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AWARD NUMBER: W81XWH-06-2-0002

TITLE: Image-Guided, Minimally Invasive Diagnosis and Treatment of Prostate Cancer

PRINCIPAL INVESTIGATOR: Faina Shtern, M.D.

CONTRACTING ORGANIZATION: AdMeTech Foundation
Boston, Massachusetts 02114

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Fort Detrick, Maryland 21702-5012

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14. ABSTRACT This conference brought together leaders of philanthropic and advocacy communities, government, industry and academia to discuss the state-of-the-art and to create the future vision for prostate cancer care. The goal of this conference is two-fold: 1) To expedite development and implementation of advanced imaging technologies for improved screening and early diagnosis; assessment of staging and aggressiveness; and 2) To advance integration between imaging and treatment modalities for facilitated drug development, treatment planning, guidance and monitoring.					
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"Image-Guided, Minimally Invasive Diagnosis & Treatment of Prostate Cancer"

October 27-29, 2005 Washington, DC



OCTOBER 27, 2005

**The Cannon House
Caucus Room -
U.S. Congress**

Washington, DC

OCTOBER 28-29, 2005

L'Enfant Plaza Hotel

Washington, DC

**Women Have Life-Saving
Mammograms...**

**Where Is Prostate
Imaging for Men?**

Organized by the AdMeTech
Nonprofit Foundation
for the Advancement of
Medical Technologies

In cooperation with
AdVaMed

National Electrical Manufacturers Association

National Cancer Institute

Telemedicine and Advanced Technology
Research Center (TATRC)

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FOUNDATION



For the Advancement
of Medical Technologies

This meeting/conference/workshop is held in collaborative partnership with the Telemedicine and Advanced Technology Research Center (TATRC), and is made possible by a contract administered through the U.S. Army Medical Research and Materiel Command (USAMRMC). Contract number: DAMD17-03-2-0055.

FINAL PROGRAM

CONFERENCE AT A GLANCE

Thursday
October 27, 2005
U.S. Congress

10:00 a.m.
Press Conference
Rayburn Building—Room 2105

11:00 a.m.
Luncheon
Cannon Caucus Room

12:00 p.m.
Public Conference
Cannon Caucus Room

12:10 p.m.—5:40 p.m.
Session 1: Technology Transfer from Laboratories to Clinics

12:15 p.m.
Perspectives from the Advocacy Community

12:27 p.m.
Perspective from the Academic Community

12:50 p.m.
Perspective from the Philanthropic Community

1:02 p.m.
Perspective from National Institute of Biomedical Imaging and Bioengineering

1:25 p.m.
Perspective from the National Cancer Institute

1:42 p.m.
Perspective from the US Army, Department of Defense

2:10 p.m.
Perspective from the Food & Drug Administration

2:27 p.m.
Perspective from the Centers for Medicare & Medicaid Services

2:45 p.m.
Industry Leadership Panel

4:30 p.m.
Small Business Panel

5:00 p.m.
Private Investment Panel: Perspective from Venture Capital Investment

5:10 p.m.
The Impact of the Media on Consumer Education & Transformation of Health Care

5:30 p.m.
General Discussion

6:00 p.m.
Cocktail Reception
B338 Rayburn Building

Friday
October 28, 2005
L'Enfant Plaza Hotel

7:00 a.m.
Breakfast, Exhibits & Posters

8:00 a.m.
Session 2: Keynote Presentations

8:50 a.m.
Session 3: Emerging Trends in Imaging Technologies: Current and Future Research and Development

8:50 a.m.
3A: Technologic Innovation in Medical Imaging of Near Term Benefit

8:50 a.m.
3D Visualization and Analysis for Prostate Cancer

9:15 a.m.
Magnetic Resonance Imaging (MRI)

10:10 a.m.
Coffee Break, Exhibits & Posters

10:30 a.m.
Session 3A: Technologic Innovation in Medical Imaging of Near Term Benefit (con't)

10:30 a.m.
Nuclear Medicine & PET Imaging

10:55 a.m.
Contrast-Enhanced Ultrasound Imaging of Prostate Cancer

11:20 a.m.
Session 3B: Technologic Innovation in Medical Imaging of Long-Term Benefit

11:20 a.m.
Molecular Imaging

12:30–2:00 p.m.
Lunch, Exhibits & Posters

2:00 p.m.
Session 3B: Technologic Innovation in Medical Imaging of Long-Term Benefit (con't)

2:00 p.m.
Optical Imaging

3:20–3:50 p.m.
Coffee Break, Exhibits & Posters

3:50 p.m.
Session 4: Novel Tools for Image-Guided Treatment

5:20 p.m.–6:30 p.m.
Reception, Exhibits & Posters

Saturday
October 29, 2005
L'Enfant Plaza Hotel

7:00 a.m.
Breakfast, Exhibits & Posters

8:00 a.m.
Session 5: Novel Technologies for Tissue Characterization and Treatment

9:00 a.m.
Session 6: Clinical Management of Prostate Diseases: State of the Art and Potential Role of Imaging Technologies

9:00 a.m.
Radiation Oncology Perspective

9:50 a.m.
Coffee Break, Exhibits & Posters

11:40 a.m.
Session 6: Clinical Management of Prostate Diseases: State of the Art and Potential Role of Imaging Technologies (con't)

11:40 a.m.
Urology Perspective

1:00–2:30 p.m.
Lunch, Exhibits & Posters

2:30 p.m.
Session 6: Clinical Management of Prostate Diseases: State of the Art and Potential Role of Imaging Technologies (con't)

2:30 p.m.
Pathology Perspective

2:55 p.m.
Medical Oncology Perspective

3:45 p.m.
Coffee Break, Exhibits and Posters

4:00 p.m.
Session 7: Summary and Closing Remarks

5:00 p.m.
Adjourn



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SAVE THE DATE

Next AdMeTech Foundation Conference:
FEBRUARY 8-10, 2007
WASHINGTON, DC



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GENERAL INFORMATION

Business Center

The Business Center is located on the lobby level of the L'Enfant Plaza Hotel in the Executive Office from 7:00 a.m.–7:00 p.m. They offer copying, faxing and Internet service.

Cell Phones and Beepers

Cell phones and beepers should be on silent notification during sessions as a courtesy to other attendees.

Conference Meals

The following meals will be provided during the conference.

Continental Breakfast

Friday, October 28	7:00 a.m. – 8:00 a.m.
Saturday, October 29	7:00 a.m. – 8:00 a.m.

Lunch

Thursday, October 27	11:00 a.m. – 12:00 p.m.
Friday, October 28	12:30 p.m. – 2:00 p.m.
Saturday, October 29	1:00 p.m. – 2:30 p.m.

In addition, mid-morning a.m. breaks and afternoon refreshment breaks will be served at the L'Enfant Plaza Hotel.

Exhibitor Presentations

During lunch on Friday and Saturday, we will have presentations from exhibitors.

Exhibits

The exhibit hall will be open during the following hours in the Ballroom Solarium and Foyer:

Friday, October 28	7:00 a.m. – 8:00 a.m. 10:10 a.m. – 10:30 a.m. 12:30 p.m. – 2:00 p.m. 3:20 p.m. – 3:50 p.m. 5:20 p.m. – 6:30 p.m.
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Exhibits (continued)

Saturday, October 29	7:00 a.m. – 8:00 a.m. 9:50 a.m. – 10:20 a.m. 1:00 p.m. – 2:30 p.m. 3:45 p.m. – 4:00 p.m.
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Message Center

Callers who wish to leave a message should contact the registration desk (202) 484-1000 x7208. A message will be taken during registration hours and posted on a message board.

Poster Sessions

Posters will be displayed on Friday and Saturday outside of the ballroom in the L'Enfant Plaza Hotel. Posters will be presented during the continental breakfasts, luncheons, during breaks and a special evening reception.

Receptions

You are cordially invited to attend a reception in honor of our sponsors. Please join us on Thursday—6:00–7:30 p.m. in the Rayburn Building—Room B338 for this event. Please also join us for a networking reception on Friday in the exhibit area.

Registration

Registration hours are as follows:

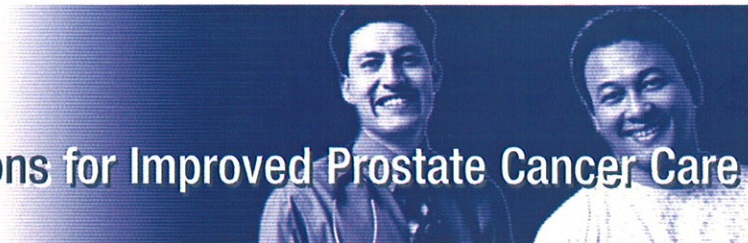
Thursday, October 27	10:00 a.m. – 5:00 p.m.
Friday, October 28	6:30 a.m. – 5:00 p.m.
Saturday, October 29	6:30 a.m. – 2:00 p.m.

Speaker Ready Room

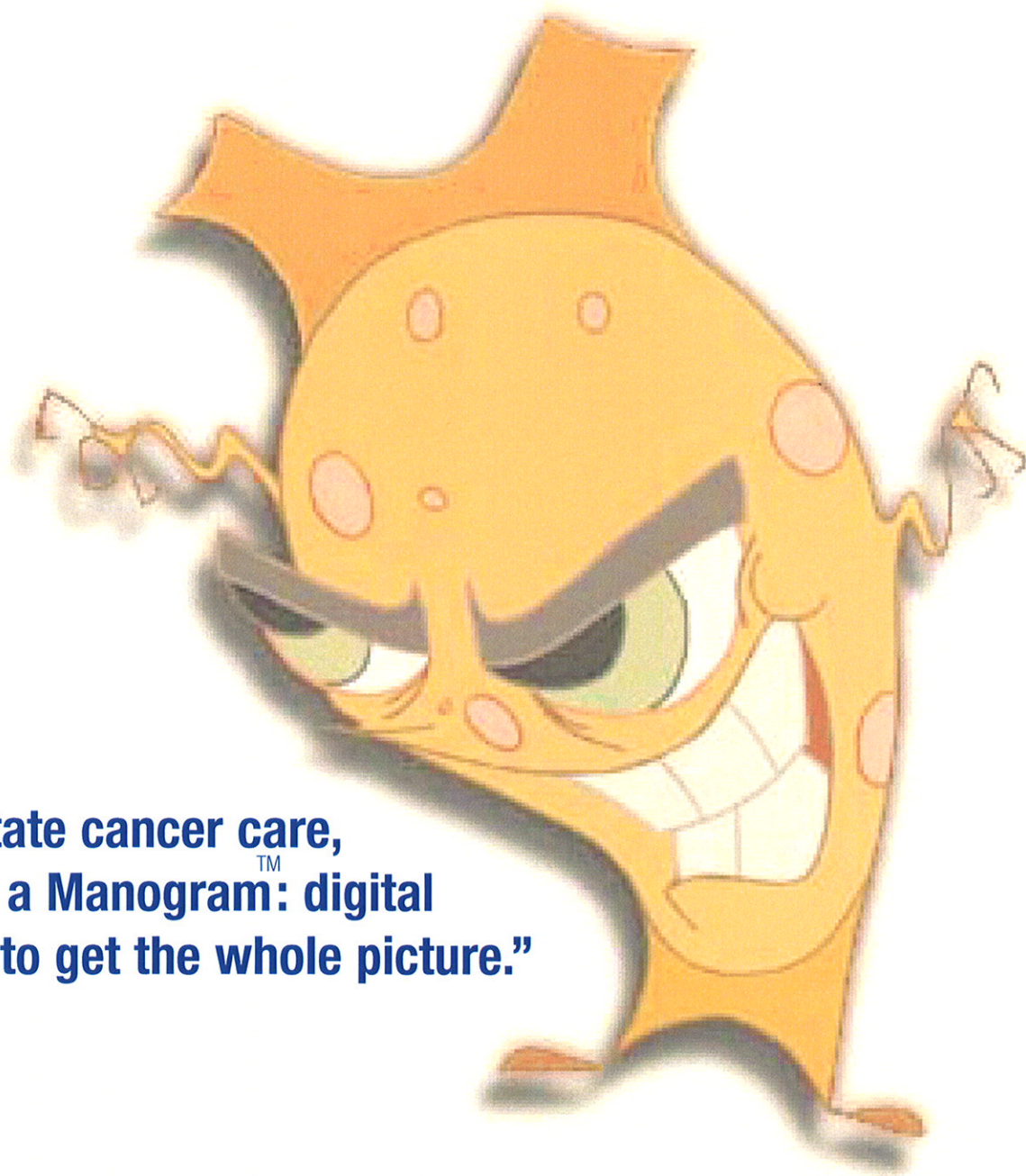
The Montcalm Room in the L'Enfant Plaza Hotel has been designated for speakers to view their presentations. It is located on the lobby level of the Hotel. Speakers are encouraged to visit the speaker ready room at least 90 minutes before their presentation.



Innovative Solutions for Improved Prostate Cancer Care



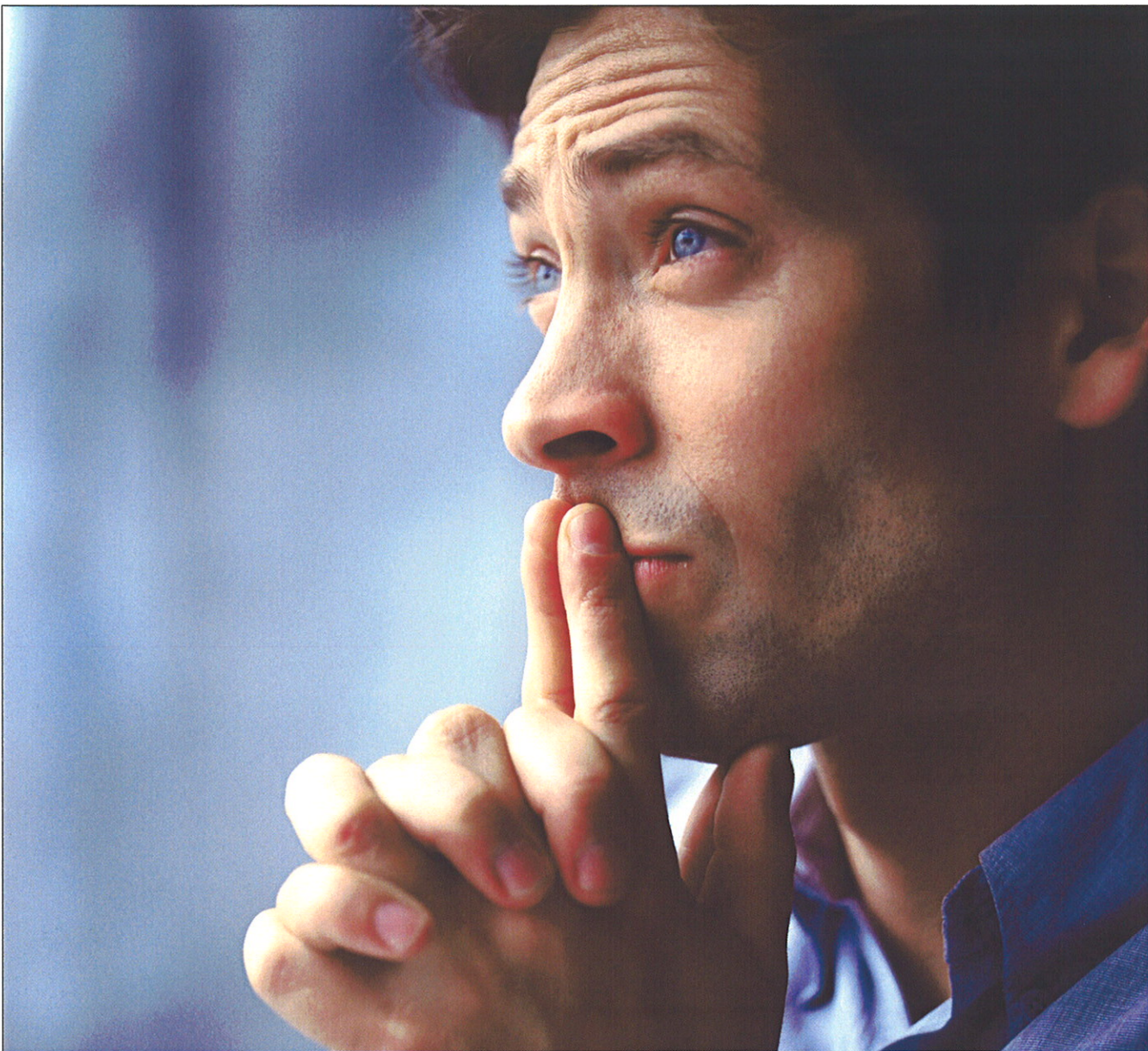
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You can't solve a problem if you can't see it.

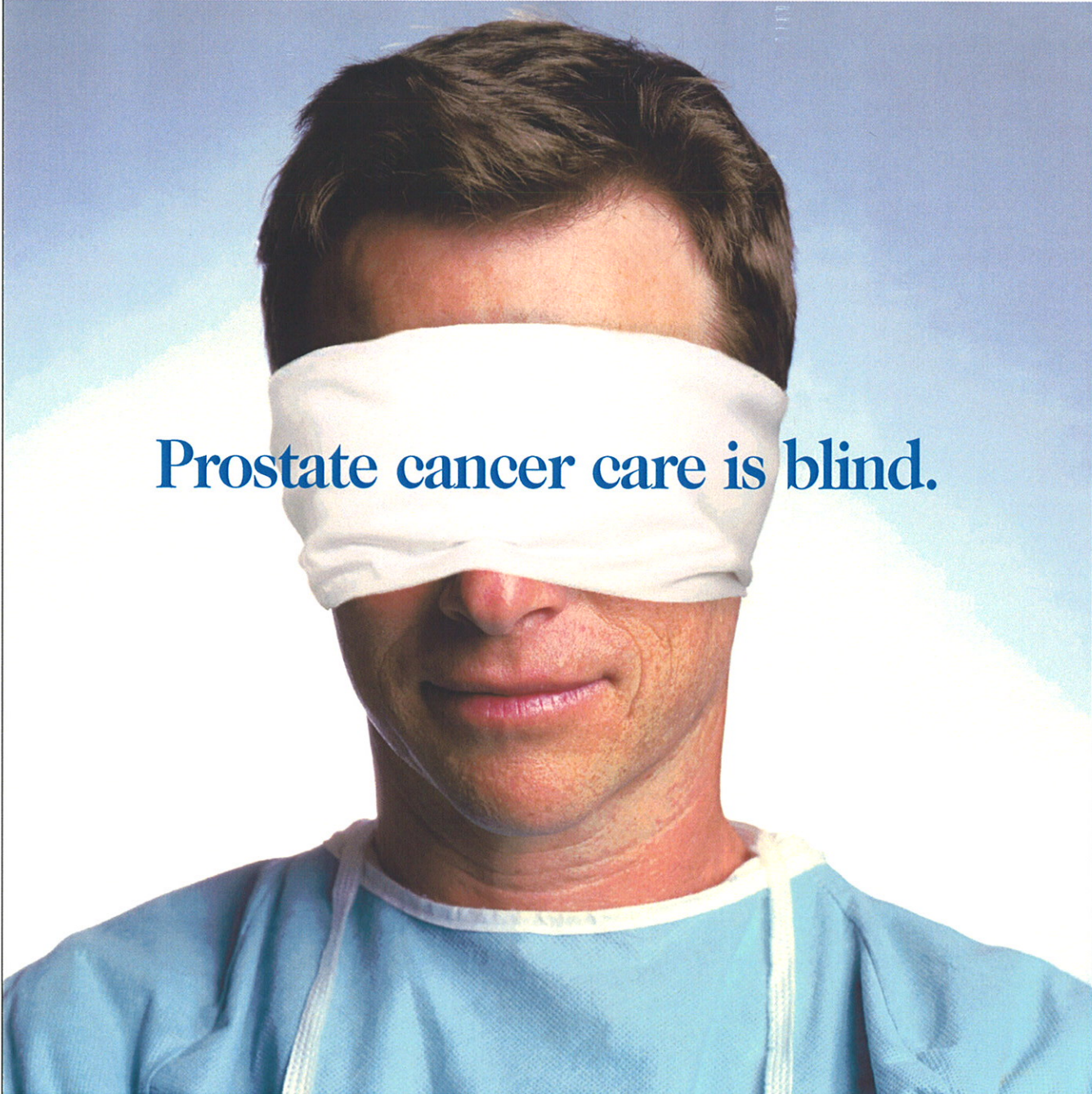
Without accurate and affordable imaging technologies, the prostate is one of the last human organs where detection and treatment methods are essentially blind. There are no accurate, affordable imaging tools for early detection, guidance of biopsy and treatment. Treatment results in many complications, including impotence and incontinence in up to 80% of patients.

But there is hope. New imaging technologies will arm physicians with accurate visualization tools critical for early detection and informed clinical decisions. Ultimately, image-guided, minimally invasive treatment will shift prostate cancer care to ambulatory clinics, with minimal discomfort, complications and costs.

At the non-profit AdMeTech Foundation, we are committed to the advancement of imaging technologies for prostate cancer care, embracing solutions that can put an end to the pain and suffering prostate cancer causes men and their families.



For more information, visit www.admetech.org



Prostate cancer care is blind.

Prostate cancer has reached epidemic proportions. It strikes 1 in 6 men and has become the second leading cause of cancer deaths in men. Yet men do not have accurate and affordable imaging to guide early detection, biopsy and treatment. Without such imaging, patient care may be blind. Worse yet, treatment is costly and leaves up to 80% of patients impotent and incontinent.

New imaging technologies will arm physicians with accurate visualization tools critical for early detection and informed clinical decisions. Ultimately, image-guided, minimally invasive treatment will shift prostate cancer care to outpatient clinics, with minimal discomfort, complications and costs.

The AdMeTech Foundation, a non-profit organization committed to fostering advancements in imaging technologies, is committed to ending the fear, pain, suffering and costs prostate cancer causes men, their families and our society.



For more information, visit www.admetech.org

We face a prostate cancer epidemic:
1 in 6 men stricken.



Where's our Manogram[™]:
life-saving imaging for men?

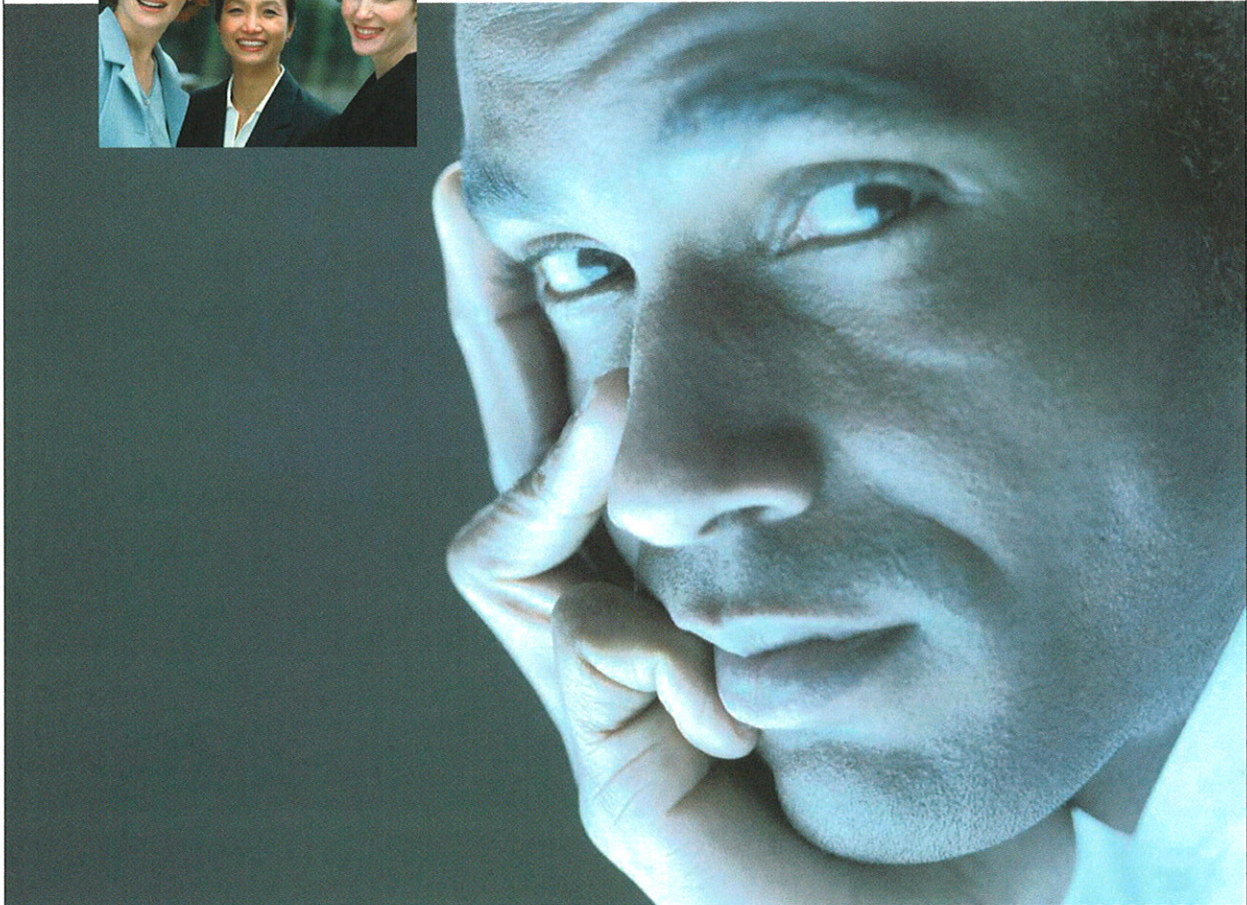
More men get prostate cancer than women get breast cancer. Over 230,000 men were stricken, 30,000 died and over 1.5 million had biopsies in 2004. And yet, men do not have accurate diagnostic tools for early detection and treatment. According to a recent study by the National Cancer Institute, PSA blood tests that screen for prostate cancer result in false-negative reassurances and numerous false-positive alarms. Some 15% of men with normal PSA levels still have prostate cancer. Even when PSA levels are abnormal, some 88% of men end up not having prostate cancer but undergoing unnecessary biopsies.

