Example R21 and R01 Abstracts

for Mock Study Section

R21 Vulnerable Plaque Detection with Carotid Stain Imaging

Current clinical criteria for treatment of atherosclerotic plaque or atheromas, has focused primarily on percent stenosis of the vessel. However, percent stenosis does not identify plaque prone to rupture that may release emboli into the blood stream of the sensitive cerebral vasculature. These ‘vulnerable’ plaques are particularly prone to produce sudden major problems, such as a heart attack or stroke. Atheromas become vulnerable if they grow rapidly and have only a thin fibrous cap separating the soft lipid pool and other plaque constituents from the bloodstream. Structural stability of carotid plaque is a result of its chemical composition, cellular material and new vessel formation. Various studies have indicated that pulsatile pressure induced due to blood flow may rupture the thin cap overlying lipid rich lesions, leading to subsequent thrombosis and plaque rupture. Plaque vulnerability is therefore determined primarily by the mechanical (elastic) properties of the vessel wall and plaque composition.

Ultrasound-based strain imaging can provide a means of identifying vulnerable plaque. A novel approach to strain imaging, where pulsation of blood through the carotid artery is used to induce tissue displacements for strain imaging, will be developed and evaluated. We propose the use of three ‘strain indices’ namely; maximum accumulated axial strain, maximum lateral displacement and strain, and shear strains in plaque over the cardiac cycle as measures of plaque vulnerability. To obtain the normal and shear strain tensors, we propose to utilize beam-steered radiofrequency data acquired along different angular insonification directions to compute the displacement vectors and subsequently the strain tensors. We will also incorporate a modified dynamic 2D multi-level cross-correlation method to track local displacements with the angular data acquired. Our preliminary results demonstrate the ability to differentiate between soft and stiffer plaque noninvasively. The long term objectives are to provide a non-invasive measurement of patients at risk for plaque rupture, expanding upon the current criteria for treatment for atherosclerotic risk based on focal transient ischemic attacks or strokes. The limited in-vivo study on patients will be complimented by a similar analysis on a control group of age-matched volunteers to determine the significance of the ‘strain indices’ for discrimination of vulnerable plaque.

Finally, the entire excised plaque core following carotid endarterectomy will be further evaluated using histological analysis at the same in-vivo transverse cross-sections (based on measurements from the flowdivider) where strain imaging was performed to better understand plaque composition and structure (along with microulcerations and neovascularity) to the information displayed on the normal and shear strain images.

R01 Eyestrain in Radiologists

Today's advanced imaging modalities are acquiring more and more images that must be interpreted in less time. Concerns have been raised that radiologist workloads are so demanding that fatigue and reduced time for interpretation are **negatively impacting diagnostic accuracy**. Inadequate knowledge about the frequency, cause and impact of errors, as well as effective methods for error prevention is a major obstacle for improving health care quality. The failure to report abnormal radiographic findings accounts for about *half* the errors made. Avoiding false negative errors is critical - with such errors treatment does not occur. In the previous funding period we demonstrated that **fatigue significantly reduces detection accuracy** in simple detection tasks and that oculomotor strain is a contributing factor. The goal of the proposed research is to determine whether ***cognitive fatigue*** can more accurately and fully account for increases in errors in ***complex*** radiologic decision tasks. **The long-term goal is to reduce diagnostic errors by studying an obvious but serious problem, fatigue, to determine whether it is indeed a root cause of error.** This research will address the problem by applying comprehensive measures of cognitive fatigue and determining whether they generate diagnostic errors. At the end of the project, we will understand the influence of cognitive fatigue on diagnostic accuracy, which will help us in our general goal of ***reducing diagnostic errors*** thereby ***improving patient care.*** Our overall hypothesis is that the current practice of radiology produces cognitive fatigue that reduces diagnostic accuracy. Progress in understanding the causes of error in diagnostic radiology has been achieved by experiments focusing on error-prone situations such as Satisfaction of Search (SOS), but to date the role of fatigue in SOS has yet to be examined and thus the *first aim* will discover ways to help radiologists obviate SOS errors by *testing* whether cognitive fatigue exacerbates the SOS phenomenon. Our *second and third aims* relate cognitive fatigue to radiological performance using two types of complex imaging tasks studied before and after long hours of image interpretation work. The *accuracy* and *efficiency* of radiologist's reports will be analyzed and correlated with measures of cognitive fatigue.