

Meeting abstract

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2132 Assessment of myocardial oxygenation in the canine heart using blood oxygen level-dependent magnetic resonance imaging

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Introduction

Blood Oxygen Level-Dependent Magnetic Resonance Imaging (BOLD-MRI) has been used to assess myocardial oxygenation but implementation in clinical application has suffered from long scan times and inconsistent image quality. Steady-state free precession (SSFP) based sequences have been shown to have BOLD sensitivity. In addition they tend to have fewer artifacts.

Purpose

To test whether a new SSFP-based sequence is robust and has sufficient diagnostic accuracy for detecting changes in myocardial oxygenation induced by endothelium-dependent and endothelium-independent coronary flow changes in the canine heart.

Methods

A T2-prepared SSFP sequence with T2- and T2*-sensitivity was developed. Three anesthetized dogs were instrumented with a coronary infusion catheter in the circumflex coronary artery (LCX), an MR compatible epivascular flow probe around the LCX and a catheter in the coronary sinus. Using a clinical 1.5 T MRI system (Avanto, Siemens Medical Solutions, Germany), BOLD-sensitive imaging with the new sequence and additional T2* mapping were performed during LCX intracoronary infusion of adenosine and acetylcholine (ACh). The perfusion territory of the LCX was identified by intracoronary injection of a small Gd-DTPA bolus. Images were analyzed using validated

software. Paired T-tests were used to compare results before and after intracoronary infusion. Correlations of BOLD signal intensity and T2* values in the LCX territory with coronary venous oxygen saturation (SaO₂) were calculated by linear regression analysis (SPSS13).

Results

Good image quality was achieved in all dogs with excellent reproducibility of signal intensity during 20 baseline scans (SD 1.1%). In one dog ACh infusion led to a flow decrease in the LCX most likely representing a paradoxical coronary vasospastic reaction. These data were not included in the calculations for ACh effects but were included in the regression analysis. Compared to baseline and rest myocardium, there was a significant signal increase in the LCX territory during infusion of 1.0 microg/min ACh and 0.3 mg/min adenosine (32.3%, CI 18.3% to 46.3%, $p < 0.05$ and 32.3%, CI 18.3% to 46.3%, $p < 0.05$ resp.). Both drugs resulted in a similar flow increase in the LCX (141% and 133.4% resp.). Coronary venous SaO₂ increased by 10.4% and 13.1% resp. (relative increase 16.3% and 20.6%). Compared to baseline, T2* in the LCX territory increased by 30% and 25.8% resp. (Figure 1). There was a significant correlation between BOLD MRI signal intensity and corresponding coronary venous SaO₂ ($r^2 = 0.37$, $p = 0.047$, Figure 2) as well as T2* values ($r^2 = 0.30$, $p = 0.023$).

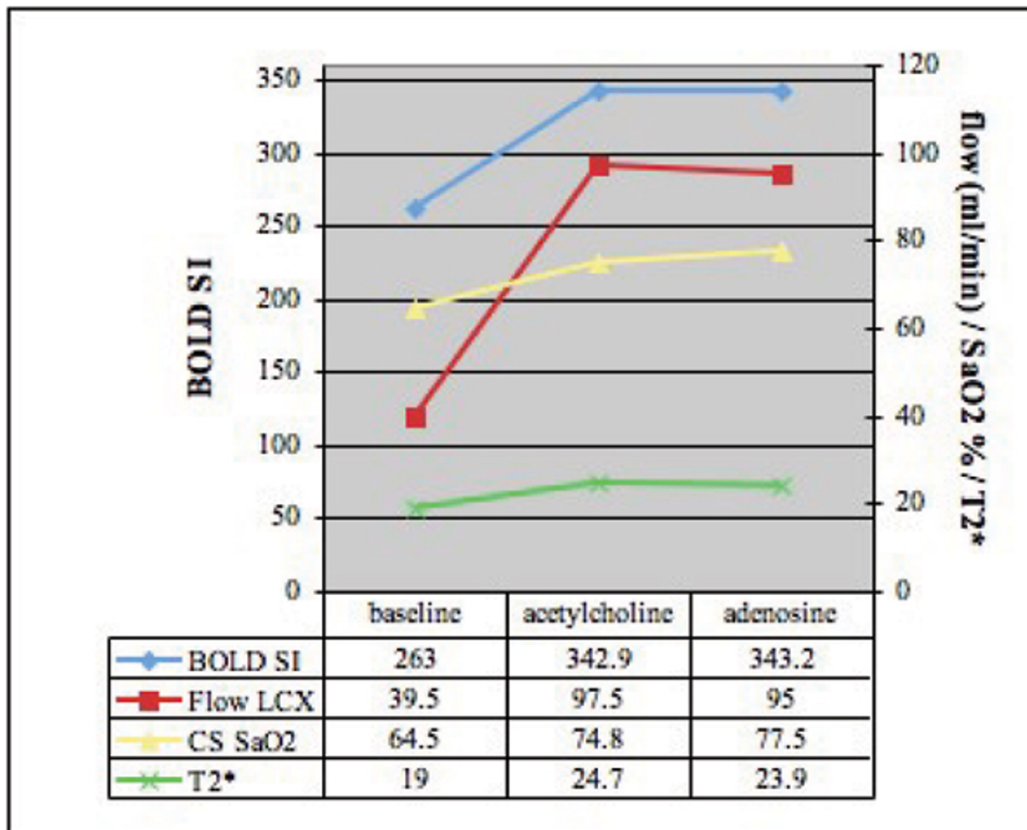


Figure 1

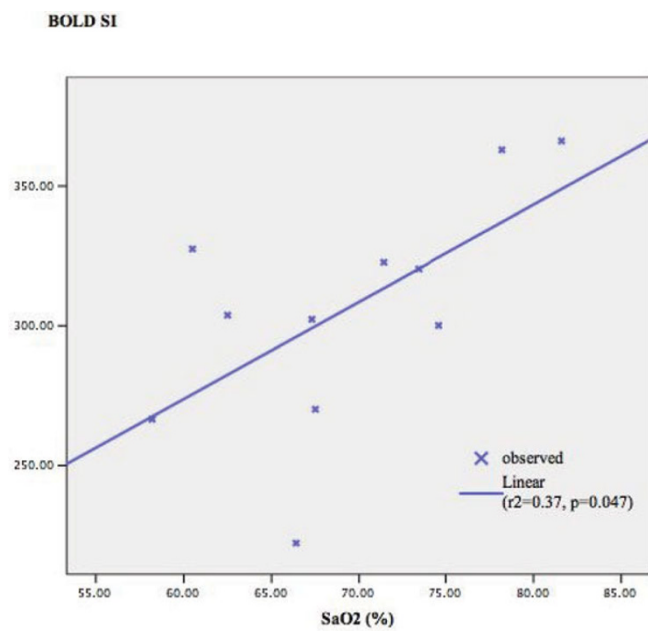


Figure 2

Conclusion

SSFP-based BOLD-sensitive MRI allows for imaging of myocardial oxygenation induced by endothelium dependent and independent vasodilation. Signal intensities correlate with coronary venous SaO₂ and T2* of the myocardium. Further studies should address its feasibility in clinical settings.