

Fifth Annual Alavi-Bradley Symposium on Molecular Imaging and Theranostics

SMC Campus Center
University of Maryland, Baltimore

November 3, 2026

Keynote Address:

Ananth Annapragada, PhD, Texas Children's Hospital and Baylor College of Medicine

Additional Speakers:

Abass Alavi, MD, University of Pennsylvania

Dmitri Artemov, PhD, Johns Hopkins School of Medicine

Jonathan Lindner, MD, University of Virginia Medical Center

Ali Pirasteh, MD, University of Wisconsin-Madison

Babak Saboury, MD, United Theranostics

Erik Shapiro, PhD, Michigan State University

Eliot Siegel, MD, University of Maryland School of Medicine, University of Maryland College Park & University of Maryland Baltimore County; United Theranostics

David Wilson, MD, PhD, University of California San Francisco

The symposium is organized by the Department of Diagnostic Radiology and Nuclear Medicine and made possible by a generous gift from Drs. Abass and Jane Alavi.

The Alavi-Bradley Organizing Committee: Vikas Kundra, MD, PhD (Chair), Vasken Dilsizian, MD, Dirk Mayer, Dr rer nat, and Piotr Walczak, MD, PhD.

Dear Colleagues:

As the Chair of the Department of Diagnostic Radiology and Nuclear Medicine, it is my pleasure, on behalf of the organizing committee, to welcome you to the Fifth Annual Alavi-Bradley Symposium on Molecular Imaging and Theranostics at the University of Maryland School of Medicine. This symposium continues our tradition of providing an enriching forum for learning, networking, and the exchange of ideas across institutions, highlighted by Dr. Alavi's lecture celebrating 50 years of FDG-PET imaging.

We are honored to feature an outstanding program of speakers. Our keynote address will be delivered by **Dr. Ananth Annapragada**, Professor of Radiology, Director of Basic Research and Vice Chair of Research at Texas Children's Hospital and Baylor College of Medicine. Joining him and Dr. Alavi are seven distinguished experts: **Dr. Dmitri Artemov** (Johns Hopkins School of Medicine); **Dr. Jonathan Lindner** (University of Virginia Medical Center); **Dr. Ali Pirasteh** (University of Wisconsin-Madison); **Dr. Babak Saboury,** (United Theranostics); **Dr. Erik Shapiro** (Michigan State University); **Dr. Eliot Siegel** (University of Maryland School of Medicine & University of Maryland College Park); and **Dr. David Wilson** (University of California San Francisco). We are grateful to each of them for sharing their expertise and advancing dialogue in the rapidly evolving field of molecular imaging and theranostics.

The organizing committee received numerous abstract submissions, five of which were selected for oral presentation. The remaining abstracts will be presented as posters and available for viewing throughout the day.

This symposium was established five years ago with a generous gift from **Drs. Abass and Jane Alavi** to our department. I extend my sincere thanks to them and to our sponsor CDL Nuclear Technologies for the educational grant they provided, and to all who contributed to planning and preparing this year's symposium.

Once again, welcome to the 2026 Alavi-Bradley Symposium. I hope you find today's sessions both intellectually stimulating and inspiring.

Sincerely,

Tarek N. Hanna, MD, FASER
Professor and Dean John M. Dennis Chair
Department of Diagnostic Radiology and Nuclear Medicine
University of Maryland School of Medicine

AGENDA

8:00 AM *Breakfast & Registration* SMC Campus Center Ballroom Reception Area

8:30 – 8:45 *Opening Remarks:* **Tarek Hanna**, Professor and Dean John M. Dennis Chair, Department of Diagnostic Radiology and Nuclear Medicine

8:45 – 9:00 *Introduction:* **Vikas Kundra**

Session One **Moderator: Vikas Kundra**

9:00 – 9:50 *Keynote Address* ***Ananth Annapragada:*** *"Nanoparticle Enhanced CT and MR Imaging"*

9:50 – 10:00 *Questions*

10:00 – 10:25 **Eliot Siegel:** "AI in Imaging: What Will the Future Look Like?"

10:25 – 10:50 **Jonathan Lindner**: "Emerging Applications for Ultrasound Molecular Imaging and Theranostics"

10:50 – 11:00 *Round Table* Drs. Kundra, Annapragada, Siegel, and Lindner

11:00 – 11:20 *Coffee Break and Networking*

Session Two **Moderator: Dirk Mayer**

11:20 – 11:45 **Dmitri Artemov:** "Ready, Target, Fire: Pretargeting for Precision Imaging and Therapy"

11:45 – 12:10 **Erik Shapiro:** "'Functional' PET/MRI and Protein Engineering of Hepatic Transporters"

12:10 – 12:35 **David Wilson:** "Metabolic Strategies to Detect Living Bacteria *In Vivo*-Peptidoglycan and Beyond"