Developing new imaging technologies is critical for accurate early detection, when prostate cancer can be treated with minimal discomfort, complications and costs. It's time to end the fear, pain and suffering caused by prostate cancer. Isn't it time for a "Manogram[™]" — life-saving imaging for men?



For more information, visit www.admetech.org

**Breast cancer strikes 1 in 7 women.
Mammograms save lives.**



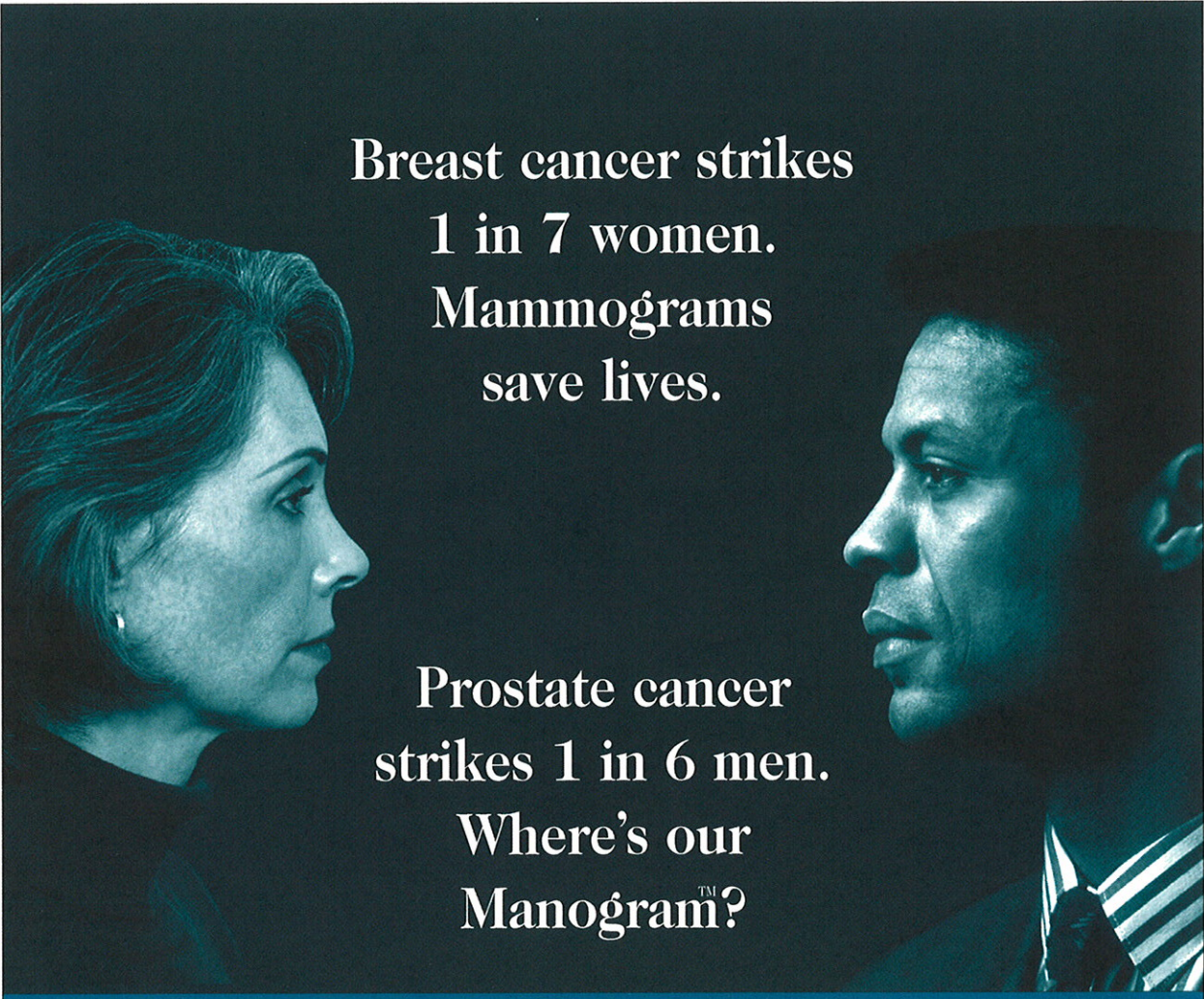
Prostate cancer strikes 1 in 6 men. Where's our Manogram™?

More men get prostate cancer than women get breast cancer. Over 230,000 men were stricken, 30,000 died and over 1.5 million had biopsies in 2004. And yet, men do not have accurate diagnostic tools for early detection and treatment. According to a recent study by the National Cancer Institute, PSA blood tests that screen for prostate cancer result in false-negative reassurances and numerous false-positive alarms. Some 15% of men with normal PSA levels still have prostate cancer. Even when PSA levels are abnormal, some 88% of men end up not having prostate cancer but undergoing unnecessary biopsies.

Developing new imaging technologies is critical for accurate early detection, when prostate cancer can be treated with minimal discomfort, complications and costs. It's time to end the fear, pain and suffering caused by prostate cancer. Isn't it time for a "Manogram™" — life-saving imaging for men?



For more information, visit www.admetech.org



Breast cancer strikes
1 in 7 women.
Mammograms
save lives.

Prostate cancer
strikes 1 in 6 men.
Where's our
ManogramTM?

More men get prostate cancer than women get breast cancer. Over 230,000 men were stricken, 30,000 died and over 1.5 million had biopsies in 2004. And yet, men do not have accurate diagnostic tools for early detection and treatment. According to a recent study by the National Cancer Institute, PSA blood tests that screen for prostate cancer result in false-negative reassurances and numerous false-positive alarms. Some 15% of men with normal PSA levels still have prostate cancer. Even when PSA levels are abnormal, some 88% of men end up not having prostate cancer but undergoing unnecessary biopsies.

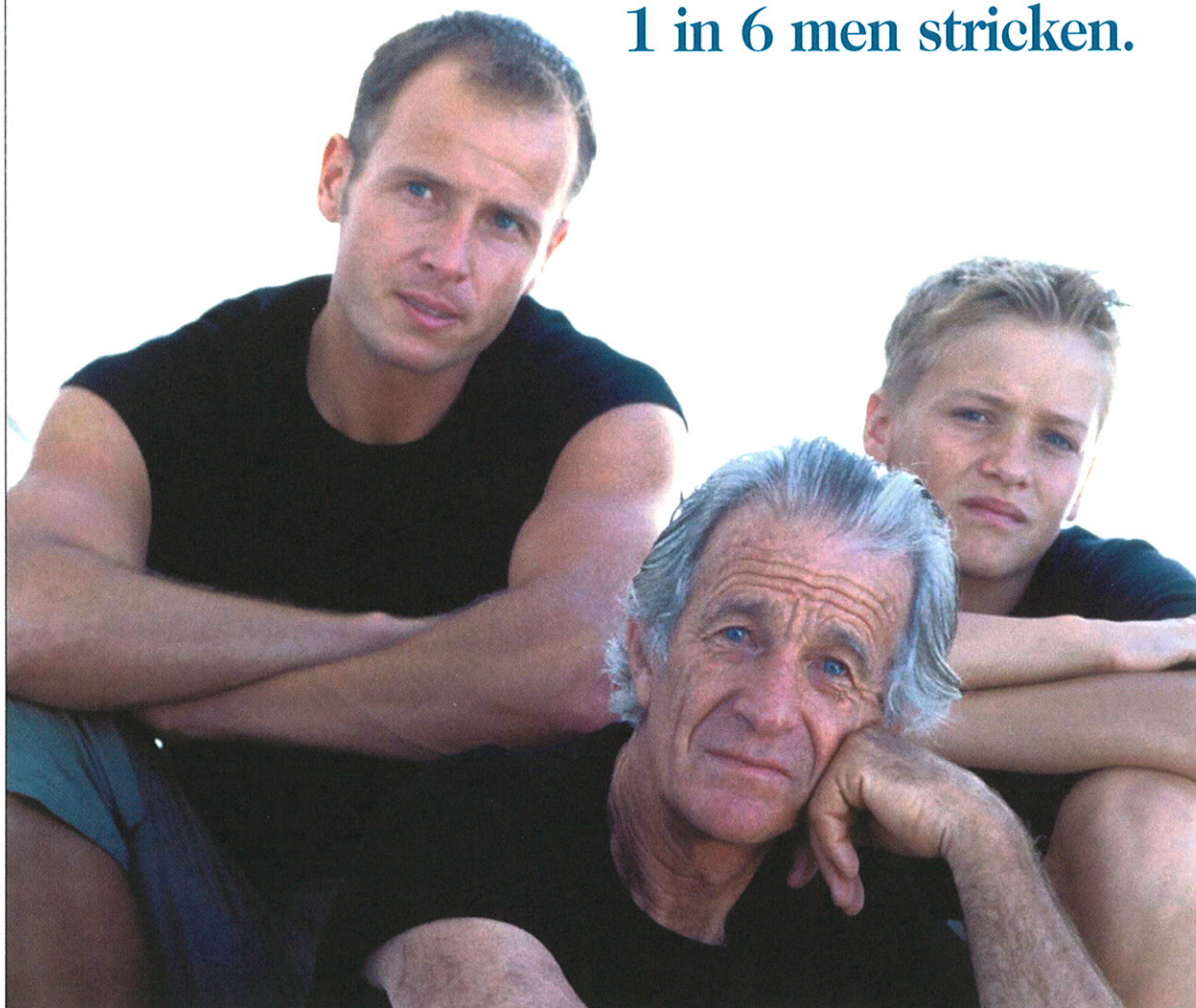
Developing new imaging technologies is critical for accurate early detection, when prostate cancer can be treated with minimal discomfort, complications and costs. It's time to end the fear, pain and suffering caused by prostate cancer. Isn't it time for a "ManogramTM" — life-saving imaging for men?



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**We face a prostate cancer epidemic:
1 in 6 men stricken.**



**Where's our Manogram:[™]
life-saving imaging for men?**

More men get prostate cancer than women get breast cancer. Over 230,000 men were stricken, 30,000 died and over 1.5 million had biopsies in 2004. And yet, men do not have accurate diagnostic tools for early detection and treatment. According to a recent study by the National Cancer Institute, PSA blood tests that screen for prostate cancer result in false-negative reassurances and numerous false-positive alarms. Some 15% of men with normal PSA levels still have prostate cancer. Even when PSA levels are abnormal, some 88% of men end up not having prostate cancer but undergoing unnecessary biopsies.

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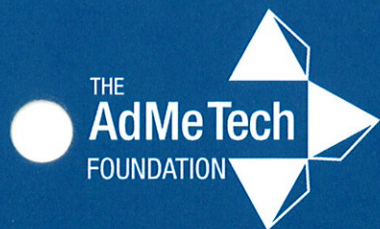
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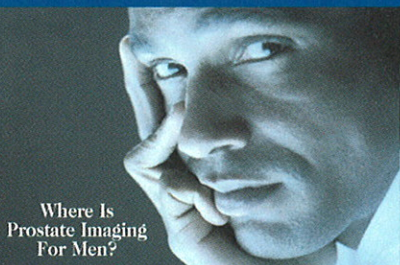
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Image-Guided, Minimally Invasive Diagnosis & Treatment of Prostate Cancer 2005

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CONFERENCE AGENDA

Thursday, October 27, 2005

The Cannon House Caucus Room—U.S. Congress

11:00 a.m. **Luncheon**

12:00 p.m. **Opening Remarks: Introduction and Statement of Purpose**
Faina Shtern, MD
Conference Chair, President, AdMeTech Foundation
Director of Radiology Research, Boston Children's Hospital, Harvard Medical School

"Learning from the Past—Research to Advance Curing Prostate Cancer"
Bruce J. Hillman, MD
Network Chair, American College of Radiology Imaging Network
Professor of Radiology, University of Virginia

12:47 p.m. **Questions & Answers**

SESSION 1: TECHNOLOGY TRANSFER FROM LABORATORIES TO CLINICS

12:10 p.m. **Moderators:**
Faina Shtern, MD
Conference Chair, President, AdMeTech Foundation
Director of Radiology Research, Boston Children's Hospital, Harvard Medical School
Walter Robb, PhD
Chair, AdMeTech Foundation
Bruce Hensel, MD
Chief Medical and Science Editor and Correspondent NBCTV Los Angeles
Invited Congressional Members (tentative)
The Honorable Michael Capuano
(D-Massachusetts) (Member, House Cancer Caucus)
The Honorable Sue Myrick
(R-North Carolina) (Co-chair, House Cancer Caucus)

Perspectives from the Advocacy Community

12:15 p.m. **Jim Kiefert, EdD**
Chairman of the Board of Directors
Us TOO International, Inc.
Thomas N. Kirk
President and CEO
Us TOO International, Inc.

12:25 p.m. **Questions & Answers**

Perspective from the Academic Community

12:27 p.m. "The Need for New Imaging Approaches for Prostate Cancer"
William G. Nelson, MD, PhD
Professor of Oncology, Urology, Pharmacology, Pathology, Medicine, and Radiation Oncology
Johns Hopkins School of Medicine

Perspective from the Philanthropic Community

12:50 p.m. **The Milken Family Foundation: Decades of Advancing Medical Research**
Howard R. Soule, PhD
Managing Director
Knowledge Universe Health and Wellness Group

1:00 p.m. **Questions & Answers**

Perspective from National Institute of Biomedical Imaging and Bioengineering

KEYNOTE PRESENTATION
 1:02 p.m. **Roderic I. Pettigrew, PhD, MD**
Director
National Institute of Biomedical Imaging and Bioengineering

1:22 p.m. **Questions & Answers**

Perspective from the National Cancer Institute

1:25 p.m. **Daniel C. Sullivan, MD**
Associate Director, Cancer Imaging Program

1:40 p.m. **Questions & Answers**

Perspective from the US Army, Department of Defense

1:42 p.m. "Advanced Medical Technology R&D: The Triple Helix Approach"
Greg T. Mogel, MD
Deputy Director, Telemedicine and Advanced Technology Research Center (TATRC)
Assistant Professor of Research Radiology and Biomedical Engineering
University of Southern California

CONFERENCE AGENDA

Leo Giambarresi, PhD
Program Manager, Prostate Cancer Program
Department of Defense

2:00 p.m. Questions & Answers

Perspective from the Food & Drug Administration

2:10 p.m. "Regulatory Considerations of Medical Devices"
Janine M. Morris
Chief, Urology and Lithotripsy Devices Branch
Center for Devices and Radiological Health
U.S. Food & Drug Administration

2:25 p.m. Questions & Answers

Perspective from the Centers for Medicare & Medicaid Services

2:27 p.m. "CMS Role in the Diagnosis and Treatment of Prostate Cancer"
Steve E. Phurrough, MD, MPA
Director, Coverage and Analysis Group
Centers for Medicare & Medicaid Services

2:42 p.m. Questions & Answers

Industry Leadership Panel

2:45 p.m. **GE Healthcare**
Reinaldo A. Garcia, President and CEO, Global Diagnostic Imaging
William R. Clarke, Executive Vice President and Chief Technology & Medical Officer
 "Improving Cancer Care—Opportunities and Challenges Ahead"
Siemens Medical Solutions
Mohammad Naraghi, MD, PhD
Senior Vice President, Global Business Development
 "Raising the Bar in Healthcare Through Innovation"
National Electrical Manufacturers Association
Thomas N. McCausland
President, Customer Solutions Group, Siemens Medical Solutions, USA
Past Chair, Board of Directors (NEMA)
 "Developing Improved Clinical Measures for Drug Development"
Pfizer Inc
Wayne O. Carter, DVM, PhD
Executive Director, Global Clinical Technology

"Advances in Diagnostic Imaging for Prostate Cancer: A Urologist's Perspective in the Imaging Industry"

Cytogen Corporation
Michael Manyak, MD, FACS
Vice President of Medical Affairs

Advanced Medical Technology Association (AdvaMed)
Stephen J. Ubl
President and CEO

Small Business Panel

4:30 p.m. "Prostate Cancer—Where Do We Go From Here?—The Role of Imaging in Diagnosis and Therapy"
Everette C. Burdette, PhD
President and CEO
Acoustic MedSystems, Inc.

"Optical Imaging: An Emerging Set of Preclinical and Clinical Modalities"
Christopher H. Contag, PhD
Associate Professor of Pediatrics, Radiology and Microbiology & Immunology, Stanford University

"Prostate MRI—hurdles regarding routine clinical use and the new strategies to address the existing medical needs"
Andreas Muehler, MD, MBA
President, 3TP Imaging Sciences

Perspective from Venture Capital Investment

5:00 p.m. "Challenges to Funding Breakthrough Technologies"
William D. McPhee, LLB
Managing General Partner, Mi3 Venture Partners

The Impact of the Media on Consumer Education & Transformation of Health Care

5:10 p.m. **Bruce Hensel, MD**
Chief Medical and Science Editor and Correspondent
NBCTV Los Angeles

5:30 p.m. General Discussion

6:00 p.m. **RECEPTION—Rayburn Building**
Room B338

**National Electrical
Manufacturers Association**

CONFERENCE AGENDA

Friday, October 28, 2005

**L'Enfant Plaza Hotel
(All presentations held in Grand Ballroom)**

7:00 a.m. Continental Breakfast, Exhibits and Posters

9:10 a.m. Questions & Answers

SESSION 2: KEYNOTE PRESENTATIONS

9:00 a.m. **Howard I. Scher, MD**
*Chief, Genitourinary Oncology Service
Department of Medicine
Memorial Sloan-Kettering Cancer Center*

9:20 a.m. "Imaging Prostate Cancer, today and tomorrow"
Hedvig Hricak, MD, PhD
*Chair, Department of Radiology
Memorial Sloan-Kettering Cancer Center*

9:40 a.m. Discussion: Session 2

SESSION 3: EMERGING TRENDS IN IMAGING TECHNOLOGIES: CURRENT AND FUTURE RESEARCH AND DEVELOPMENT

9:50 a.m. Moderators:
Melvin Clouse, MD
*Professor of Radiology
Harvard Medical School*
Alexander R. Margulis, MD, DSc (hc)
*Clinical Professor of Radiology
Weill Medical College of Cornell University*

SESSION 3A: TECHNOLOGIC INNOVATION IN MEDICAL IMAGING OF NEAR-TERM BENEFIT

3D Visualization and Analysis for Prostate Cancer

9:50 a.m. "Multimodality Image Guidance for Prostate treatment"
Ferenc A. Jolesz, MD
*B. Leonard Holman Professor of Radiology
Director, MRI and Image Guided Therapy and Vice
Chairman Research, Department of Radiology,
Brigham and Women's Hospital
Harvard Medical School*

Magnetic Resonance Imaging (MRI)

9:15 a.m. "Ultra-High-Resolution MRI for Cancer Detection & Staging"
Mitchell D. Schnall, MD, PhD
*Matthew J. Wilson Professor of Radiology
Associate Chair of Research
University of Pennsylvania Health System*

9:40 a.m. Questions & Answers

9:55 a.m. "Dynamic Contrast Enhanced MRI of the Prostate: Molecular Implications"
Peter L. Choyke, MD
*Chief, Molecular Imaging Program
National Cancer Institute*

9:55 a.m. Questions & Answers

9:55 a.m. "Prostate Cancer Imaging and Interventional Developments in a Collaborative Environment"
Gregory J. Metzger, PhD
*Associate Professor
University of Minnesota*

10:05 a.m. Questions & Answers

10:10 a.m. Coffee Break, Exhibits & Posters

Nuclear Medicine & PET Imaging

10:30 a.m. "Molecular Imaging in Treatment Response"
Steven M. Larson, MD
*Chief, Nuclear Medicine Service
Memorial Sloan-Kettering Cancer Center*

10:50 a.m. Questions & Answers

Contrast-Enhanced Ultrasound Imaging of Prostate Cancer

10:55 a.m. "Recent Advances in Ultrasound Imaging for Prostate Cancer Detection"
Ethan J. Halpern, MD
*Professor of Radiology and Urology
Director, Jefferson Prostate Diagnostic Center
Thomas Jefferson University*

11:15 a.m. Questions & Answers

SESSION 3B: TECHNOLOGIC INNOVATION IN MEDICAL IMAGING OF LONG-TERM BENEFIT

Molecular Imaging

- 11:20 a.m. "Imaging Prostate Cancer"
Ralph Weissleder, MD, PhD
*Director, Center for Molecular Imaging Research
 Massachusetts General Hospital
 Professor of Radiology, Harvard Medical School*
- 11:40 a.m. Questions & Answers
- 11:45 a.m. "Magnetic Resonance Imaging Based Biomarkers of Therapeutic Response of Prostate Cancer"
John Kurhanewicz, PhD
*Associate Professor of Radiology
 Director of the Prostate Imaging Program and the Biomedical NMR lab
 University of California San Francisco*

12:00 p.m. Questions & Answers

- 12:05 p.m. "Optical Imaging: Advancing Biotherapies Through Imaging"
Christopher H. Contag, PhD
Associate Professor of Pediatrics, Radiology and Microbiology & Immunology, Stanford University

12:20 p.m. Questions & Answers

12:35-2:00 p.m. **Lunch, Exhibits, Exhibit Presentations, Posters**

Optical Imaging

- 2:00 p.m. "Confocal and two-photon microscopy, in vivo flow cytometry and bone marrow imaging"
Charles P. Lin, PhD
*Associate Professor of Dermatology
 Harvard Medical School
 Associate Biophysicist, Wellman Laboratory of Photomedicine
 Massachusetts General Hospital*
- 2:15 p.m. Questions & Answers
- 2:20 p.m. "Bioluminescence Imaging of Tumors and Gene Expression: Impact on Drug Development"
Andrew Kung, MD, PhD
*Assistant Professor of Pediatrics
 Dana-Farber Cancer Institute
 Harvard Medical School*
- 2:35 p.m. Questions & Answers

- 2:40 p.m. "Development of near infrared and multimodal molecular probes for imaging tumors"

Samuel I. Achilefu, PhD
*Associate Professor of Radiology
 Washington University School of Medicine*

2:55 p.m. Questions & Answers

- 3:00 p.m. "Potential Clinical Applications of Optical Technologies for Prostate Cancer"

Irving J. Bigio, PhD
*Professor, Departments of Biomedical Engineering and Electrical & Computer Engineering
 Boston University*

3:15 p.m. Questions & Answers/General Discussion

3:20-3:50 p.m. **Coffee Break, Exhibits, Posters**

SESSION 4: NOVEL TOOLS FOR IMAGE-GUIDED TREATMENT

- 3:50 p.m. Moderators:
Theodore L. DeWeese, MD
*Professor and Chairman, Department of Radiation Oncology
 Johns Hopkins University*

Clare M.C. Tempany, MD
*Professor of Radiology, Harvard Medical School
 Director, Clinical MRI
 Brigham & Women's Hospital*

- 3:50 p.m. "Image-Guided Interventions in the Prostate"

Clare M.C. Tempany, MD
*Professor of Radiology, Harvard Medical School
 Director, Clinical MRI
 Brigham & Women's Hospital*

4:10 p.m. Questions & Answers

- 4:15 p.m. "Image-Guided Cryotherapy of the Prostate"

Neal D. Shore, MD, FACS
*Medical Director
 Carolina Urologic Research Center*

- 4:30 p.m. "Photodynamic Therapy for Prostate Cancer"

Stephen G. Bown, MD, FRCP
*Professor of Laser Medicine and Surgery
 Director, National Medical Laser Centre,
 University College London*

4:50 p.m. General Discussion: Session 4

5:20-6:30 p.m. Reception, Exhibits & Posters

CONFERENCE AGENDA

Saturday, October 29, 2005

**L'Enfant Plaza Hotel
(All presentations held in Grand Ballroom)**

7:00 a.m. Continental Breakfast, Exhibits and Posters

SESSION 5: NOVEL TECHNOLOGIES FOR TISSUE CHARACTERIZATION AND TREATMENT

8:00 a.m. "Robot-Assisted Prostate Interventions"
Gabor Fichtinger, PhD
*Director of Engineering, Center for Computer Integrated Surgery
Johns Hopkins University*

