

University of Vermont Center for Biomedical Imaging

DOE Grant #: SC0001753

Final Technical Report

This grant was awarded in support of Phase 2 of the University of Vermont Center for Biomedical Imaging. Phase 2 outlined several specific aims including:

The development of expertise in MRI and fMRI imaging and their applications

The acquisition of peer reviewed extramural funding in support of the Center

The development of a Core Imaging Advisory Board, fee structure and protocol review and approval process.

Progress

During the project period a Core Imaging Advisory Group was established and monthly meetings were initiated. These meetings were coordinated and scheduled by Jay Gonyea, who serves as the administrative director for the Imaging Center along with Dr. Christopher Fillippi MD, a trained Neuroradiologist, who served as the medical director for the center during this grant cycle. The Advisory Group established a fee schedule which differentiated federal supported grant activity from industry initiated and supported research activity. Categories for characterizing MRI studies were developed which included; A: Federally funded peer reviewed research, B: Investigator initiated industry funded research, C: Investigator initiated departmentally funded research, D: Industry initiated industry funded research; and E: Local Investigator initiated unfunded Pilot Studies. Additionally a review process was created both to advise grant applicants regarding center imaging center capability and availability as part of the extramural application process.

During the period of 2008-2010 the MRI Center experienced steady growth in terms of publications, funding, and overall productivity. Despite the fact that university researchers did not have access to a dedicated human MR imaging facility prior to July, 2007, the MRI Center was able to garner a healthy amount of grant support to contribute to its growth. Over \$7.3 million in grant funding was secured to support MRI related research studies through the Department of Psychiatry's Clinical Neuroscience Research Unit at UVM. In addition, the MRI Center received funding from private industry funded research studies to help generate a steady source of income for the facility. In total, over 50 IRB approved research studies were initiated during this period of time.

Publications

At least 10 peer-reviewed journal articles were produced with data that was acquired at the MRI Center between 2008 and 2010. More than 27 abstracts and poster presentations were accepted at scientific meetings during the same period of time. (see below). Functional MRI (fMRI) studies of the effects of hormones on memory and aging; magnetic resonance diffusion tensor imaging (MRDTI) of the human brain and spinal cord involving various pathologies; as well as fMRI studies of the brain and language

processing were published. There were several abstracts and posters produced, which demonstrated improved MR image quality with Multi-RF Transmit technology at 3 Tesla.

Productivity

The year 2008 resulted in 99 scans that were funded through NIH agencies. An additional 43 MRI scans were funded by industry. Over 250 scans were acquired by various investigators as “pilot” data to be used for future grant applications. While these numbers are modest in comparison to most busy research MRI Centers, they are in line with that of a newly established MRI research facility. The initial 12-18 months of operation were primarily dedicated to establishing new IRB approved research studies, and acquiring pilot data for future grant applications.

During the year 2009 the MRI Center continued to show positive growth with respect to funded studies and the number of scan sessions. The number of NIH sponsored scans increased to 242 and the number of industry funded studies climbed to 81. This more than doubled our numbers of funded scans over the previous year. In addition, 398 scans were acquired as pilot data; most of which were fMRI's. The MRI Center continued to expand with additional researchers who were interested in probing the brain's response to chronic pain. Other studies looked at regions of brain activation in patients with impulsivity disorders; including smokers. A large majority of the imaging studies were focused on the brain; however, the MRI Center continued to accommodate the needs of various types of investigators, who studied various types of human pathology. Studies of porcine cardiac function and myocardial perfusion were performed. Another study of ultra-fast acute abdominal MRI in children was underway; eventually leading to publication in AJR. These non-neuro type research projects allowed the MRI Center to expand upon the depth and breadth of service that has now become available to researchers at UVM.

The UVM MRI Center became the first clinical/research site in North America to install dual radio frequency (RF) amplifiers on a 3T MRI system. The use of dual RF amplifiers helps to eliminate standing wave artifacts that are prevalent at 3T. Standing wave artifacts often rendered spine or abdominal 3T MR images to be poor quality or unreadable prior to the availability of multi-transmit. A research collaboration agreement with Philips Healthcare, Best, Netherlands allowed our site to have first use of the technology; while at the same time giving us the opportunity to provide critical feedback to Philips Healthcare about our experiences with multi-transmit. This dramatically improved image quality for 3T MRI sites across the US and the world. Philips has stationed an onsite MRI physicist at UVM to work collaboratively with researchers at the University of Vermont on various MRI related projects. He has worked collaboratively with UVM investigators toward the design and publication of several journal articles and abstracts during his time at UVM.

