PET scans

Amyloid PET

Participants over age 55 undergo ^{1}F-Florbetaben PET scans to assess amyloid burden. Participant preparation consists of intravenous catheterization followed by the bolus injection (over 10-20 sec) of the tracer. PET scans are acquired on a Siemens Biograph64 mCT/PET scanner in dynamic, 3D imaging mode beginning 50 min after injection. Brain images are acquired in 4 X 5-minute frames over a period of 20 minutes. The images are immediately assessed for technical validity. If considered inadequate, the participant will have an additional 20 minutes of continuous imaging. Transmission scans are done prior to the scan. If there is a repeat scan, transmission will be done after the scan.

Amyloid SUVR are available by FreeSurfer regions using an automatic quantification technique to reconstruct Amyloid PET scans. [2]The process starts by aligning four dynamic PET frames to the first frame using rigid-body registration and generating a static PET image by averaging the four registered frames. The static PET volume is then registered with the CT and merged to generate a composite image. Each individual's structural T1 scan, after being reconstructed with FreeSurfer, is registered directly to the static Tau PET volume using an inter-modal and intra-subject registration technique (rigid-body registration: 6 degree of freedom, mutual information). FreeSurfer regional masks are then used to extract regional uptake values. Regional and voxel-wise Tau PET SUVRs are obtained by normalizing the regional and voxel-wise uptake value with the average uptake value in the cerebellum gray matter region. We use K-means clustering of log-transformed SUVR values to classify each participant's overall scan as "amyloid positive" or "amyloid negative"[3]. In addition, a reading of the generated static PET images by two trained radiologists yields a rating of amyloid positive or negative.

Tau Burden

Participants over age 55 undergo 18F MK-6240 imaging to assess Tau burden using the same mCT/PET scanner. An intravenous bolus injection (target dose: 5 mCi) of the tracer is administered 80 to 100 minutes prior to the image acquisition. Six dynamic frames are acquired within 30 minutes (6x5 mins) of scanning. An iterative reconstruction algorithm is used to generate dynamic PET volumes with 1x1x2 mm voxel size.

Tau SUVR are also available following the same procedures described above for amyloid PET. We use K-means clustering of the global SUVR values of the participants to determine a threshold for classify each participant's overall scan as "Tau positive" or "Tau negative". A reading by two trained radiologists also yields a rating of Tau positive or negative. In addition, we use the method described by Scholl et al[4] to determine a Braak score.

[1]Lee S, Habeck C, Razlighi Q, Salthouse T, Stern Y. Selective association between cortical thickness and reference abilities in normal aging. Neuroimage. 2016. doi: 10.1016/j.neuroimage.2016.06.041. PubMed PMID: 27353567.

[2]Tahmi M, Bou-Zeid W, Razlighi QR. A Fully Automatic Technique for Precise Localization and Quantification of Amyloid-beta PET Scans. J Nucl Med. 2019;60(12):1771-9. Epub 2019/06/07. doi: 10.2967/jnumed.119.228510. PubMed PMID: 31171596; PMCID: PMC6894379.

[3]Villemagne VL, Mulligan RS, Pejoska S, Ong K, Jones G, O'Keefe G, Chan JG, Young K, Tochon-Danguy H, Masters CL, Rowe CC. Comparison of 11C-PiB and 18F-florbetaben for Abeta imaging in ageing and Alzheimer's disease. Eur J Nucl Med Mol Imaging. 2012;39(6):983-9. doi: 10.1007/s00259-012-2088-x. PubMed PMID: 22398958.

[4]Scholl M, Lockhart SN, Schonhaut DR, O'Neil JP, Janabi M, Ossenkoppele R, Baker SL, Vogel JW, Faria J, Schwimmer HD, Rabinovici GD, Jagust WJ. PET Imaging of Tau Deposition in the Aging Human Brain. Neuron. 2016;89(5):971-82. doi: 10.1016/j.neuron.2016.01.028. PubMed PMID: 26938442; PMCID: PMC4779187.