8:15 a.m. Questions & Answers

8:20 a.m. "Nanotechnologies for Early Detection and Therapy of Cancer"
Piotr Grodzinski, PhD
*Director, Nanotechnology for Cancer Programs
National Cancer Institute*

8:35 a.m. "NanoSystems Biology & Cancer"
James R. Heath, PhD
*Elizabeth W. Gillon Professor
California Institute of Technology*

8:55 a.m. Questions & Answers

SESSION 6: CLINICAL MANAGEMENT OF PROSTATE DISEASES: STATE OF THE ART AND POTENTIAL ROLE OF IMAGING TECHNOLOGIES

9:00 a.m. Moderators:
Theodore L. DeWeese, MD
*Professor and Chairman
Department of Radiation Oncology
Johns Hopkins University*

Christopher J. Logothetis, MD
*Professor and Chair, Genitourinary Medical Oncology
University of Texas M.D. Anderson Cancer Center*

Radiation Oncology Perspective

9:00 a.m. Overview
Theodore L. DeWeese, MD
*Professor and Chairman
Department of Radiation Oncology
Johns Hopkins University*

9:20 a.m. Questions & Answers

9:25 a.m. "MRI-Guided Brachytherapy in the Treatment of Low-Risk Prostate Cancer"
Anthony V. D'Amico, MD, PhD
*Chief, Genitourinary Radiation Oncology
Brigham & Women's Hospital
Professor of Radiation Oncology
Harvard Medical School*

9:45 a.m. Questions & Answers

9:50 a.m. Coffee Break, Exhibits & Posters

10:20 a.m. "3D Image-Guided Administration of External Radiation Beam"
Julian G. Rosenman, MD, PhD
*Professor, Department of Radiation Oncology
Adjunct Professor, Department of Biomedical Engineering
University of North Carolina at Chapel Hill*

10:40 a.m. "The Role of Image Guidance in Dynamic Adaptive Radiation Therapy"
Kolleen T. Kennedy, MS
*Vice President
Varian Oncology Systems*

11:00 a.m. Questions & Answers

11:05 a.m. "Clinical Perspective: Current Challenges and Future Role of Imaging"
Alan Pollack, MD, PhD
*Chair, Department of Radiation Oncology
Fox Chase Cancer Center*

11:25 a.m. Questions & Answers

Urology Perspective

11:40 a.m. Overview
"Clinical Management of Prostate Diseases: State of the Art and Potential Role of Imaging Technologies"
Joel B. Nelson, MD
*Frederic N. Schwenker Professor and Chairman of Urology
University of Pittsburgh School of Medicine*

12:00 p.m. Questions & Answers

12:05 p.m. "New Tumor Markers for Prostate Cancer"
Alan W. Partin, M.D., Ph.D.
*Professor and Director of Urology
The Brady Urological Institute
The Johns Hopkins Medical Institution*

CONFERENCE AGENDA

12:25 p.m. "The Evolution of Radioimmunoscintigraphy:
Fuzzy Photos to Outcomes Data"
Michael Manyak, MD, FACS
Vice President of Medical Affairs
Cytogen Corporation
Professor of Urology, Engineering, Microbiology and
Tropical Medicine
George Washington University Medical Center

12:35 p.m. Questions & Answers

1:00 p.m. Lunch, Exhibits, Exhibit Presentations
and Posters

Pathology Perspective

2:30 p.m. **Angelo De Marzo, MD, PhD**
Associate Professor of Pathology and Urology
Department of Pathology, Urology, and Oncology
Johns Hopkins University School of Medicine

3:00 p.m. Questions & Answers

Medical Oncology Perspective

KEYNOTE PRESENTATION

2:00 p.m. The Pathogenesis of Prostate Cancer: On
Opportunity for New Imaging Approaches"
William G. Nelson, MD, PhD
Professor of Oncology, Urology, Pharmacology,
Pathology, Medicine, and Radiation Oncology
Johns Hopkins School of Medicine

3:15 p.m. Questions & Answers

3:20 p.m. "The Development of a Treatment Strategy
for the Management of Prostate Cancer"
Christopher J. Logothetis, MD
Professor and Chair, Genitourinary Medical Oncology
University of Texas M.D. Anderson Cancer Center

3:40 p.m. Questions & Answers

3:45 p.m. Coffee Break, Exhibits & Posters

SESSION 7: SUMMARY AND CLOSING REMARKS

4:00 p.m. Conference Summary and Highlights
William G. Nelson, MD, PhD
Hedvig Hricak, MD, PhD
Angelo De Marzo, MD, PhD

4:20 p.m. Questions & Answers

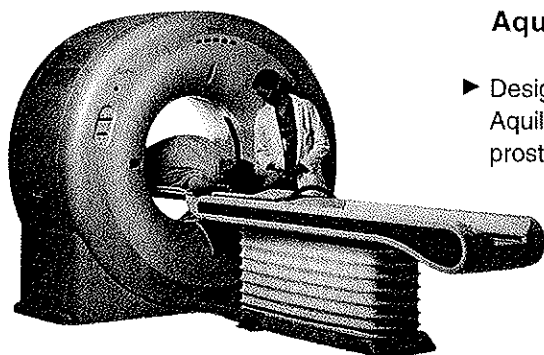
4:40 p.m. Closing Remarks
Faina Shtern, MD
President, AdMeTech Foundation
Director of Radiology Research, Boston Children's
Hospital,
Harvard Medical School

5:00 p.m. Adjourn

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FACULTY BIOGRAPHIES

Samuel Achilefu, PhD, *Associate Professor of Radiology and Interim Director of the Optical Radiology Laboratory, Washington University School of Medicine*. Dr. Achilefu is internationally acclaimed for his work on contrast agent-mediated imaging of tumors by optical methods. His expertise includes the design, synthesis, and biological evaluation of diagnostic and therapeutic molecules for cancer applications. His current interests include the development of multimodal molecular probes for diagnostic and therapeutic interventions. Dr. Achilefu is on the editorial boards of scientific journals and consults for major instrument development and pharmaceutical companies. Dr. Achilefu is well-published and holds 26 issued US patents in contrast agent-mediated optical imaging and monitoring of diseases.

Irving J. Bigio, PhD, *Professor, Departments of Biomedical Engineering and Computer Engineering, Boston University*. Dr. Irving J. Bigio received his PhD in Physics from The University of Michigan in 1974. Until 2000 he was at Los Alamos National Laboratory, including service as Leader of the Laser Science and Applications Group. He has been a Fulbright Lecturer at the Weizmann Institute in Israel, and a Visiting Professor at the University of Copenhagen and Oxford University. In 2001 he joined Boston University as Professor of Biomedical Engineering, Electrical Engineering, and Physics. Dr. Bigio serves on several government and academic advisory panels. He is a Fellow of the OSA, the AIMBE and ASLMS, and is a member of the American Physical Society and the SPIE.

Stephen G. Bown, MD, FRCP, *Professor of Laser Medicine & Surgery, University College London Surgery and Director, National Medical Laser Center*. Dr. Stephen Bown is a graduate in both physics and medicine. The National Medical Laser Centre is a clinical translational research group focusing on understanding how the interaction of light with living tissue can be used for the diagnosis and treatment of human disease. The main research interest is in photodynamic therapy (PDT), where his group has pioneered the image guided treatment of tumors of internal organs such as the pancreas and prostate.

Everette C. Burdette, PhD, *President and CEO of Acoustic MedSystems, Inc.* Acoustic MedSystems, Inc. is a company developing image-guided localized therapy using high intensity ultrasound. For the past three years, he was Vice President of Research and Clinical Design at

Computerized Medical Systems (CMS) and President of the Image Guidance Division of CMS. He was President and Chief Executive Officer of Burdette Medical Systems from its inception in 1997 until its acquisition by CMS in 2002. Dr. Burdette holds a Ph.D. in Physiology from Emory University and MS degrees in Electrical Engineering and in Physics, and BS in Physics from the Georgia Institute of Technology. He was Director of Advanced Technology Development for Dornier Medical Systems, Inc., a Daimler-Benz company, 1992-97. He was President of Labthermics Technologies, Inc., a medical therapeutic equipment company, from 1986 to 1992. He was a faculty member at the University of Illinois at Urbana-Champaign, Emory University School of Medicine, and Georgia Tech. He has worked in the radiation oncology, hyperthermic oncology, and urological fields for 26 years and prior to that worked in the development of radar systems and microwave devices for military applications for 7 years. He has managed the development of ultrasound medical devices for therapeutic and diagnostic applications for over 20 years. He has authored more than 180 technical reports and scientific publications and 7 book chapters, and holds 34 patents.

Wayne O. Carter, DVM, PhD, *Executive Director, Global Clinical Technology, Pfizer*. Global Clinical Technology is a unit that innovates and delivers technology applications that harness biomarker science. Examples of technology applications span from MRI and PET to computational medicine and voice acoustics. Additionally, the expertise in the unit spans all phases of development and all therapeutic areas and exists as a matrix of expertise between technology and therapeutic areas. Dr. Carter has been at Pfizer for 9 years and was working in Preclinical Pharmacology at Bayer for 2 years prior to joining Pfizer. Dr. Carter received his DVM from Purdue, was in private practice for 5 years and is boarded in Veterinary Internal Medicine. He received his PhD from Purdue in Immunophysiology focusing on the interaction of reactive oxygen and nitrogen intermediates in endothelial cell and neutrophil physiology and has expertise in fluorescence and optical systems.

Peter Choyke, MD, *Chief of the Molecular Imaging Program, National Cancer Institute*. Dr. Choyke received his M.D. from Jefferson Medical College, his residency in Diagnostic Radiology at Yale and his post graduate training at the University of Pennsylvania. He has been at the NIH since 1988. His research focuses on imaging of

angiogenesis, lymphangiogenesis and growth factors/receptors using MRI, optical probes and radionuclides.

William R. Clarke, MD, *Executive Vice President and Chief Technology & Medical Officer, GE Healthcare*. Dr. Bill Clarke joined GE in April 2004. Prior to that Bill was Executive Vice President, Research & Development, Amersham Health, a role he served in from 2000 to 2004. In his current position, Bill will oversee all of the Technology and Medical innovation portfolio for General Electric Healthcare, an annual spend of approximately \$1 B. Bill will also oversee the medical and regulatory strategy and policy for GE Healthcare, he is a member of the GE Healthcare Executive Committee reporting directly to the CEO and he is an officer of the company.

Christopher H. Contag, PhD, *Associate Professor of Pediatrics in the division of Neonatal and Developmental Medicine and Associate Professor, Departments of Radiology and Microbiology & Immunology, Stanford University School of Medicine*. Dr. Contag is the director of Stanford's Center for Innovation in *In Vivo* Imaging (SCI³) and co-director of the Molecular Imaging Program at Stanford (MIPS). He joined the Stanford faculty in 1995. Dr. Contag received his B.S. from the University of Minnesota, St. Paul in 1982; and earned his Ph.D. in Microbiology from the University of Minnesota, Minneapolis in 1988. He was a postdoctoral fellow at Stanford University from 1990-1994.

Anthony V. D'Amico, MD, PhD, *Chair of Genitourinary Radiation Oncology and MR Guided Prostate Brachytherapy Programs, Dana-Farber Cancer Institute and Brigham and Women's Hospital*. Dr. D'Amico is also a Professor at Harvard Medical School. He is an internationally known expert in the treatment of prostate cancer and has defined combined modality staging, which is used to select patients with localized prostate cancer for specific surgical or radiotherapeutic treatment options. He is the principal investigator of several federally funded grants that support his investigations in Image Guided Therapy for early stage prostate cancer, drug development for advanced stage prostate cancer, and clinical trials that are aimed at defining future management strategies for men with prostate cancer.

Dr. Anthony D'Amico is currently developing and testing optical and molecular imaging technology, which holds great promise for significantly improving the way in which prostate cancer is detected and treated. In conjunction with this work, Dr. D'Amico is currently leading the effort towards the creation of a Prostate Cancer Institute in the Harvard Medical Complex.

Dr. D'Amico holds two undergraduate and three graduate degrees: a B.S. in physics, a B.S. in nuclear engineering, M.S. in nuclear engineering, and a Ph.D. in radiation physics, all from the Massachusetts Institute of Technology, and an M.D. from the University of Pennsylvania School of Medicine. He completed his residency in the department of radiation oncology of the Hospital of the University of Pennsylvania in Philadelphia, where he served as chief resident during his final year. He has over 100 peer reviewed original publications and editorials, and his teaching contributions include his position as Associate Master of the Oliver Wendell Holmes Society, editorial board member of 6 scientific journals, and editor of several textbooks on the management of prostate cancer.

Angelo De Marzo, MD, PhD, *Associate Professor of Pathology, Urology and Oncology, The Johns Hopkins University*. He is the director of the Johns Hopkins Tissue Microarray Core Facility and of the Pathology Core for the Prostate SPOR grant. He also maintains a basic science laboratory for conducting both human and rodent prostate cancer research. For more information please see my website at: <http://demarzolab.pathology.jhmi.edu/>

Theodore L. DeWeese, MD, *Professor of Radiation Oncology, Oncology and Urology and Chair, Department of Radiation Oncology and Molecular Radiation Sciences, Johns Hopkins University*. He continues to develop unique, molecularly-based radiation sensitizing strategies to enhance treatment response. He and his colleagues were the first to develop and report on the use of shRNA as a potential radiation sensitizing approach targeting the DNA repair proteins ATM and DNA-PKcs. This targeting results in substantial radiation sensitization of human prostate cancer cells. This work continues with the development and testing of an adenoviral-based vector system to deliver the shRNA.

Dr. DeWeese and his team also study cellular DNA damage introduced by radiation. Dr. DeWeese and colleagues have recently shown that low dose rate radiation does not activate the DNA damage sensor ATM and that failure to activate ATM-associated repair pathways contributes to the increased lethality of continuous LDR radiation exposures. This work has a broad range of implications for carcinogenesis and the clinical treatment of solid tumors.

Dr. DeWeese and his collaborators continue to plan for translation of their newly designed vectors, particularly those with the ability to modulate DNA repair via targeted shRNA's, once pre-clinical testing is completed. Dr. DeWeese is expanding his clinical research to include a trial of hypofractionated radiation therapy for men with localized prostate cancer using IMRT which will provide the basis for a trial of IMRT in combination with the viral-based vector platforms he is developing.

FACULTY BIOGRAPHIES

Gabor Fichtinger, PhD, *Associate Research Professor of Computer Science, Mechanical Engineering and Radiology, Johns Hopkins University*. Dr. Gabor Fichtinger received a BS and MS in Electrical Engineering, and a PhD in Computer Science from the Technical University of Budapest, Hungary, in 1986, 1988, and 1990, respectively. He did his postdoc training at UT Austin between 1990-1992 in computer graphics and biomedical visualization. In 1993 he joined the George Washington University Hospital where he architected stereotactic radiosurgery and computer-assisted neurosurgical planning systems. Dr. Fichtinger has been with the Johns Hopkins University since 1999, focusing his research on computer-integrated surgery, a subject that involves problems in surgical visualization, modeling, planning, execution, monitoring, and system-level integration of all those. His subspecialty is robot-assisted image-guided needle-placement procedures, primarily for prostate cancer therapy.

Reinaldo A. Garcia, President & CEO, Diagnostic Imaging, GE Healthcare. Reinaldo Garcia has served in a number of strategic leadership roles at General Electric Company for the past 20 years. He has a diverse background in general management, sales, service, sourcing, finance, business development and manufacturing. Most recently, he was named President and CEO of Diagnostic Imaging, a \$5 billion business that is a leader in advanced X-ray, CT, MR and Functional Imaging systems and clinical applications. Prior to this role, he served as President and CEO of GE Healthcare Technologies-International, based in France; President and CEO of GE Medical Systems-Europe; President and CEO of GE Clinical Services; VP of Services and VP of Manufacturing in GE Medical Systems-Europe.

Leo Giambarresi, PhD, *Project Manager, Prostate Cancer Research Program, Department of Defense*. Dr. Giambarresi received his Ph.D. in Experimental Pathology from the University of Pittsburgh. He served 20 years as a U.S. Navy Medical Service Corps Biochemist where he served in numerous research, administrative and academic positions including six years at the Armed Forces Radiobiology Research Institute (AFFRI) in Bethesda MD. He also served at the US Naval Academy, as Associate Chairman of the Chemistry Department and Associate Professor of Chemistry and Biology. His research interests include chemical carcinogenesis, experimental pathology, and radiation biology. Dr. Giambarresi assumed management of the Prostate Cancer Research Program in January 1999 after retiring from the Navy.

Piotr Grodzinski, PhD, *Director of Nanotechnology for Cancer Programs, Nanotechnology Alliance of National Cancer Institute*. He coordinates program and research activities of the Alliance which dedicated \$144M over next 5 years to form interdisciplinary centers as well as fund individual research and training programs targeting nanotechnology solutions for improved prevention, detection, and therapy of cancer.

Prior to joining NCI, Dr. Grodzinski was with Bioscience Division of Los Alamos National Laboratory where he served as a Group Leader and an interim Chief Scientist for DOE Center for Integrated Nanotechnologies (CINT). He also held research management positions at Motorola where he directed Microfluidics Laboratory at Physical Sciences Research Laboratories in Tempe, AZ.

Dr. Grodzinski is an internationally recognized expert in the area of bio- and nano-chips and microfluidics for genetic recognition. He received Ph.D. in Materials Science from the University of Southern California, Los Angeles in 1992. He has 12 patents awarded and 10 disclosures pending. He co-authored over 100 technical publications and conference presentations. Dr. Grodzinski has been an invited speaker and served on the committees of numerous bio- and nano-MEMS conferences in the past years.

Ethan J. Halpern, MD, *Professor of Radiology and Urology, Thomas Jefferson University*. Dr. Halpern serves as the director of the Jefferson Prostate Diagnostic Center, a collaborative effort of the departments of urology, radiology, and pathology at Thomas Jefferson University to provide state of the art prostate imaging and biopsy services in the Delaware Valley. Dr. Halpern has conducted numerous clinical trials of new imaging techniques for detection of prostate cancer, and has published a textbook on Imaging of the Prostate. His primary area of interest is the evaluation of prostatic blood flow to discriminate benign from malignant prostate tissue.

James R. Heath, PhD, *Elizabeth W. Gilloon Professor and Professor of Chemistry at Caltech, Professor of Molecular & Medical Pharmacology, UCLA*. Dr. Heath received a B.Sc. degree in 1984 (Baylor) and his Ph.D. in Chemistry (Rice) in 1988 where he was the principal student involved in the Nobel Prize-winning discovery of C₆₀ and the fullerenes. Heath was a Miller Fellow at UC Berkeley from 1988-91, and on the Technical Staff at IBM Watson Labs from 1991-93. In 1994 he joined the faculty at UCLA. He founded the California NanoSystems Institute in 2000 and served as its Director until moving to Caltech. Heath has investigated quantum phase transitions, and he has developed architectures, devices, and circuits for molecular electronics. His group has recently been applying their advances on nanoelectronics circuitry toward addressing problems in

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cancer. He has received a number of awards, including a Public Service Commendation from Governor Grey Davis, the Sackler Prize, the Spiers Medal, the Feynman Prize, the Jules Springer Prize, and the Arthur K. Doolittle Award.

Bruce Hensel, MD, *Chief Medical and Science Editor and Correspondent at NBC4 "Channel 4 News"*. Dr. Hensel has dedicated a good portion of his life to the Arts and The Communication of Medicine to the lay public: airing a weekly radio show on ABC, producing two award winning documentaries and developing Science related Dramatic Series and reality shows. His expertise extends to the internet as he was the Chief Medical officer and content provider for DrKoop.com. Dr. Hensel remains a teaching and practicing physician. He is Board Certified in both Internal Medicine and Emergency Medicine, is Associate Professor of Medicine at UCLA, and runs two emergency rooms where he still works occasional shifts.

Bruce J. Hillman, MD, *Theodore E. Keats Professor of Radiology, University of Virginia*. Dr. Hillman previously served as department chair and President of the UVA Health Services Foundation. He also currently serves as the founding PI and Chair of ACRIN, the NCI-funded clinical trials cooperative group focusing on imaging technology, as well as founding Editor-in-Chief of the *Journal of the American College of Radiology*. Dr. Hillman has published 160 peer-reviewed articles, more than 70 book chapters, review articles, and editorials, and several texts. Among his honors, Dr. Hillman has presented over 30 honorary, and keynote lectures, as well as receiving the Gold Medal of the Association of University Radiologists and Honorary Membership in the French Society of Radiology.

Hedvig Hricak, MD, PhD, *Chairman, Department of Radiology, Memorial Sloan-Kettering Cancer Center, Professor of Radiology, Weill Medical College of Cornell University*. Her specialty is cross-sectional anatomic and molecular imaging of the genitourinary tract, with emphasis on oncologic imaging. Her publications include more than 280 original research articles in peer-reviewed journals. She is a member of the Institute of Medicine of the National Academies and an honorary member of the British Institute of Radiology, the Croatian Academy of Science and Art, and the German Radiological Society. She holds an honorary doctorate from the Ludwig Maximilian University of Munich.

Ferenc A. Jolesz, MD, *B. Leonard Holman Professor of Radiology, Harvard Medical School, Vice Chairman for Research, Department of Radiology, Brigham and Women's Hospital, Director of the Division of Magnetic Resonance Imaging, Brigham and Women's Hospital*. His research focus is in basic and clinical neurosciences,

magnetic resonance imaging, and image guided therapy. Dr. Jolesz has published over 300 articles in scholarly, peer-reviewed journals and has contributed many chapters and review articles in the fields of surgery, computer science, neurology, neurosurgery, and radiology.

Kolleen T. Kennedy, MS, *Vice President, Varian Oncology Systems*. Varian Oncology Systems is the world's largest dedicated supplier of radiation oncology equipment. She holds responsibility for worldwide marketing and engineering, creating the organization's strategic product vision as well as operational execution. Ms. Kennedy received her Radiation Therapy and Psychology undergraduate degrees from Wayne State University in Detroit, Michigan. Her graduate degree in Medical Physics was received from the University of Colorado.

Early in her career, Ms. Kennedy spent several years in clinical practice at small comprehensive cancer centers and in large university environments. She has spent the last 15 years working in industry focusing on radiation oncology and the delivery of cancer care.

Jim Kiefert, EdD, *Chairman of the Board of Directors, Us TOO International, Inc., Prostate Cancer Education and Support Network*. Jim was diagnosed with prostate cancer in 1989 at age 50. He had surgery and radiation which did not eliminate the cancer. Jim retired in 2001 as a school district superintendent. Kiefert was a Fulbright Scholar who studied at the American University in Cairo, Egypt and served as Executive Secretary of the Washington Educational Research Association for 19 years. In addition to serving as Chairman of Us TOO International, Jim serves as Chairman of the Washington State Prostate Cancer Task Force, a part of the state Comprehensive Cancer Control program funded by CDC. Jim says, "Living with prostate cancer makes you realize that every day is a gift, to be spent wisely."

Thomas N. Kirk, MSSW, *President and CEO, Us TOO International, Inc. Prostate Cancer Education and Support Network*. Tom joined Us TOO in November 2004 and brings over 30 years of experience as a family service leader. He has worked in the area of Alzheimer's disease for nearly 20 years, having served 13 years with the National Alzheimer's Association. He also worked for over a decade in a Family Service Association where he developed and managed outpatient mental health and crisis services as well as support and outreach programs for Vietnam Veterans and their families. His wife Margaret, who serves as the CEO for Y-ME National Breast Cancer Organization, lost her father to prostate cancer.

FACULTY BIOGRAPHIES

Andrew Kung, MD, *Assistant Professor of Pediatrics, Dana-Farber Cancer Institute*. Dr. Kung received his Ph.D. in Cancer Biology in 1993, and his M.D. in 1994 from Stanford Medical School, followed by postgraduate training at Children's Hospital Boston and the Dana-Farber Cancer Institute. He is board certified in Pediatrics and Pediatric Hematology/Oncology, with a clinical focus on Hematopoietic Stem Cell Transplantation. Dr. Kung was a postdoctoral research fellow in the laboratory of Dr. David Livingston, and joined the Dana-Farber Cancer Institute and Harvard Medical School faculty in 2002. His research interests are focused on aberrant signal transduction pathways in cancer, and the development of targeted therapies.

John Kurhanewicz, PhD, *Associate Professor, Departments of Radiology and Pharmaceutical Chemistry, University of California San Francisco*. Dr. Kurhanewicz is also a member of the Cancer Center and faculty in the UCSF-UCB Bioengineering Graduate Group. He is recognized internationally for his research on imaging and spectroscopic imaging of patients with prostate cancer, and is Director of the Prostate Imaging Program and the Biomedical NMR lab. Other areas of research include; (^{13}C and ^{31}P) spectroscopy, diffusion and perfusion imaging of prostate cancer on high field MR scanners, and the identification of new biomarkers using a combination of ex vivo HR-MAS spectroscopy, pathology and gene expression of tissue samples and bio-fluids.

