Combined Multi-Pinhole and Fan-Beam Brain SPECT

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Country

USA

Title of project or programme

Combined Multi-Pinhole and Fan-Beam Brain SPECT

Source of funding information

NIH (NINDS)

Total sum awarded (Euro)

€ 1,307,028.44

Start date of award

18/05/2016

Total duration of award in years

4

The project/programme is most relevant to:

Parkinson's disease & PD-related disorders

Keywords

Collimator, Tomography, Emission-Computed, Single-Photon, Occipital lobe, Parkinson Disease, imaging agent

Research Abstract

? DESCRIPTION (provided by applicant): The recent FDA approval of the SPECT imaging agent I-123 labeled DaTscan for diagnosis and monitoring progression of Parkinson’s Disease

(PD) has open up a new era in SPECT brain imaging. Unlike with perfusion imaging where the entire brain is the volume of interest, with PD the structures of interest are the putamen and caudate (and potentially substantia nigra) which lie in the interior portion of the brain. However imaging of the occipital lobe is also required with PD for calculation of the striatal binding rati (SBR), a parameter of significance in the early diagnosis and differentiation of PD from other disorders with similar clinical presentations. Our hypothesis is that combining a specifically designed multi-pinhole (MPH) collimator on one detector head with a fan-beam collimator on the remaining head of current dual-headed SPECT systems, coupled with iterative reconstruction with modeling system spatial resolution, will result in improved detection and quantification of structures in the interior region of the brain at marginal cost (the price of collimator(s) and reconstruction software). The MPH collimator would be designed to provide enhanced spatial resolution / sensitivity for the interior of the brain. The fan-beam collimator would provide lower resolution but complete sampling of the brain addressing data sufficiency and allowing a volume-of-interest to be defined over the occipital lobe for calculation of SBR's. Clinically this would provide a low-cost system allowing improved visualization and relative quantification of function of structures in the interior region of the brain, potentially as small as the ~4 mm substantia nigra, which cannot currently be achieved by other than expensive, brain dedicated, SPECT systems. This would greatly impact the early detection and differentiation of PD, and possibly other neurological disorders as new SPECT imaging agents are approved. Our approach for further investigating our hypothesis is based on the initial exploration we have conducted under funding provided by NIH R21 EB016391 and is organized into five specific aims. The first specific aim is to complete the optimization of the MPH collimator design through task-based optimization for the tasks of detection using the Channelized Hotelling Observer (CHO) and quantification of striatal function by calculation of the SBR. The second specific aim is to finish development of inclusion of MPH system geometry and response in reconstruction. The third specific aim is to have our colleagues at the Center for Gamma Ray Imaging (CGRI) at the University of Arizona construct the MPH. The fourth specific aim is to install and test the combined fan-beam and MPH system on a SPECT/CT camera using phantoms. Our fifth specific aim is to image five patients with the combined system.

Lay Summary

PUBLIC HEALTH RELEVANCE: The recent FDA approval of the SPECT imaging agent I-123 labeled DaTscan for diagnosis and monitoring progression of Parkinson’s Disease (PD) has open up a new era in SPECT brain imaging where the structures of interest are the putamen and caudate (and potentially substantia nigra) which lie in the central interior portion of the brain. However imaging of the occipital lobe is also required with PD for calculation of the striatal uptake ratio, a parameter of significance in the differentiation of PD from other disorder with similar clinical presentations. Our hypothesis is that combining a specifically designed multi- pinhole (MPH) collimator on one detector head with a fan-beam collimator on the remaining head of current SPECT systems, coupled with iterative reconstruction with modeling system spatial resolution will result in improved detection and quantification of structures in the interior region of the brain at marginal cost (price of collimator(s) and software). This would greatly impact the early detection and differentiation of PD, and potentially other neurological disorders as new SPECT imaging agents are approved. The improved resolution could enable the use of new relative quantification strategies which could further improve detection and tracking. It would also serve as an example of what could be accomplished with MPH collimators designed for other clinical procedures.

Further information available at:

Types:
Investments > €500k

Member States:
United States of America

Diseases:
Parkinson's disease & PD-related disorders

Years:
2016

Database Categories:
N/A

Database Tags:
N/A