



# Imaging in Medicine

## NEWS



## RESEARCH HIGHLIGHTS



## Diffusion tensor imaging technique demonstrates variation in patient responses to brain injury

A recent study published in the journal *Brain Imaging and Behavior* has revealed that concussion victims have unique spatial patterns of brain abnormalities that change over time. The research was performed at the Gruss Magnetic Resonance Research Center at Albert Einstein College of Medicine of Yeshiva University (Bronx, NY, USA).

It is known that patients vary widely in their response to concussions, however, until recently scientists have not found a way to determine the reason this happens. Using a new application for analyzing data from neuroimaging studies, researchers have revealed that concussion victims have unique spatial patterns of white matter abnormalities that change over time.

Diffusion tensor imaging was performed on a 3T MR scanner in 34 patients with mild traumatic brain injury and 30 healthy control subjects. The patients were imaged within 2 weeks of injury, 3 months after injury, and 6 months after injury. To visualize any individual differences, fractional anisotropy (FA; a diffusion anisotropy measure) images were computed and analyzed for each patient. To examine white matter diffusion abnormalities across the entire brain of the patients, the study authors applied Enhanced Z-score Microstructural Assessment for Pathology (EZ-MAP), a voxel-wise analysis optimized for the assessment of individual subjects.

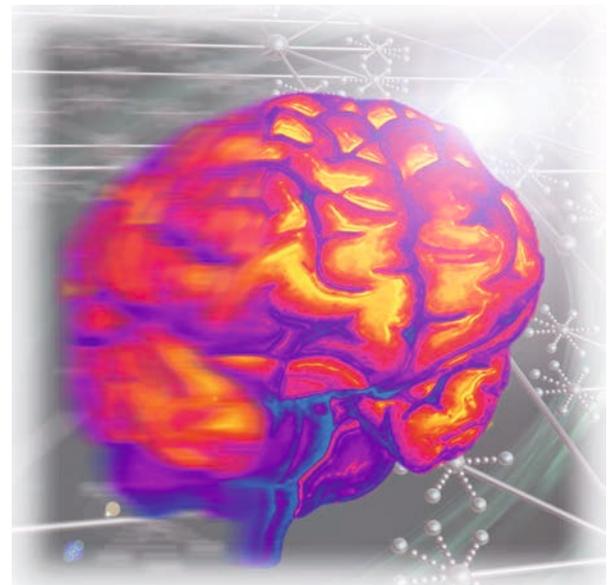
The study revealed areas of abnormally low or high FA. The spatial pattern

of white matter FA abnormalities varied among patients; areas of low FA were consistent with known patterns of traumatic axonal injury, and areas of high FA were most frequently detected in the deep and subcortical white matter of the frontal, parietal, and temporal lobes, and in the anterior portions of the corpus callosum.

Interestingly, the number of both abnormally low and high FA voxels changed during follow-up.

The researchers concluded that the individual subject assessments revealed unique spatial patterns of white matter abnormalities attributable to interindividual differences in anatomy, vulnerability to injury and mechanism of injury.

Lead author of the study, Michael Lipton, who is Associate Director of the Gruss Magnetic Resonance Research Center, explains that "In fact, most researchers have assumed that all people with concussions have abnormalities in the same brain





regions ... But that doesn't make sense, since it is more likely that different areas would be affected in each person because of differences in anatomy, vulnerability to injury and mechanism of injury."

Lipton adds that "We found widespread high FA at every time point, all the way out to 6 months and even in patients more than 1 year out from their injury ... We suspect that high FA represents a response to the injury. In other words, the brain may be trying to compensate for the injury by developing and enhancing other neural connections. This is a new and unexpected finding."

The authors hope that this new technique may help in the assessment of mild

traumatic brain injury, predicting which head injuries are likely to have long-lasting neurologic problems, and evaluating the effectiveness of treatments.

– Written by Sam Rose

Source: Lipton ML, Kim N, Park YK et al. Robust detection of traumatic axonal injury in individual mild traumatic brain injury patients: intersubject variation, change over time and bidirectional changes in anisotropy. *Brain Imaging Behav.* 6(2), 329–342 (2012).

## New development set to sharpen up cardiac 4D PET images

A novel development in molecular imaging – 4D PET image reconstruction – has recently been unveiled at the Society of Nuclear Medicine's 59th Annual Meeting (Miami, FL, USA). The method compensates for the blurring caused by rhythmic movements of the heart and lungs commonly seen in currently used diagnostic cardiac imaging, providing a sharper image.

Although a long way from clinical implementation, the Chinese researchers behind the development are hopeful that their work will improve heart viability studies: "This research provides an opportunity to further improve the diagnostic accuracy of cardiac PET imaging, which can be exchanged to some degree for faster scanning and lower

dose," explained Si Chen, lead author of the study and research scientist for the Department of Engineering Physics at Tsinghua University (Beijing, China).

"People have previously worked on compensating for either cardiac or respiratory motion in image reconstruction in the past, but our research is the first viable reconstruction of a PET image with compensation for both cardiac and respiratory motion using all the PET data," Chen continued.

The 4D PET image reconstruction uses quantitative image data and a specially developed algorithm to transform the blurred image into a clearer version. Using PET data from multiple cardiac stress tests the researchers found that the new method significantly improved imaging

contrast between the myocardium and heart chambers by 15% and that it reduced image noise by 60% compared with conventional methods of image reconstruction with cardiac gating.

It is estimated that 2–3 years of further investigation are required before the 4D PET image reconstruction is suitable for clinical implementation; however, once the multiple phases of clinical evaluation are complete, its use could reduce patient exposure and the time taken to perform diagnostic cardiac imaging.

