Quantification of myocardial blood flow with 82Rb positron emission tomography: clinical validation with 15O-water.

Summary / Zusammenfassung

PURPOSE: Quantification of myocardial blood flow (MBF) with generator-produced (82)Rb is an attractive alternative for centres without an on-site cyclotron. Our aim was to validate (82)Rb-measured MBF in relation to that measured using (15)O-water, as a tracer 100% of which can be extracted from the circulation even at high flow rates, in healthy control subjects and patients with mild coronary artery disease (CAD).

METHODS: MBF was measured at rest and during adenosine-induced hyperaemia with (82)Rb and (15)O-water PET in 33 participants (22 control subjects, aged 30 ± 13 years; 11 CAD patients without transmural infarction, aged 60 ± 13 years). A one-tissue compartment (82)Rb model with ventricular spillover correction was used. The (82)Rb flow-dependent extraction rate was derived from (15)O-water measurements in a subset of 11 control subjects. Myocardial flow reserve (MFR) was defined as the hyperaemic/rest MBF. Pearson's correlation r, Bland-Altman 95% limits of agreement (LoA), and Lin's concordance correlation $\rho_c$ (measuring both precision and accuracy) were used.

RESULTS: Over the entire MBF range (0.66-4.7 ml/min/g), concordance was excellent for MBF ($r = 0.90, [(82)Rb-(15)O-water] mean difference ± SD = 0.04 ± 0.66 ml/min/g, LoA = ±1.26 to 1.33 ml/min/g, $r = 0.88$) and MFR (range 1.79-5.81, $r = 0.83$, mean difference = 0.14 ± 0.58, LoA = -0.99 to 1.28, $r = 0.82$). Hyperaemic MBF was reduced in CAD patients compared with the subset of 11 control subjects (2.53 ± 0.74 vs. 3.62 ± 0.68 ml/min/g, $p = 0.002$, for (15)O-water; 2.53 ± 1.01 vs. 3.82 ± 1.21 ml/min/g, $p = 0.013$, for (82)Rb) and this was paralleled by a lower MFR (2.65 ± 0.62 vs. 3.79 ± 0.98, $p = 0.004$, for (15)O-water; 2.85 ± 0.91 vs. 3.88 ± 0.91, $p = 0.012$, for (82)Rb). Myocardial perfusion was homogeneous in 1,114 of 1,122 segments (99.3%) and there were no differences in MBF among the coronary artery territories ($p > 0.31$).

CONCLUSION: Quantification of MBF with (82)Rb with a newly derived correction for the nonlinear extraction function was validated against MBF measured using (15)O-water in control subjects and patients with mild CAD, where it was found to be accurate at high flow rates. (82)Rb-derived MBF estimates seem robust for clinical research, advancing a step further towards its implementation in clinical routine.


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