ORIGINAL ARTICLE

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Fluctuation of adenosine concentration by modes of intravenous infusion based on mathematical simulation and experiments

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Objective: Adenosine, which has been used for a myocardial perfusion scan, shows rapid clearance from blood because of its short half-life of <10 seconds. This simulation study evaluates influences of modes of radionuclide injection on ventricular adenosine concentration when one intravenous injection line is used. ***Methods:*** Assuming that radionuclide injection is a unit impulse, time-activity curves were measured in the left ventricle (LV) and fitted by a gamma function. Typical patterns of concentration fluctuation when adenosine infusion was temporarily modified were calculated by the convolution integral of input function and unit impulse response. Variation of concentration was measured by experiments using continuous ^{99m}Tc injection and co-infusion of water via a three-way stopcock. Modes of co-infusion with various infusion speeds and volumes were examined. ***Results:*** Intermission of adenosine infusion and rapid displacement by radionuclide co-injection significantly influenced the adenosine concentration in LV. Intermission of adenosine infusion for 2 seconds caused a 15% decrease in the adenosine concentration in the left ventricle. When a square-shaped input was assumed, a three-fold higher concentration of adenosine for 3 seconds created by radionuclide injection resulted in a +42% increase in the LV concentration. Based on a measured input function, radionuclide injection using three-way stopcock through one route caused a two- to three-fold increase in the steady concentration in the vein just after injection. When 0.5 m*l* of radionuclide was slowly co-injected, with three ways opened, it caused a relatively low fluctuation, creating a +34% to –47% change in concentration of LV. A flush of radionuclide with physiological saline significantly increased the adenosine concentration in LV, when short half-lives were assumed. ***Conclusion:*** An intravenous adenosine and radiopharmaceutical injection in the same line is feasible. However, the fluctuation of concentration depends significantly on the mode of injection. To minimize the fluctuation, a slow injection of a small volume of a myocardial imaging agent via a co-injection route, with three ways opened, is recommended.

Key words: adenosine, myocardial perfusion imaging, adverse effect, simulation