal surgery. Our goal is to bring this technology into the operating room to assist renal percutaneous access procedures. Successfully creating and viewing these models in the interactive 3-D VR environment represents the first-steps in achieving this goal.
THE USE OF A NOVEL SURGICAL ADHESIVE (BIOGLUE®)
DURING LAPAROSCOPIC AND OPEN PARTIAL NEPHRECTOMY:
INITIAL CLINICAL EXPERIENCE

Ravi Munver1,2, Ihor S. Sawczuk1, Joseph J. Del Pizzo2, Michael A. Palese2, R. Ernest Sosa2, Douglas S. Scherr2, Ilya A. Volfson1, Pedram Ilbeigi1, Salvatore A. Lombardo1, and E. Darracott Vaughan, Jr.2

Hackensack University Medical Center, Hackensack, N.J.1; New York-Presbyterian Hospital-Weill Medical College of Cornell University, New York, N.Y.2

Introduction: During laparoscopic (LPN) or open (OPN) partial nephrectomy, obtaining hemostasis is among the most challenging aspects of the procedure. Recently, a variety of techniques, devices, and sealants have been described to assist with hemostasis. We have assessed the efficacy of bovine serum albumin/glutaraldehyde (BioGlue®) [Cryolife, Kennesaw, GA] and report our experience with this tissue adhesive as a hemostatic agent and collecting-system sealant during LPN or OPN.

Methods: 30 consecutive partial nephrectomies (11 LPN, 19 OPN) were performed by six surgeons at two institutions for radiographically enhancing renal masses. Perioperative data regarding these procedures were retrospectively reviewed.

Results: Mean surgical time was 155 +/- 37min (LPN) and 199 +/- 46min (OPN), and mean blood loss was 112 +/- 148mL (LPN) and 392 +/- 189mL (OPN). The renal pedicle was occluded in 9 (81%) LPNs and 18 (94%) OPNs. Following excision, initial hemostasis was achieved with electrocauterization, argon-beam coagulation, or suturing. Collecting system entry in 0 (0%) LPNs and 14 (73%) OPNs was suture-repaired. BioGlue® was applied to the surgical defect and maintained hemostasis in all cases. The mean tumor diameter was 2.1 +/- 1.0 cm (LPN) and 4.0 +/- 2.2 cm (OPN). Post-operative urine leaks after tenuous collecting system repair (n=2), were successfully managed with extended flank drain duration (n=1) and ureteral stent placement (n=1). At a minimum of 12 months follow-up, no adverse effects or complications related to the surgical adhesive were noted.

Conclusions: Conventional temporizing hemostatic measures combined with BioGlue® allows for successful hemostasis during LPN or OPN. Our experience suggests that this adhesive may reinforce small collecting system repairs, but does not appear to have sealing properties for large leaks. The use of this compound adds to the armamentarium of agents available during nephron-sparing surgery.
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CRYOABLATION OF RENAL MASSES IN PATIENTS WITH SOLITARY KIDNEY OR SEVERE RENAL INSUFFICIENCY

Salvatore A. Lombardo¹, Vladislav G. Bargman¹, Ravi Munver¹,², and Ihor S. Sawczuk¹,²

University of Medicine and Dentistry of New Jersey - New Jersey Medical School, Newark, NJ¹
Hackensack University Medical Center, Hackensack, NJ²

Introduction: Cryoablative therapy may be a useful technique for the treatment of renal masses in patients with solitary kidneys or renal insufficiency. The purpose of this study was to evaluate the role of cryoablation in patients with solitary kidneys with the goal of tumor destruction or removal, and maximal renal parenchymal preservation.

Methods: 9 patients with single tumors were treated, of which 7 patients had solitary kidneys, 1 had a nonfunctioning contralateral kidney, and 1 had renal insufficiency. Seven tumors were treated with in-situ cryoablation and 2 tumors were treated with cryo-assisted partial nephrectomy. All masses were biopsied prior to freezing. Procedures were performed under real-time intraoperative sonographic guidance. In each case, tumor was easily discernable ultrasonographically, allowing for precise placement of cryoprobes. After cryprobe placement, tumor masses were treated with 2 freeze cycles (-40 degrees Celsius for 15 minutes per cycle) separated by an active thaw process. 7 tumors were left in situ and 2 were resected with a scalpel by tracing the edge of the ice ball.