12:35 – 12:45 *Round Table* Drs. Mayer, Artemov, Shapiro, and Wilson

12:45 – 1:45 *Lunch and Poster Presentations*

Session Three **Moderator: Vasken Dilsizian**

1:45 – 2:10 **Abass Alavi:** "Five Decades of Unparalleled Impact of FDG-PET on the Day-to-Day Practice of Medicine"

2:10 – 2:35 **Ali Pirasteh:** "PET & MRI, Integrating Clinical, Research, and Operational Goals"

2:35 – 3:00 **Babak Saboury:** "Radiophenomics and Immuno-Imaging: The Indispensable Role of Positron Emission Tomography in Clinical and Computational Nuclear Oncology"

3:00 – 3:10 *Round Table* Drs. Dilsizian, Pirasteh, Alavi, and Saboury

3:10 – 3:30 *Coffee break*

Awards Session (Talks from submitted abstracts chosen for podium presentation)

Moderator: Piotr Walczak

3:30 – 3:35 **Behnaz Ghaemi**: "SEZ6-Targeted Theranostics for Metastatic Small Cell Lung Cancer"

3:35 – 3:40 **Woonghee Lee**: "Epidermal Growth Factor Receptor as a Radiotheranostic Target in Orthotopic Models of Hepatocellular Carcinoma"

3:40 – 3:45 **Aruna Singh**: "Unmasking Early Renal Alterations in Methylmalonic Acidemia using Non-invasive MRI Relaxometry"

3:45 – 3:50 **Lorissa McDougall**: "Delivery of HIV Broadly Neutralizing Antibody-Releasing Glial Progenitors to the Brain for the Clearance of Viral Reservoirs"

3:50 – 3:55 **Janaka Senarathna**: "Color-sensing Miniscopes Can Characterize the Genetic Heterogeneity of Brain Tumors In Vivo"

3:55 – 4:00 *Presentation of Awards*

Panel Discussion

4:00 – 4:30 *Panel discussion on the topic voted by the participants (~5 proposed topics) & Future Directions: All speakers. Moderator: Dr. Kundra*

4:30 – 4:45 *Closing Remarks*

End

This symposium is approved for Continued Medical Education (CME). The University of Maryland School of Medicine has designated this live activity for a maximum of 6.25 AMA PRA Category 1 Credits™. *Physicians should claim only the credit commensurate with the extent of their participation in the activity.*

Keynote Speaker: Ananth Annapragada, PhD
Professor of Radiology, Director of Basic Research, Vice-Chair of Research
Edward B. Singleton Department of Radiology
Professor of Obstetrics and Gynecology
Member, Dan L. Duncan Comprehensive Cancer Center
Texas Children's Hospital and Baylor College of Medicine



Ananth Annapragada is Professor of Radiology, Director of Basic Research and Vice-Chair of Research in the Edward B. Singleton Department of Radiology, Professor (by courtesy) of Obstetrics and Gynecology, and Member of the Dan L. Duncan Comprehensive Cancer Center at Texas Childrens Hospital and Baylor College of Medicine. An engineer by training, Ananth received his Ph.D. in Chemical Engineering from The University of Michigan in 1989. After Post-Doctoral Fellowships at the University of Minnesota and MIT, he worked in the pharma and small biotech industry for 10 years before returning to academia. Ananth's research interests are broad, and include placental biology, oncology, neurodegenerative disease, new imaging technologies, 3D bioprinting, and artificial intelligence. He serves on the Board and the Scientific Advisory Board of A2C Inc. and on the Scientific Advisory Board of Sante Ventures. He is an elected Fellow of the American Institute of Medical and Biological Engineers (AIMBE) and the National Academy of Inventors (NAI).

Title: Nanoparticle Enhanced CT and MR Imaging

Abstract

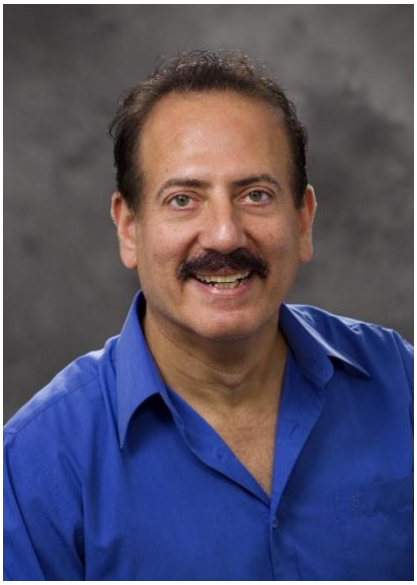
Nanoparticle contrast agents for CT and MR exhibit unique features—they have very long half-lives in the blood enabling blood pool imaging without bolus tracking, and altered biodistribution, dramatically altering toxicity profiles and use-cases. MR nanoparticles can also be made hyper-relaxive, increasing the signal-to-noise levels sufficiently to enable molecular imaging. Patterns of localization within regions of interest are amenable to texture analysis, yielding information about the cellular microenvironment within lesions. The same particle carriers used in these imaging agents can also be used to carry therapeutic payloads, and quantitative imaging can predict drug distribution, thus guiding treatment protocols. Molecularly targeted agents can also provide therapeutic effects directly by binding certain targets,with additional effects enabled by the delivered payload. In this presentation, the history of nanoparticle contrast agents over the last 25 years will be

presented, with vignettes of all the applications described above, ranging from discovery to clinical use.