Steven M. Larson, MD, *Attending Physician, Department of Radiology and Member, Memorial Sloan Kettering Cancer Center, Professor, Department of Radiology, Weill Cornell University Medical Center*. Dr. Larson is Chief of Nuclear Medicine Service, Department of Radiology and Director, the Laurent and Alberta Gerschel Positron Emission Tomography Center. Dr. Larson is Vice Chairman for Radiology Research, Department of Radiology. Dr. Larson is also Laboratory Head, Molecular Pharmacology and Chemistry Program, and Co-Director of the Imaging and Radiation Sciences Bridge Program of SKI. He is a member of the Executive Council, for the Molecular Pharmacology and Therapeutics Program, Sloan Kettering Institute. Dr. Larson's research focus is molecular imaging and targeted therapy, particularly PET and radioantibody targeted therapy in oncology. Dr. Larson has had a long term interest in the development of radiopharmaceuticals for oncologic applications in nuclear medicine and he has been working in various aspects of PET since 1979.

Charles P. Lin, PhD, *Associate Biophysicist, the Wellman Center for Photomedicine, Massachusetts General Hospital, Associate Professor of Dermatology, Harvard Medical School*. Dr. Lin received his Ph.D. in Physical Chemistry. Dr. Lin's group is highly collaborative and multidisciplinary, with

group members coming from fields as diverse as biophysics, engineering, ophthalmology, immunology, and dermatology. In collaboration with investigators from other laboratories (both within and outside the Wellman Center), they are pursuing projects in ophthalmology, cancer metastasis, angiogenesis, stem cell biology, and tissue engineering.

Christopher J. Logothetis, MD, *Professor and Chairman, Department of Genitourinary Medical Oncology, The University of Texas M. D. Anderson Cancer Center*. Dr. Logothetis is an internationally recognized leader in prostate cancer research and is Principal Investigator of the M. D. Anderson SPORC in Prostate Cancer. He has validated clinical biologic markers in prostate cancer. Dr. Logothetis is Director of the Genitourinary Cancer Center and the Prostate Cancer Research Program, multidisciplinary collaborations of physicians and scientists dedicated to genitourinary cancer treatment, research, prevention, and education. Among other responsibilities, Dr. Logothetis is a leader in the Therapy Consortium, an active collaborative of researchers involved in the development of innovative therapy for prostate cancer.

Michael J. Manyak, MD, FACS, *Vice President for Medical Affairs, Cytogen Corporation*. Dr. Manyak is a Professor of Urology, Engineering, Microbiology, and Tropical Medicine at The George Washington University Medical Center (GWUMC). Dr. Manyak completed a fellowship in biotechnology at the National Cancer Institute and spent 16 years at GWUMC, nine as Chairman of the Department of Urology. He has served on the scientific advisory board or as a consultant to over 25 biomedical technology and pharmaceutical companies, chaired the American Urological Association Technology Assessment Council, has been granted 11 patents with several pending, and published over 200 professional abstracts, book chapters, and journal articles. Dr. Manyak was the medical editor for national award-winning Time-Life Medical Publications, PBS, and the Virtual Prostate educational videos and recently was selected as one of the 50 **The Best and Brightest of Washington** by *Washingtonian Magazine*. Dr. Manyak maintains an avid interest in expedition medicine and has been the medical director for expeditions to remote areas in Africa, Antarctica, and to the Titanic wreck site.

Alexander R. Margulis, MD, *Clinical Professor of Radiology, Weill Medical College of Medicine, Cornell University and attending radiologist, New York Presbyterian Hospital (Cornell Medical Center)*. He is also a member of AdMe Tech's Board of Directors. Dr. Margulis is a graduate of Harvard University Medical School. After completing his residency training in radiology at the University of Michigan, he became Professor of Radiology at Washington University,

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Mallinckrodt Institute of Radiology in St. Louis. He was Chairman of the Department of Radiology, Associate Chancellor for Special Projects, Special Consultant to the Vice Chancellor for University Advancement and Planning, and Director of the Magnetic Resonance Science Center at the University of California at San Francisco, where he became Emeritus Professor of Radiology.

Dr. Margulis is a member of the Institute of Medicine and of multiple radiological societies throughout the world, and he has served as president of several professional societies. His awards and honors include honorary doctorates from Aix en Provence (Marseille), Toulouse, Montpellier, Karolinska, Louvain, Muenchen, and the Medical College of Wisconsin; the J. Allyn Taylor International Prize in Medicine (MRI); and medals including the Beclere (France), Radiological Society of North America, American Roentgen Ray Society (ARRS), Association of University Radiologists, Caldwell (ARRS), and Cannon (Society of Gastrointestinal).

He is Chairman of the Medical Advisory Committee of the R2 Corporation and Chairman of the Board at ITI Medical Technologies. He is also a member of numerous boards of scientific, medical, and radiological journals. A past editor of *Current Opinion in Radiology*, he has written more than 250 articles on various aspects of and issues in radiological science and technologies and a number of books that have gone into multiple editions. He is also author of a book on leadership: *Be in Charge*.

Thomas N. McCausland, *President, Customer Solutions Group, Siemens Medical Solutions, USA*. His responsibilities include sales, service and logistics of the U.S. business, including medical information technology software, imaging equipment and medical therapy.

He joined Siemens in 1986 in its Energy and Automation division as deputy general manager of Large Motor and Generators, vice president of the Motor Drives Division, and vice president of Sales and Marketing before joining the Medical Division. Prior to joining Siemens, McCausland held numerous senior-level sales, marketing, engineering and manufacturing positions during his 20 years with Westinghouse.

McCausland is on the board of directors of the National Electrical Manufacturers Association (NEMA) and Adva Med. He holds a bachelor's degree in electrical engineering from Syracuse University and a master's degree in business administration from the State University of New York in Buffalo.

William D. McPhee, LLB, *Managing General Partner and founder, Mi3 Venture Partners*. Mr. McPhee has been a private equity investor since 1998. Entrepreneur, bioimaging domain expert, strategist and visionary. Originally with PepsiCo and Bain & Company. He founded two successful professional service organizations, including Lucas, McPhee

and Company, a 25-professional strategy consulting firm. McGill University: B.Sc. (Hons. Physiological Psychology) and LL.B. (law degree). Represented the venture capital industry on NIH Biomedical Entrepreneurial Science Working Group. Presented at Institute of Medicine & NIH conferences.

Gregory J. Metzger, PhD, *Associate Professor, Center for Magnetic Resonance Research, University of Minnesota*. Dr. Metzger has recently joined the Center for Magnetic Resonance Research at the University of Minnesota with a primary focus on prostate cancer research. Prior to his academic position, Dr. Metzger was a senior clinical scientist for Philips medical Systems where he supported collaborative research activities at luminary sites since 1998. His last two years with Philips were spent at the National Institutes of Health working with the Clinical Center under a Cooperative Research And Development Agreement (CRADA), with a focus on diagnostic and interventional magnetic resonance prostate procedures.

Greg T. Mogel, MD, *Deputy Director of the Telemedicine and Advanced Technology Research Center (TATRC)*. TATRC, part of the US Army Medical Research and Materiel Command outside of Washington, DC, manages almost \$300M of federal medical technology research and development funding at a wide range of academic and industrial centers. Dr. Mogel is also Assistant Professor of Radiology and Biomedical Engineering at the University of Southern California in Los Angeles, CA. Prior to his joining the University, Dr. Mogel spent ten years as an active duty officer in the US Army Medical Corps. Dr. Mogel remains active in a wide variety of medical research programs ranging from digital imaging to medical robotics. Dr. Mogel, a Diplomat of the American Board of Radiology, received his medical training at the University of Pennsylvania after graduating Summa Cum Laude from Temple University in Philadelphia, PA. His research interests are related to the impact of advanced technology on the practice of medicine and the development of novel applications of medical imaging in the clinical setting by exploiting new forms of networking, decision support and informatics.

Janine M. Morris, *Branch Chief for the Urology and Lithotripsy Devices Branch (ULDB), Division of Reproductive, Abdominal, and Radiological Devices (DRARD), Office of Device Evaluation (ODE), Center for Devices and Radiological Health (CDRH)*. CDRH is part of the Food and Drug Administration (FDA) and is responsible for the regulatory oversight of medical devices. Prior to becoming the Branch Chief of ULDB Janine was a senior scientific reviewer for over 10 years. She has had experience in

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several medical device areas including neurology, cardiovascular, orthopedics, plastic surgery, and general surgery. Her academic background is in mechanical engineering where she obtained a BSME from the University of Maryland and a Licentiate degree from the University of Luleå in Sweden. She has taken the lead and responsibility in several special projects working with industry to understand the regulatory process including FDA workshops with the Surfaces in Biomaterials Foundation, Society for Biomaterials and the Center for Biofilm Engineering.

Andreas Muehler, MD, MBA, President, 3TP Imaging Sciences. Dr. Muehler has extensive experience in the fields of Medical Imaging and Medical Imaging Pharmaceuticals, among others. While at Berlex Laboratories from 1995 to 2003, Andreas' last position was Head of Marketing for the Radiology Business Unit. Prior to that, Andreas was Director of Corporate Business Development and guided in-licensing of new technologies as part of global business strategy. He also developed the initial business plan for diagnostic optical breast cancer screening (NIR breast imaging). Prior to Berlex, a U.S. subsidiary of Schering AG, Andreas served as Scientist of Pre-Clinical Pharmacology, MRI Contrast Media Research for Schering AG from 1992 to 1995. Based in Berlin, Germany, among his other responsibilities, he performed imaging assessments of contrast enhancement by MRI blood pool agents to differentiate benign and malignant cancer lesions. Dr. Muehler earned an MBA from Duke University and an MD from Humboldt University Medical School in Germany. He was a Post-Doctoral Research Fellow in the Department of Radiology at the University of California/San Francisco and a Clinical Resident, Department of Radiology at Charite University Hospital in Berlin.

Mohammad Naraghi, MD, PhD, Senior Vice President, Global Business Development, Siemens Medical Solutions. Dr. Naraghi was born in 1964 in Iran. After finishing high school in Germany, he concurrently studied medicine and mathematics in Aachen, Bonn and Vienna. He achieved his MA in mathematics in 1988 and his MD in 1991, both at the University of Aachen. He did residency in cardiology before moving to California Institute of Technology (Caltech) to join the Program for Computational Neuroscience and work on neural systems where he also received a MSc in 1993. He then moved to the Max-Planck-Institute for Biophysical Chemistry in Goettingen to work with the Nobel Laureate Professor Erwin Neher on Bioimaging and Quantitative Image Reconstruction. During his stay at Goettingen, he finished a PhD thesis in Physiology (1997) and a second PhD thesis in Biophysics (1998). From 1998 to 2002, he was a consultant and manager with McKinsey & Company where

he focused on strategy and operations projects in healthcare, in Asia and Europe. Since September 2002, he is working at Siemens Medical Solutions. As a SVP, he is currently heading the Global Business Development Department.

Joel B. Nelson, MD, Frederic N. Schwentker Professor and Chairman, Department of Urology, University of Pittsburgh School of Medicine, Co-Director, Prostate and Urologic Cancer Center. Urologist and urologic surgeon Joel B. Nelson, MD, earned his medical degree from Northwestern University. Following surgical and urologic residencies at the McGaw Medical Center of Northwestern University and a fellowship at the Brady Urologic Institute, he was assistant professor of urology and oncology at the Johns Hopkins University School of Medicine and director of urologic oncology at the Johns Hopkins Bayview Medical Center. His clinical interests include prostate cancer and other urinary tract malignancies.

William G. Nelson MD, PhD, Professor of Oncology, Medicine, Pathology, and Urology, Johns Hopkins University School of Medicine. Dr. Nelson completed his M.D. and Ph.D. degrees, internal medicine residency, and medical oncology fellowship at the Johns Hopkins University School of Medicine. Now a Professor of Oncology, Urology, Pharmacology, Medicine, Pathology, and Radiation Oncology at Johns Hopkins, with a Joint Appointment in Environmental Health Sciences at the Bloomberg School of Public Health, Dr. Nelson directs a research laboratory focused on discovering new strategies for prostate cancer treatment and prevention. At the Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins, Dr. Nelson serves as the Associate Director for Translational Research and the Co-Director of the Prostate Cancer Program.

Alan W. Partin, MD, PhD, Professor and Director of Urology, The Brady Urological Institute, The Johns Hopkins Medical Institution. Dr. Partin is a Hopkins trained physician and scientist. He received his B.A. in Chemistry from the University of Mississippi, his M.D. from Johns Hopkins University and his Ph.D. in the Department of Pharmacology and Molecular Sciences at the Johns Hopkins University. He is currently the David Hall McConnell, Professor and Director, Urologist-in-Chief at Johns Hopkins Medicine Brady Urological Institute. He is the Editor of *UROLOGY*, the author and co-author of more than 400 papers and the recipient of notable honors, including an award by the American Urological Association, given yearly to the urologist who has made the greatest impact within the first 10 years after completing his residency. Dr. Partin was the first urologist to receive this honor after only five years of practice, and he was the youngest urologist to be inducted into the prestigious American Association of Genitourinary Surgeons.

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Roderic I. Pettigrew, PhD, MD, *Director, National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health*. Prior to his appointment at the NIH, he was Professor of Radiology, Medicine (Cardiology) at Emory University and Bioengineering at the Georgia Institute of Technology and Director of the Emory Center for MR Research, Emory University School of Medicine, Atlanta, Georgia. Dr. Pettigrew is known for his pioneering work at Emory University involving four-dimensional imaging of the heart using magnetic resonance (MRI). He is a fellow of the American Heart Association, American College of Cardiology, American Institute of Medical and Biological Engineering, and International Society of Magnetic Resonance in Medicine.

Steve E. Phurrough MD, MPA, *Director of the Coverage and Analysis Group, Center for Medicare and Medicaid Services*. Using evidence-based medicine principles, Dr. Phurrough assists in developing national policy on the appropriate devices, diagnostics and procedures that should be provided by the Medicare program. Dr. Phurrough joined CMS in 2001 as the Director of the Division of Medical and Surgical Services in the Coverage and Analysis Group after completing a long and distinguished career in the United States Army. In addition to being a practicing Family Practitioner, his military career also included managing Department of Defense regional healthcare delivery systems, creating national and international healthcare policy for the Army, and developing practice guidelines. Dr. Phurrough received his MD from the University of Alabama in Birmingham and a Masters in Public Administration from the University of Colorado in Colorado Springs. He is board certified by the American Board of Family Practice and is a Certified Physician Executive by the American College of Physician Executives.

Alan Pollack, MD, PhD, *Chairman and Gerald E. Hanks, MD Endowed Chair, Department of Radiation Oncology, Fox Chase Cancer Center*. After completing his Bachelor in Science, Chemistry, in 1974 from the University of Florida, Gainesville, Florida, Dr. Pollack obtained a Ph.D. in Microbiology and Immunology in 1979 from the University of Miami, Miami, Florida. He received his Medical Degree also from the University of Miami in 1987. Dr. Pollack completed a Residency in Radiation Oncology at M.D. Anderson Cancer Center in Houston, Texas in 1992. He became Professor of Radiation Oncology and Section Head of Genitourinary Radiation Oncology at M.D. Anderson Cancer Center before accepting his current position.

Dr. Pollack is on the Editorial Board of the International Journal of Radiation Oncology, Biology, Physics. He has participated in a number of state, national and international meetings as an invited speaker on genitourinary malignancies. He belongs to a number of medical oncology

societies and has published extensively in the treatment of prostate cancer with radiotherapy. He has been listed among the top doctors in local magazines while in Houston and more recently in Philadelphia.

Walter L. Robb, PhD, *Chairman of the Board of AdMeTech, management consultant and President of Vantage Management, Inc.* Dr. Robb founded Vantage in 1993 after completing a highly successful 42-year career at the General Electric Company (GE). For 26 years at GE, Dr. Robb was Senior Vice President for Corporate Research and Development. He directed the GE Research and Development Center, one of the world's largest and most diversified industrial laboratories, and served on the company's Corporate Executive Council. Dr. Robb also directed GE Medical Systems for 13 years. He directed that organization's growth into the world's leading producer of medical diagnostic-imaging equipment.

A chemical engineer with a B.S. from Pennsylvania State University and a Ph.D. from the University of Illinois, Dr. Robb is the author of numerous publications and holds a dozen patents. In September 1993, in recognition of his leadership in the development of imaging instrumentation, Dr. Robb received the National Medal of Technology from President Clinton. He presently is on the board of two public companies, Celene and MTI, and also is involved in eight high tech start-ups in his local area.

Julian G. Rosenman, MD, PhD, *Professor, Department of Radiation Oncology and Adjunct Professor, Department of Biomedical Engineering, School of Medicine, University of North Carolina (UNC) at Chapel Hill*. Dr. Rosenman is also an Adjunct Professor in the Department of Computer Science at UNC Chapel Hill. He earned his doctor of philosophy degree in physics and completed a postdoctoral fellowship in physics at The University of Texas in Austin. He earned his medical degree at Southwestern Medical School in Dallas, Texas, and completed a surgical internship at Waltham Hospital in Waltham, Massachusetts, and a residency in radiation medicine at Massachusetts General Hospital in Boston.

Dr. Rosenman has published more than 100 peer-reviewed articles in such distinguished journals as the Journal of Clinical Oncology, the International Journal of Radiation Oncology Biology Physics, and Medical Physics, among others. He has been invited to present his work at regional, national, and international meetings. Dr. Rosenman is a member of the American College of Radiology, the American Society of Therapeutic Radiology (ASTRO), and CALGB (Cancer and Leukemia Group B). He is an active investigator in the field of radiation therapy and the recipient of numerous research grants. Dr. Rosenman is board certified in Therapeutic Radiology by the American Board of Radiology.

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Howard I. Scher, MD, *Chief of the Genitourinary Oncology Service, Sidney Kimmel Center for Urologic and Prostate Cancers, Memorial Sloan-Kettering Cancer Center.* A graduate of New York University School of Medicine, he completed an internship, residency and Chief residency in Medicine at Bellevue Hospital Center in New York and a fellowship in Medical Oncology at Memorial Sloan-Kettering Cancer Center. Dr. Scher is a Professor of Medicine at the Joan and Sanford I. Weill Medical College at Cornell University, and is the first incumbent of the D. Wayne Calloway Chair in Urologic Oncology.

Dr. Scher's work is focused on the development of mechanism based treatments for prostate cancer, including vaccines, monoclonal antibodies, and drugs that target the specific signaling pathways that contribute to prostate cancer growth. He has a particular interest in clinical trial design.

A national and international lecturer, Dr. Scher has served as editor of *Prostate Cancer* and *Prostatic Diseases*, he presently serves on editorial boards and is a reviewer for many journals including; *The New England Journal of Medicine*, *Clinical Cancer Research*, *Journal of Clinical Oncology*, *Journal of Urology*, and *Journal of the American Medical Association*. He has written extensively on prostate cancer and has published over 300 peer-reviewed articles. He has been the recipient of numerous honors and awards, including the Memorial Sloan-Kettering Teaching Excellence Award and the Donald S. Coffey-Prostate Cancer Foundation Physician-Scientist Award.

An internationally recognized investigator in the field of prostate cancer, he is repeatedly sought for National Advisory Panels because of his expertise in the development of new therapies.

Mitchell D. Schnall, MD, PhD, *Matthew J. Wilson Professor of Radiology, Magnetic Resonance Imaging (MRI) section of the Department of Radiology, University of Pennsylvania School of Medicine.* Dr. Schnall has been affiliated with Penn since 1978 when he enrolled as an undergraduate Physics student. He received his BA in 1981 and continued on to earn a dual M.D./Ph.D. in 1986 in Biophysics. In that same year, he performed his Internship at Lankenau Hospital in Wynnewood, PA. After a year, Dr. Schnall came back to Penn as a Resident from 1987-1991, at which time he was also named an Assistant Instructor in the Department of Radiology. He has since risen through the ranks at Penn, becoming a full Professor of Radiology in 2002. Dr. Schnall is board-certified by the American Board of Radiology and is licensed to practice in Pennsylvania, New York and Ohio. He holds numerous positions in national societies including the Radiological Society of North America, American College of Radiology and International Society for Magnetic Resonance in Medicine. He is the

Deputy Chair of ACRIN, an NCI funded multicenter trial group for imaging. During the past five years, he has been invited to give more than 85 lectures across the country on MRI and its medical significance. His research is internationally known and his studies have been published in leading peer-reviewed journals.

Neal D. Shore, MD, *Medical Director, Carolina Urologic Research Center.* Dr. Shore received his B.A. degree from Duke University in 1980 and his MD degree from Duke University in 1984. He completed his General Surgery/Urology training from New York Hospital-Cornell Medical Center and Memorial Sloan Kettering Cancer Center in 1990. He has multiple publications and has delivered numerous presentations on prostate disease; his practice and clinical research has focused on therapeutic strategies and diagnostic devices for the treatment of prostate disease.

Faina Shtern, MD, *President and CEO, AdMeTech, Director of Research, Department of Radiology, Children's Hospital Boston (CHB), Harvard Medical School.* Under her leadership, funding for radiology research programs at CHB has increased from \$150,000 in November 2000 to about \$6 million in June 2004. Between October 1999 and October 2002, Dr. Shtern also served as Director of the Office of Research Affairs and Technology Transfer, Department of Radiology, Beth Israel Deaconess Medical Center of Harvard Medical School, where her mentorship of new and established investigators resulted in grant awards totaling more than \$11 million. From March 1997 until October 1999, she was Associate Director for Research and Technology Affairs at the U.S. Public Health Office on Women's Health, Office of the Secretary of the Department of Health and Human Services, where she organized and directed the Federal Multi-Agency Consortium on Imaging and Other Technologies.

Between January 1990 and March 1997, Dr. Shtern served as Chief of the Diagnostic Imaging Research Branch of the National Cancer Institute (NCI), National Institutes of Health (NIH), Department of Health and Human Services—a leading unit of the U.S. government that supports and administers radiology research. Under her stewardship, the annual research budget for diagnostic imaging research increased from about \$32 million to over \$53 million, and diagnostic imaging research and technologies have become one of the top priorities of NCI. At NCI, Dr. Shtern was also appointed (1) a Special Assistant (for Diagnostic Imaging) to the Director of the Division of Cancer Treatment, Diagnosis and Centers; (2) a member of the Strategic Technologies Task Force; and (3) Chair of the NIH-wide Diagnostic Radiology Research Committee. In these positions, she designed, formulated, and administered multiple national and international research programs to accelerate technologic innovation and its transfer to routine clinical use.

Howard R. Soule, PhD, *Managing Director, Knowledge Universe Health and Wellness, LLC*. Knowledge Universe Health and Wellness is a private investment firm focused on companies in the general areas of disease prevention and treatment.

From 1997–2004, Dr. Soule was Executive Vice President and Chief Science Officer at the Prostate Cancer Foundation (formerly CaP CURE). Founded by Michael Milken in 1993, the overall goal of the organization is to promote the rapid development of new treatments and a cure for advanced prostate cancer. Dr. Soule was responsible for coordinating scientific and clinical research funded by the Prostate Cancer Foundation.

Prior to joining The Prostate Cancer Foundation, Dr. Soule was a senior R&D executive for nine years at Corvas International, Inc., a public biotechnology company. He was responsible for the discovery and development of innovative products for the treatment of life-threatening cardiovascular diseases.

Daniel C. Sullivan, MD, *Associate Director, Cancer Imaging Program (CIP), Division of Cancer Treatment and Diagnosis, National Cancer Institute*. Dr. Sullivan completed radiology residency and nuclear medicine fellowship in 1977 at Yale-New Haven Hospital, and was an academic radiologist for 20 years before coming to NIH in 1997. He has held faculty appointments at Yale University Medical Center, Duke University Medical Center, and University of Pennsylvania Medical Center. His areas of clinical and research expertise are in nuclear medicine and breast imaging. The Cancer Imaging Program at NCI promotes the development of novel imaging technologies and image-guided therapies. CIP initiated several collaborative groups, including the In Vivo Cellular and Molecular Imaging Centers, the Small Animal Imaging Resource Programs, the Lung Imaging Database Consortium, the Network for Translational Research in Optical Imaging and the American College of Radiology Imaging Network. Dr. Sullivan is also Chair of the NIH Bioengineering Consortium (BECN).

