

An Investigation Of Partially Extracted Tracers Used To Determine Myocardial Blood Flow With PET

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Position Emission Tomography (PET) provides the ability to quantitatively measure mass-specific blood flow to myocardial tissue (ml/min/g tissue). The partially extracted tracers ^{52}Cu -PTSM and two single photon emission computed tomography (SPECT) agents, teboroxime and sestamibi were studied. The latter two demonstrate the effectiveness of PET as a pharmacological tool for SPECT perfusion tracer development. The characteristics of these tracers were compared to commonly used partially extracted tracers $^{13}\text{NH}_3$ and ^{82}Rb .

Positron emitting $^{94\text{m}}\text{Tc}$ was used to label ligands originally developed for $^{99\text{m}}\text{Tc}$ labeling. $^{94\text{m}}\text{Tc}$ can be produced by the bombardment of a natural molybdenum foil with an 11MeV proton beam, via the $^{94}\text{Mo}(p,n)^{94\text{m}}\text{TC}$ reaction. The production of $^{94\text{m}}\text{Tc}$ is accompanied by ^{92}Tc , ^{94}Tc , ^{95}Tc , $^{95\text{m}}\text{Tc}$, ^{96}Tc , and $^{99\text{m}}\text{Tc}$ due to the isotopic mixture of natural Mo. The presence of these radionuclidic impurities increase the radiation dose received by the patient and radio chemist. The elimination of these impurities was achieved by irradiating an isotopically enriched target material, $^{94}\text{MoO}_3$. The ability to reclaim the enriched target is essentially due to the high cost of the material. Recovery was accomplished by a solvent extraction technique yielding an activity recovery of 80% and target material recovery of 95%.

Preliminary data was measured for the myocardial perfusion tracer ^{62}Cu -PTSM. It was found that the uptake of ^{62}Cu -PTSM is linear for resting flows but a high degree of variability is observed at stress induced flows. This same result was found in the human studies when compared to $^{13}\text{NH}_3$ measured myocardial perfusion values.

The dynamic analysis of multiple tracers in the sequence of protocols:

- acutate canine prep (^{11}Co , ^{82}Rb , ^{62}Cu -PTSM, $^{123}\text{NH}_3$, $^{94\text{m}},^{99\text{m}}\text{Tc}$ -BATO, H214O, $^{18}\text{FCH}_3$)
- chronic canine prep (^{82}Rb , $^{13}\text{NH}_3$, ^{62}Cu -PTSM)
- normal human studies ($^{13}\text{NH}_3$, $^{94\text{m}}\text{Tc}$ -BATO, $^{94\text{m}}\text{TC}$ -MIBI, ^{62}Cu -PTSM)
- ischemic patients ($^{13}\text{NH}_3$, $^{94\text{m}}\text{TC}$ -BATO, $^{94\text{m}}\text{Tc}$ -MIBI, ^{62}Cu -PTSM)

illuminates the limitations of all partially extracted myocardial perfusion tracers. The breadth of this comparative study points out clearly the need to address the problems of flow-dependent extraction and blood-borne labeled metabolites in the compartmental analysis of these imperfect tracers.