Learning Objectives:

- Describe the mechanisms of signal generation by nanoparticle CT contrast
- Describe the mechanisms of signal generation by nanoparticle MR contrast
- Describe the pharmacokinetics and biodistribution of nanoparticle contrast agents
- Describe the performance of nanoparticle contrast agents in molecular imaging applications
- Describe methods to analyze nanoparticle enhanced image data

Eliot Siegel, MD
Adjunct Professor of Diagnostic Radiology and Nuclear Medicine
University of Maryland School of Medicine
Adjunct Professor of Bioengineering, University of Maryland College Park
Adjunct Professor of Computer Science, University of Maryland Baltimore County
Co-Founder & Chief Scientific Officer, United Theranostics



Dr. Eliot Siegel is a diagnostic radiologist, nuclear medicine physician, and nuclear oncologist. He serves as the co-founder and Chief Scientific Officer of United Theranostics, a national diagnostic and therapeutic nuclear medicine practice. Although retired from his primary clinical posts, he remains deeply involved in academia as an Adjunct Professor of Diagnostic Radiology and Nuclear Medicine at the University of Maryland School of Medicine, Adjunct Professor of Bioengineering at the University of Maryland College Park, and Adjunct Professor of Computer Science at the University of Maryland Baltimore County. Before retiring, he served as Professor and Vice Chair of Research Information Systems at the University of Maryland, Chief of Diagnostic Radiology and Nuclear Medicine at the VA Maryland Healthcare System (a role he assumed in 1986), and Lead Radiologist for the VISN 5 Diagnostic Service.

A recognized pioneer in medical imaging informatics, Dr. Siegel helped establish the world's first filmless healthcare enterprise and PACS at the VA. At the national level, he created the National Cancer Institute's (NCI) National Cancer Image Archive and served as Workspace Lead of the NCI's caBIG In Vivo Imaging Workspace.

Dr. Siegel is a leading voice in integrating artificial intelligence into healthcare and has an extensive publication record on AI in medical imaging. He serves as a Senior Consulting Editor for *Radiology: Artificial Intelligence*, a peer-reviewed journal published by the Radiological Society of North America (RSNA). For the past decade, he has served as Co-Director of the annual conference on Machine Intelligence in Medical Imaging (CAIMI), and he helped establish the University of Maryland Medical Intelligent Imaging Center. An extensively published academic, he has written over 350 articles and book chapters, and edited ten books on PACS, digital imaging, and nuclear medicine. Notably, he served as the principal editor for a recent special edition of *Radiologic Clinics of North America* dedicated to PET/CT, and he co-edited the two-volume series *Artificial Intelligence and PET Imaging* for *PET Clinics*. To date, he has delivered more than 1,000 presentations worldwide on computer applications in imaging and medicine.

In recognition of his widespread contributions to the field, Dr. Siegel currently serves on the Board of Directors for the Institute of Nuclear Medicine. His past leadership roles include serving as symposium chairman for the Society of Photo-optical and Industrial Engineers (SPIE) Medical Imaging Meeting for three years. His peers have honored him as Radiology Researcher and Radiology Educator of the Year, and named him one of the Top Ten radiologists. He is a fellow of both the American College of Radiology and the Society of Imaging Informatics in Medicine (SIIM). He previously served on SIIM's board of directors, which awarded him its Gold Medal in 2023.

Title: AI in Imaging: What Will the Future Look Like?

Abstract

For over three decades, medical imaging informatics focused primarily on digitizing, archiving, and distributing pixels; a transition that solved the physical problem of lost film but left the core diagnostic interpretive workflow largely transactional. While early artificial intelligence debates fixated on external predictions of radiologist and nuclear medicine physician obsolescence and narrow computer-vision models designed simply to "find the mass," the future of imaging AI is shifting toward systemic contextual intelligence. Tomorrow's imaging environment will be defined by multimodal AI agents and large language models (LLMs) that act as clinical co-pilots across the entire continuum of care.

This presentation explores how AI is expanding beyond isolated pixel analysis to synthesize fragmented patient histories, lab trends, and longitudinal records prior to image acquisition, automate guideline-concordant protocoling, and cross-correlate complex clinical trial protocols in seconds. Downstream, AI shifts the radiologist and nuclear medicine physician from manual dictator to editor-in-chief, generating structured reports tailored dynamically to distinct audiences, from technical quantitative summaries for subspecialists to plain-language explanations for patients. Finally, addressing the long-standing challenge first articulated in Fryback and Thornbury's 1991 efficacy hierarchy, this session details how frameworks like the Medical Imaging Life Cycle (MILC) and Diagnostic Imaging Provenance (DIP) harness LLMs to link imaging findings directly to downstream therapeutic decisions and measurable patient outcomes. This fundamentally elevates radiology and nuclear medicine from transactional image interpretation to high-value clinical orchestration.