Clare M.C. Tempany, MD, *Professor of Radiology, Harvard Medical School, Director Clinical MRI and Clinical focused ultrasound, Brigham & Women's Hospital*. Dr. Tempany's major areas of research interest are MR imaging of the pelvis and image-guided therapy. She has had a long-standing interest in MR imaging of prostate cancer—diagnosis, staging, and treatment. She leads an active research group—the MR guided prostate interventions laboratory, which encompasses basic research in IGT and clinical programs. There are over 10 faculty and multiple students and fellows working in this group. Currently the group is working on the introduction of 3T MR imaging for prostate cancer, MR spectroscopy, and the new MR guided Focused ultrasound for prostate cancer research. Since 1997, the group has been performing clinical research in MR-guided interventions of the prostate, including diagnostic biopsies and MR-guided

brachytherapy. In this research the team is seeking to integrate the multi-modal image data sets into the MR operating room to maximize the image-based information at the time of the procedure. This work now includes new techniques for image analysis and display for interactive real-time display during procedures.

Stephen J. Ubl, *President and CEO, AdvaMed*. AdvaMed, the world's largest medical technology association, is based in Washington, DC and represents 1,300 manufacturers of life-saving medical devices, diagnostic products and medical information systems.

Influential inside-the-beltway publications including *The Hill* newspaper and *Legal Times* have both cited Ubl as one of Washington's top lobbyists, specifically recognizing his work in passing landmark reforms related to the U.S. Food and Drug Administration product review process and Medicare's coverage and reimbursement of medical technologies.

He first joined AdvaMed in 1998 as executive vice president of federal government relations. He left the organization in 2004 to open his own health care consulting firm, which served clients including Fortune 500 health care companies, and leading investment banks. Ubl was recruited back to AdvaMed in July 2005 as its president and CEO.

Ralph Weissleder, MD, PhD, *Professor, Harvard Medical School, Director of the Center for Molecular Imaging Research, Massachusetts General Hospital, Attending Interventional Radiologist, Massachusetts General Hospital*. Dr. Weissleder is also a member of the Dana Farber Harvard Cancer Center and regularly participates in four programs: the Prostate Cancer Program, the GI-cancer Program, the Neurooncology Program and the Program in Cancer Imaging). He is also an Associate Member of the Broad Institute (Chemical Biology Program) and a member of the Harvard Stem Cell Institute (HSCI) leading its Imaging Program. Dr. Weissleder's research interests include the development of novel molecular imaging techniques, tools for detection of early detection of cancer and development of nanomaterials for sensing. His research has been translational and some of his developments have led to advanced clinical trials with anticipated major impacts when these methods become routinely available. Dr. Weissleder is currently the principal investigator of several RO1 NIH grants, a P50 Center grant, a R24 grant, and a UO1 consortium focusing on nanotechnology. He has published over 400 publications in peer reviewed journals, has authored and co-authored several textbooks and holds 15 patents. He is a founding member of the Society for Molecular Imaging Research and has served as its President in 2002. His work has been honored with numerous awards including the J. Taylor International Prize in Medicine, the Millennium Pharmaceuticals Innovator Award, the AUR Memorial Award, the ARRS President's Award and The Society for Molecular Imaging Lifetime Achievement Award.

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— J Frank Wilson, MD
Chairman, Radiation Oncology Medical College
of Wisconsin - Froedtert Hospital

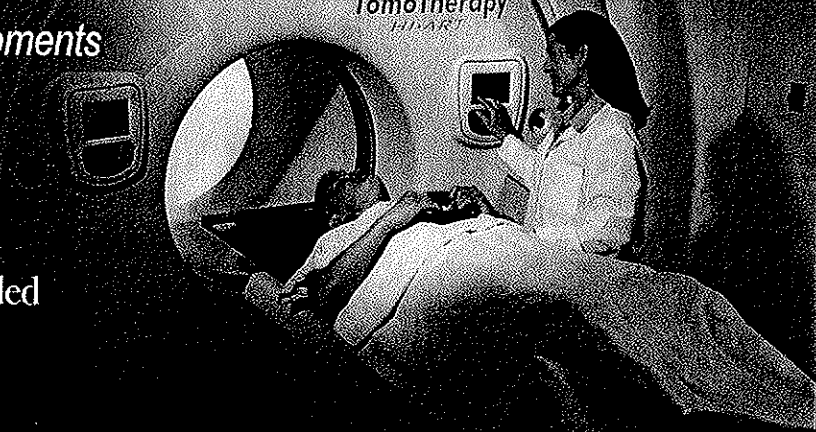
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FACULTY ABSTRACTS

Thursday, October 27, 2005

Prostate Cancer—Where Do We Go From Here?— The Role of Imaging in Diagnosis and Therapy

Everette C. Burdette, PhD

Acoustic MedSystems, Inc., Champaign, Illinois, USA

There are significant innovations in therapy, including localized ablation, IMRT, and conformal brachytherapy, among others. Yet there are few tools for image-based targeting and diagnoses. Precision imaging for all forms of treatment is necessary to improve therapeutic results and reduce complications. This has been shown already for the case of permanent implant prostate brachytherapy. Also, there have been many advances in diagnostic imaging and expert system image analysis for other disease sites, but little for prostate cancer. A success example includes advances in digital mammography using intelligent image analysis software tools. Similar advances are needed for prostate diagnostic imaging and biopsy guidance. Image guidance is also gaining traction in conjunction with various therapeutic interventions. For example, linear accelerator vendors are adding various forms of imaging to their linacs, but how this large volume of new image data will be managed, analyzed and used in therapy is largely unknown. Clearly, image guidance is the *enabler*, the means to ensure appropriate target coverage and realizing the promise of both existing and new therapies (e.g. IMRT). Without it, cancer in the prostate can be easily missed, or normal adjacent critical tissues receive excessive treatment dose. With image guidance, the much-needed feedback loop in treatment delivery can be closed at last. Many therapies have been mostly delivered in an "open loop" manner, with total delivered dose distribution assumed to be correct. Precision imaging is the vehicle by which the dose to critical structures can be minimized, and the spatial delivery of dose can be monitored and the treatments adjusted to increase the therapeutic effectiveness. Industry has a responsibility to innovate in partnership with academia, government, and philanthropic and consumer groups to bring this vision to reality.

Developing Improved Clinical Measures for Drug Development

Wayne O. Carter, DVM, PhD

Pfizer, Inc., Groton, CT USA

Clinical practice is generally based in the subjective assessment of disease, diagnosis and response to treatment.

To make accurate and timely assessments of drugs in all stages of development, we need more quantitative tools on which we can base our development decisions. Validation of these technology applications is one of the most important deliverables for Global Clinical Technology. Our definition of validation means "fit for purpose" so that there is a perceived understanding of how a customer will use the technology for a decision. The development of quantitative endpoints includes many pieces such as QC methods, standardized acquisition parameters and robust semi-automated image analysis methods. We have developed these technology applications to inform development decisions, but we work to extend our understanding to demonstrate outcome linkage to these endpoints so they achieve some level of surrogacy and can be used to help inform rapid clinical decisions to drive better patient management.

Optical Imaging: An Emerging Set of Preclinical and Clinical Modalities

Christopher H. Contag, PhD

Stanford University School of Medicine, Stanford, California, USA

Although mammalian tissues are relatively opaque, light is transmitted through tissues at low levels such that measures of disease status and molecular signatures of disease can be assessed optically. Transmission of light through tissues occurs in a wavelength dependent manner with longer wavelengths having the greatest penetration. Optical methods of imaging and sensing can be based on scatter, absorption, reflectance, fluorescence or bioluminescence. Many of these emerging technologies are well suited for animal models and have contributed greatly to our understanding of complex processes in the context of the living body. Whole body optical imaging refines animal models and accelerates their analyses while providing more and improved information. The unmet clinical needs that are being addressed using optical imaging tools include frequent monitoring in high-risk populations, early detection of disease and providing rapid outcome measures. Intrinsic optical properties of tissues change during progression to malignancy and can provide important information without the use of exogenous probes. The development of optical approaches benefit from the use of nonionizing radiation, a rich data from multiple wavelengths and relatively simple, and often inexpensive, detection systems. The field of in vivo optical imaging offers significant opportunity for advances in corporate and academic settings.

Reinaldo A. Garcia

GE Healthcare, Waukesha, Wisconsin, USA

The last 20 years have brought a revolution in the diagnosis and treatment of prostate cancer. Following PSA tests, more men than ever are being diagnosed and treated. Imaging technologies today are enabling clinicians to see the location and extent of the disease. Diagnostic imaging also helps physicians stage cancer, design the most effective treatment plans, and monitor treatment effectiveness. GE Healthcare, a \$15 billion unit of General Electric Company, is providing a wealth of transformational medical technologies that are shaping a new age of cancer patient care. GE Healthcare's expertise in medical imaging and information technologies, medical diagnostics, research drug discovery, and biopharmaceutical manufacturing technologies is paving the way for physicians to detect cancer earlier and tailor personalized treatments for their patients. Reinaldo Garcia, President and CEO of GE Healthcare's Diagnostic Imaging business, will give an overview of the current challenges in prostate cancer and provide an overview of GE's available technologies. He'll also discuss promising future technologies that could play a significant role in oncology.

Learning from the Past—Research to Advance Curing Prostate Cancer

Bruce J. Hillman, MD

University of Virginia, Charlottesville, Virginia, USA

There are four major focuses that require our attention if we are to improve outcomes for patients with prostate cancer:

- ✧ Early detection
- ✧ Diagnosis and staging
- ✧ Less invasive treatment
- ✧ Determining the effectiveness of treatment

In each case, we have proven technologies that fulfill these functions. However, in various ways, these established technologies fall short of what we ideally would hope for in the way of ease of performance, low morbidity, and effectiveness. Innovative technologies that address these needs are emerging into initial clinical research and showing promise. Unfortunately, what we have seen in the past for other technologies and conditions is a prolonged translational period that needs to be shortened if the next generation of men with prostate cancer is to benefit from their potential. Promising technological innovations need to be more quickly advanced into multi-center clinical trials, where they can be standardized and validated for early, broad dissemination into general practice. Such trials also will spur regulators' and payers' recognition of the value of these technologies so that they will be accessible to everyone who might benefit from their application.

Perspectives from the Advocacy Community

Jim Kiefert, EdD and Thomas N. Kirk, MSSW

Us TOO International, Inc., Downers Grove, Illinois, USA

Support, Education and Advocacy are the core functions of Us TOO International a not-for-profit organization founded by a group of 5 patients and their family members 15 years ago to send the message men have under-recognized prostate cancer concerns and issues. Us TOO today is an international network of support groups in 44 states and 10 countries with the mission of Communicating Timely, Personalized and Reliable Information and Enabling Informed Choices Regarding Detection and Treatment of Prostate Cancer. The presenters will discuss the importance of informed patient decision making, the urgency of prostate cancer screening and treatment given the aging population and the available resources of Us TOO as a partner in treatment and care.

Advances in Diagnostic Imaging for Prostate Cancer: A Urologist's Perspective in the Imaging Industry

Michael J. Manyak, MD, FACS

Cytogen Corporation, Princeton, New Jersey, USA,

George Washington University Medical Center, Washington, DC, USA

The next major quantum leap in medical advances will be driven by our enhancement of imaging for diagnosis, for refinement of treatment, and for sophisticated evaluation of treatment efficacy. The convergence of technology in the fields of material science, the defense and communications industries, and biology have greatly advanced diagnostic imaging. Precision in control of the spatial and temporal properties of light along with understanding of light and its heterogeneous scattering properties within tissue have extended our capability for imaging. Radioimmunosintigraphy has been utilized for a decade for prostate cancer imaging and refinements in image acquisition, fusion of images, and outcomes data which provide greater clinical information now suggest use for image-guided therapy. Optical coherence tomography (OCT) uses diffuse reflectance to image subepithelial structures to identify neurovascular tissue and radiation effects. The introduction of newer magnetic resonance imaging agents such as the dextran-coated iron oxide nanoparticles appear to provide significant imaging capabilities to detect malignant lymph nodes. Future applications of electron paramagnetic resonance imaging and hyperspectral imaging promise further refinements of our ability to image tissues for diagnosis.

Raising the Bar in Healthcare Through Innovation**Thomas N. McCausland***Siemens Medical Solutions USA, Malvern, Pennsylvania, USA*

The level of innovation in healthcare technology is at an all-time high—from medical equipment that allows radiologists to capture lifelike images from within the body, to radiation therapy that targets disease while preserving quality of life by causing the least possible damage to surrounding healthy tissue.

While these innovations are dramatically improving the quality of care we receive, it is also important to ensure that we are presenting the multitude of information to caregivers in a way that helps them make timely and accurate diagnosis and treatment decisions. The increased emphasis on standards, particularly in relation to electronic health records that contain medical images as well as patient information, is crucial to optimizing clinical workflow and increasing patient safety. Standardization of information—including all imaging and information technology solutions—is mandatory if we are going to achieve the degree of inter-operability called for by the U.S. Federal Government.

Fostering this innovation in healthcare technology requires continued partnerships between vendors, healthcare providers, and government agencies. Technology companies rely on the medical community to help them develop products that will bring the greatest benefit to patients, as well as the greatest return on investment to healthcare institutions. Their collective feedback helps justify the costs and the long-term benefits associated with the next generation of life-saving technology.

Challenges to Funding Breakthrough Technologies**William D. McPhee, LLB***Mi3 Venture Partners, Wellesley, Massachusetts, USA*

Historically the venture capital industry, with all its positives and negatives, has been critical to fueling commercialization of innovative diagnostic and therapeutic approaches to cancer. In the last 10 years, however, scientists, physicians and venture capitalists have often oversold the benefits of unproven technology and underestimated the capital and time required to achieve real results for patients. And it is not only patients who have suffered. All too often, investments in life technologies have proven not to be the next El Dorado. The dot com implosion at the dawn of the millennium exacerbated the often lackluster financial returns of these investments. Consequently, investors in private equity funds have become wary of promises and are concerned with the risk/reward profile of investing in life technologies. With a focus on the prostate, Mr. McPhee will explore whether current models of private equity can accelerate or derail commercialization of revolutionary technologies in cancer diagnosis and treatment.

Advanced Medical Technology R&D:**The Triple Helix Approach****Greg T. Mogel, MD***Telemedicine and Advanced Technology Research Center (TATRC), Fort Detrick, Maryland and Marina del Rey, California, USA*

Advanced medical technology research and development is widely agreed to represent a key pillar in any broad strategy that might address many of our current healthcare dilemmas, including the diagnostics and therapeutics of the disease broadly known as 'prostate cancer'. Yet our research culture and traditional means to fund such technology focused efforts remains gravely out of step with the nature of technology discovery, development and implementation in the modern healthcare ecosystem. The Telemedicine and Advanced Technology Research Center (TATRC), a Department of Defense research agency, is evaluating the concept of the "Triple Helix" model for medical technology research endeavors. This model engages government, industry and academia in tightly controlled partnerships that appear to generate greater returns on investment in invention disclosures, intellectual property, and, most critically, reduction to practice in the healthcare setting. In this presentation, we will present a background on TATRC, its research portfolio, and the potential impact of the "Triple Helix".

Regulatory Considerations of Medical Devices**Janine M. Morris***Center for Devices and Radiological Health (CDRH), US Food and Drug Administration, Rockville, Maryland, USA*

The US Food and Drug Administration (Agency) is responsible for protecting the public health by assuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation. The Agency accomplishes this through the dedication and leadership of several different Centers each responsible for the regulation of food, drugs, biologics, devices and other products. The Center for Devices and Radiological Health is the Center responsible for the regulation of medical devices as defined by section 201(h) of the Federal Food, Drug, and Cosmetic Act. Medical devices used in the treatment of prostate cancer are regulated differently by statute than the regulation of pharmaceutical drugs which are regulated by the Center for Drugs Evaluation and Research. An understanding of these differences needs to be appreciated to interpret what are the different regulatory requirements of these products. The subject of this presentation is to outline the regulatory authority for medical devices which is the basis for requirements of new treatment modalities for prostate cancer involving medical devices.

Prostate MRI—Hurdles Regarding Routine Clinical Use and the New Strategies to Address the Existing Medical Needs

Andreas Muehler, MD, MBA

3TP Imaging Sciences, White Plains, NY, USA

Although prostate MRI has been described in the scientific literature as having value for the detection and diagnosis of prostate cancer, its routine clinical use outside academic centers and availability to patients has been very limited. For a company like ours developing new solutions for prostate MRI, it has been a challenge to learn why this lack of routine clinical use has been a persistent challenge.

In my presentation, I would like to explore the reasons for this situation. I will explore such hurdles as a) the strict adherence of the academic scientific community to the use of the endo-rectal coil, b) the divergent application of imaging and biopsies in prostate cancer, and c) the reading of prostate MRI data.

The presentation will also go into the different medical needs for which prostate MRI are applied to. The scientific community, to my mind, has focused too much on “high-end” hospital-relevant applications of prostate MRI. The reality for patients and urologists, however, demands more “community-based” applications, such as the imaging of patients with negative biopsies but rising PSA values.

Recently, 3TP Imaging Sciences has developed and brought to market the ProStream™ product that we believe will address the “community-based” medical needs, can be performed by the private practice radiologist and will move prostate MRI closer to be routine imaging method offered to prostate cancer patients.

Improving Cancer Care—Opportunities and Challenges Ahead

Mohammad Naraghi, MD, PhD

Siemens Medical Solutions, Erlangen, Germany

Siemens Medical Solutions' strategy is focused on developing and delivering health care solutions which increase the quality of care and its efficiency. Our vision on the future of cancer care is one which

1. Addresses medical needs through all stages in the health continuum: from prevention over diagnosis and therapy to home care/aftermonitoring,
2. Builds on leveraging the power of molecular technologies to unlock their potential for clinical use,
3. Uses information technologies (IT) to integrate patient-related medical information across the health continuum and extract, structure and present actionable medical knowledge to the practitioners within the context of clinical decision support systems and

4. Has a disease—and workflow orientation to enable standard-setting within efficient processes.

We will present an example to illustrate how the clinical management of cancer in the future could like and discuss the challenges which we need to address. The focus will be on outlining the required integration of imaging, molecular methods and IT.

Perspective from the Academic Community The Need for New Imaging Approaches for Prostate Cancer

William G. Nelson, MD, PhD

The Sidney Kimmel Comprehensive Cancer Center, The Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

In 2003, an estimated 220,900 prostate cancer diagnoses were made in the United States (US), accompanied by an estimated 28,900 prostate cancer deaths. Beginning around 1994-6, with widespread use of serum prostate-specific antigen (PSA) testing and digital rectal examination for prostate cancer screening, and with increased treatment of clinically-localized prostate cancer with surgery or radiation therapy, age-adjusted prostate cancer death rates have fallen steadily. Although this trend might indicate a beneficial impact of prostate cancer screening and/or early prostate cancer treatment on prostate cancer mortality, mass screening of the general population for prostate cancer remains controversial. One challenge for prostate cancer screening is the prevalence of the disease in the US: autopsy series have revealed small prostate cancers in as many as 29% of men between age 30 and 40 and 64% of men between age 60 and 70. Obviously, not all of these men are at risk for symptomatic or life-threatening prostate cancer progression. In fact, many such men, if diagnosed with prostate cancer, may be at greater risk for treatment-associated morbidity. Currently, for US men, the lifetime risk of a diagnosis of prostate cancer is about 1 in 6, while the lifetime risk of death from prostate cancer is on the order of 1 in 30. Over the past two decades, treatment approaches for men with prostate cancer have changed dramatically, with improvement in established prostate cancer treatments and the introduction of new prostate cancer treatment approaches. Now, men diagnosed with prostate cancer often face a bewildering array of treatment choices. Clearly, the physicians that care for these men must weigh the risks of prostate cancer progression against the potential for side effects from treatment, in the context of other health risks and life choices, to best use the current collection of treatments for the greatest benefit. Imaging technologies have great promise to aid in such decisions. New approaches to imaging of the prostate, and of prostate cancer, will likely be rapidly adopted if able to better diagnoses, stratify, and monitor men before, during, and after different prostate cancer treatment interventions.

CMS Role in the Diagnosis and Treatment of Prostate Cancer

Steve E. Phurrough MD, MPA

Center for Medicare and Medicaid Services, Baltimore, Maryland, USA

Prostate cancer is an extremely common disease in the Medicare population resulting in significant morbidity and mortality for Medicare beneficiaries and in significant costs to the Medicare Trust Fund. Though prostate cancer screening through digital exams and PSA are reimbursed by the Medicare program, the lack of an evidentiary base as to the effectiveness of this screening is concerning. CMS is also concerned with the rapid proliferation of various interventions some of which have a meager evidentiary base. This discussion will focus on CMS' desire for a strong evidentiary base for both new diagnostic and therapeutic interventions for prostate cancer.

The Milken Family Foundation: Decades of Advancing Medical Research

Howard R. Soule, Ph.D.

*Knowledge Universe Health and Wellness Group,
Santa Monica, California, USA*

The Milken Family Foundation has funded nearly 2,000 innovative medical research programs throughout the world since inception in 1982. Co-Founders, Michael and Lowell Milken have revolutionized medical science focused on solutions for unmet medical needs. The venture-style research has seeded discover and development for new treatments for a broad array of human diseases. The following programs will be discussed:

- ✱ Cancer Research Awards
- ✱ Epilepsy Research Award Grants and Fellowships
- ✱ General Medical Research Awards
- ✱ Prostate Cancer Foundation

In addition to these programs, Michael Milken founded a nonpartisan "action tank" in Washington DC named FasterCures. The goal of this organization is to affect policy change that will result in the acceleration of solutions for all major human diseases.

Perspective from the National Cancer Institute

Daniel C. Sullivan, MD

National Cancer Institute, Rockville, Maryland, USA

The development of novel imaging technologies and methods, and the development and clinical evaluation of minimally-invasive, image-guided therapies are important priorities for the Cancer Imaging Program in the National Cancer Institute. Targeted imaging agents have the potential to identify the particular molecular phenotype of a given cancer, to provide, for example, prognostic information such as degree of aggressiveness. In this way, targeted imaging agents may make personalized medicine a reality. In addition, image-guided, minimally-invasive ablative therapies have the potential to cure localized cancer or precancerous lesions, and eliminate the morbidity associated with systemic or more invasive therapies. NCI funds a spectrum of programs intended to facilitate the development of targeted imaging agents, to speed translation of new method such as optical technologies to clinical applications, to validate imaging methods as biomarkers for therapy development, to stimulate the development of software for extracting quantitative data from medical images, and to conduct clinical trials of promising image-guided therapies. All of these programs and priorities are bringing new imaging technologies to bear on the challenge of early detection and therapy of prostate cancer.

Stephen J. Ubl

AdvaMed, Washington, DC, USA

AdvaMed is the world's largest association representing manufacturers of medical devices, diagnostic products and medical information systems. The organization has worked to secure policy changes that speed and expand patient access to new technologies that are saving and improving lives.

The power of medical innovations will lead to earlier disease detection, less invasive treatment and faster recovery for patients. Technologies such as drug-eluting stents, Positron Emission Tomography (PET) scans and image-guided surgery are among these innovations. PET imaging, for example, has enabled physicians to detect an additional 10 percent of patients with tumors that have spread to other sites and were missed with other imaging techniques. Imaging technologies for prostate cancer hold great promise.

We have made progress in recent years to speed patient access to medical technologies. Recent policy proposals, however, for gainsharing, pay-for-performance and efficiency standards may have a negative impact on patient care and may hinder the development of less invasive diagnosis and treatment technologies for prostate cancer patients. Recent media scrutiny of the necessary collaboration between physicians and manufacturers that is necessary to develop new technology also threatens innovation. Physician groups, patient groups, and medical technology companies must work together to advocate for a legal, regulatory and economic climate that supports medical advancements for prostate cancer patients.

GUERBET

Friday, October 28, 2005

Development of Near infrared and Multimodal Molecular Probes for Imaging Tumors

Samuel Achilefu, PhD

Washington University School of Medicine, St. Louis, Missouri

Accurate and rapid detection of tumors is of great importance for interrogating the molecular basis of cancer pathogenesis, preventing the onset of complications, and implementing a tailored therapeutic regimen. While many human diseases have been studied successfully by using differences in the intrinsic optical properties of normal and pathologic tissues, molecular imaging of the expression of aberrant genes, proteins, and other pathophysiologic processes would be enhanced by the use of highly specific exogenous molecular probes. Accordingly, we are designing and developing a variety of molecular contrast effectors for imaging tumors. These molecular probes target cell surface receptors that are over-expressed in tumors relative to normal surrounding tissue. Some examples include RGD peptides for imaging integrins, octreotate analogues for targeting somatostatin receptors (neuroendocrine tumors), bombesin peptide analogues for targeting gastrin-releasing peptide receptor (prostate cancer), and neurotensin peptide mimics for targeting neurotensin receptor (pancreatic ductal adenocarcinoma). In vivo evaluation of the contrast effectors shows that they are highly specific for their target receptors. A recent study demonstrates the possibility of using fluorescent bombesin peptides to detect human prostate cancer. The development, biological evaluation, and in vivo imaging of optical and multimodal contrast effectors will be presented.