Results: Cryoablation was well tolerated by all patients without any perioperative complications. Mean patient age was 62.1 years (range 49-79), and the tumor location included: 4 (upper pole), 2 (mid-kidney), 3 (lower pole).

<table>
<thead>
<tr>
<th>Mean Values (Range)</th>
<th>Mean Tumor Size in (cm)</th>
<th>Mean Pre-op Cr (mg/dl)</th>
<th>Mean Post-op Cr (mg/dl)</th>
<th>Mean Cr at 4 to 30 months post-treatment (mg/dl)</th>
<th>Mean Pre-op HCT (%)</th>
<th>Mean Post-op HCT (%)</th>
<th>Mean EBL (cc)</th>
<th>Mean Operative time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.7 (1.2-4.3)</td>
<td>1.49 (1.3-1.9)</td>
<td>1.72 (1.1-2.5)</td>
<td>1.57 (1.3-2.1)</td>
<td>41.0 (34-46.1)</td>
<td>35.5 (32.9-42.7)</td>
<td>114.4 (30-250)</td>
<td>215.5 (180-270)</td>
</tr>
</tbody>
</table>

Mean hospitalization was 4.6 days (range 4-8). The patients that underwent cryo-assisted partial nephrectomy had negative margins. Seven patients received an MRI for a minimum of 5 months to a maximum of 30 months post-procedure, follow up. In six patients, postoperative imaging has revealed no evidence of tumor recurrence. One patient had an enhancing area that is indeterminate for recurrence. Mean post-operative Cr was 1.57 (range 1.3-2.1) at a mean of 17 months post-procedure.

Conclusions: Intermediate-term results of renal cryoablation suggest that this technique may offer an advantage for patients that require a maximal nephron-sparing effort. Our results demonstrate preservation of renal function with minimal risk of tumor recurrence.
ARTIFICIAL INTELLIGENCE METABOLIC STONE ASSISTANT

Sijo J. Parekattil, M.D, Nicholas J. Hegarty, M.D, Stevan B. Streem, M.D.
Cleveland Clinic Foundation, Cleveland, OH.

**Introduction and Objective:** The evaluation and medical management of recurrent stone formers can be challenging. To this end, we proposed to develop a model to facilitate urologists in the workup, diagnosis and treatment of patients undergoing metabolic testing.

**Methods:** Currently published metabolic stone disease evaluation and treatment guidelines from our institution were employed to generate rules for an artificial neural network (ANN) model. The resultant algorithm computed specific combinations of diagnosis and treatment recommendations based on the patient’s serum and urine parameters, diagnostic imaging, medical history, current medications and prior stone analysis. The program was developed in two stages: 1) model training on data from 161 consecutive patient encounters evaluated for metabolic stone disease from March to July 2004, and 3) prospective blinded testing of the model’s diagnostic accuracy on data from 46 consecutive patients from August to September 2004.

**Results:** The model allows for the input of the previously mentioned patient parameters and then instantaneously provides multiple diagnoses and management recommendations. The figure below illustrates a screenshot of the program. The diagnostic accuracy of the model in the 46 patient test group was 87%. The diagnostic errors were minor compared to the actual treatment plan that was provided to the patients. For example, type of citrate therapy in patients with a history of diabetes (polycitra™ LC) or short bowel syndrome (polycitra™ or citracal™). These errors were then corrected to further refine the model. The program was designed with secure access features, the ability to store several thousand patient entries, a simplified data entry form, the ability to sort records by any chosen criteria and to provide print out reports for each patient.