Learning Objectives:

- **Analyze the Evolution from Pixel AI to Contextual Intelligence:** Differentiate narrow computer-vision algorithms from context-aware generative AI models, examining how upstream synthesis of unstructured electronic medical records, laboratory values, and prior imaging changes diagnostic interpretation.
- **Evaluate AI Co-Pilot Applications Across the Imaging Life Cycle:** Identify practical implementations of LLM-driven orchestration in molecular imaging, including automated exam protocoling, rapid chart summarization, and clinical trial eligibility matching.

- **Assess Multi-Audience Communication and Reporting Strategies:** Describe how generative AI transforms traditional reporting into dynamically tiered communication, delivering tailored insights for theranostic specialists, primary care providers, and patients.
- **Operationalize Value-Based Metrics Beyond Diagnostic Accuracy:** Apply the Medical Imaging Life Cycle (MILC) and Diagnostic Imaging Provenance (DIP) concepts to track imaging findings from initial image acquisition through downstream therapeutic choices and longitudinal patient outcomes.
- **Critique Industry Replacement Narratives Against Clinical Reality:** Appraise historical informatics trends alongside recent public predictions about AI replacing radiologists and nuclear medicine physicians, and explain why human-AI collaboration improves clinical relevance and patient care delivery.

Jonathan R. Lindner, MD, FACC, FASE
Frances Myers Ball Endowed Professor of Medicine
Vice-chief for Research
Cardiovascular Division
University of Virginia



Dr. Lindner is a physician-scientist with expertise in advanced cardiovascular imaging, vascular biology, and microvascular physiology. He is currently the principal investigator on multiple R01 grants from the National Institutes of Health, and grants from NASA. His research laboratory has pioneered the use of advanced ultrasound methods for microvascular perfusion imaging, non-invasive molecular imaging, and for site-directed gene therapy. His current research spans from studying novel mechanisms for microvascular dysfunction, including deep space travel and hypertrophic myopathies, reversible mechanisms for aortic stenosis progression, inflammation signaling in atherosclerosis, and ultrasound cavitation for site targeted gene therapy with AAV and nanoparticle vectors. Dr. Lindner is a Past President for the American Society of Echocardiography. He is the Chair for the Exam Writing Committee and the President Elect for the National Board of Echocardiography. He has served as the chair for multiple NIH study sections and is currently the Co-chair of the NHLBI DSMB for Gene and Cell Therapy Trials.

Title: Advances in Ultrasound Molecular Imaging and Theranostics

Abstract

Non-invasive in vivo molecular imaging technologies are being developed according to the goal of precision medicine through precision imaging. These techniques are unique in their ability to spatially and temporally evaluate cardiovascular pathobiology at the cellular and molecular level. The relative contribution for each individual molecular imaging technology is governed by practical aspects in terms of resolution, cost, safety, and speed; and also by differences in the ability of each specific tracer to reveal a pathway of interest. In cardiovascular medicine, ultrasound molecular imaging techniques have been developed that rely on site-targeting of ultrasound contrast agents, and are capable of imaging events that occur at the blood pool-endothelial interface within a matter of minutes. Accordingly, diagnostic applications for ultrasound molecular imaging include

point-of-care detection of recent but resolved myocardial ischemia, myocardial inflammation, thrombotic angiopathies, and transplant rejection. Probes used for imaging endothelial activation and thormboinflammation have also provided an important opportunity to accelerate many phases of drug discovery and drug development. Moreover, the bioeffects produced by microbubble cavitation has led to novel applications for site-targeted gene therapy through effects on vascular permeability, and augmentation of tissue perfusion through purinergic signaling.

Learning Objectives:

- To be able to identify the clinical gaps that are likely to be addressed by ultrasound (US) -based diagnostic molecular imaging
- To understand how US molecular imaging with US is being used for drug delivery
- To be able to identify the mechanisms and potentials for gene delivery and augmented tissue perfusion with contrast ultrasound

Dmitri Artemov, PhD
Professor of Radiology and Radiological Science
Johns Hopkins School of Medicine
Associate Director, Cancer Functional Imaging Core
The Sidney Kimmel Comprehensive Cancer Center



Dmitri Artemov, Ph.D., The Albert B. Shackman, M.D., F.A.C.R. Professor of Radiology in the Division of Cancer Imaging Research, has been working at the intersection of physics, molecular imaging, and oncology, developing innovative technologies to make cancer diagnosis and treatment more precise, personalized, and safe. His laboratory focuses on molecular imaging and image-guided therapeutic strategies, including dual-contrast MRI for monitoring targeted drug delivery and release, angiogenesis-targeted PET tracers for mapping tumor vasculature, and "click therapy," an emerging approach that integrates multicomponent molecular targeting with image guidance for highly specific drug delivery.

