Cold Pressor Test in MRI for Quantitative Myocardial Perfusion Imaging

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Purpose

Alterations in myocardial perfusion are crucial for coronary artery disease (CAD). In nuclear medicine a risk assessment is established that can reveal endothelial dysfunction which is the first step towards CAD: the cold pressor test (CPT) [1, 2]. Nuclear medicine provides the opportunity to quantify myocardial blood flow but suffers from two main drawbacks: limited spatial resolution and the use of radioactive tracers. In contrast first-pass perfusion MRI is able to evaluate myocardial perfusion with a high spatial resolution and with waiving of radiation.
Thus, it was the aim of this study to establish a CPT in the MRI environment.

Materials and Methods

For this study 10 healthy non-smoking volunteers were examined in a 1.5 T scanner (Magnetom Quantum Symphony, Siemens Medical Solutions, Erlangen/Germany) using a multislice-SSFP-perfusion sequence (TR 2.8 ms, TE 1.1 ms, TI 110 ms, FA 50°, resolution 2.7 x 3.3 x 8.0 mm^3, 3 short-axis slices). For quantification of myocardial blood flow the prebolus-technique [3] was used with 1ml/4ml Gd-BOPTA.
CPT was performed by putting the left hand in an over-head ice-water bath for one minute before the measurement was started to create an adequate stimulus. During the measurement the hand remained in the ice-water. 15 minutes after the CPT a rest-examination was performed to obtain baseline values of the subjects' MBF.
The acquired perfusion series were automatically motion-corrected using an algorithm similar to the one proposed by Adluru et. al. [4]. Subsequently an image-segmentation was performed using the software Developer Life (Definiens, Munich/Germany) to obtain signal intensity time courses of eight sectors in the left ventricular myocardium and of the blood pools [5]. The myocardial courses were evaluated using both baseline and contamination correction [6] to obtain absolute MBF values.

Results

All healthy volunteers were able to keep the hand in the ice-water bath during the whole measurement and it was possible to evaluate all datasets with the mentioned postprocessing tools. The averaged rest values for all volunteers were 0.61 ± 0.34 ml/g/min (mean ± standard deviation) while during CPT values of 1.16 ± 0.66 ml/g/min were obtained. For every single subject the mean perfusion was significantly higher during CTP compared to the rest examination (significant: $p < 0.05$).

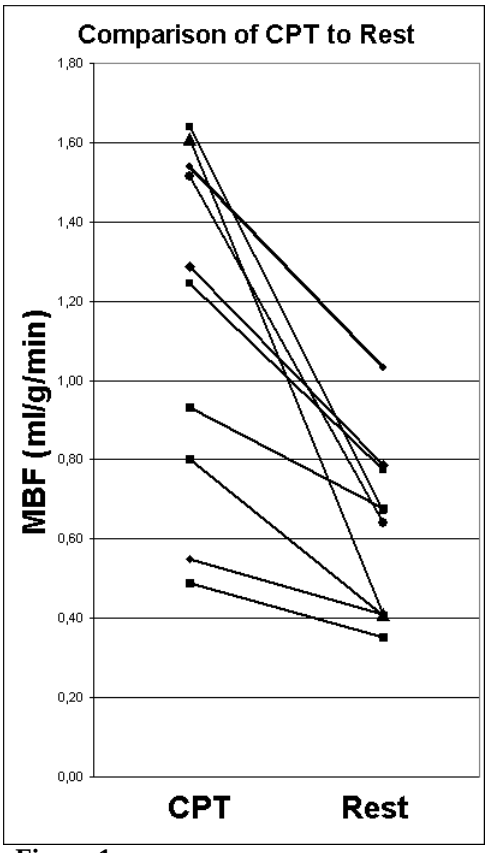

Figure 1
Comparison of the MBF values obtained in CPT and in rest.

Conclusion

Absolute quantification of myocardial blood flow during CPT is feasible. MBF values showed a significant increase during CPT in comparison to the rest examination. Further studies with patients with known cardiac risk factors like hypercholesterolemia, diabetes or hypertension have to prove the capabilities of this new MRI application.

References

[1] Campisi et al, Circulation, 1998; 98: 119 – 125
[2] Campisi et al, 1999; 99: 491 – 497
[3] Köstler et al, MRM, 2004, 52: 296 – 299
[4] Adluru et al, JMRI, 2006, 24: 1062 – 1070
[5] Weng et al, MAGMA ,2008, 21 Suppl. 1: 444
[6] Köstler et al., MRM, 2004; 51: 848 – 852