**Conclusions:** This program illustrates the successful use of artificial intelligence methods to facilitate urologists in metabolic stone workup and management. The model provided a diagnostic accuracy of 87%. Further testing will enhance the model.
EVALUATION OF TARGETSCAN DEVICE IN PROSTATE CANCER DETECTION

Erica J. Traxel1, Jay S. Belani1, David G. Bostwick2, Peter A. Humphrey3, Gerald L. Andriole1
1Division of Urology, Washington University School of Medicine, St. Louis, MO
2Bostwick Laboratories, Richmond, VA
3Department of Pathology, Washington School of Medicine, St. Louis, MO

Introduction: The Envisioneering TargetScan® is a novel transrectal ultrasound (TRUS) device that uses a flexible needle to biopsy the prostate in a template fashion. First a computer algorithm identifies an ideal biopsy scheme using the measured dimensions of the prostate. The system then uses a fixed template that allows the physician to biopsy the prostate at a specific location and to target the same area of the prostate for future treatment.

Methods: Twenty patients with prostate cancer who underwent radical prostatectomy were entered into the study. After the prostate was removed, the maximum height, longitudinal length and transverse width were measured. Using these dimensions, a computerized algorithm generated specific coordinates at which to biopsy the specimen. The prostate was then placed in our model and 12 cores were taken in 16 and high grade PIN in an additional 2. Among those 4 positive by TargetScan biopsy (48 positive cores for 16 specimens), while only 1.79 cores were positive by preoperative biopsy (34 positive cores for 19 specimens). This difference was statistically significant, p=0.027.

When comparing Gleason scores, the preoperative biopsies were up-graded in 45%, down-graded in 0% and had the same grade as the final pathology in 55%. The TargetScan biopsies were up-graded in 18.75%, down-graded in 12.5% and had the same grade as the final pathology in 68.75% of cases. These differences were also statistically significant (p=0.046).

When assessing the position within the specimen where cancer was located, a total of 64 out of 80 quadrants contained cancer on final pathology. The TargetScan biopsy system had identified the cancer in 31 of these 64 quadrants (48%). Among the 14 prostates for which two different surgeons performed the biopsies using the TargetScan system, a total of 168 biopsy cores were obtained by each surgeon. Comparing these two sets of cores, 143 (85.11%) of the biopsies matched on pathologic analysis. Of the 38 cores containing adenocarcinoma obtained by the first surgeon, 25 (65.79%) were positive on repeat biopsy by the second surgeon.

Conclusion: The TargetScan device is a novel method for performing a template-driven transrectal prostate biopsy. The device better predicts Gleason score when compared to conventional biopsy techniques and has the ability to target the same area of the prostate on repeat biopsy, suggesting potential future application in directed local treatment of prostate cancer.

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A CONSTITUTIVE MODEL OF THE HUMAN LIGAMENT FOR FINITE ELEMENTS SIMULATION

Lucian G. Gruionu\textsuperscript{1}, Constantin Bratianu\textsuperscript{2}

\textsuperscript{1}University of Craiova, \textsuperscript{2}Polytechnic University of Bucharest, Romania

\textbf{Introduction:} This paper describes a three-dimensional constitutive model for biological soft tissue, at this point the knee anterior cruciate ligament and its finite element implementation. The main difficulties in the development of such numerical models are the properties of the soft tissues considered to be anisotropic, viscoelastic, inhomogeneous, incompressible and experiencing large deformations.

\textbf{Methods:} Previously published constitutive models of the ligaments are based on various linear interpretations of material behavior. In this present study a non-linear constitutive model of ligaments was developed based on the hyper-visco-elastic hypothesis and on experimental data taken from literature. Hyperelastic materials are described in terms of a strain energy potential $W_e$, which defines the strain energy stored in the material per unit of reference volume (volume of the initial configuration) as a function of the strain at that point in the material. The hyper-viscous-elastic constitutive model uses the following form for the strain energy potential of an isotropic material in terms of the strain invariants $I_1$, $I_2$, $I_3$: 

$$W_e = \alpha \left( \beta (I_1 - 3) + \beta^2 (I_1 - 3)^2 \right) - \alpha (I_2 - 3)$$