Dr. Artemov also serves as Associate Director of the Cancer Functional Imaging Core at the Sidney Kimmel Comprehensive Cancer Center. His recent work focuses on pretargeted therapy, an innovative strategy that separates the targeting and therapeutic phases of treatment. By decoupling tumor recognition from delivery of the therapeutic agent, this approach is designed to increase targeting specificity while reducing associated toxicity.

Dr. Artemov received his training in molecular physics at Moscow State University and earned a Ph.D. in Physics and Mathematics from the Russian Academy of Sciences. He subsequently completed an Alexander von Humboldt Fellowship in magnetic resonance imaging at the University of Würzburg, followed by postdoctoral training at Johns Hopkins. After joining the Johns Hopkins faculty in 1997, he earned an M.S. in Biotechnology and continued to develop molecular and functional imaging methods that support translational cancer research.

A Fellow of the International Society for Magnetic Resonance in Medicine and longtime member of the World Molecular Imaging Society, Dr. Artemov embodies a collaborative, cross-disciplinary approach to biomedical research to advance molecularly targeted and image-guided strategies for cancer diagnosis and treatment.

Title: Ready, Target, Fire: Pretargeting for Precision Imaging and Therapy

Abstract

Image-guided pretargeting strategy separates target recognition from subsequent delivery of a therapeutic effector. In the initial pretargeting step, a high-affinity targeting agent, such as a monoclonal antibody (mAb), binds to specific receptors expressed on tumor cells and can be visualized using PET. In the subsequent effector-delivery step, administered after clearance of the mAb from circulation, the therapeutic component selectively recognizes and binds the pretargeting agent through bioorthogonal click chemistry. The distribution of the effector component can also be monitored using an orthogonal imaging modality, enabling multimodal assessment of both targeting and therapeutic delivery.

We report an image-guided pretargeting strategy for chemotherapy of HER2-positive breast cancer using a trastuzumab-based pretargeting agent and albumin-based cytotoxic drug carriers. Tetrazine–trans-cyclooctene (TCO) click chemistry is used for rapid bioorthogonal conjugation of the two components. MR-detectable iron oxide nanocarriers can also serve as effector components, enabling highly specific pretargeted delivery with complementary PET-MRI visualization.

We further demonstrate pretargeted immunotherapy of triple-negative breast cancer (TNBC) using NK cells in combination with sacituzumab-based pretargeting. This approach results in efficient cancer cell killing in vitro and antitumor effects in mouse models. Finally, we present a pretargeted bacterial therapy strategy for HER2-positive breast cancer that enhances bacterial homing to and colonization of tumors, with potential therapeutic effects. Taken together, these studies demonstrate the versatility of image-guided pretargeting as a platform for the selective delivery of diverse therapeutic effectors, including drug carriers, immune cells, and bacteria. This approach may be particularly advantageous for tumors with well-defined, highly expressed extracellular targets and favorable receptor internalization kinetics, potentially enabling efficient tumor-directed therapy while minimizing systemic exposure and toxicity.

Learning Objectives:

- Describe key therapeutic applications of monoclonal antibodies (mAbs) and their role in targeted therapy.
- Explain the fundamental features of bioorthogonal click-chemistry reactions and their relevance to *in vivo* conjugation.
- Explain the concept of biological pretargeting for targeted imaging and therapy, including how target/receptor persistence, antibody retention, and internalization influence pretargeting efficiency.
- Discuss in vivo applications of pretargeting for targeted chemotherapy, radionuclide therapy, and cellular therapy.

Erik Shaprio, MS, PhD
Associate Chair of Research and Professor, Department of Radiology
Division Director for Biomedical Imaging, Institute for Quantitative Health Science and Engineering
Michigan State University



Dr. Erik M. Shapiro is Professor of Radiology, Physiology, Biomedical Engineering, and Chemical Engineering at Michigan State University. He serves as Division Director for Biomedical Imaging in the Institute for Quantitative Health Science and Engineering. He also directs the Molecular and Cellular Imaging Laboratory.

Dr. Shapiro earned a BS in chemistry from the State University of New York at Binghamton and MS and PhD degrees in chemistry from the University of Pennsylvania. He completed postdoctoral training in molecular imaging at the National Institutes of Health and subsequently spent six years as an assistant professor at Yale University before joining Michigan State University.

Quantitative molecular imaging has been a consistent theme throughout Dr. Shapiro's career. His doctoral research established quantitative sodium and proton MRI methods for the noninvasive assessment of cartilage biochemistry and early osteoarthritis. During his postdoctoral fellowship, he pioneered the use of micron-sized iron oxide particles for MRI-based cell tracking. Using a hepatocyte transplantation model, he produced the first demonstration that MRI could robustly detect individual cells in vivo and monitor transplanted hepatocytes. He subsequently extended these approaches to image endogenous neural stem-cell migration in vivo.

