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Optimization of Injected Dose for Myocardial Flow Quantification in ^{13}N ammonia PET with Time of Flight Scanner. Noise Equivalent Count Rate analysis

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[Purpose]

Myocardial blood flow quantification (MBF) is one of the distinctive features for cardiac PET. It is commonly known that the MBF is not influenced by injected dose because the input function (IF) is obtained from time activity curve (TAC). However, there is a substantial risk of count-loss when obtaining TAC because high radioactivity of perfusion tracer goes through left-ventricular cavity sized 10-40mL within a few minutes. We aimed to determine the optimal dose for MBF using noise equivalent count rate analysis (NECR).

[Methods]

We used a high resolution, time of flight scanner with LYSO crystal (Biograph mCT, Siemens) for phantom study. 10mL of syringe was placed in thyroid uptake neck phantom to mimic end-systolic left ventricular cavity. 1500MBq of ^{13}N was filled in the syringe, and a set of single session with 3D list-mode scan for 120sec (60sec acquisition followed by 60sec stand-by) was repeated 31 times to simulate the acquisition with injected dose of 1500 down to 20MBq. This session was repeated for 6 days (6 sessions with 186 scans in total) to obtain mean value. Radioactivity (MBq/mL) was measured by drawing volume of interest on the 3D-OSEM reconstruct images. Random and net true count rate were calculated and compared to the estimated injected doses. NECR curve analysis was used to determine the optimal injected dose.

[Results]
The attenuation curves showed best correlation at dose of 185, 370 and 740 MBq (r = 1.0, 1.0, and 1.0; p <*0.001*, <*0.001*, and <*0.001*, respectively). NECR analysis revealed that the random counts were significantly suppressed for the injected dose with 22 to 40 MBq/mL, while the count rate started to decrease over 40MBq/mL (figure). The optimized injected dose was determined as 222 to 555MBq.

[Conclusion]
Simulative analysis for ^{13}N derived MBF using cylindrical phantom mimicking end-systolic left ventricular cavity confirmed that the risk of count-loss was minimized at the recommended dose in guideline. This result confirmed the feasibility of myocardial flow quantification and can be supportive data in clinical routine.