– Written by Sarah Miller

Source: Society of Nuclear Medicine Press Release: <http://interactive.snm.org/index.cfm?pageid=11718>

## New guidelines proposed for low-dose CT lung cancer screening

A recent US task force has recommended new guidelines for lung cancer screening, based on new research that low-dose CT can reduce lung cancer-specific mortality by 20%. The guidelines were published in the *Journal of Thoracic and Cardiovascular Surgery*.

The lung screening and surveillance multispecialty task force was established by the American Association for Thoracic Surgery (AATS; Beverly, MA, USA) and led by clinicians from Brigham and Women's Hospital (Boston, MA, USA). The 14-member team comprises thoracic

surgeons, thoracic radiologists, medical oncologists, a pulmonologist, a pathologist and an epidemiologist. A review of screening trials in the USA and Europe, an examination of current literature and discussions of clinical practices led the task force to create new evidence-based screening guidelines, specifically for groups at a higher risk of developing lung cancer and survivors of lung cancer in North America.

The new AATS guidelines call for annual lung cancer screening using low-dose CT for smokers and former smokers

in North America between the ages of 55 and 79 years who have smoked the equivalent of a pack of cigarettes a day for 30 years. In addition, other at-risk groups that have been identified as candidates are smokers and former smokers between the ages of 50 and 79 years who have smoked the equivalent of a pack of cigarettes a day for 20 years, and have an additional cumulative risk of developing lung cancer of 5% or greater over the following 5 years; and long-term lung cancer survivors up to the age of 79 years (to detect a second case of primary lung cancer).



Other societies have previously proposed guidelines for lung cancer screening, however, these differ in that they recommend screening for patients up to the age of 79 years, as opposed to up to the age of 74 years. In addition, they address lung cancer survivors and recommended that screening should not be performed for individuals with conditions that would preclude successful treatment for lung cancer.

David Sugarbaker, the chief of the division of thoracic surgery at Brigham and Women's Hospital and president-elect of the AATS, initially decided to create the guidelines. He said that "This work will result in a greater chance for patients

stricken with early lung cancer to receive curative therapy."

Michael Jaklitsch, another Co-Chair of the task force, explained, "Lung cancer is an epidemic with over a quarter of a million new cases each year. Now, for the first time in history, there is a clear screening tool that identifies early stages of lung cancer, when treatment is most successful. Our analysis shows this tool of low-dose CT scans to be safe and very cost efficient. Lung cancer screening will save lives, save lungs and inspire many Americans to quit smoking."

The researchers emphasize that lung cancer screening requires participation by a subspecialty-qualified team. The AATS

will continue engagement with other specialty societies to refine future screening guidelines.

– Written by Sam Rose

Source: Jaklitsch MT, Jacobson FL, Austin JH et al. *The American Association for Thoracic Surgery guidelines for lung cancer screening using low-dose computed tomography scans for lung cancer survivors and other high-risk groups.* J. Thorac. Cardiovasc. Surg. 144(1), 33–38 (2012).

## PET/CT for staging esophageal cancer may help improve survival

Researchers have demonstrated that primary staging of esophageal cancer with PET/CT can distinguish incremental information that could significantly impact patient management plans. The findings were recently published in the *Journal of Nuclear Medicine*.

Initial staging of esophageal cancer is of particular importance in order to determine whether to opt for curative or palliative therapy for the patient. This study sought to evaluate the benefits of primary staging with PET/CT compared with conventional staging investigations, with regard to its effect on incremental staging information, management impact and prognostic stratification of PET/CT in the primary staging of esophageal cancer in a cohort of patients with mature survival data.

Thomas Barber, from the Center for Cancer Imaging of the Peter MacCallum Cancer Center (East Melbourne, Victoria, Australia), and lead author of the study, said "The superior accuracy of PET/CT compared with conventional staging investigations, such as CT, allows clinicians to more appropriately choose and more

appropriately plan patient therapy. Our data also show that when PET/CT changes management, it does so correctly in almost all cases."

The study followed 139 patients with newly diagnosed esophageal cancer. Each of the patients underwent conventional staging investigations of CT and/or endoscopic ultrasound, followed by PET/CT. When staging data from the conventional staging investigations differed from the PET/CT information, results were confirmed by pathologic/intraoperative findings or serial imaging and clinical follow-up. The impact on patient management plans was assessed by comparing pre-PET/CT plans with post-PET/CT plans. Survival rates of patients were also recorded after 5 years.

Results of the study demonstrated that information collected from imaging with PET/CT altered the stage group for 59 of the patients (40%) and the management plan for 47 of the patients (34%). Of the 47 patients who had a change in their management plan, imaging results were validated in 31 patients, and PET/CT correctly changed management in 26 (84%)

of these. The 5-year survival rate for patients with stage IIB–III disease was 38%, which is considerably higher than results previously reported (9–34% in stage IIB and 6–16% in stage III).

Barber added, "These results demonstrate the power of metabolic imaging with FDG PET/CT when staging esophageal cancer ... Our results demonstrate that this technique should be incorporated into routine clinical practice."

This study demonstrates that PET/CT can provide incremental staging information compared with conventional staging methods, which may change the management in one-third of patients with a view to improve their survival. The authors believe that PET/CT has powerful prognostic stratification in the primary staging of esophageal cancer.

– Written by Sam Rose

Source: Barber TW, Duong CP, Leong T, Bressel M, Drummond EG, Hicks RJ. *<sup>18</sup>F-FDG PET/CT has a high impact on patient management and provides powerful prognostic stratification in the primary staging of esophageal cancer: a prospective study with mature survival data.* J. Nucl. Med. 53(6), 864–871 (2012).

### ■ About the News

The News highlights some of the most important events and research in the field of imaging in medicine. If you have newsworthy information, please contact: Sam Rose, Commissioning Editor, *Imaging in Medicine*, s.rose@futuremedicine.com