Potential Clinical Applications of Optical Technologies for Prostate Cancer

Irving J. Bigio, PhD

Boston University, Boston, Massachusetts, USA

Optical spectroscopy using fibre-optic probes can be used to perform noninvasive, or minimally-invasive, real-time assessment of tissue pathology *in-situ*. The most common approach has been based on UV-induced fluorescence spectroscopy, although Raman spectroscopy has also been investigated. These methods are responsive to biomolecular/biochemical changes in cells. On the other hand, the method of elastic-scattering spectroscopy (ESS) is sensitive to the sub-cellular architectural changes, such as nuclear grade or nuclear to cytoplasm ratio, mitochondrial size and density, etc., that correlate with features used in

histological assessment. The ESS method senses those morphology changes in a semi-quantitative manner, without actually imaging the microscopic structure.

Clinical demonstrations of ESS have been conducted for organs sites that are endoscope-accessible or directly-accessible. In the case of prostate diagnosis, "optical biopsy" measurement can be conducted through very fine needles (smaller than 27-gauge) and thus can be integrated with core biopsies to reduce sampling error and improve sensitivity. This results in reduced trauma from multiple core specimens. Moreover, continuous measurement can be performed over the entire insertion track of the needle, from the entrance surface to the opposite side of the capsule. Thus, a larger range of sites can be assessed in the gland, with reduced trauma compared with TRUS-guided core biopsies.

We have conducted a preliminary study of ESS on freshly-excised glands. Within minutes of surgical excision the glands are sectioned in the pathology lab, exposing different volumes of the gland, and ESS measurements are taken on various locations of each "slice." The site of each measurement is marked precisely, and those sites are the subject of careful histological assessment following standard fixation and staining procedures. The correlation of spectral measurements with histology results is encouraging.

Photodynamic Therapy for Prostate Cancer

Stephen G. Bown, MD, FRCP

National Medical Laser Center, University College London, England

Photodynamic therapy (PDT) produces localized tissue necrosis with light after prior systemic administration of a photosensitising drug. No heat is involved, collagen is essentially unaffected and it is repeatable, even after radiotherapy. In the prostate, light can be delivered via fibers inserted through needles positioned percutaneously under image guidance. Canine studies have demonstrated glandular necrosis with safe healing. A pilot study using the photosensitiser mTHPC (Foscan) showed marked reductions in PSA (prostate specific antigen) with extensive areas of glandular necrosis on MRI scans in untreated cancers and those recurring after radiotherapy (with less complications than after alternative salvage therapies). Recent studies with WST09 (Tookad), which primarily targets vascular tissue, give similar results, with the major advantage of a drug light interval of only a few minutes and no prolonged skin photosensitivity. As prostate cancer is a

multi-focal disease, the challenge is to ensure destruction of all glandular tissue with no unacceptable effects on adjacent normal tissue. On current evidence, the effects on the rectum and on continence and potency are less in severity and duration than after other local therapies.

Dynamic Contrast Enhanced MRI of the Prostate: Molecular Implications

Peter L. Choyke, MD

National Cancer Institute, Bethesda, Maryland, USA

The versatility of MRI allows multiparametric maps based on the T2, spectroscopic and enhancement characteristics of prostate cancer. The combination of these parameters allows pathologic tissue to be distinguished from normal tissue in the majority of cases. High resolution T2 weighted imaging relies on the differences in water content between normal prostate and cancer. MR spectroscopy relies on the relative abundance of the metabolites citrate and choline in normal prostate compared with cancer. Dynamic Contrast Enhanced MRI relies on the relative vascularity of normal tissue compared with cancer bearing tissue.

In order to perform DCE-MRI a T1 map is obtained prior to injection in order to convert MR signal intensity into gadolinium concentration. Once acquired, data is transferred to an analysis program that computes parametric maps reflecting the vascular permeability (K_{trans} , k_{ep}) and tissue vascular volume (fpv). The area under the curve (AUC) is also computed. Static color maps are generated and are co-localized with the T2 and MR spectroscopic images.

Cancers typically demonstrate increased vascular permeability which generally correlates with tumor grade. Proteomic and genomic differential expression can identify novel diagnostic and therapeutic molecular targets in specimens. The biopsy tissue is especially useful because it can be immediately frozen, thus preserving proteins with short biologic half lives that would otherwise be unlikely to survive in prostatectomy specimens. In order to perform targeted biopsies we have designed an MR guided biopsy device.

It is unclear whether MRI will provide sufficient specificity to direct therapy. Current research focuses on radiolabeled based alternatives that may improve targeting.

Optical Imaging: Advancing Biotherapies Through Imaging

Christopher H. Contag, PhD

Stanford University School of Medicine, Stanford, California, USA

Biological light sources that report externally the inner workings of mammalian biology can be built into animal models of human physiology and disease. This has been used to study two immune cell populations that are key to recovering from malignant disease, the effector population

that kills residual tumor cells and stem cells that enable reconstitution of immune function following therapy. We have used the optical reporter genes to reveal immune cell-tumor interactions and study stem cell differentiation. The early events of stem cell engraftment were studied after transfer of a single labeled hematopoietic stem cell. We have added oncolytic functions to immune cells and imaged the processes of delivery and tumor response. The untoward effects of graft vs. host disease (GvHD) have been evaluated and we have identified cell populations that will confer immunity to the threat of infection without causing GvHD. Using whole body imaging, difficult questions can now be approached in the context of the living body, and we have begun to use imaging to probe the use of biological therapies for efficient control of malignancy. Access to critical spatiotemporal information in whole biological systems offers tremendous opportunities to analyze experimental therapeutic intervention, accelerate their preclinical development and refine animal disease models.

Recent Advances in Ultrasound Imaging for Prostate Cancer Detection

Ethan J. Halpern, MD

Thomas Jefferson University, Philadelphia, Pennsylvania, USA

Detection of prostate cancer is a major public health issue, with more than 700,000 prostate biopsy procedures annually in the US. A major limitation in the diagnosis of prostate cancer is our inability to visualize the cancer. Most clinicians use a systematic biopsy approach with spatially distributed biopsy cores to sample the entire prostate. The optimal systematic biopsy strategy remains a matter of controversy, but the accepted number of biopsy cores in clinical practice is increasing, along with an increase in biopsy related complications and pathology costs.

Conventional ultrasound techniques, including gray scale and color Doppler, improve the detection of prostate cancer, but cannot replace systematic biopsy. Recent technological advances may allow improved detection of prostate cancer with fewer targeted biopsy cores. Microbubble contrast agents enhance visualization of the microvasculature associated with prostate cancer. A federally funded study at Thomas Jefferson University demonstrated improved prostate cancer detection with contrast-enhanced ultrasound (Cancer—in press). Further improvement may be achieved by pre-treatment with a 5-alpha reductase inhibitor to reduce blood flow to benign prostate tissue (Radiology—in press). Preliminary studies of other techniques, including radiofrequency analysis and tissue elastography, suggest promising results.

Recent advances in ultrasound and contrast agent technology provide promising strategies for detection of prostate cancer. An intelligent approach to the diagnosis of

prostate cancer should utilize fewer targeted biopsy cores, but maintain the sensitivity of a systematic biopsy approach. Continued research and clinical trials are needed to achieve this goal and to improve cost-effectiveness in the diagnosis of prostate cancer.

Imaging Prostate Cancer, Today and Tomorrow

Hedvig Hricak, MD, PhD

Memorial Sloan-Kettering Cancer Center, New York, New York, USA

Combined anatomic and metabolic imaging is already in clinical use for prostate cancer. Magnetic resonance imaging (MRI) has been shown to aid in prostate cancer detection, localization and evaluation of local tumor extent (i.e., detection of extracapsular extension and seminal vesicle invasion). MRI can also serve as a road-map in surgical and radiation treatment planning. Commercially available proton MR spectroscopy (¹H-MRS) software packages provide a metabolic map of the prostate, displaying concentrations of citrate, creatine, choline, and polyamines. Prostate cancer identification with ¹H-MRS is based on the detection of an increased [choline+creatine] to citrate ratio and a decrease in polyamines. The addition of volumetric data from ¹H-MRS significantly increases accuracy and decreases interobserver variability in the evaluation of extracapsular extension on MRI. ¹H-MRS can also contribute to the assessment of tumor aggressiveness, as the ratio of [choline+creatine] to citrate in prostate cancer correlates with Gleason grade. Research is under way to determine whether a combination of non-invasive MRI/¹H-MRS and PSA testing could add incremental value in evaluating the individual patient's risk of disease progression and need for treatment.

Multimodality Image Guidance for Prostate treatment

Ferenc A. Jolesz, MD

Harvard Medical School, Brigham and Women's Hospital, Boston, Massachusetts, USA

The role of imaging in diagnosing and treating prostate cancer has been changing. In this stage we identify the needs, opportunities and issues associated with future advances in image-guided interventions (biopsies, surgery, and other image-guided therapies). The introduction of new imaging modalities, and the availability of high performance computing, novel image-guided therapies are being developed at an impressive rate. Indeed, across a broad front of imaging technology rapid advances are being realized. At the same time, advances in clinical evaluation and complementary technologies will provide the necessary

infrastructure through which Image-Guided Therapy can be applied in diverse therapeutic settings for prostate interventions.

The Advanced Multimodality Image Guided Operating Room (AMIGO) project is designed for minimally invasive treatments, image guided interventions, biopsies, and surgical procedures. The goal of this project is to develop the next generation of interventional/intraoperative suite equipped with state-of-the-art integrated image-guidance technology and instrumentation comprising high field MRI (3 Tesla), PET-CT, X-Ray Fluoroscopy, Ultrasound and Optical Imaging, integrated with various therapy devices and with a navigational system. It is our goal to refine and expand the resources of existing image-guided clinical procedures as well as to develop the technology to enable new ones that will benefit from a multi-modality approach.

Bioluminescence Imaging of Tumors and Gene Expression: Impact on Drug Development

Andrew Kung, MD

Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts, USA

Mouse cancer models play a critical role in the development of new cancer therapies. However, over the years, serious questions have been raised as to the value of traditional subcutaneous xenograft models for predicting clinical efficacy. The fidelity of tumor models may be improved by localizing tumors to their originating anatomical sites. So-called orthotopic models, however, are generally inaccessible to caliper measurements, necessitating alternative methods of tumor quantification. Bioluminescence imaging (BLI) is a conceptually and technically simple methodology for non-invasive imaging of tumor cells located anywhere within small animals. BLI can be used to create orthotopic models of essentially any solid tumor, such as prostate, breast, kidney, or brain tumors. BLI can also quantify disseminated tumors such as hematologic malignancies and metastases. These cellular imaging applications of BLI are useful for assessing drug effects on tumor burden. However, BLI can also be used for molecular imaging, where light emission is a biomarker of molecular pathways. These approaches can serve as near real-time pharmacodynamic read-outs of drug effects. Together, these approaches hold the promise of accelerating targeted drug discovery by allowing rapid *in vivo* assessment of drug efficacy.

Magnetic Resonance Imaging Based Biomarkers of Therapeutic Response of Prostate Cancer

John Kurhanewicz, PhD

University of California San Francisco, San Francisco, California, USA

Preliminary studies suggest that a multi-parametric magnetic resonance imaging exam involving the acquisition of high spatial resolution anatomic images (T_2 weighted MRI), diffusion tensor images (DTI) and magnetic resonance spectroscopic imaging data (MRSI) can provide a direct measure of the location and extent of cancer prior to therapy, a direct measure of residual/recurrent cancer within the prostate after unsuccessful therapy, and a time course of metabolic response that compliments PSA changes. Prior to therapy, cancer within the prostate can be discriminated from healthy tissues based on a combination of reduced signal intensity on T_2 MRI, decreased water diffusion on DTI, and increased choline and reduced citrate and polyamines on MRSI. On MRSI after therapy, there is a time dependent decrease of choline, eventually resulting in an absence of all metabolism (metabolic atrophy) which has been associated with effective therapy. Whereas, residual prostate cancer after therapy has been identified based on the presence of 3 or more spectroscopic voxels having elevated choline. On DTI, residual cancer can still be discriminated from regions of residual healthy tissue and atrophy based on significantly lower mean water diffusion. This multi-parametric imaging technology is commercially available and is being tested in multi-center trials. Therefore it will be possible to utilize this technology in clinical trials of new prostate cancer therapies.

Molecular Imaging in Treatment Response

Steven M. Larson, MD

Memorial Sloan-Kettering Cancer Center, New York, New York, USA

We are entering the era of molecular medicine, in which a growing understanding of the biology of cancer causation and persistence is leading to the development of better and better molecular targeted therapies that can be effective in the control of cancers in individual patients. In the future, these individualized treatments are likely to be guided by molecular imaging. Molecular imaging in oncology means imaging the molecules and molecular based events which are responsible for producing and maintaining the malignant state. Molecular imaging can assess a number of the altered properties of tumors in vivo, and positron emission tomography (PET) is particularly well-suited for this purpose. With the widespread availability of pet CT imaging, diagnostic imaging applications to many common human tumors are facilitated. In recent years, the potential value of molecular imaging for monitoring treatment response has been recognized. Tumor response has been studied with [^{18}F] 2-Fluoro-2-deoxy-D-glucose (FDG), a tracer which

measures glycolysis. Because tumors have fundamentally deranged control of growth, markers of proliferation such as [^{18}F] Fluorothymidine (FLT), are particularly useful to monitor treatment response and induce a change in growth state. The selective effect of anticancer drugs on key molecules, may also be imaged with [^{18}F] Fluoridihydrotestosterone (FDHT), and androgen receptor binding agent useful in prostate cancer; and [^{68}Ga] Gallium-Fab'2 Herceptin (HER scan), are a radiotracer which binds to the human tyrosine kinase link growth factor receptor Her 2. Finally the pharmacology and pharmacodynamics of drugs such as tyrosine kinase inhibitors, tumoricidal antibodies, and adoptive immunotherapy is also being studied with pet imaging.

Confocal and Two-photon Microscopy, In Vivo Flow Cytometry, and Bone Marrow Imaging

Charles P. Lin, PhD

Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

Optical microscopy allows high resolution imaging down to the cellular and subcellular scale that is not possible with other imaging modalities. We describe modern optical microscopy techniques that are being used to visualize dynamic cellular processes in live animals. Advances in molecular probe development make it possible to track individual cell populations in vivo and image their interaction with the host microenvironment by fluorescence microscopy. We are particularly interested in imaging the bone marrow, which is a major site of metastasis for many types of cancers including the prostate cancer. We are also interested in tracking cancer cells in circulation and monitoring their circulation during disease progression and in response to therapy. A new method called in vivo flow cytometry has been developed to detect and quantify circulating cancer cells in live animals without the need to draw blood samples.

Prostate Cancer Imaging and Interventional Developments in a Collaborative Environment

Gregory J. Metzger, PhD

Center for Magnetic Resonance Imaging, University of Minnesota, Minneapolis, Minnesota, USA

Clinical and basic research greatly benefits from a close partnership between industry and leading research institutions. The official mechanism under which a collaboration is undertaken at the National Institutes of Health involves the drafting of a Cooperative Research And Development Agreement (CRADA) which defines the goals and roles of the parties involved in an agreed upon research objective.

Philips Medical Systems has entered into a CRADA with the Clinical Center at NIH. One of the goals of this CRADA is to "focus on the detection of prostate cancer and to refine advanced methods of Magnetic Resonance (MR) technology to identify and biopsy specific regions within the prostate in order to obtain molecular correlates of the tissue".

The progress of this collaboration will be demonstrated with data from clinical cases currently acquired on a 3 Tesla system. Modified acquisition methods, hardware and post processing methods will be highlighted as they pertain to diagnostic imaging and MR guided biopsies of the prostate.

Image-Guided Cryotherapy of the Prostate

Neal D. Shore, MD

*Medical Director, Carolina Urologic Research Center,
Myrtle Beach, South Carolina, USA*

The management of localized prostate cancer continues to progress toward minimally invasive technologies. The introduction of third-generation cryotechnology using 17-gauge cryoablation needles as well as improvements in ultrasound/software have enabled urologists to effectively and safely treat localized prostate cancer. Despite advances in delivering radiation to the prostate, using brachytherapy

and/or external beam therapy, there are subsets of unsuccessful outcomes. Since surgical salvage prostatectomy is associated with significant morbidity, many physicians/patients choose expectant management or palliation with androgen deprivation. The role of cryosurgery in the management and selection of localized prostate cancer will be discussed.

Image-guided Interventions in the Prostate

Clare M.C. Tempny, MD

*Harvard Medical School, Brigham & Women's Hospital,
Boston, Massachusetts, USA*

This talk will review the current approach being taken at our institution for MR guided interventions in the prostate. The vision behind the prostate interventional program will be reviewed and milestones discussed. The MR guided prostate brachytherapy and prostate biopsies procedures will be explained with detailed review of the current and potential future role of imaging. The validation/outcomes measures will be discussed. The future of IGT with the totally non-invasive thermal ablation method, MR guided Focused ultrasound (MRgFUS) will be reviewed. This procedure will be described and the potential for such a procedure to be performed in prostate cancer will be proposed.

VAR*i***AN**
medical systems

Saturday, October 29, 2005

MRI-Guided Brachytherapy in the Treatment of Low-Risk Prostate Cancer

Anthony V. D'Amico, MD, PhD

Dana-Farber Cancer Institute and Brigham and Women's Hospital, Boston, Massachusetts, USA

Seven-year estimates of PSA control following either RP or partial prostatic irradiation using an IMRI guidance technique in select patients are not significantly different. While estimates of Grade 3 rectal bleeding were low following implant monotherapy, they were significantly higher following combined modality therapy. Nearly all patients experienced a decrease in erectile function compared to the baseline, however the vast majority of patients returned to at least baseline function with the use of oral agents. Urethral and bladder toxicity were rare which may be attributed to the urethral sparing technique of the MRI guided approach.

Angelo De Marzo, MD, PhD

Johns Hopkins University, Baltimore, Maryland, USA

Prostate atrophy is an extremely common histological alteration in the human prostate. Although most investigators over the last several decades have assumed that it is not relevant to prostate cancer, as early as the 1930s pathologists suggested that prostate cancers might arise from prostate atrophy. Chronic inflammation is a major contributing cause of cancer in many organ systems. Only in the last few years have investigators begun to examine whether chronic inflammation, which is virtually always associated with prostate tissue that is atrophic, may be also involved in the pathogenesis of prostate cancer. In this presentation, the data regarding the histological features, as well as the cellular and molecular biology of prostate atrophy will be examined in relation to a potential role of prostate atrophy and inflammation in the development of prostate cancer. The distinction between focal atrophy and diffuse/ hormonal atrophy and on the patterns of inflammatory infiltrates that are commonly seen in association with focal atrophy will also be presented.

Robot-Assisted Prostate Interventions

Gabor Fichtinger, PhD

Johns Hopkins University, Baltimore, Maryland, USA

The talk will outline fundamental clinical engineering aspects of image-guided robot assisted systems used in the diagnosis and therapy of prostate cancer. The central theme will be the coupling of surgical action with digital imaging and sensory information. The talk will touch a range of issues including medical robotics, image guidance, surgical planning, process monitoring, and the system-level integration in the context of specific clinical applications.

Nanotechnologies for Early Detection and Therapy of Cancer

Piotr Grodzinski, PhD

National Cancer Institute, Bethesda, Maryland, USA

National Cancer Institute is engaged in efforts to harness the power of nanotechnology to radically change the way we diagnose, image, and treat cancer. Novel and multi-functional nanodevices will be capable of detecting cancer at its earliest stages, pinpointing its location within the body, delivering anticancer drugs specifically to malignant cells, and determining if these drugs are effective. Functionalized nanoparticles would deliver multiple therapeutic agents to tumor sites in order to simultaneously attack multiple points in the pathways involved in cancer. Such nano-therapeutics are expected to increase the efficacy of drugs while dramatically reducing potential side effects. In vivo biosensors would have the capability of detecting tumors and metastatic lesions that are far smaller than those detectable using current, conventional technologies. Furthermore, they will provide rapid information on whether a given therapy is working as expected.

In order to further these research goals, NCI Alliance for Nanotechnology in Cancer has been formed in 2004. The Alliance is investing \$144.3 million over the next 5 years to pursue applied nanotechnologies for cancer detection, therapy, and prevention with an aim to achieve clinical translational stage of these technologies towards culmination of the program. The Alliance funds Centers of Cancer Nanotechnology Excellence, the development of nanotechnology platforms, and internal Nanotechnology Characterization Laboratory.

This presentation will describe the details behind the organization and science and technology of the Alliance.

NanoSystems Biology & Cancer

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As we enter the 21st century, we stand at a major inflection point for biology and medicine—the way we view and practice these disciplines is changing profoundly. These changes are being driven by systems biology, a new, data driven approach to biology, and which will increasingly transform medicine from disease-driven and reactive to health-driven and predictive and preventative. Systems biology and predictive and preventative medicine are both data driven and, accordingly, both require new tools for making large numbers of measurements. Microfluidics, chemical, and nanotechnologies are revolutionizing our ability to generate comprehensive data sets that span from individual cells to

patients, and will allow us to build multiparameter analysis tools for cancer diagnosis and molecular imaging probes for spatially localizing specific cancers. It may eventually be that diagnostic tools will be designed so that they can move from the clinic to the home. I will describe a systems biology approach toward disease, using cancer as the model, and I will describe nano-, micro-, and fluidics technologies designed toward achieving the early stage detection and the molecular imaging of various cancers.

The Role of Image Guidance in Dynamic Adaptive Radiation Therapy

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Image guided 3D CRT and IGRT have the potential to achieve both unparalleled tumor control and normal tissue sparing. To confidently administer highly conformal radiation to complex three-dimensional volumes, clinicians can track and manage tumor motion in all four dimensions by using Image Guided Radiation Therapy (IGRT). IGRT should be comprised of a series of tools that reduce uncertainties in both patient set-up and internal organ motion.

Achieving image guided motion management throughout the radiation oncology process requires an efficient, simple, integrated system to manage all patient data including biologic, functional, and anatomical plan data and images efficiently and effectively. The implementation of IGRT for prostate cancer will be examined with an assessment of technology adoption, process re-engineering, training requirements, and clinical benefits.

The Development of a Treatment Strategy for the Management of Prostate Cancer

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The improved understanding of the pathobiology of prostate cancer is an opportunity to develop a rational management strategy for afflicted patients. Examples of the increased knowledge of the mechanism include: the identification of individuals at increased risk, the contribution of inflammation in progression of the cancer, the elucidation of the pathways leading to androgen independent progression and the understanding of the bone epithelial interaction that result in prostate cancer progression in bone. The understanding of the underlying biology of prostate carcinogenesis provides the opportunity to develop new diagnostics and prognostic and predictive markers, in addition to therapy targets.

The use of the understanding of the pathobiology to the development of a rational treatment strategy is dependent

upon techniques for handling small tissue, serum markers and clinically applicable imaging. The tumor microenvironment of prostate cancer has been well characterized and interactions between endothelial, epithelial host and tumor cell interactions influence the outcome of the disease. It is likely that the treatment strategies of the future will continue to be based in part on androgen ablation for a finite period, combined with cytotoxic therapy that has recently been demonstrated to have anti-tumoral activity. Added to this will likely be a strategy that can anticipate and treat bone metastases in addition to targeting pathways leading to androgen independent growth (MTOR, MEK inhibitors, PDGF blockade, etc). Our approach is to develop, refine and apply a treatment strategy with the aid markers and imaging techniques to monitor effect and individual therapy selection.

The Evolution of Radioimmunoscinigraphy: Fuzzy Photos to Outcomes Data

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The practical ability to label tissue-specific antibodies has long been sought to both improve detection and to provide novel therapeutic applications. One of the most intriguing targets for prostate cancer is the prostate-specific membrane antigen (PSMA), a 100 kD transmembrane glycoprotein that is upregulated in prostate cancer and its metastases. Early investigations with the radiolabeled 7E11 antibody, capromab pendetide (ProstaScint), significantly improved sensitivity for prostate cancer detection compared to standard cross-sectional imaging based on tissue confirmation. However, image acquisition and interpretation was erratic and the imaging technology was not widely embraced. Over the past 5 years, significant improvements in image acquisition due to major gamma scanner advances and the use of co-registration to fuse images have dramatically enhanced localization of prostate cancer. Outcomes data from several sources has spurred a resurgence in interest in this imaging modality. For example, overexpression of PSMA in tissue samples from prostate cancer patients points to twice the rate of biochemical recurrence and a faster time to recurrence. Tissue confirmation of fused scan results show an 83% accuracy for detection of prostate cancer. The presence of mid-abdominal signal on ProstaScint scans has now been shown to have a nearly 3-fold increased incidence of death from prostate cancer compared to those without increased signal over a median time of 4 years, regardless of use or timing of use of androgen blockade. Seven year outcomes data from a large cohort of brachytherapy patients who had alteration of the treatment plan based on radioimmunoscinigraphy show a strongly significant difference in biochemical disease free survival on the basis of fused scan results, not seen with stratification by any other parameter. This outcomes data

strongly supports the aggressive treatment of those intermediate and high risk category patients without signal detected outside of the prostatic fossa. In the very near future, this PSMA antibody complex is scheduled to be used in a therapeutic application with attachment of 177-Lu which can be used for both imaging and treatment of prostate cancer. Furthermore, although not related to imaging, at least 3 PSMA-based prostate cancer vaccines are under development, with one poised to begin clinical trials shortly.