His current research combines multimodality contrast agents and nanomaterials, engineered transporter proteins, large-animal disease models, and artificial-intelligence-based image analysis. Major applications include monitoring regenerative medicine via cell and gene therapy, early diagnosis of liver disease, development of clinically viable radiopaque biomaterial implants, and imaging cellular activity and circuits in the intact brain. Dr. Shapiro's honors include an NIH Fellows Award, an NIH Director's New Innovator Award, and a Distinguished Investigator Award from The Academy for Radiology & Biomedical Imaging Research. He was also most recently Program Chair for the 2026 World Molecular Imaging Congress.

Title: "Functional" PET/MRI and Protein Engineering of Hepatic Transporters

Abstract

Hepatic organic anion transporting polypeptides (OATPs) mediate the uptake of hepatobiliary MRI contrast agents, creating multiple opportunities for molecular imaging. For functional liver imaging, we pair dynamic Gd-EOB-DTPA MRI with radiolabeled analogs in simultaneous PET/MRI and use physiologically based kinetic modeling to quantify hepatic delivery, OATP-mediated uptake, and biliary clearance. PET provides direct tracer-concentration measurements, addressing uncertainty inherent in converting MRI signal to gadolinium concentration. Imaging studies in rodents, zebrafish, and large-animal models support translation toward early detection of transporter dysfunction in liver disease and highlight the need for new PET agents to "light the way."

In parallel, we are developing hepatic OATPs as MRI reporter proteins for cell and gene therapies. Current OATP reporter approaches require approximately 50–100 times the clinical dose of Gd-EOB-DTPA because of strong hepatic background and limited ectopic probe accumulation. Although we have demonstrated in vivo detection of OATP-expressing cell transplants at a clinical contrast dose using DCE-MRI, clinical translation would benefit from simple, clinically familiar static T1-weighted imaging. We therefore redirected transport toward Gd-BOPTA, which undergoes minimal hepatic uptake in humans. We have engineered chimeric transporters derived from human and nonhuman OATPs that exhibit enhanced Gd-BOPTA transport. By combining improved probe transport with low hepatic background, these engineered transporters may provide the key to widespread molecular imaging for longitudinal monitoring of cell and gene therapies in humans.

Learning Objectives:

- Explain how hepatic OATPs mediate hepatobiliary contrast-agent uptake and enable functional liver imaging.
- Discuss how species-specific differences in OATP transport affect preclinical imaging studies and clinical translation.
- Identify the limitations of current OATP-based MRI reporter systems, including hepatic background and the need for supraclinical Gd-EOB-DTPA doses.

David Wilson, MD, PhD
Professor of Radiology
University of California San Francisco School of Medicine



Dave Wilson, M.D., Ph.D. is a clinical neuroradiologist who trained with bio-organic chemist Professor Ronald Breslow at Columbia University, motivating Dave's career interest in chemical and biochemical mimicry. The Wilson laboratory has focused on the development of PET, hyperpolarized ^{13}C MR, and ^{2}H MRS tools for imaging metabolism *in vivo*, with an emphasis on tumor-relevant analytes especially reactive oxygen species (ROS), and bacteria-specific metabolic pathways. The goal is to translate several promising PET technologies into the clinic- especially those to detect and image bacteria in the acute care setting. Recent efforts have focused on developing PET tracers targeting the bacterial cell wall, transitioning from D-amino acid derivatives to a carbohydrate component of peptidoglycan namely *N*-acetyl muramic acid. In addition, the Wilson lab has developed numerous new ways to chemically and chemoenzymatically transform the common radiotracer [18F]FDG to target more specific metabolic pathways in vivo. Finally, metabolic strategies to detect bacteria in vivo have been extended to [13C]CO2 breath testing using an expanded arsenal of 13C-enriched metabolites.

Title: Metabolic Strategies to Detect Living Bacteria *In Vivo*— Peptidoglycan and Beyond

Abstract

The identification of bacterial infection is critical in clinical practice. Patients with suspected infection are frequently investigated via anatomic imaging using computed tomography or magnetic resonance imaging, or nuclear imaging using positron emission tomography (PET) or single photon emission computed tomography (SPECT). These methods mainly image the host response to bacterial infection and can be misleading in sterile inflammatory processes and patients with compromised immune systems. A newer and promising PET approach to image infection is the direct identification of living bacteria based on pathogen-specific structures and metabolic pathways. One such structure is peptidoglycan, the complex polymer found in the cell walls of most bacteria, composed of both carbohydrates (alternating residues of beta-linked N-acetyl glucosamine and N-acetyl muramic acid) and amino acids including D-alanine and D-glutamine/glutamate. As summarized in this lecture, positron-labeled D-amino acids have been pursued in our laboratory to image bacteria *in vivo* using PET. Based on the known incorporation of exogenous, non-canonical D-amino acids into bacterial peptidoglycan, the easily radiolabeled D-[methyl-^{11}C]methionine amino

