A National Neuroimaging Database: A Call to Action

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Special Report

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The Cardiovascular Health Study (CHS) was funded by the National Heart, Lung, and Blood Institute (NHLBI) in 1989 to assess risk factors for myocardial infarction, stroke, and other cardiovascular diseases. Participants aged 65 and older were recruited from random samples of Medicare eligibility lists in four communities: Sacramento County, California; Washington County, Maryland; Forsyth County, North Carolina; and Pittsburgh, Pennsylvania. MR imaging was performed between 1991–1994 and then again between 1997–1999. Imaging examinations included sagittal T1-weighted, axial dual-echo proton density–weighted and T2-weighted, and axial T1-weighted sequences at 5-mm intervals with no intersection gaps. Patients who underwent MR examination during the second imaging period (1997–1999) also underwent 3D axial spoiled gradient echo imaging at 1.5-mm intervals to obtain high-quality volumetric images. There were 3660 participants during the initial MR imaging period, and 2317 underwent imaging during the second period; 2116 participants were imaged during both periods. Thus, the database includes 5977 images obtained in 3861 participants. The investigators of the CHS would like to invite neuroscience researchers to make use of the MR images and summary data collected from the participants in the CHS study.

An original cohort of 5201 participants was enrolled between 1989–1990 and a second cohort of 687 African American participants was enrolled 3 years later. The combined cohort of 5888 comprised 58% female and 16% African American participants. Average age at enrollment was 73 years. Details of study design and recruitment have been published previously and are available for review (1, 2). Participants underwent an extensive clinical examination at baseline that included recording of medical history and medication, venipuncture, blood pressure measurement, physical examination, electrocardiography, and sonography of the carotid arteries. Components of the examination were repeated annually through May 30, 1999. New cardiovascular events were reported by participants during semi-annual interviews, and medical records were obtained and events adjudicated by committee (3).

MR imaging findings were interpreted by two readers for the presence of infarcts, white matter ischemic changes, and parenchymal volume loss. Infarcts were graded for size and location and lesions classified on the basis of 23 anatomic locations. The degree of white matter ischemic change, sulcal prominence, and ventricular prominence were assessed by use of a 10-point scale from zero to nine (zero, least advanced; nine, most advanced). Assessment was based on a pattern-matching approach comparing participant images to a library of template images. The reproducibility of the scores within one grade was high.

The data from this study have recently been archived in a central database that can be queried electronically according to demographic information or study time. The CHS Executive Committee has elected to offer data to interested parties to maximize the potential benefit of this longitudinal study of atherosclerosis and aging. Interested researchers are referred to the CHS website (http://chs-nhlbi.org) for information on proposing an original investigation or ancillary study that makes use of the CHS MR imaging data. The Johns Hopkins Reading Center, under the direction of David M. Yousem, MD, MBA, will be coordinating the dissemination of this protected, confidential imaging database, while the main study center at the University of Washington will provide clinical information. Requests for ratings without raw image data will be handled by the University of Washington Coordinating Center.

The mechanism for submitting ancillary studies (as in RO1s) to the main grant is available through the main CHS center, and requests for a limited-access dataset may be submitted to the NHLBI as described at http://www.nhlbi.nih.gov/resources/deca/directry.html. The limited-access dataset contains clinical data and MR imaging summary variables for CHS participants who consented to general use of their imaging findings. Electronic files of the images reside at the MRI Reading Center with Dr. Yousem.

CHS investigators have published articles on the association of MR imaging abnormalities with cardiovascular (4–9), disease and cognitive impairment with

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aging (10–18). Investigators have correlated the presence of MR-demonstrated infarctions on T2-weighted images and clinical history of transient ischemic attacks (19), homocysteine levels (20), diabetes and stroke (4, 6, 8, 21), sonographically demonstrated carotid atherosclerosis and stroke (9, 22), incidence of white matter foci (4, 8, 10, 11) and many vascular risk factors (4, 5), sex (12), and age (15, 23) have been published. Others have used volumetric pulse sequences to analyze relationships of brain size with age or educational level (24). Current studies in progress include evaluations of change in MR imaging measurements between two studies and their associations with cognitive function, risk factors, and outcomes. More work and creative ideas are needed in all of these areas to maximize this resource. Exploring associations with laboratory, clinical, echocardiographic, or electrocardiographic data are also possible. For example, an investigator wishing to correlate apolipoprotein E allelic type with rate of temporal lobe volume loss between two time points could use CHS data to his or her advantage. If one wanted to correlate depression with orbitofrontal ischemic changes, CHS could supply age- and sex-adjusted scales for both. The wealth of data present in this material is astounding, because both imaging and clinical-laboratory data are of excellent quality.

Now that this resource has become electronically available, the onus is on the members of the neurosciences community not to squander this opportunity. This invitation to participate is initially extended to neuroradiologic and general radiologic researchers to partake of the fruits of many years' labor. The database will also be of interest to our clinical colleagues, and subsequent editorials and promotional advertisements will appear in clinical journals and websites.

Who within the neuroradiologic community will take advantage of this opportunity?

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