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Mass spectrometry imaging as a tool for surgical decision-making

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Surgical teams have available a number of real-time imaging tools to help identify and locate tumor tissue. Mass spectrometry, is proven capable of producing molecular signatures from resected tissue which, in turn, has long promised to aid in determining if all tissue which exhibits tumorous molecular signatures has been removed. A few groups have pioneered the transitioning of mass spectrometry from research lab to surgical suite and among these are Professor Nathalie Agar's team at Brigham And Women's Hospital - Harvard Medical School, who present our Special Feature. Agar's team have sited an ion trap system with DESI ion source into the Advanced Multimodality Image Guided Operating (AMIGO) suite and show that MS information can play a role in surgical decision making.

Authors' biographies

David Calligaris received his Ph.D. in biochemistry from Aix-Marseille University (France) where his research focused on biological mass spectrometry applied to cancer research. He did a first postdoctoral position in the Mass Spectrometry Laboratory of Liege University (Belgium). He is currently a postdoctoral researcher at Brigham and Women's Hospital-Harvard Medical School on projects involving use of DESI and MALDI mass spectrometry imaging.

Isaiah Norton is a research programmer in the Agar and Golby labs at Brigham and Women's Hospital, focusing on mass spectrometry analysis and classification, pre-operative imaging, and surgical navigation. He received a BS in Mathematics from Boston University, and is a contributor to several open source projects including 3D Slicer and OpenIGTLink.

Daniel Feldman received his B.S. in chemistry and biology from Brandeis University in 2012. As an undergraduate, he studied nonlinear chemical dynamics and investigated wavenumber locking of Turing patterns with spatial-temporal forcing. He is currently working as a Research Assistant in the Surgical Molecular Imaging Lab at Brigham and Women's Hospital.

Jennifer Ide received her B.S. from Emmanuel College and performed undergraduate research on the implementation of mass spectrometry into surgical care under Dr Nathalie Agar at Brigham and Women's Hospital, Harvard Medical School. After a year of working as a technical research assistant, she left to pursue a M.S. in Biomedical Sciences at Tufts University School of Medicine where she is currently a student.

Ian F. Dunn is Assistant Professor of Surgery, Harvard Medical School. His neurosurgery practice focuses on glioma, pituitary, and skull-base tumors, and research focus is on tumor genetics. He is a frequent collaborator and co-author in translational mass-spectrometry work. Dr Dunn earned his AB from Harvard College and MD from Harvard Medical School (2002), and completed neurosurgery residency at Brigham & Women's Hospital.

Livia S. Eberlin received her BS in Chemistry in 2007 from the State University of Campinas, Sao Paulo, Brazil. In 2012 she received her PhD in Analytical Chemistry from Purdue University where she used DESI-MS imaging in biomedical research under the direction of Prof. R. Graham Cooks. She is currently a postdoctoral researcher at Stanford University.

Graham Cooks received Ph. D. degrees from the University of Natal (now KwaZulu-Natal) and Cambridge University. He is the Henry Bohn Hass Distinguished Professor of Chemistry at Purdue University and Distinguished Professor at the Indian Institute of Technology Madras. He is a pioneer in the conception and implementation of MS/MS and of desorption ionization. These interests led to the construction of miniature ion trap mass spectrometers and their application to problems of trace chemical detection. His work on ionization methods has contributed to the ambient ionization methods including desorption electrospray ionization.

Ferenc Jolesz is the B. Leonard Holman Professor of Radiology in the Department of Radiology at Brigham and Women's Hospital and Harvard Medical School. Dr Jolesz has achieved international recognition as one of the great innovators and leaders in radiological research. Indeed, he continues to distinguish himself with ongoing, cutting edge research in magnetic resonance imaging and image-guided therapy. The related translational research involves extensive interdisciplinary collaborations and the development and clinical implementation of several novel minimally invasive methods.

Alexandra J. Golby is Associate Professor of Surgery and Radiology, Harvard Medical School, and an expert in pre-operative functional and diffusion MRI, image-guided surgical navigation, and clinical neuroscience. She is director of Image-Guided Neurosurgery at Brigham & Women's Hospital, as well as director of the National Center for Image-Guided Therapy Neurosurgery Core, and clinical co-director of the Advanced Multimodality Image-Guided OR. She completed her M.D., junior residency, and NIH National Research Service Award Post-doctoral fellowship (2001) at Stanford University, and was Chief Resident in Neurosurgery (2002) at Brigham and Women's Hospital.

Sandro Santagata is an Assistant Professor of Pathology at Harvard Medical School, Neuropathologist at the Brigham and Women's Hospital, and an Affiliated Member at the Broad Institute. He leads a laboratory at the Harvard Institute of Medicine studying the molecular pathology of brain tumors. He completed his M.D., Ph.D. at Mount Sinai Medical School of New York University (2002), and is board-certified in anatomic pathology and neuropathology by the American Board of Pathology (2007).

Nathalie Y.R. Agar is the founding Director of the Surgical Molecular Imaging Laboratory (SMIL) in the Department of Neurosurgery at Brigham and Women's Hospital, and an Assistant Professor of Surgery and of Radiology at Harvard Medical School. Dr Agar's multidisciplinary training includes a B.Sc. in Biochemistry (1997), Ph.D. in Chemistry (2002), a postdoctoral fellowship in Neurology and Neurosurgery from McGill University, and further postdoctoral training in Neurosurgery at the Brigham and Women's Hospital, Harvard Medical School. From this unique background, she has developed distinct skills to better understand the requirements and limitations regarding the implementation of novel instrumentation, sample and data analysis, and cancer and surgical needs in the medical environment. She has also developed a network of specialists to satisfy the many different aspects of translational research activities.

