AbstractID: 7307 Title: Activity Recovery from Dual Radiotracer PET Scans

Purpose: Comprehensive assessment of tumor biological substructure requires multiple PET radiotracers resulting in time-consuming imaging procedures. Ideally, multiple PET scans should be performed during one "imaging session," resulting in the presence of multiple radiotracers during the later scans. We aim to develop a methodology to recover the activities of two mixed radionuclides present during a PET scan.

Method and Materials: A heterogeneous tumor phantom composed of empty acrylic spheres mounted inside a cylindrical "background region" filled with low-activity ^{18}F solution was scanned for 10-minutes. Then, high-activity ^{64}Cu solution was injected into the spheres while low-activity ^{64}Cu solution was mixed into the background region and a 600-minute dynamic PET scan was acquired. Images containing one radionuclide were subtracted from dual-radionuclide images, yielding "recovered images" of each radionuclide. Recovered images were compared with single radionuclide reference images.

Subsequently, canine subjects with nasopharyngeal tumors were injected with ^{64}Cu-ATSM (hypoxia radiotracer) and scanned 24 hours later, followed immediately by ^{18}FLT injection (cellular proliferation radiotracer) and another scan. Images from ^{64}Cu-ATSM canine scans were subtracted from dual-radiotracer images.

Results: Recovered phantom images closely correlated with reference images. ^{64}Cu image correlation coefficients were consistently higher than 0.96 and increased as ^{18}F "contamination" decayed. ^{18}F image correlation coefficients were higher than 0.95 for ^{18}F background activities greater than 14% of the total background activity. By image subtraction, the biological distribution of ^{18}FLT in the canine nasopharyngeal tumors was recovered from the dual-radiotracer images.

Conclusions: Radionuclide activities can be effectively recovered from PET scans containing two mixed radionuclides. Subtraction of single radiotracer images from dual-radiotracer images is a reliable method of activity recovery, provided the pharmacokinetics of one radiotracer is stable during dual-radiotracer image acquisition. Implications are positive for sequential imaging of different physiological functions using multiple radiotracers during one "multiple PET scan" imaging session.