As the MRI Center advanced through the year 2010, an additional MRI technologist and a MRI physicist were hired to accommodate the increased demand for MRI scanning and data processing expertise. This enabled us to not only expand our hours of operation; it also helped to augment our MRI pulse programming and data processing capabilities. Studies that used state-of-the-art MRI techniques like pseudo continuous arterial spin labeling (pCASL) allowed researchers from the Department of Obstetrics and Reproductive Services to obtain non-contrast brain perfusion values of women to help them to better understand the effects of preeclampsia. At year-end 2010 the MRI Center completed 303 NIH funded and 198 industry funded scans. The number of no charge pilot scans decreased to 189.

Publications

Dumas, J.A., Kutz, A.M., Naylor, M.R., Johnson, J.V., Newhouse, P.A. (2010) Increased memory load related frontal activation after estradiol treatment in postmenopausal women. *Hormones and Behavior*, epub ahead of print.

Cauley KA, Waheed W, Salmela M, Filippi CG. MR Imaging of Psychosurgery: Rostral Atrophy Following Stereotactic Subcaudate Tractotomy. *BJR British Journal of Radiology* 2010

Nickerson JP, Salmela MB, Koski CJ, Andrews T, Filippi CG. Diffusion Tensor Imaging of the Pediatric Optic Nerve: Intrinsic and Extrinsic Pathology Compared to Normal Controls. *Journal of Magnetic Resonance Imaging* 2010 July; 32 (1) : 76-81

Filippi CG, Andrews T, Gonyea JV, Linnell G, Cauley K, Magnetic resonance diffusion tensor imaging and tractography of the lower spinal cord: application to diastematomyelia and tethered cord, *European Society of Radiology*/ May 2010

Cauley K, Andrews T, Gonyea JV, Filippi CG, Magnetic Resonance Diffusion Tensor Imaging and Tractography of Intracranial Cavernous Malformations: Preliminary Observations and Characterization of Hemosiderin Rim, *J Neurosurg*. April 2010 112(4): 814-23

Salmela MB, Cauley KA, Nickerson JP, Koski CJ, Filippi CG. Magnetic Resonance Diffusion Tensor Imaging (MRDTI) and Tractography in Children with Septo Optic Dysplasia. *J Ped Radiology* 2010; 40 (5): 708-13

Salmela MB, Cauley KA, Andrews T, Gonyea JV, Filippi CG, Tarasiewicz I, Filippi CG, Magnetic Resonance Diffusion Tensor Imaging of the Optic Nerves to Guide Treatment of Pediatric Suprasellar Tumors, *Pediatric Neurosurg* 2009; 45: 467-471

Cauley KA, Filippi CG. Diffusion Tensor Imaging and Tractography of Rasmussen's Encephalitis. *J Ped Radiology* 2009; 39 (7):727-30

Nickerson JP, Koski CJ, Boyer AC, Burbank HN, Tandan R, Filippi CG. Longitudinal Decline in Fractional Anisotropy in Patients with Amyotrophic Lateral Sclerosis: Preliminary Results. *Klin Neuroradiol* 2009; 19 (2): 129-134.

Coderre, Emily L, Filippi, Christopher G, Newhouse, Paul A, Dumas, Julie A. The Stroop effect in kana and kanji scripts in native Japanese speakers: An fMRI study. *Brain and Language* 2008;107 (2): 124-132.