where $\alpha = 0.660$ MPa and $\beta = 12.050$. The elastic constitutive law was given by a partial derivative of the elastic potential with respect to incompressibility assumption. The identification of the parameters has been completed using a least square fit of the experimental stress-strain points. Rate effects were taken into account through linear viscoelasticity by a convolution integral of the form $S_g = \int_0^t G_{i\omega} (t - \tau) \frac{\partial E_{i\omega}}{\partial \tau} d\tau$ where the relaxation functions is $G_{i\omega} (t - \tau)$, $S_g$ is the second Piola-Kirchhoff stress tensor and $E_{i\omega}$ is the Green’s strain tensor. This stress was added to the stress tensor determined from strain energy functional. Only simple rate effects were included. The relaxation function was represented by the first six terms from the Prony series $G(t) = \sum_{i=1}^{6} G_i e^{-\beta_i t}$ characterized by input shear moduli $G_i$ and decay constants $\beta_i$: $G_1 = 0.2820$, $G_2 = 0.12934$, $G_3 = 0.6912$, $\beta_1 = 0.202$, $\beta_2 = 0.0005$, $\beta_3 = 0.0004$. All parameters were determined by fitting the experimental stress-strain points using a least square procedure.

\textbf{Results:} Constitutive equation was implemented in the hyperelastic rubber material model in the Ls-Dyna software to obtain the approximate solutions to the problem of stress/strain pattern determination of the ligament. An explicit dynamic analysis was performed, where the tibia region of the ligament was constrained and the femoral region was moved according to computed kinematics data for normal walking and cycling.

\textbf{Conclusion:} The importance of the present biomechanics model of the knee ligament arises from the constitutive model developed here that could be used for any biological fibrous tissues in finite element simulations for virtual surgery or medical devices design.

\textbf{Stress distribution (MPa) in 4 points over ACL posterior bundle during cycling function of time (s), for a flexion angle from 0 to 20°.}
ABSTRACTS – Session 2

20th E&U Annual Meeting, May 21, 2005, San Antonio, TX

POSTER 225

2nd BEST PAPER AWARD

TOWARDS DEVELOPMENT OF A POINT-OF-CARE MICRO-LABORATORY FOR UTI DIAGNOSIS: A NOVEL BIOFILTER FOR UROPATHOGEN CONCENTRATION

Joseph C. Liao¹, Yanbao Ma², Mitra Mastali³, David A. Haake³, Chih-Ming Ho², Bernard M. Churchill¹
¹Department of Urology, David Geffen School of Medicine at UCLA
²Institute for Cell Mimetic Space Exploration and Mechanical Engineering Dept., UCLA Henry Samueli School of Engineering, ³Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, CA

Introduction: Lab-on-a-chip is microfluidics-based platform incorporating automated biological and chemical reactions and microsensor array for sensitive detection of relevant biological markers. Point-of-care detection of pathogens will have significant clinical, environmental, and biodefense utilities. We recently described the application of a microfabricated sensor array for direct molecular identification of uropathogens. A major challenge to integrate this sensor into a lab-on-a-chip platform is the ability to concentrate clinical urine specimens without centrifugation. We report here a prototype biofilter that concentrates uropathogens directly from clinical urine specimens. The concentrated samples are then assayed with the electrochemical microsensor for uropathogen identification.

Methods: A schematic drawing of the biofilter is shown. Polyethersulfone membrane with 0.45µm pore size is used for micro-filtration. The acrylic filter chamber is fabricated with a computer numerically controlled (CNS) machine. Grooves 250µm wide and 0.75mm deep are cut on bottom to form a screen to support the filter membrane. The biofilter is driven by a miniature peristaltic pump. Clinical urine specimens from the UCLA Clinical Microbiology Laboratory were first concentrated then lysed within the biofilter. The biofilter also served as a mixing chamber for DNA probe hybridization against the target bacterial 16S rRNA. The hybridization products are directly deposited on the 16-sensor array for detection.

Results: 8 clinical specimens have been tested to date (filtration volume 2-10cc). A representative result is shown in the bar chart. A clinical urine specimen with and without filtration was assayed with the electrochemical sensor array (inset). The signals obtained (nano-ampere) with filtration were significantly higher than without filtration. Positive signals were seen in sensors containing probes that bind to Klebsiella-Enterobacter spp., as well as probes that bind to all bacteria (Universal) and enteric organisms (Enterobacteriaceae). The species-specific assay without centrifugation was achieved in approximately 50’. The clinical microbiology laboratory confirmed the presence of E. aerogenes.

