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Meeting abstract

2009 High dose dobutamine stress gradient echo imagíng and tagging at 3 Tesla in patients with suspected coronary artery disease

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Background

3 Tesla (3 T) MR units are increasingly being used for cardiac applications. Currently the feasibility and accuracy of high dose dobutamine stress testing for detection of significant CAD at 3 T are unknown. Myocardial tagging techniques benefit from 3 T imaging due to an increased SNR and prolonged T1 relaxation time resulting in better tag definition and longer tag persistence. At the same time bSSFP sequences are known to suffer from flow-related off-resonance artifacts, especially at high heart rates. Standard gradient echo cine imaging (GRE) may serve as an alternative, being very robust to artifacts at 3 T.

Purpose

The aims of this study were: (1) to evaluate the feasibility and accuracy of standard GRE and myocardial tagging for detection of obstructive CAD in a high dose dobutamine stress protocol and (2) to investigate the additive value of myocardial tagging in a combined standard cine GRE & tagging stress protocol at 3 T.

Materials

Patients with known or suspected CAD were included. A standard high dose dobutamine protocol was employed with incremental doses of dobutamine (10 mcg/kg up to 40 mcg/kg) and eventually fractionated atropine (up to 1 mg) until the target heart rate was achieved, or a new wall motion abnormality (WMA) developed. GRE and tagging images were acquired at rest and at each stress level. GRE and tagging images were acquired in 4 identical short axis locations: Slice thickness 8 mm, FOV 320–380 mm, reconstructed matrix 256^2, sense factor 2–2.5 for both sequences. TR 4.8 ms, TE 2.6 ms, α 20° and 25 cardiac phases for the GRE sequence and TR 3.7 ms, TE 2.2 ms, α 10°, 16 cardiac phases, 8 mm tag separation, grid-tag pattern, for the tagging scan. Image quality was rated at the highest stress level for both sequences using a four point grading scale (1: excellent to 4: non-diagnostic). A luminal stenosis > 70% in native and graft vessels at invasive coronary angiography was considered as positive finding indicative of significant CAD. A true positive stress MRI – finding was defined as a new or worsening WMA in the GRE or tagging sequence during any stress level with a corresponding finding at coronary angiography.

Results

All patients (n = 33/33) completed the combined protocol. No major side effects (as death, myocardial infarction, ventricular fibrillation/tachycardia) occurred. Minor side effects were seen in 5/33 patients (hypertensive dysregulation n = 3, headache n = 2). Image quality was graded diagnostic in all tagging exams (n = 33) and all GRE exams (n = 33). The mean image quality score was 1.9 for both sequences. The sensitivity and specificity of

stress tagging in comparison to gradient-echo cine imaging for the detection of significant CAD were 93% vs 79%, and 79% vs. 84%. One out of 14 positive cases was missed by tagging, while 3 of 14 cases were missed by GRE alone. The separate analysis of the 11 cases with ischemia induced WMA detected by tagging as well as GRE revealed that WMAs were detected at a lower stress level by tagging in 4 cases (pathologic tagging: 4 cases at 30 mcg/kg, 7 cases at 40 mcg/kg; pathologic GRE: 1 case at 30 mcg/kg, 8 cases at 40 mcg/kg, 2 cases at 40 mcg/kg plus atropine).

Conclusion

The combined cine GRE and tagging high dose dobutamine protocol is feasible at 3 T and well tolerated by patients. The addition of stress tagging increases the sensitivity of high dose dobutamine stress studies for detection of CAD and allows for the detection of ischemia-induced WMAs at lower dobutamine stress levels compared to cine GRE sequences.

Myocardial tagging in addition to GRE cine imaging at 3 T is a promising tool for high dose dobutamine stress testing and non-invasive diagnosis of significant CAD.