UROLOGY PERSPECTIVE: OVERVIEW

Clinical Management of Prostate Diseases: State of the Art and Potential Role of Imaging Technologies

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Better imaging of prostate cancer would significantly impact every facet of patient care. It could be reasonably argued that the lack of innovative management strategies for prostate cancer is limited by the inability to precisely locate and characterize the disease. There is clear room for improvement. Wide-spread screening for prostate cancer using digital rectal exam and prostate specific antigen (PSA) has resulted in a large increase in the number of men diagnosed with the disease. Digital rectal exam is limited to the posterior aspect of the prostate and given the fact that approximately 80% of men with prostate cancer have a normal exam (clinical stage T1c) indicates the deficiencies of this "technology" in diagnosing prostate cancer. Likewise, PSA testing is notoriously non-specific: many men with "normal" PSA levels harbor life-threatening tumors. Local therapy of primary prostate cancer must consider the multifocality of the disease within the gland: reliable localization of these tumors would permit confident use of focally ablative therapies. Disease recurrence, heralded by a rising PSA level, can be local, systemic or both: imaging that allows accurate staging would certainly improve on the 50% efficacy of salvage radiotherapy. Shifting from assessable imaging of bone scanning to a truly measurable technique will facilitate the development of therapeutic agents for systemic disease: precise definitions of disease progression and/or response are critical in evaluating efficacy.

The Pathogenesis of Prostate Cancer: On Opportunity for New Imaging Approaches

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Prostate cancer ought to be a preventable cause of morbidity and mortality: although prostate cancer incidence and death rates are generally high in the United States and Europe and low throughout Asia, Asian men adopt higher

prostate cancer risks when residing in North America, especially after 25 years or more (see Nelson, W.G. *et al.* *New Engl. J. Med.*, 349: 366-381, 2003). The diet has been the major lifestyle factor thus far implicated in prostate cancer development; however, recently, increased attention has been directed at the role of prostatic infection and/or inflammation in the pathogenesis of the disease. About 9% of men between 40 and 79 years of age report suffering with symptomatic prostatitis, with half of these men having repeated episodes. Asymptomatic prostatitis seems to be even more common, though the prevalence and age distribution of asymptomatic prostatitis, in the U.S., in Europe, in Asia, or anywhere else, has not yet been reported. Increased prostate cancer risk has been associated with sexually transmitted infections, independent of the specific pathogen, hinting that the inflammatory response to infection, rather than the infectious agent itself, might lead to prostate cancer. Host responses to prostate infections may also underlie some familial prostate cancer clusters: two candidate genes implicated in familial clusters of prostate cancer, *RNASEL* and *MSR1*, encode proteins with critical functions in host responses to a variety of infectious pathogens. An inflammatory lesion in the prostate, termed proliferative inflammatory atrophy (PIA), appears to be a precursor to prostatic intraepithelial neoplasia (PIN) and to prostate cancer. The prostate may be prone to carcinogenesis in the setting of chronic or recurrent inflammation because the early somatic genome alterations characteristic of prostate cancers tend to target genes that function in defenses against genome damage. Glutathione S-transferases (GSTs), enzymes catalyzing the conjugation of glutathione various reactive chemical species, have long been recognized to protect against the development of many different cancers by detoxifying carcinogens. Somatic inactivation of *GSTP1*, encoding the human γ -class GST, by CpG island hypermethylation, has been reported in >90% of prostate cancers. Imaging of prostate inflammation, or of the impact of inflammation on the prostate, may identify men at risk for prostate cancer development. Also, since anti-inflammatory drugs and anti-oxidants may reduce prostate cancer risk, imaging of prostate inflammation may provide an surrogate endpoint for the development of new approaches to prostate cancer prevention.

New Tumor Markers for Prostate Cancer

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The discovery and utilization of tumor markers has positively impacted early detection, diagnosis, and staging for many malignancies. By improving early detection, tumor markers contribute to improved curative success rates. Optimal treatment and cure depend not only on accurate and early diagnosis, but also on reliable follow-up for

efficient detection of clinical recurrence. The identification of new markers and the development of sensitive tools to measure them will contribute to improved cure rates for prostate cancer.

Among urologic malignancies the management of prostate cancer has greatly benefited from the discovery and application of tumor markers. Since its discovery in 1979 to clinical application in the late 1980's through 1990's, prostate specific antigen (PSA) has evolved into an invaluable tool for the detection, staging, and monitoring of men diagnosed with prostate cancer. The widespread use of PSA screening has generated greater awareness about prostate cancer. During the PSA era, identification of cancers while confined to the prostate has improved curability with either radical prostatectomy or radiation therapy. While the majority of prostate cancers in the 1980's and early 1990's commonly presented with an abnormal DRE and/or elevated PSA, today most prostate cancer presents as clinically non-palpable (stage T1c) disease with PSA between 2.5-10. ng/mL. The evolving demographics and natural history of prostate cancer has resulted in a stage migration to nonpalpable, clinically localized (stage T1c) disease and a parallel reduction in mortality. However these PSA detected T1c cancers are not homogenous. While PSA screening has improved survival, outcomes are not the same for all T1c detected disease as some of these cancers may not pose a threat to survival. Methods (new biomarkers) for improved detection of clinically significant prostate cancer are needed. Today we present the work leading up to the clinical use of proPSA, BPSA and cPSA.

Clinical Perspective: Current Challenges and Future role of Imaging

Alan Pollack, MD, PhD

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The treatment of prostate cancer with external beam radiotherapy and brachytherapy is dependent on image guidance both in the planning and implementation of treatment. In the planning process, MRI has proven beneficial in more accurately identifying the borders of the prostate (particularly the base and the apex). MRI spectroscopy and Indium-111 Capromab Pendetide scans have been used to identify bulky areas that could be boosted with higher doses of radiation either through external beam or implantation of radioactive sources. PET imaging of hypoxic regions has promise as well.

Imaging daily during treatment reduces the uncertainties of day-to-day (interfraction) prostate position changes. Fiducial markers, ultrasound, conventional CT, and cone beam CT are all being used for this purpose. At Fox Chase Cancer Center, we have used ultrasound and CT to correct for interfraction motion and found these modalities to be highly correlated.

One problem that has not been fully addressed is correction of prostate motion during treatment (intrafraction) motion. Methods to track fiducial markers with electronic portal images are available. More recently, wireless radiofrequency emitting trackable markers have been developed, which will be commercially available in the next year.

Post-radiotherapy imaging methods to determine whether complete tumor eradication has been achieved and to recognize local recurrence earlier are under development. Indium-111 Capromab Pendetide, MRI spectroscopy, and radiotracers imaged by PET (^{11}C -choline, ^{18}F -choline, ^{18}F -fluoromethylcholine, ^{18}F -fluoroethylcholine, ^{11}C -acetate) may prove valuable in this setting.

Three-dimensional imaging methods have dramatically altered the planning for and delivery of radiation for the treatment of prostate cancer. The promise of molecular imaging is in better identification and targeting of potentially resistant areas and the early identification of recurrence.

Prostate Cancer Meets High Technology

Julian G. Rosenman, MD, PhD,

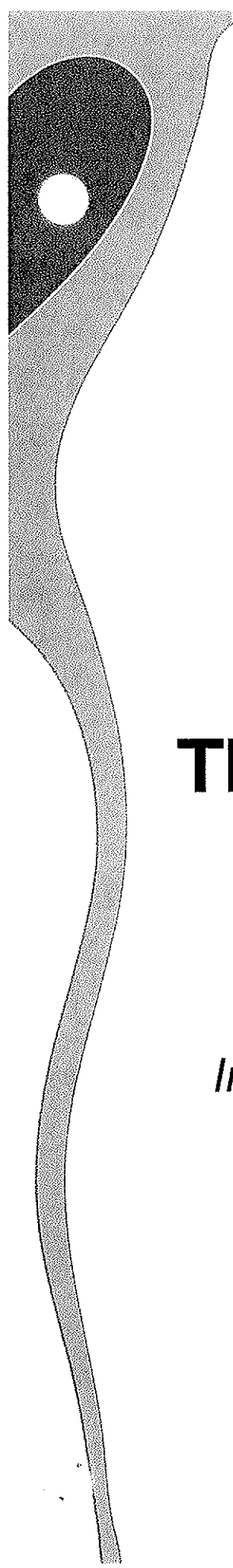
University of North Carolina at Chapel Hill, North Carolina, USA

Although external beam radiation therapy remains a viable method of treating prostate cancer there is still much room for improvement. There are three general reasons why radiation therapy can fail to control local disease. First, the prostate may be mis-identified and thus the patient planned incorrectly. Second, the radiation dose actually delivered to the patient may be lower than was planned because of patient setup error, movement, and patient shape changes during the course of therapy. Finally, for some patients, the prostate cancer may be intrinsically radiation resistant. In this talk I will suggest ways of overcoming these problems.

First we examine the ways that the prostate (or the prostatic tumor) is identified on CT and the inherent problems defining the tumor edge. We will discuss new and exciting methods that may improve this process (m-reps) and show examples of other imaging modalities for defining the prostate volume.

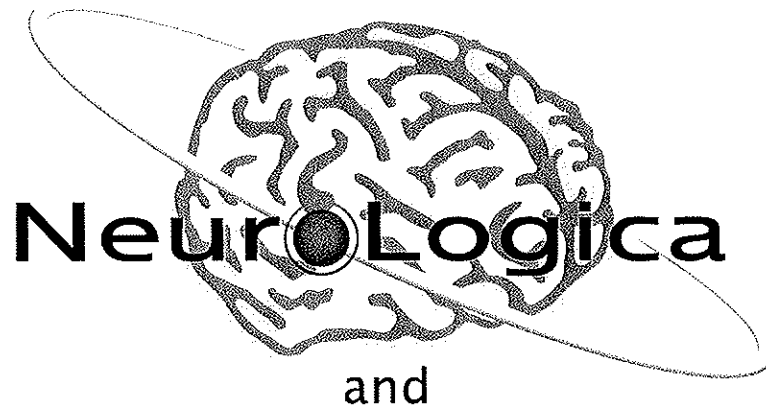
Next we discuss in detail methods for assuring that the radiation dose is delivered as planned. We report here on a new technique for calculating the delivered (not planned!) radiation dose and illustrate the method with nine prostate cancer patients. We speculate that in the future it may be possible to analyze patient outcome in terms of delivered, not prescribed dose.

Finally we discuss ways that the killing power of radiation might be improved. These include radiation dose escalation, hormone/radiation combinations and the use of chemoradiation for patients with "high risk" prostate cancer.



Bernard M. Gordon

on behalf of



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POSTER SESSIONS

Friday, October 28—Saturday, October 29, 2005

Ballroom Foyer L'Enfant Plaza Hotel

Location	Abstract Title	Presenter
P-1	The Use of Molecular Imaging to Investigate Tumor Lymphangiogenesis and Metastasis in Prostate Cancer	Lily Wu, M.D., Ph.D., Associate Professor, Departments of Urology, Molecular & Medical Pharmacology, and Pediatrics, David Geffen School of Medicine at UCLA
P-2	Prostate Cancer-Targeted Suicide Gene Therapy Achieved Effective Tumor Destruction While Safeguarding Against Systemic Toxicity	Lily Wu, M.D., Ph.D., Associate Professor, Departments of Urology, Molecular & Medical Pharmacology, and Pediatrics, David Geffen School of Medicine at UCLA
P-3	Developing Computerized Tools for Automated Planning of Prostate Cryosurgery	Yoed Rabin, D.Sc., Ladd Associate Professor, Department of Mechanical Engineering, Carnegie Mellon University
P-4	A New Cause and Promising Treatment for Prostate Cancer	Henry Lardy, Ph.D., D.Sc., Vilas Professor of Biochemistry Emeritus, University of Wisconsin, Madison
P-5	Nanoparticle-Aptamer Targeting of Prostate Cancer Cells	Jordan Dimitrakov, M.D., Ph.D., Instructor in Surgery (Urology), Harvard Medical School, Harvard Urological Diseases Research Center, Staff Scientist, Children's Hospital Boston
P-6	Multimodality Molecular Imaging Guided Treatment for Prostate Cancer: Radiofrequency Thermal Ablation and Photodynamic Therapy	Baowei Fei, Ph.D., Assistant Professor, Imaging Research Center, Department of Radiology, School of Medicine, Case Western Reserve University and University Hospitals of Cleveland
P-7	Approaching Molecular Imaging in Prostate Cancer: Combined Analysis of MR Imaging and MR Spectroscopy Datasets	Matthias Althaus, M.D., Physicist (MR Spectroscopy, Molecular Imaging) Mevis Center for Medical Diagnostic Systems and Visualization
P-8	Cavitation Ultrasound: A Noninvasive Nonthermal Modality for Controlled Tissue Ablation (Histotripsy) in the Canine Prostate	William W. Roberts, M.D., Assistant Professor of Urology, University of Michigan Health System
P-9	Tookad Vascular Photodynamic Therapy (VTP) for Prostate Cancer—Early Results from a Light Dose Escalation Study (Phase I/II) Using Two Light Delivery Fibres	Caroline Moore MRCS (Ed), Clinical Research Fellow, National Medical Laser Centre, University College London
P-10	Is It Necessary to Cure Prostate Cancer When It Is Possible? (A Review of a Prospective Study on Diet and Nutrition)	Ronald E. Wheeler, M.D., Medical Director of the Prostatitis & Prostate Cancer Center
P-11	A Renaissance™ in Radiation Therapy: A New Hope for Cancer Patients	James F. Dempsey, Ph.D., Assistant Professor, Department of Radiation Oncology University of Florida
P-12	A System for Targeted Radiation Research of Small Laboratory Animals	Dr. John Wai-Chiu Wong, Ph.D., Director of Division of Medical Physics, Associate Professor of Radiation Oncology, Johns Hopkins University

P-1

The Use of Molecular Imaging to Investigate Tumor Lymphangiogenesis and Metastasis in Prostate Cancer

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Introduction

Metastatic disease is a major cause of prostate cancer mortality. The molecular mechanism of metastatic progression is not well understood. The blood and lymphatic vessels provide important routes of cancer cell dissemination. The extent of lymph node metastasis is a key prognostic indicator of patient survival in prostate cancer. Tumor cells can control the extent of intra-tumoral lymphangiogenesis by the expression of lymphatic growth factors, such as VEGF-C, which induce the proliferation of lymphatic endothelial cells via a cell-specific receptor (VEGFR-3). The lack of an appropriate model to study lymphangiogenesis in prostate tumor has limited progress.

Methods/Results

In gene-based imaging studies, we observed differential metastatic potential in different human prostate cancer xenografts. The expression of several vascular growth factors in the tumor was evaluated by real-time quantitative PCR. Interestingly, the expression of VEGF-C but not VEGF-A was elevated by greater than 10-fold in the metastatic LAPC-4 tumors compared to the non-metastatic LAPC-9 tumors. Detailed immunohistochemistry and confocal microscopy revealed patent intra-tumoral lymphatic vessels containing tumor cells in LAPC-4 tumors. To follow-up these findings, the low metastatic LAPC-9 model was marked by the optical luciferase reporter gene and was engineered to over-express VEGF-C, lymphogenic specific mutant VEGF-C (C156S) and VEGF-A. Preliminary results demonstrated that VEGF-C and VEGF-C (C156S) enhanced tumor cell dissemination to ipsilateral lymph nodes and the lung to a great extent than VEGF-A. Bioluminescence imaging was applied to facilitate the detection of metastasis in vivo. When a lentiviral vector expressing soluble VEGFR-3 was applied to sequester the VEGF-C in the tumor, metastasis to regional and distant sites was greatly inhibited.

Conclusion

Molecular imaging greatly facilitates the monitoring of the metastatic process in pre-clinical models. Tumor lymphangiogenesis is a contributing factor to prostate cancer metastasis. It represents a therapeutic target to manage metastatic disease.

P-2

Prostate Cancer-Targeted Suicide Gene Therapy Achieved Effective Tumor Destruction While Safeguarding Against Systemic Toxicity

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Cancer gene therapy based on tissue-restricted expression of cytotoxic gene should achieve superior therapeutic index over an unrestricted method. This study compared the therapeutic effects of a highly augmented, prostate-specific gene expression method to a strong constitutive promoter-driven approach. Molecular imaging was coupled to gene therapy to ascertain real-time therapeutic activity. The imaging reporter gene (luciferase) and the cytotoxic gene (herpes simplex thymidine kinase) were delivered by adenoviral vectors injected directly into human prostate tumors grafted in SCID mice. Serial bioluminescence imaging, positron emission tomography (PET) and computed tomography (CT) revealed restriction of gene expression to the tumors when prostate-specific vector was employed. In contrast, administration of constitutive active vector resulted in strong signals in the liver. Liver serology, tissue histology, and frail condition of animals confirmed liver toxicity suffered by the constitutive active cohorts, while the prostate-targeted group was unaffected. The extent of tumor killing was analyzed by apoptotic staining and human prostate marker (PSA). Overall, the augmented prostate-specific expression system was superior to the constitutive approach in safeguarding against systemic toxicity, while achieving effective tumor-killing. Integrating non-invasive imaging into cytotoxic gene therapy will provide a useful strategy to monitor gene expression and therapeutic efficacy in future clinical protocols.

P-3

Developing Computerized Tools for Automated Planning of Prostate Cryosurgery

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Background

Cryosurgery is the destruction of undesired tissues by freezing. Minimally-invasive cryosurgery is currently performed by means of an array of cryoprobe, where a dozen or more cryoprobes operating simultaneously in a single procedure is already common practice. If localized effectively, one of the primary benefits of using a large number of miniaturized cryoprobes is superior control over the freezing process. The optimal arrangement of the cryoprobes, which is known to have a dramatic effect on the quality and cost of the cryoprocure, remains an art held by the cryosurgeon, based on the cryosurgeon's experience and "rules of thumb."

Objective

To develop an automated computerized tool for cryosurgery planning. This tool could be used for real time planning while the patient is on the operating table, or as a virtual training tool for surgeons.

Methods

Planning is based on bioheat transfer simulations of the clinical operation, with the goal of optimizing the temperature field with a reconstruction of the target region. The optimization parameter is a temperature threshold, known as the lethal temperature. The optimization process includes two phases, first to determine initial placement of cryoprobes (termed bubble-packing phase), and second to systematically move the cryoprobes until an optimum is found (termed force-field analogy phase). Parallel efforts are devoted to developing efficient numerical schemes for the bioheat transfer simulation, known to be the most time consuming element in computerized planning. Other efforts are aimed at including ultrasound imaging with bioheat transfer simulations.

Project Status

The force-field analogy has proven to be a robust technique for cryosurgery planning, which is very expensive in terms of computer resources. The bubble-packing technique has proven to be an extremely effective means of reducing the run time of the force-field analogy phase. A recently developed numerical scheme makes automated planning practical in a clinical time frame of a few minutes.

Broader Perspective

While the current development of automated planning targets cryosurgery, the same methodology can be applied

to other energy modalities in medicine, such as laser probes, focused ultrasound heating, and radio frequency heating.

Acknowledgments

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P-4

A New Cause and Promising Treatment for Prostate Cancer

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It is known that normal growth of the prostate gland and the malignant growth of prostate cancer (CaP) are completely dependent on androgen (e.g. testosterone) stimulation. Consequently, treatment of CaP by androgen ablation (administering antiandrogens or castration) is effective in stopping cancer growth but, after a period of remission, malignant growth is renewed and now is not susceptible to antiandrogen therapy. This phase of the disease is termed "androgen-independent". It is the androgen-independent growth that must be blocked if we wish to conquer Prostate cancer.

For many years it was known that the natural steroid 3b,17b-dihydroxyandrost-5-ene (Adiol) has estrogen activity, but in 1998 we found that it also possessed androgen activity which is not inhibited by Casodex or Hydroxyflutamide.

Adiol is concentrated in the malignant prostate gland to concentrations that strongly activate the androgen receptor.

We have made many steroids in a search for inhibitors of Adiol and have three that are effective. 3b-Acetoxyandrost-1,5-diene-17-ethylene ketal (ADEK) is more effective than Casodex vs Dihydrotestosterone in LNCaP cells. ADEK fed to rats at 0.1% of the diet, or injected sc in an equivalent amount, had no effect on growth or organ weight, except that the seminal vesicles and the ventral prostate were shrunk and showed collapse of the papillary projections.

The efficacy of ADEK should be tested in terminal CaP patients.

P-16

Multimodality Molecular Imaging for Potential Applications of Image-Guided Treatment for Prostate Cancer: Thermal Ablation and Photodynamic Therapy

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We are developing multimodality image-guided, minimally invasive treatment methods for prostate cancer. We currently use interventional magnetic resonance imaging (iMRI) to guide radiofrequency thermal ablation treatment of abdominal cancers. We use a low field, open magnet system that allows patient access during imaging. A unique aspect of iMRI-guided thermal ablation therapy is that real-time feedback is provided from images of treated regions and from non-invasive three-dimensional (3D) temperature measurements. Before this method can be extended to the prostate, significant technology developments are required.

Although anatomic MRI provides excellent structural detail, it does not reliably identify prostate cancer. Fortunately, MR spectroscopic imaging (MRSI), monoclonal antibody imaging with single photon emission computed tomography (SPECT), and positron emission tomography (PET) with radioactive choline, promise to improve detection of prostate tumor. Although these functional images promise to help identify prostate tumor, they do not provide the anatomical information required for treatment delivery.

The solution is to register and superimpose the functional images with 3D high-resolution MRI or CT images. To incorporate image data from other sources in an iMRI-guided treatment procedure, we first register the functional image volume with a high-resolution MR volume; then when we register iMRI slice images quickly acquired on the iMRI scanner in real-time to the high-resolution MR volume, we can also map the images to the functional image data for tumor targeting.

We developed automatic image registration and fusion methods to correlate features from SPECT with high-

resolution anatomic MR images to aid in the identification of prostate cancer. To improve tumor targeting during treatment, this multimodality information is registered with freshly acquired iMRI-slice images for highly accurate, interventional MRI-guided thermal ablation of prostate cancer. For the registration of iMRI slice with high-resolution MR volumes, we developed a robust slice-to-volume (SV) registration algorithm with special features. The concept was tested using image data from three patients and three volunteers. The SV registration accuracy was $0.4 \text{ mm} \pm 0.2 \text{ mm}$ compared to our volume-to-volume registration that was previously shown to be quite accurate for these image pairs. With our image registration and fusion software, simulation experiments show that it is quite feasible to incorporate SPECT, MR spectroscopic images, and high resolution MRI into the iMRI-guided minimally invasive treatment procedures.

We are also applying the registration and fusion methods to another treatment modality, photodynamic therapy (PDT), which is a promising and relatively new therapeutic modality for cancer treatment. With PDT, a tumor-localized photosensitizing drug is irradiated with visible light to generate reactive oxygen that efficiently kills cells and ablates tumors. PDT can be administered deep into tumors using minimally invasive techniques as only the small laser fiber that delivers the light to the tumor needs to be inserted into the lesions. An important advantage of PDT is that both the photosensitizing drug and the light are inert by themselves, and the light can be precisely delivered onto a selected region, thereby allowing extreme specificity in the localization of the photodynamic effect. Consequently, systemic toxicities are minimized and the therapy is minimally invasive.

We are using multimodality imaging to study the tumor response to PDT in mice. Micro-PET imaging with ^{18}F -fluorodeoxyglucose (FDG) provides physiological and functional information regarding the tumors. Super high-resolution ($50 \text{ } \mu\text{m}$) micro-MRI images from a 9-T scanner provide anatomical and morphological details regarding the lesions. The combination of micro-MRI and micro-PET provides a powerful tool for improved tumor monitoring. Preliminary results from animal experiments have shown that twenty minutes after therapy, treated tumors have a decreased FDG uptake compared to the control that indicates the rapid response to the therapy.

In summary, multimodality molecular imaging may provide a powerful tool for potential applications of image-guided minimally invasive treatments for prostate cancer.

P-7

Approaching Molecular Imaging in Prostate Cancer: Combined analysis of MR imaging and MR Spectroscopy Datasets

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Introduction

Recent studies (see¹ and references therein) provided compelling evidence that the combined analysis of MR imaging and MR spectroscopy (especially spectroscopic imaging) data with PSA and biopsy results improve the characterization of prostate cancer in individual patients prior to therapy. Furthermore, the response to therapy can easily be monitored. However, a growing yet limited number of medical centers have experience with this new technology. In order to further improve the sensitivity and specificity of prostate cancer detection and characterization a combined effort of physicians and other basic scientists has to be made. This abstract displays the recent advances and outlines the need for further improvements.