Conclusion: We report a successful prototype biofilter for uropathogen concentration from clinical urine specimens and detection using an electrochemical sensor. This filter can replace the traditional centrifugation process which is the roadblock for completely automated sample preparation. These are important milestones for an eventual integrated and fully automated lab-on-a-chip system for point-of-care urinary tract infection (UTI) diagnosis.
THE USE OF BIOGLUE FOR LAPAROSCOPIC PARTIAL NEPHRECTOMY

Michael Conlin, MD, FACS,
Oregon Health & Sciences University, Portland, Oregon

Introduction: Laparoscopic partial nephrectomy involves the technical challenges of renal vascular control, precise excision of the tumor, closure of collecting system, renal vessels, and parenchyma, and minimization of warm ischemia. Bioglue (Cryolife, Kennesaw, Georgia) is a novel substance consisting of albumin and gluteraldehyde which may facilitate laparoscopic partial nephrectomy. We review our experience using Bioglue during laparoscopic partial nephrectomy.

Methods: Laparoscopic partial nephrectomy was performed in 18 patients for renal mass. Laparoscopic partial nephrectomy was performed in a transperitoneal technique, utilizing vascular control with either laparoscopic bulldogs or a laparoscopic Statinsky clamp. No cooling of the kidney was performed. Cold excision of the tumor was performed followed by (when necessary) closure of the collecting system and larger vessels with intracorporeal suturing, and closure of the parenchyma over Surgicel bolsters. Bioglue was used in all of these cases as an additional seal of the cut surface of the kidney.

Results: 18 patients were treated with laparoscopic partial nephrectomy for the excision of a renal mass. Nine were men, nine were women. The average age was 53 (22 to 78). Pathology consisted of renal cell carcinoma (9), oncocytoma (3), and angiomyolipoma (2). There were no significant complications. One patient had postoperative pyelonephritis and proximal ureteral narrowing which was successfully dilated. There were no transfusions, significant bleeding, or urine leaks.

Conclusion: Bioglue may help seal the renal parenchyma, vessels, and collecting system following laparoscopic partial nephrectomy. Further studies to determine its reliability should be performed.

Cut surface of kidney being treated with Bioglue
KTP LASER LAPAROSCOPIC PARTIAL NEPHRECTOMY WITHOUT HILAR CLAMPING IN THE SURVIVAL CALF MODEL


Section of Laparoscopic and Robotic Surgery, Glickman Urological Institute, Department of Anatomic Pathology, Cleveland Clinic Foundation, Cleveland, Ohio, USA.

Ω Laserscope, San Jose, California, USA.

Purpose: Laparoscopic partial nephrectomy (LPN) with hilar clamping presents the various challenges associated with warm ischemia. We test the feasibility, and acute and chronic outcomes of LPN using a potassium-titanyl-phosphate (KTP) laser without vascular hilar clamping in the survival calf model.

Materials and Methods: Six Jersey calves, each weighing 76-94 kilograms, underwent 12 staged bilateral transperitoneal laser LPNs of the mid/lower pole using the 80-Watt KTP laser: left kidney chronic LPN with 1 month follow up (n=6), right kidney acute LPN with immediate euthanasia (n=6). Two techniques, (a) ablative vaporization (n=5), and (b) wedge resection (n=7) were evaluated. Renal parenchymal resection and hemostasis were achieved solely with the laser, without any adjunctive hemostatic sutures or bioadhesives. Retrograde pyelography, renal arteriography, and histologic analyses were performed.

Results: All 12 procedures were successful laparoscopically without open conversion, 11 (92%) without hilar clamping. Mean total operative time was 2.9 hours (1.5-5), and blood loss was 119 cc (25-300). Mean lasing time was 56 minutes (20-100), with an average energy use of 54 Kilojoules. Mean preoperative and postoperative hemoglobin (10.38 g/dl and 10.52 g/dl) and serum creatinine (0.46 mg/dl and 0.4 mg/dl) were similar. At one month follow up, there was no evidence of urinary leak or arteriovenous fistula.

