AbstractID: 3579 Title: Radiation Dose Response Curve of Human Cerebral Cortex Measured with [F-18]-FDG and [O-15]-H2O PET Imaging

Purpose:

To study radiotherapy (RT)-induced dose-dependent functional changes in the human cerebral cortex region using serial ^{18}F-FDG and ^{15}O-H_2O PET imaging before and after RT.

Method and Materials:

Eleven human subjects were enrolled in an IRB-approved prospective study to quantitatively measure changes in post-RT brain function. ^{18}F-FDG and ^{15}O-H_2O PET images were taken pre-RT, and again at 3 weeks and 6 months post-RT, to quantitatively assess for RT-induced changes in relative metabolism and relative regional blood flow (RBF). The 3 week and 6 month follow-up evaluations were available for 7 and 6 patients, respectively. Follow-up images were registered to their corresponding pre-RT baseline images, as well as to the treatment planning CT/MRI scans, for quantitative analysis. Relative changes in regional ^{18}F-FDG and ^{15}O-H_2O PET activities were related to regional RT dose. Regions of the cerebral cortex receiving <5Gy served as "controls" for imaging normalization. Irradiated regions were binned, based on 5Gy intervals, up to 62Gy. Individual and population dose response curves were then generated in PLUNC (PlanUNC).

Results:

At both post-RT time intervals, stable reductions in relative FDG uptake (average 2-6%, range -8 to 13%, generally <8%) were seen in the cerebral cortex, particularly in the regions receiving >40-50Gy. Initially, relative RBF increases (generally <10%) were observed on 15O-H2O PET imaging (3 week follow-up), but were much less significant at the 6-month follow-up.

Conclusion:

The response of cerebral cortex tissue to RT can be detected, in a dose-dependent manner, using ^{18}F-FDG PET. The magnitude of the changes, however, was typically small (<8%). Initially there were increases in relative RBF, but no discernable changes were seen at 6 months followup in ^{15}O-H_2O PET. Further studies are needed for more conclusive results. Results from neuropsychological testing will be used to assess the potential clinical impact of the changes measured by PET.