

A Window on the Role of Blood Vessels In Cancer

Recent research by Dr. Arvind P. Pathak, Assistant Professor of Radiology in the Division of Cancer Imaging Research led by Dr. Zaver M. Bhujwala, has been highlighted on the cover of four different journals. Images from his research on the role of blood vessels in cancer and wound healing were featured on the cover of the *Journal of Cerebral Blood Flow & Metabolism*, *Angiogenesis*, the *Annals of Biomedical Engineering* and *Current Angiogenesis*. Dr. Pathak attributes this honor to the outstanding students and collaborators at Hopkins with whom he is fortunate to work. The highlighted research includes work by Eugene Kim in the Pathak lab, who used Magnetic Resonance (MR) microscopy to characterize differences in the vasculature of brain tumor models at different stages; a collaboration with Drs. Abhishek Rege and Nitish V. Thakor using Laser Speckle Imaging to characterize angiogenesis (i.e., new blood vessel formation) during wound healing; and a collaboration with Drs. Spyros Stamatelos and Aleksander S. Popel on image-based mathematical modeling of tumor blood flow. All the collaborators on these studies are from the Department of Biomedical Engineering at Hopkins.

Dr. Pathak's lab focuses on elucidating the role of the vasculature in disease, particularly brain and breast cancer, from the cellular to the whole-tumor scale. "We're developing new imaging methods to visualize blood vessels in cancer," Dr. Pathak explained.

He went on to say that, "we use novel imaging methods that no one has applied to these disease models. We acquire images in 3D and over time, so essentially we image in 4D, and then employ state-of-the-art visualization techniques to convey this multidimensional information. Our lab has developed tools for integrating imaging data from magnetic resonance imaging (MRI), computed tomography (CT) and optical microscopy, to come up with a 'multi-scale' picture of these cancer models. One can then 'zoom' from the spatial scale of the whole tumor, down to the smallest blood vessel. This approach helps us relate the macroscopic changes measured in live animal models of cancer to MRI, and the microscopic changes assessed in tissue sections using optical microscopy."

Dr. Pathak said another focus of his research is the

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development of clinical biomarkers to identify response to therapy and the potential for metastasis. "For example, MRI biomarkers of tumor angiogenesis can tell us whether a certain anti-angiogenic drug is working. If we can non-invasively see drug-induced vascular changes in cancer, and we can help patients avoid invasive

biopsies to assess the therapeutic efficacy of such drugs," he explained. "We use imaging methods and reagents already approved by the FDA, which makes our work potentially translatable to the clinic," he said. The next phase of the research will involve establishing collaborations with clinicians to test these imaging biomarkers.

Currently, Dr. Pathak's lab has seven students, Eugene Kim, Charlesa Plummer, Leland Pung, Woo-Taek Lim, Stacy Gil, Daniel Levenson, and Kareem Fakhoury. The lab employs imaging, computational models and visualization tools to answer critical questions in cancer biology. Details of ongoing research in the Pathak Lab can be found at www.pathak-lab.org. "We hope that addressing these issues will eventually affect patient outcome and disease management", he said. ■



Dr. Arvind Pathak and the journal covers depicting his work.