



Feasibility of Vasodilator Stress Testing in a 70 cm Wide Bore 1.5T Scanner

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INTRODUCTION

The small bore size of standard 1.5T scanners prohibits MR imaging of certain patient populations. Obesity, claustrophobia, and heart failure complicated by orthopnea are all conditions that limit feasibility of cardiac MR examinations in standard bore scanners. This issue is particularly important in obese patients who are technically difficult to image by other means and heart failure patients. Furthermore, pharmacologic stress testing requires close monitoring of the patient and would be safer and easier to perform in a less confined setting. Many of these problems might be alleviated by a novel 70 cm bore magnet design. We describe our initial experience with performing vasodilator stress MRI exams with a wide bore 1.5T scanner.

OBJECTIVE

To test the feasibility of performing pharmacologic stress MRI exams in a 70 cm wide bore 1.5T scanner.

METHODS

Sixty-four patients with clinical indications for cardiac stress testing underwent vasodilator stress with dipyridamole 0.56 mg/kg IV over 4 minutes. Imaging consisted of steady state free precession (SSFP) localization, SSFP short and long axis cine, gradient echo accelerated echoplanar (GRE-EPI) first pass perfusion with a TSENSE factor of 2, and phase sensitive delayed enhancement.¹ Images were acquired with a Siemens 1.5 Tesla Magnetom Espree system with a 70 cm bore size and 125 cm length which is 10 cm wider in diameter and 35 cm shorter in length than traditional scanners. Each imaging technique was assessed for quality and artifact by two readers.

RESULTS

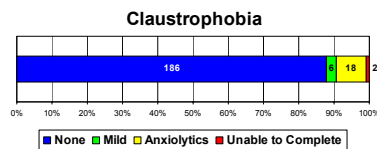


Figure 1. Twenty-six of 212 patients undergoing stress or rest evaluation were claustrophobic. Six of these patients were mildly claustrophobic and 18 required oral anxiolytics. Only 2 did not complete scanning due to claustrophobia.

RESULTS

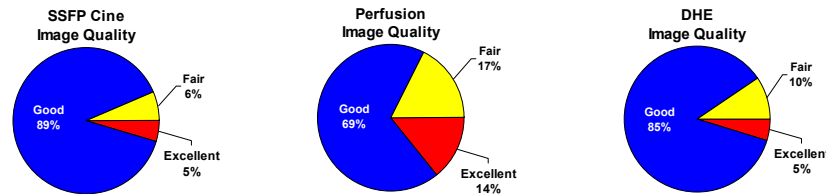


Figure 2. Image quality was comparable to what we have experienced with standard bore scanners. SSFP was the most robust sequence with regards to quality. Perfusion imaging, when compromised, was due to EPI ghosting, arrhythmia, or gating artifact. Delayed enhancement imaging was occasionally affected by arrhythmia or poor gating. No portion of the imaging protocol was deemed poor or non-diagnostic in any patient.

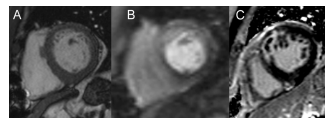


Figure 3. Examples of cine (A), stress perfusion (B), and delayed enhancement imaging (C) acquired from different patients. Note the severe stress perfusion defect in the inferoseptal, inferior, and inferolateral walls. The delayed enhancement image demonstrates an anterior and anteroseptal infarct with microvascular obstruction.

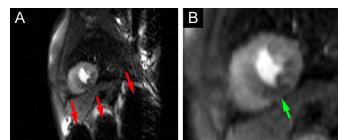


Figure 4. Panel A demonstrates a true positive perfusion exam in full field of view which shows peripheral off-resonance artifacts (red arrows) that do not interfere with interpretation of the inferior perfusion defect (green arrow) as shown in panel B.

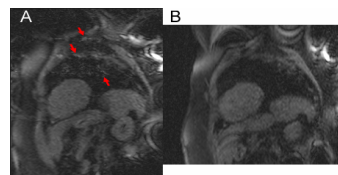


Figure 5. Off resonance artifacts occasionally contribute to EPI ghosting artifacts (panel A, red arrows) which is reduced by swapping phase and frequency directions as seen in panel B.

Patient Weights

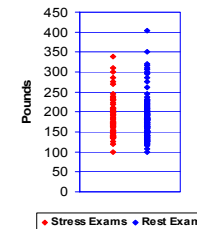


Figure 6. Scatter plot of patient weights in pounds. Note that 5 patients between 271 and 339 pounds underwent stress examinations successfully. Seven patients undergoing rest studies were greater than 300 pounds with a maximum weight of 404 pounds.

CONCLUSIONS

Vasodilator stress MRI exams can be performed on a large bore system with high image quality but with some off-resonance artifacts near the edges of the field of view. In our broader experience with stress and rest MRI studies, we have scanned 18 patients between 261-404 pounds, four patients requiring pillows for orthopnea, and 24 claustrophobic patients demonstrating that imaging patients previously unsuitable for MRI is possible. In an era where obesity and heart failure are increasing clinical problems, the feasibility of performing high quality non-invasive cardiac testing in these populations is a clinically important advance.

The rate of claustrophobia should be considered in light of two important facts. Referral bias may have excluded patients with severe claustrophobia leading to an underestimation of the true prevalence. On the other hand, specifically recruiting patients heavier than 250 pounds may have contributed to a higher than normal rate of claustrophobia since larger patients may have a greater sensation of confinement.

REFERENCES

1. Kellman P. Magnetic Resonance in Medicine. 47(2): 372-383, 2002.