Abstracts/Presentations (selected)

Andrews T, Gentchos GE, Kouwenhoven M, Kotys MS, Gonyea J, Filippi CG. Reduction in Shading Artifacts at 3.0T Black Blood TSE Cardiac MR Imaging Using B1 Shimming, *Proceeding of the Radiologic Society of North America*, Chicago, 2010

Andrews T, Kotys M, Kouwenhoven M, Gonyea J, Ashikaga T, Gentchos GE. Image Quality Improvements for Balanced TFE at 3T Using a Clinical Parallel RF Transmission MR System. *ISMRM International Society of Magnetic Resonance in Medicine* 2010, Stockholm

Andrews T, Johnson AK, Gonyea J, Gallant J, Higgins TJ, Braff SP. Feasibility of 3 Tesla MR with Parallel Imaging in the Evaluation of Acute Abdominal Pain in Children. Proceedings of 94th Scientific Assembly and Annual Meeting, 2008

Christian, TF, Bell, SP, Gonyea JV, Andrews T. Mouse Cardiac MRI on a 3T Clinical system Using a Low Cost Setup. Journal of Cardiovascular Magnetic Resonance 2009

Dumas, J.A., Newhouse P.A. (2009) Working Memory and Emotional Processing in Geriatric Depression: An fMRI Study. Society of Neuroscience, Chicago IL.

Dumas, J.A., Kutz, A.M., Edgren, C., Newhouse P.A. (2009) Estrogen Modulation of Frontal Lobe Circuitry During Verbal Working Memory in Older Women. American Federation for Aging Research Grantee Conference, Santa Barbara, CA

Dumas, J.A. (2009) Hormones, Neurotransmitters, and Cognitive Aging: A New Hypothesis. International Congress of the International Psychogeriatric Association, Montreal, Quebec, Canada

Dumas, J.A., (2009). Aging, Sex Steroids, and Circuits: Hormonal Effects on Brain Activity Associated with Cognitive and Emotional Processes. American Association of Geriatric Psychiatry, Honolulu, HI

Johnson A, Johnson JM, Filippi CG, Braff S, Lemos F. Learning How to Interpret Ultrafast Abdominal MR Imaging at 3T for Acute Abdominal Pain with the Aid of CT Correlation in Pediatric and Young Adult Patients. RSNA Radiological Society of North America 2010, Chicago

Johnson JM, Gonyea JV, Andrews T, Filippi CG. VISTA 3D FLAIR Improves Lesion Detection and Conspicuity in Multiple Sclerosis. Proceedings of Annual ESNR (Eastern Society of Neuroradiology) Meeting, 2008

Kutz, A.M., Newhouse, P.A., Dumas J.A. (2009) Age Difference in Memory for Emotional Information: The Effect Encoding Instructions and Emotional Valence. Society for Neuroscience, Chicago, IL

Naylor, MR, Krauthamer M, Dumas, J, Filippi, C, Newhouse, P, Functional Magnetic Resonance Imaging Investigates Treatment Response to Cognitive-behavioral Therapy in Patients with Chronic Pain. World Psychiatric Association International Congress, Florence, Italy April 2009. World Psychiatry Journal, Volume 8 Supplement 1, PO3.95, p2f74. February 2009

Naylor MR, Krauthamer M, Dumas J, Filippi CG, Newhouse P, Change the mind and you can change the Effects on Brain Activity Associated with Cognitive and Emotional Processes. American Association of Geriatric Psychiatry, Honolulu, HI

Naylor MR, Krauthamer M, Dumas J, Keefe F, Newhouse P, fMRI to evaluate CBT treatment response to CBT in patients with chronic pain, the Neuroscience the Society of Behavioral Medicine's 30th Annual Meeting and Scientific Sessions, April 2009, Montreal, Quebec,

Naylor, M.R., Krauthamer G.M., Dumas, J.A., Filippi, CG, Newhouse, P.A., (2009) fMRI Investigates Treatment Response to CBT in Patients with Chronic Pain. Society for Neuroscience, Chicago IL.

Singh, P, Quick, A., Dumas, J.A., Filippi, CG, Lenox, S, Tandan, R (2009) Longitudinal Changes in Brain Activation on fMRI in ALS in Response to Finger Tapping and Word Generation Tasks. American Academy of Neurology

Zeeb LM, Kaye J, Green CE, Andrews T, Gentchos GE. Is 2-D Velocity Encoded Cardiac MRI Accurate at 3T? ISMRM International Society of Magnetic Resonance in Medicine 2010, Stockholm