Conclusions: This initial study of laparoscopic KTP-laser partial nephrectomy without hilar clamping confirms its technical feasibility in most cases and good short-term outcomes. This success of laser LPN in the robust survival calf model with its human-sized kidney holds promise for future clinical application.
TEMPERATURE DETERMINATION AT THE ICE BALL EDGE DURING PERCUTANEOUS CT-GUIDED RENAL CRYOABLATION

Sompol Permpongkosol¹, Guilherme Lima¹, Richard E. Link¹,
Stephen B Solomon¹, ², Louis R. Kavoussi¹

¹ Department of Urology, James Buchanan Brady Urological Institute
² The Russell H. Morgan, Department of Radiology
Johns Hopkins Medicine, Baltimore, MD

Purpose: Knowledge of the temperature at the edge of the ice ball can help in assessing the effectiveness of cryoablation at the time of treatment. Herein, we demonstrated the correlation between temperature at the radiographic ice ball edge and ice ball size during CT-guided percutaneous cryoablation of renal tumors.

Methods and Material: Two patients with solid enhancing renal masses underwent percutaneous CT–guided biopsy and renal cryoablation under conscious sedation on an outpatient basis. The temperature of the ice ball edge was recorded during a double freeze-thaw cycle cryotherapy during which a temperature probe was placed approximate 10 mm. from the center of the ice ball.

Result: Tumor sizes were 1.4 and 2.0 cm, respectively. Renal cryotherapy under CT guidance produced a dark area corresponding to the ice ball. A temperature probe placed at the edge of the iceball recorded a temperature of 0 ºC. The temperature of the ice ball edge and frozen area at the end of second freeze revealed -11 ºC and 2.4 and 4.5 cm, respectively. 1 and 3 month imaging follow-up demonstrated an absence of contrast enhancement of both lesions, suggesting successful cryoablation. No complications occurred during this study.

Conclusion: Knowledge of the temperature at the ice ball edge during cryoablation can be used to predict the extent of tissue necrosis and thus provide an estimate of cryotherapy effectiveness during the procedure. Further work is necessary to establish a firm relationship between the thermal conditions and the zone of damage.
DESIGNING TREATMENT PROTOCOLS FOR MANAGING TRANSURETHRAL ULTRASOUND THERAPY FOR BENIGN PROSTATIC HYPERPLASIA

Chandrasekhar Thamire\textsuperscript{1}, Prabhakar Pandey\textsuperscript{2}
\textsuperscript{1}Department of Mechanical Engineering, University of Maryland, College Park, MD, USA
\textsuperscript{2}Urology Clinic of Cumberland, Cumberland, MD, USA

Introduction: Hyperthermia is becoming increasingly popular as a minimally invasive treatment modality for benign prostatic hyperplasia. Microwave, radio-frequency, and ultrasound energy sources are currently among the commonly used methods for treating this disease. Successful therapy using such methods requires an accurate estimation of the thermal necrosis the treatment may produce. The purpose of this study is to theoretically evaluate the thermal damage from ultrasound sources for different values of operating parameters.

Methods: Using computational methods, the Pennes bio-heat transfer equation is solved for different levels of design and operating parameters for transurethral ultrasound heating devices. Internal and external cooling is applied to the device to preserve the urethral and rectal lining and to control the temperatures within the tissue. The operating parameters varied are input power, heating duration, angular span of the heating element, coolant temperatures and flow rates, and the duration of pre- and post-cooling, if any. Variations in blood perfusion and source attenuation are included in the analysis. The extent of thermal coagulation caused is determined by evaluating the temperature history data against the thermal damage data available for prostate tissue slices and HeLa cells.

Results: Results from calculations for device powers between 30 W to 180 W and angular spans between 90\textdegree~to 360\textdegree~for various heating times are presented. Sample temperature distributions and thermal necrosis zones for a 90 W and 90\textdegree~appplicator are shown above.

Conclusion: The ultrasound devices, though can be less efficient due to cooling enclosures, exhibit a good directional control to effectively target the energy towards the desired tissue zones. Based on the results, a set of operating protocols are designed that can localize necrosis to example target zones.
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