Methods

High resolution T2-weighted images in axial and coronal planes and axial T1-weighted images are essential for MR imaging evaluation of the prostate gland. The primary role of MRI is in staging carcinoma of the prostate. The major goal of preoperative MR imaging in prostate cancer is to detect extraprostatic (or extracapsular) extension, seminal vesicle invasion, as well as nodal and bone marrow metastasis, thus avoiding unnecessary surgery. T1-weighted images are useful in assessing extraprostatic tumor extension to the neurovascular bundles, post-biopsy hemorrhage, iliac nodal enlargement and focal bone marrow signal abnormality. The characteristic MRI findings of prostate cancer are focal area of decreased signal intensity in the peripheral zone of the prostate on T2-weighted images. The most commonly used criteria for extraprostatic extension include asymmetry of the neurovascular bundle, obliteration of retroprostatic angle, and budging of the prostatic contour.

Considerable interobserver variation in interpreting prostate MR imaging studies remains problematic when MR imaging is used as a screening tool, e.g. radiologists with expertise in MR imaging of the prostate have been documented to be more accurate in diagnosing extraprostatic extension than radiologists without the expertise². MR spectroscopy can depict relative values of cellular metabolites which help discriminate prostate cancer from normal peripheral zone based on reduced citrate and elevated choline in the region of cancer.

Discussion

Technical developments have allowed the application of localized three-dimensional proton MR spectroscopic imaging to the in-vivo evaluation of human prostate with a spatial resolution of about 0.3 cm³. 3D MR spectroscopic imaging (MRSI) combined with MR imaging has been shown to improve tumor localization, staging and volume measurement compared with those with MR imaging alone⁴⁻⁶. 3T MRSI has shown an improved spectral resolution compared to 1.5T examinations; the choline peak can be distinguished from the creatine peak at 3T MRSI⁷.

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P-8

Cavitation Ultrasound: A Noninvasive Nonthermal Modality for Controlled Tissue Ablation (Histotripsy) in the Canine Prostate

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Introduction

Widespread prostate cancer screening in the United States has resulted in earlier diagnosis of prostate cancers in men who are younger and healthier than in the past. Many of these men will elect treatment in the form of radical prostatectomy with the associated risks of impotence and incontinence. As many of these patients have a lengthy life expectancy a premium has been placed on developing effective techniques that minimize morbidity and maintain post surgical quality of life. To this end there exists a need for a non-invasive technology capable of precise prostate tissue ablation without injury to adjacent critical structures.

Methods

We have developed and tested an annular array pulsed ultrasound system capable of delivering high intensity (>20 kW/cm²), short ultrasound pulses (15 cycles = 20 microsec) at 100 Hz repetition frequency resulting in low time-averaged power (~5 W total acoustic output). Application of this energy induces non-thermal cavitation within the targeted tissue volume (10 x 3 x 3 mm).

Following approval from the institutional animal care committee, initial experiments were performed to characterize the tissue effects following cavitation ultrasound ablation in the kidneys of anesthetized rabbits. Current experiments are focused on transcutaneous prostate ablation in anesthetized dogs.

Results

In rabbit renal tissue cavitation induced 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 with greater 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.

Preliminary studies of cavitation ultrasound prostate ablation in anesthetized dogs have produced a similar histological pattern.

Conclusions

Cavitation ultrasound is a promising transcutaneous therapy capable of precise tissue destruction (histotripsy) in the focal zone. Large tissue volumes can be effectively treated with use of an electronically steerable ultrasound phased array. Initial results from prostate ablations are promising and demonstrate the feasibility of this technology. Experiments are currently underway to establish the non-viability of the residual liquefied material within the ablation zone following treatment and to assess the differential cavitation threshold between prostate tissue and periprostatic structures such as the neurovascular bundle, urinary sphincter, and rectal wall.

P-3

Tookad Vascular Photodynamic Therapy (VTP) for prostate cancer— Early results from a light dose escalation study (Phase I/II) using two light delivery fibres

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Introduction

Photodynamic therapy uses a photosensitising drug activated by monochromatic light from a laser, to produce localised tissue necrosis. Tookad (WST-09) is a new gener-

ation vascular targeting photosensitiser which causes blockage of blood vessels when activated by 763 nm light. WST09 has a long wavelength absorption, which allows deeper light penetration into the tissues and effective photosensitization even of relatively large solid tumours (up to 4 cm diameter in pre clinical work). It remains inside the vascular walls, and is rapidly cleared from the circulation, and thus has no skin phototoxicity.

We report the early results of a two fibre light dose escalation study in patients with previously untreated localised prostate cancer.

Methods

Men with localised prostate cancer not undergoing immediate definitive treatment were recruited. Under general anaesthetic a 20 minute infusion of 2 mg/kg Tookad was given. To coincide with the maximal plasma concentration of Tookad, 763 nm light was delivered to the prostate, using cylindrical diffuser fibres within hollow plastic needles. The needles were positioned transperineally with the aid of a perineal template and transrectal ultrasound. The active length of the diffuser fibre ranged from 1 to 3 cm, depending on prostate length. For the first step of the study, the light dose varied from 50 to 300 J/cm, given at a power of either 150 or 200 mW.

To assess the PDT effect, dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) was done using gadolinium prior to PDT and at 1 week post PDT. PSA was recorded at regular intervals. Questionnaires regarding urinary and sexual function were administered before and after PDT.

Results

Ten men have undergone the two fibre procedure, and subsequent DCE-MRI at 1 week. In 8 men, necrosis occurred at light doses of 150 J/cm or more. The volume of necrosis (seen as hypoperfusion on MRI) varied with the light dose per cm and the total light dose.

All men have had a PSA reduction at 1 or 3 months. Some patients experienced irritative urinary symptoms for up to two weeks after the procedure. All patients have had successful catheter removal the day following PDT. No patient has had any skin photosensitivity after PDT. 8 patients have had transient liver enzymes changes following PDT, shown by an increase in gamma GT and transaminases. This has resolved spontaneously within fifteen days.

Conclusions

VTP using Tookad is a promising modality in the treatment of localised prostate cancer. The ability to place fibres in the prostate with a high degree of accuracy using a perineal template and trans rectal ultrasound, combined with the localised nature of necrosis at MRI and advances

in prostate cancer imaging will enable Tookad VTP to be used as a focal treatment for localised prostate cancer. The next phase of the current study will assess the use of multiple fibres on the volume of TOOKAD VTP effect associated with different light doses and power.

This work was supported by Steba Biotech and Negma Lerads, France.

P-111

Is It Necessary to Cure Prostate Cancer When It Is Possible?

(A Review of a Prospective Study on Diet and Nutrition)

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Objective

The medical propensity to treat men definitively with Radical Prostatectomy or Radiation generally follows the diagnosis of prostate cancer when men have at least 10 years to live. Notwithstanding the current medical paradigm, there is concern worldwide regarding over treatment of prostate cancer. In this prospective diet and nutritional study, it was our goal to analyze the efficacy and validity of treating prostate cancer conservatively.

Method

23 men aged 43-74 with biopsy proven, organ-confined prostate cancer agreed to avoid a curative cancer treatment course (Radical Prostatectomy or Radiation therapy) in favor of a dietary and nutritionally based conservative protocol. The diet was a modified Mediterranean Diet while a patented prostatitis formula Peenuts[®] was the nutritional supplement common to all patients. Peenuts[®] is a complex synergistic formula consisting of vitamins, minerals, herbs and amino acids that has shown clinical effectiveness versus prostatitis and urinary symptoms. PSA, a recognized marker of prostate disease activity, was the primary indicator to validate exacerbation or suppression of disease. With the exception of one man with a Gleason 7, two men with Gleason 6/7 scores and three men with Gleason 5/6 scores, all men exhibited either a Gleason 5 (n=6) or a Gleason 6 (n=11) pathology pattern. Referencing the Partin Tables, organ confinement was predicted to be 59%.

Results

87% of men (n=20) noted a 58% reduction (range of improvement: 13-91%) in PSA over an average of 36 months (range: 12-72 months). Statistical significance was noted using the t-Test and Wilcoxon analyses. The remaining 13% of men included three men who experienced a mild elevation in PSA of 0.3, 0.7 and 0.9 ng/ml over 14 months,

34 months and 42 months, respectively. 13 men had completed an initial and secondary IPSS-Index while 12 men had undergone an initial and secondary EPS. The mean reduction in IPSS-Index was 5 (range: 2-11). Men evaluated for EPS noted a mean percentage reduction in white blood cells of 80%.

Conclusion

With SEER Projections predicting a 3 fold increase in prostate cancer deaths by 2045, there is a need to develop effective alternative therapies. The prospective study findings appear to demonstrate rather convincingly that Gleason 5 or 6 prostate cancers may be over treated and that social change through dietary and nutritional modification may provide a safe and effective treatment alternative. Further study is encouraged.

P-112

A. Renaissance[™] in Radiation Therapy: A New Hope for Cancer Patients

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We describe, the ViewRay Inc. Renaissance[™], a novel image-guided intensity modulated radiation therapy (IGIMRT) device under development (patent pending, not approved for clinical use) that is designed to allow for the real-time volumetric magnetic resonance imaging (MRI) assessment of intra-fraction organ motion simultaneous with radiation therapy delivery. The device consists of the combination of an open split-solenoid MRI scanner equipped for parallel imaging and a ⁶⁰Co g-ray IMRT unit. The ViewRay technology cleverly circumvents heretofore insurmountable engineering and safety challenges to providing real-time MRI imaging with optimized external beam radiation therapy. The Renaissance[™], promises to be the world's first radiation therapy device to allow real-time volumetric MRI simultaneous with beam-on radiation delivery. For the first time in the history of radiation therapy, the treating physician will be able to accurately know where the dose is going and if it's actually hitting the intended target. Clinical studies have shown that patient movement and organ motion related, dose-delivery errors can significantly degrade the treatment. While treatment plans are currently based on the position of the tumor targets as they appear in a static x-ray or CT image, the patient inherently and inevitably has body and internal organ motion that can cause the tumor to be in a different position when treatment occurs. This movement can be significant in the

radiotherapy of prostate cancer, where transient motions caused by rectal gas or bladder filling can range from 2 to 15 mm and last for a minute or more during therapy (see e.g. Padhani *et al.* Int J Radiat Oncol Biol Phys. 1999 Jun 1;44(3):525-33). As a result, the prescribed target area can be in error, and healthy tissue can be repeatedly and unnecessarily irradiated, while the tumor target receives an insufficient dose. The *Renaissance*™ is designed to provide rapid volumetric parallel MRI ciné *simultaneous with* radiation delivery; acquiring the imaging data necessary to determine the actual dose delivered to the patient in the presence of intra-fraction organ motion—a feat not possible with X-ray CT based systems due to the speed of current systems and the additional ionizing radiation delivered to the patient.

11-12

A System for Targeted Radiation Research of Small Laboratory Animals

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Modern radiation therapy employs advanced imaging and irradiation technologies to achieve accurate conformal treatment of the target lesion. These technologies include 3D treatment planning, intensity modulation and image

guidance. They are in stark contrast with the simple irradiation methods employed for small animals in laboratory research. The widening chasm between the radiation methods of human treatment and animal research brings into question the applicability of traditional radiobiological principles. In the present era of highly localized radiation treatments, the current laboratory methods also seem ill-fit to address important questions about normal tissue toxicity, regulation of therapeutic agents used in conjunction with radiation, and the response of tumor micro-environment to radiation. In order to bridge the gap, we have embarked on a major effort to down-size the irradiation capabilities of human treatment to small animals, ranging from mice to rabbits. An imaging subsystem and an irradiation subsystem will be mounted on a rotating gantry with an isocenter of 40 cm. The former allows radiographic and cone-beam CT imaging (at 0.5 mm resolution) to ensure accurate repeat animal setup. The irradiation subsystem allows conformal and intensity modulated irradiation for field sizes from 6 cm diameter to 0.5 cm diameter. For dose painting of smaller fields and shallow targets to the depth of 2 cm, an x-ray focusing lens is employed which emits a pencil beam of 40–80 keV with a width of 1.5 mm at full width half maximum. Treatment planning will be performed on a modified commercial system equipped with Monte Carlo capabilities. Results from our on-going dosimetric commissioning efforts will be presented.

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TOSHIBA



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October 27-28, 2005

As of 10/18/05

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3TP LLC is a privately-held company which designs and internationally distributes certain intellectual property in CAD (Computer Assisted Diagnosis) and MRA (Magnetic Resonance Angiography) software. The Company's Server2™ and WorkSpace™ software platform facilitate the analysis, interventional planning and reporting of breast and prostate MRI.

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CMS, Inc. is a world leader in the manufacture and support of radiation treatment software. With more than 1,400 treatment planning systems installed worldwide, CMS is a global resource to radiation oncology departments for treatment planning software and prostate brachytherapy systems. A privately-held corporation, CMS employs nearly 250 professionals in its headquarters located in St. Louis, MO and regional offices in the following cities around the world: St. Louis, Missouri; Freiburg, Germany; Shanghai, China; Tokyo, Japan.

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GE Healthcare provides transformational medical technologies that will help shape a new age of patient care. GE Healthcare's expertise in medical imaging and information technologies, medical diagnostics, patient monitoring systems, disease research, drug discovery and biopharmaceuticals is dedicated to detecting diseases such as cancer earlier and tailoring treatment for individual patients. GE Healthcare offers a broad range of services to improve productivity in healthcare and enable healthcare providers to better diagnose, treat, and manage patients.

GE Healthcare's Oncology offerings include a broad range of diagnostic imaging equipment and advanced applications in CT, PET/CT, X-ray, MR, Ultrasound, and Bone Mineral Densitometry to aid physicians in diagnosing, staging, and monitoring cancer treatments, as well as productivity and practice management solutions.

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IMPAC Medical Systems, Inc., a company in the Elekta Group, provides healthcare IT solutions that streamline clinical and business operations across the spectrum of cancer care. IMPAC's open integration to multiple healthcare data and imaging systems offers oncology-specific patient charting and practice management, as well as best-of-breed systems for anatomic pathology, clinical laboratory, and cancer registry.



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Invivo integrates and extends the excellence of three recognized leaders in diagnostic imaging and patient care—MRI Devices, Medical Advances, and Invivo MDE.

Now as a single source, Invivo is a world leader in the development of RF array coil designs, complete MR interventional solutions including imaging, analysis, and intervention, integrated functional imaging systems and patient monitors.

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MEDRAD® has manufactured reliable imaging devices for 40 years in angiography/cardiology, computed tomography, and magnetic resonance. Our MR endorectal prostate coil gets you closer to the problem and the solution by conforming to the shape of the prostate and our prostate immobilizer helps with radiation therapy. MEDRAD® Performance. For life.™

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MEDTEC is a global leader in design, development, and distribution of enabling technologies for radiation oncology cancer care. The company is headquartered in Orange City, Iowa. Northwest Medical Physics Equipment (NMPE), a MEDTEC Company, is located in Lynnwood, Washington and consists of professionals in medicine, physics, and

computer science developing simple solutions to complex problems in cancer treatment with radiotherapy and radiosurgery. The company pioneered the first commercially available image-guided system for verifiable target localization in 1989. The MEDTECH/NMPE organization employs 125 in its corporate facilities, field sales offices, and operations in Lyon, France and Shanghai, China.

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Nucletron is a radiotherapy company that specializes in the development, manufacture, sales, service and support of the world's most innovative products for cancer treatment. As a company, our guiding principle is the customer's demand for quality, safety and reliability.

We continuously invest in innovative research and development. This approach has made it possible to successfully treat cancers at many body sites, including gynecological, breast, bladder, brain, head and neck, lung, esophagus and prostate. We are proud to see that our products help to improve so many of the patients' lives by curative or palliative (pain relieving) treatment.

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Oncura provides minimally invasive treatments options for prostate cancer. Offering brachytherapy and cryotherapy together we have created a unique capability to serve patients, physicians and hospitals providing both of these minimally invasive treatment options through one company. In addition to this, Oncura also offers cryotherapy to treat renal cancer.

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Founded more than 125 years ago, Siemens Medical Solutions brings together innovative medical devices, information technology, and services to help customers streamline workflow—the process of moving patients, information, and resources throughout the health continuum. Siemens is committed to helping customers achieve tangible, sustainable clinical and financial outcomes to ultimately improve the health and satisfaction of their patients.

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The TomoTherapy HI-ART System® combines treatment planning, patient positioning, and treatment delivery into one, integrates radiation system. The HI-ART System features a patented MLC and a rotating, helical beam, which

is designed to simplify the treatment process, precisely deliver the planned dose and minimize dose to healthy tissues.

The HI-ART TomoCT feature allows doctors to take a CT scan just before each treatment, so they can verify the position of the treatment area, and adjust the patient position as necessary to help ensure that the radiation is precisely delivered to the target area.

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Varian Medical Systems is the world's leading manufacturer of integrated radiation therapy systems for the treatment of cancer. The company offers products for treating cancer with Dynamic Targeting™ image-guided radiation therapy (IGRT), SmartBeam™ IMRT, stereotactic radiosurgery, and conventional radiation therapy. The company also makes advanced brachytherapy products for treating cancer. All of Varian's equipment is supported by an award-winning service and education program. Varian Medical Systems employs approximately 3,300 people at manufacturing sites in North America and Europe and in its 56 sales and support offices around the world.



EXHIBITOR FORUM

Friday, October 28 – Saturday October 29, 2005

L'Enfant Plaza Hotel

(All Presentations held in Grand Ballroom)

The industry's most innovative companies in cancer care will provide brief presentations during the conference luncheons on Friday, October 28th and Saturday, October 29th. Please take advantage of this opportunity to learn about exciting developments in the field of medical imaging, novel therapies, pharmaceutical discovery and more.

3TP

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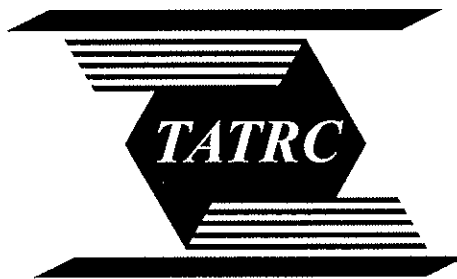
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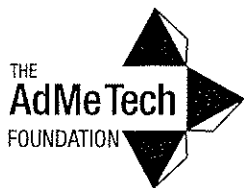
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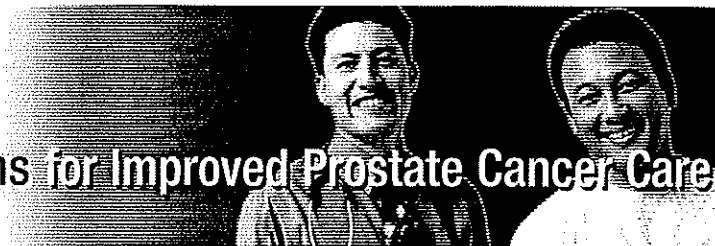


GlaxoSmithKline is one of the sponsors of this conference.

National Cancer Institute



Innovative Solutions for Improved Prostate Cancer Care



The numbers are staggering. Prostate cancer strikes more men than breast cancer does women – and kills over 30,000 men a year. One in six men will face prostate cancer at some point during their lifetimes. More than 1.5 million men undergo biopsies, and over 200,000 new cases are diagnosed annually. *While women have life-saving mammograms, men do not have accurate imaging technologies for early detection of prostate cancer. Where is the “Manogram”™?*

AdMeTech’s Challenge: Prostate Cancer Care is Blind

Despite the prostate cancer epidemic, progress has been slow on the diagnosis and treatment fronts. Without accurate imaging to guide early detection, biopsy and treatment, prostate cancer care is blind. Management of prostate cancer faces many obstacles:



- ▶ Diagnostic PSA blood tests result in false-negative reassurances and numerous false-positive alarms. Some 15% of men with normal PSA levels still have prostate cancer. Even when PSA levels are abnormal, some 88% of men end up not having prostate cancer but undergoing unnecessary biopsies.
- ▶ The prostate is the last organ in a human body where biopsies are performed blindly. A blind biopsy can miss cancer even when multiple samples are taken.
- ▶ Biopsy may cause pain, anxiety and various side effects, such as bleeding and infection.
- ▶ Treatment is also blind. Imaging methods do not exist to reliably assess tumor size, spread or the difference between virulent cancer requiring treatment vs. non-aggressive disease that does not.
- ▶ The conventional treatments done today – such as radical surgery and radiation – are very costly and result in complications, including incontinence and impotence in 50 percent to 80 percent of patients.

AdMeTech’s Distinction: In Search of the “Manogram”™

That’s where AdMeTech comes in. AdMeTech expedites advancement of imaging technologies to arm physicians with visualization tools critical for early, accurate, minimally invasive prostate cancer diagnosis and treatment – and their transition from the experimental phase to routine patient care.

Conservatively estimated, with improved image-guided, minimally invasive biopsy, diagnosis and treatment, health care savings could be more than \$3.5 billion annually.

AdMeTech’s goal is to create, discover and support pioneers of medical breakthroughs: The next Christopher Columbus, Jonas Salk, Albert Einstein or Neil Armstrong of prostate imaging who will create the “Manogram”™.

A nonprofit organization, AdMeTech speeds the advancement of imaging technologies to shift prostate cancer care from the era of blind diagnosis and treatment to the future of image-guided, minimally invasive and precisely targeted interventions. These innovations are like diamonds in the rough: unpolished, lacking luster, but full of promise. AdMeTech stimulates, funds and manages R&D projects at leading institutions that bring hidden brilliance to the fore.

For example, with AdMeTech’s funding, the Boston University engineering team developed prostate-dedicated, new-generation optical technology and demonstrated its value in detecting prostate cancer *within one year*. With AdMeTech’s support, the Johns Hopkins team developed prostate-dedicated medical robotics for precision biopsy and treatment also within one year of funding.

To facilitate support and rapid development of these innovative solutions, AdMeTech enlists leaders of government agencies (such as the National Institutes of Health), academic institutions, industry, private investors, philanthropic and advocacy groups.

AdMeTech's Promise

AdMeTech's mission is to end the pain and suffering of prostate cancer, and its impact on families and societies, by eliminating much of the blind "trials and errors" and "probing and cutting" associated with current prostate cancer care. Advanced visualization tools for detection and treatment will make it possible for many major surgical procedures now conducted in hospitals to be replaced by interventions performed in outpatient clinics with reduced patient discomforts, complications and costs.

The advancement of imaging instrumentation will enable:

- ▶ Early detection and differentiation of benign and malignant disease.
- ▶ Accurate selection of patients for and guidance of biopsies.
- ▶ Accurate assessment of tumor size, virulence and response to treatment.
- ▶ More precise guidance of treatments to eradicate tumors while sparing normal tissues to reduce complications.
- ▶ More effective, less invasive and more affordable prostate cancer care.

Department of Defense (DOD) Funding

Recently, AdMeTech has successfully worked with Members of Congress to secure critical funding through the U.S. Army medical advanced technologies budget. One DOD grant helped fund AdMeTech's work in partnership with Johns Hopkins University to develop medical robotics for precise guidance of prostate cancer biopsy and treatment. A second round of funding in 2002 helped AdMeTech partner with the Dana Farber Cancer Institute, and within about six months, produce a fundamental discovery expected to detect cancer early, to predict its virulence and to assess response to treatment earlier than was previously possible. Additional funding being sought in 2005 will help AdMeTech continue its important work.

October Conference Bringing Together Best & Brightest

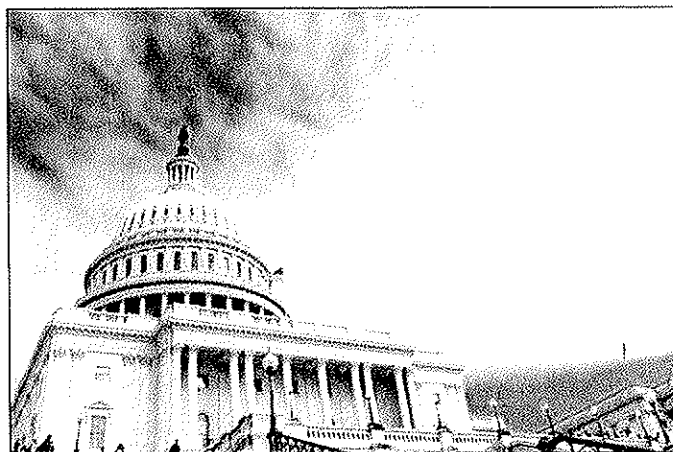
AdMeTech is hosting a public conference in Washington, DC, October 27-29, 2005. The conference is assembling leaders of the medical, industrial, philanthropic, federal, consumer, media and entertainment communities to accelerate the development and implementation of imaging technologies for improved early detection and treatment of prostate cancer. Visit www.admetech.org for more details and a copy of the conference program.

AdMeTech's Appeal

But AdMeTech needs help. Its all-volunteer Board of Directors – comprising doctors, scientists and academicians – cannot accomplish its goals alone.

In the current cost-sensitive health care environment, many promising innovative technologies do not find support from traditional funding sources such as clinical facilities, industry and government. Federal funds permit AdMeTech and its university partners to create and test novel non-invasive imaging methods and technologies. AdMeTech is seeking additional funds to continue its promising clinical trials.

For more information, visit www.admetech.org.



For the Advancement of Medical Technologies