acid was initially developed and used to image prosthetic joint infections in a cohort of patients using PET-MRI. Promising results motivated additional radiochemical advances including labeling D-[3-^{11}C]alanine itself using the asymmetric alkylation of a glycine analog, and the dipeptide D-[3-^{11}C]alanyl-D-alanine offering unparalleled sensitivity to living pathogens. Based on the longer $t_{1/2}$ of ^{18}F (110 min) versus ^{11}C (20 min), fluorinated tracers are much more likely to be used effectively in the clinic. Therefore, the fluorinated D-alanine analog [^{18}F]3,3,3-trifluoro-D-alanine tracer was developed. Finally, the most promising PET tracer targeting the bacterial cell wall used an amino sugar component of peptidoglycan, namely a fluorine-18 derivative of N-acetyl muramic acid.

Beyond the cell wall, more recent efforts have focused on PET imaging methods that are "on demand," so that a patient with an infection might be imaged right away in the acute care setting. From a radiosynthetic perspective, this might be accomplished via efficient modification of the common tracer [^{18}F]FDG, the radiolabeled glucose analog that is widely available in the United States and other countries. Our laboratory recently reported both chemical and biochemical transformation of [^{18}F]FDG. As described in this talk, metabolism-targeted imaging strategies can be extended to other diagnostic modalities, for example [^{13}C]CO_2 breath testing using ^{13}C-enriched metabolites. These methods are expected to revolutionize the diagnosis and management of bacterial infections, highlighting the application of innovative chemical tools to clinical practice.

Learning Objectives:

- Identify basic approaches to pathogen-specific imaging
- Understand the basic structure of the bacterial cell wall
- Appreciate the ways to chemically/ chemoenyzmatically transform [18F]FDG

Abass Alavi, MD, MD (Hon), PhD (Hon), DSc (Hon.)
Professor of Radiology and Associate Director of the Institute on Aging
University of Pennsylvania Perelman School of Medicine



Abass Alavi is an internationally renowned physician scientist who has developed novel techniques that have shaped the evolution of molecular imaging in medicine. Among his accomplishments, the introduction of 18F-FDG- PET has truly revolutionized the field of medicine worldwide. The impact of using FDG-PET along with CT and MRI is unparalleled by any other technique in recent history. He has received many awards for his outstanding contributions, including the Benedict Cassen Prize by the Society of Nuclear Medicine in 2012. This prize is given to those whose efforts have led to a major advancement in basic or clinical nuclear medicine science. Dr. Alavi is currently a Professor of Radiology and Neurology, Director of Research Education in Radiology, and Associate Director of Center for the Study of Aging at the University of Pennsylvania.

Title: Five Decades of Unparalleled Impact of FDG-PET on the Day-to-Day Practice of Medicine

Abstract

The concept of tomographic imaging was born by Penn investigators in the 1960s and eventually led to developing SPECT) by 1971. In 1973, the first CT instrument was installed at Penn which became a major challenge to continuing our research Tc-99m-based tracers. Therefore, investigators in the department of Radiology, in collaboration with colleagues in Neurology, shifted our efforts to developing PET as a major research domain. The early research with deoxyglucose was based on C-14-labeling and “autoradiography.” Later in 1973, investigators at Penn collaborated with colleagues at Brookhaven National Laboratory to initiate an effort to synthesize 18F-Fluorodeoxyglucose (FDG). In August 1976, the first dose of FDG was shipped to Penn and the first successful tomographic images of the brain and planar images of the whole body were obtained. During the ensuing years, a few centers in the US including Penn adopted PET as a research modality for detecting and assessing several disease and disorders.

During the past 4 decades, it has become very clear that FDG as a tracer has had unparalleled impact on the many diseases and disorders and has truly enhanced the role of imaging on the day-to-day practice of medicine. In particular, applications of FDG-PET in

managing various malignancies have changed the practice of oncology and truly made emission tomography as successful as any technique in the history of medicine. In addition, PET has been extremely useful for detection of inflammation (atherosclerosis), infection, and clot detection. During the past 25 years, the introduction of PET/CT by investigators at University of Pittsburgh has further enhanced the role of FDG-PET imaging in medicine.

Very few innovations in medicine, particularly in imaging, have had the impact of FDG-PET as we have witnessed in recent years.

Learning Objectives:

1. Describe the history of modern imaging as it has evolved during the past five decades
2. Review the evolution of PET imaging based on introduction of FDG as a molecular imaging probe
3. Outline the major applications of FDG in the day-to-day practice of medicine
4. Project the impact of five decades of this rapidly evolving technology in various disciplines in medicine

Ali Pirasteh, MD
Assistant Professor
Department of Radiology
University of Wisconsin School of Medicine and Public Health



Dr. Ali Pirasteh is an Assistant Professor of Radiology at the University of Wisconsin School of Medicine and Public Health, with an affiliate appointment in Medical Physics. He earned his BS in Chemistry at UC Berkeley and his MD at Case Western Reserve University. He did his diagnostic radiology residency and a body MRI fellowship at UT Southwestern, then a nuclear medicine fellowship at Memorial Sloan Kettering Cancer Center. He is board certified in both diagnostic radiology and nuclear medicine. At UW, Dr. Pirasteh is Chief of MRI and Director of PET/MRI, and he chairs the Department of Radiology's MRI Safety Committee. He also chairs the Safety Committee of the International Society for Magnetic Resonance in Medicine.

He has developed a sustainable balanced research and clinical PET/MRI program at the University of Wisconsin. His research develops and validates hybrid PET/MRI methods that detect and measure disease by targeting its underlying pathology directly. His clinical focus includes both nuclear medicine and abdominal imaging. His research is focused on fibrotic disease processes (oncologic and non-oncologic) and translation of novel MRI techniques and PET radiotracers into clinical trials.

Title: PET & MRI, Integrating Clinical, Research, and Operational Goals

Abstract

A PET/MRI system is among the most complex medical imaging equipment available. While it can provide a great deal of information about the disease process, its complexity lends itself to difficulties in building an effective and sustainable program. We will review some of the strategies and techniques that can overcome such complexities and demonstrate an example of a successful program at the University of Wisconsin-Madison.

Learning Objectives:

- Understand the challenges associated with PET/MRI

- Understand strategies required to mitigate those challenges and build a successful PET/MRI program
- Learn about clinical and research settings where PET/MRI is valuable

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Title: Radiophenomics and Immuno-Imaging: The Indispensable Role of Positron Emission Tomography in Clinical and Computational Nuclear Oncology

Abstract

Positron emission tomography (PET) is the only clinical imaging method that measures molecular processes quantitatively across the whole body, and that property makes it indispensable to nuclear oncology at two levels. Clinically, PET stages cancer, assesses treatment response, and selects patients for radiopharmaceutical therapy. Computationally, every PET study is a quantitative dataset from which reproducible biological measurements can be derived. This talk connects the two through radiophenomics and immuno-imaging. Radiophenomics treats the whole-body PET study as an imaging phenotype: the spatial pattern, kinetics, and inter-organ relationships of radiotracer distribution, extracted with quantitative methods and artificial intelligence and enabled by long-axial field-of-view (total-body) PET. Immuno-imaging extends molecular PET to the immune system, using probes directed at targets such as PD-L1, CD8, and

granzyme B to assess the immune response noninvasively across tumors and lymphoid organs, where a single biopsy cannot represent heterogeneous disease. The talk will review the principles of PET quantification on which both depend, from standardized uptake values to dynamic and parametric imaging; trace the computational pipeline from acquisition and segmentation to feature extraction and prediction; and summarize early human evidence for immune PET, including CD8 PET in patients receiving immune checkpoint inhibitors and its current limitations. It will then consider theranostics, where target imaging guides radiopharmaceutical therapy and radiation itself may modulate the immune response, and close with the standardization, validation, and regulatory steps needed to turn quantitative PET phenotypes into tools for clinical decisions.

Learning Objectives:

1. Explain why quantitative whole-body measurement makes PET indispensable in clinical nuclear oncology, including the roles of standardized uptake values, dynamic acquisition, and parametric imaging.

2. Define radiophenomics and describe how total-body PET and artificial intelligence enable whole-body imaging phenotypes.

3. Outline the steps of a computational PET pipeline, from image acquisition and segmentation to feature extraction and outcome prediction.

4. Identify the principal immune-targeted PET agents (PD-L1, CD8, and granzyme B) and summarize the current human evidence and limitations for CD8 PET in immune checkpoint inhibition.

5. Discuss how PET guides theranostics, and the standardization, validation, and regulatory requirements for translating quantitative PET phenotypes into clinical practice.

List of Abstract Titles and Authors

01 Epidermal Growth Factor Receptor as a Radiotheranostic Target in Orthotopic Models of Hepatocellular Carcinoma

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02 SEZ6-Targeted Theranostics for Metastatic Small Cell Lung Cancer

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Brain White Matter Microstructural Changes in Aging Individuals With HIV: A Diffusion Tensor Imaging Study

03 Brain White Matter Microstructural Changes in Aging Individuals With HIV: A Diffusion Tensor Imaging Study

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04 VOILALab Beam: An Open-Source, Low-Cost Platform for Laser Beam Characterization

Jason Liang; Yuanlong Zhao; Guanghan Meng, PhD
Herbert Wertheim School of Optometry and Vision Science, University of California, Berkeley, CA, USA

05 Blood Pressure–Cerebrovascular Regulation of Glymphatic Transport Across Aging

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08 PET/MR image-guided intra-arterial delivery of radiomagnetolabeled, genetically modified human mesenchymal stem cells to optimize stroke therapy in mice

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10 Peptide-Based Radiotheranostics for PET Imaging and α-Particle Therapy of Multiple Myeloma

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