

Moderated Poster Session II

Saturday, January 21, 2006

5:30 PM–7:00 PM

311. INFARCT SIZE BY CONTRAST-ENHANCED MAGNETIC RESONANCE IMAGING PREDICTS CARDIOVASCULAR OUTCOMES AFTER ACUTE MYOCARDIAL INFARCTION

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Background: Existing data assessing the prognostic value of contrast-enhanced magnetic resonance imaging (ce-CMR) after acute myocardial infarction (AMI) are limited by short follow-up duration and small cohort sizes. We sought to determine if infarct size and ejection fraction (EF) predict the occurrence of major adverse cardiac events (MACE) after AMI.

Methods: We studied 112 patients (mean age was 58 ± 12 ; 80% were male) who underwent standard cine and ce-CMR within 7 days of their first AMI. Infarct size as a percentage of left ventricular (LV) mass was determined by manual planimetry of contiguous short axis slices at least 10 minutes after gadolinium contrast administration. Ejection fraction (EF) was also determined by planimetry of contiguous cine short axis slices. MACE was defined as unstable angina, repeat revascularization, congestive heart failure or death. Clinical follow-up was done by chart review, telephone call, clinical office visit or at the time of repeat imaging. For analysis, the study population was divided into those with small ($\leq 20\%$) and large ($> 20\%$) infarcts based on the median infarct size of the total cohort.

Results: The mean infarct size was $24 \pm 17\%$, and the mean EF was $44 \pm 13\%$. Twenty-four patients had infarct sizes between 1 and 10%, 22 between 11 and 20%, 24 between 21 and 30%, 15 between 31 and 40%, 9 between 41 and 50%, and 12 had infarct sizes greater than 50%. Hyperenhancement was not seen in 6 patients (5%). MACE occurred in 33 patients (30%) after mean follow-up of 470 ± 489 days. Overall, there were 2 cardiac deaths in the population. Repeat revascularization and angina accounted for the most frequent events. MACE occurred more frequently in subjects with infarct sizes larger than 20% compared to those with smaller infarcts (24 vs. 9, $p = 0.001$). EF was also significantly lower in larger infarcts ($36.7 \pm 12\%$ vs. $52.0 \pm 9.5\%$; $p < 0.0001$). After 2 year follow-up, the event-free survival was significantly different between the 2 groups (Fig. 1). Step-wise multivariate linear regression analysis showed infarct size as the only predictor of MACE.

Conclusions: Areas of acute myocardial infarction were readily evident in the vast majority of patients. Infarct sizes greater

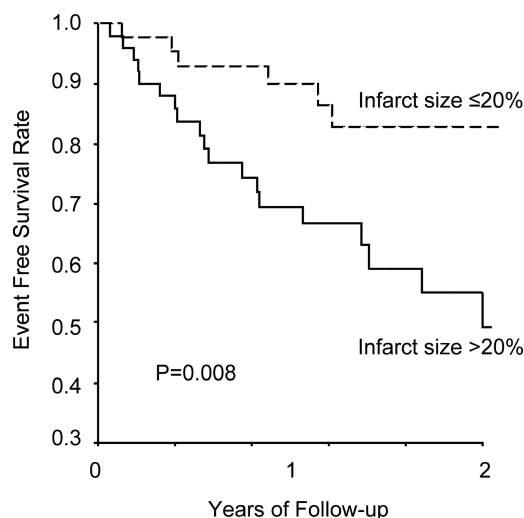


FIG. 1.

than 20% identified patients at high risk for future adverse cardiac events. This long-term follow-up study demonstrates the clinical utility of infarct imaging by ce-CMR to predict adverse outcomes in patients following AMI.

312. PREDICTION OF LEFT VENTRICULAR FUNCTION AFTER DRUG-ELUTING STENT IMPLANTATION FOR CHRONIC TOTAL CORONARY OCCLUSIONS

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Introduction: The effect of recanalization of CTO on long-term left ventricular function and the value of myocardial viability assessment with MRI is incompletely understood.

Purpose: We studied the effect of drug-eluting stent implantation for a chronic total coronary occlusion (CTO) on left ventricular volumes and function and assessed the predictive value of MRI performed before revascularization.

Methods: Twenty-seven patients underwent contrast-enhanced Magnetic Resonance Imaging (MRI) before and 5 months after successful drug-eluting stent implantation for CTO. CTO was defined as a complete occlusion of a major epicardial coronary artery existing for at least 6 weeks (mean 7 ± 5 months). Myocardial wall thickening and left ventricular volumes were quantified on cine-images and the transmural extent of infarction (TEI) was scored on delayed-enhancement images.

Results: A significant decrease in mean end-systolic volume index (34 ± 13 to 31 ± 13 ml/m²; $p = 0.02$) and mean end-diastolic volume index (84 ± 15 to 79 ± 15 ml/m²; $p < 0.002$) was observed whereas mean ejection fraction did not change significantly (61 ± 9 to $62 \pm 11\%$; $p = 0.54$). The extent of the left ventricle that was dysfunctional but viable before revascularization was related to improvement in end-systolic volume index ($R = 0.46$; $p = 0.01$) and ejection fraction ($R = 0.49$; $p = 0.01$) but not to the end-diastolic volume index ($R = 0.10$; $p = 0.53$). Segmental wall thickening improved significantly in segments with $< 25\%$ TEI (21 ± 15 to $35 \pm 25\%$; $p < 0.001$), tended to improve in segments with $25\text{--}75\%$ TEI (18 ± 22 to $27 \pm 22\%$; $p = 0.10$) whereas segments with $> 75\%$ TEI did not improve (4 ± 14 to $-9 \pm 14\%$; $p = 0.54$).

Conclusions: Drug-eluting stent implantation for a CTO has a beneficial effect on left ventricular volumes and function that can be predicted by performing MRI before revascularization.

313. PREVALENCE OF VIABLE BUT DYSFUNCTIONAL MYOCARDIUM IN PATIENTS WITH HEART FAILURE OF ISCHAEMIC ORIGIN AS ASSESSED BY CARDIAC MRI WITH DELAYED CONTRAST ENHANCEMENT

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Background: Accurate assessment of the myocardial pathology leading to chronic heart failure (CHF) in patients with ischemic heart disease may help select appropriate therapy. Cardiac magnetic resonance (CMR) imaging with gadolinium delayed enhancement (DE) can differentiate between viable and non-viable myocardium and provide unique data on the transmural extent of scar/viability.

Methods and results: We studied 134 patients with CHF of ischemic etiology using DE CMR. Myocardial contractility and extent of DE, indicating scar, were assessed blindly in a 17-segment model. At least one dysfunctional but viable (defined as DE affecting $\leq 50\%$ of wall thickness) myocardial segment was present in 128 patients (96%) and 63 patients (47%) had ≥ 5 affected segments. If only segments with no DE were deemed viable, 53 patients (40%) had at least one such segment and 27 patients (20%) had ≥ 5 such segments. Of 2278 segments assessed, 1222 were dysfunctional of which 30% showed no DE (entirely viable), 35% had DE of $\leq 50\%$ (partly viable) and 35% had $> 50\%$ of wall thickness associated with DE (deemed non-viable). Patients with significant myocardial viability (≥ 5 segments) had larger left ventricular (LV) end-diastolic and end-systolic volumes (256 ± 85 vs 220 ± 110 mL, $p = 0.034$ and 184 ± 74 vs 144 ± 109 mL, $p = 0.012$ correspondingly) and a lower LV ejection fraction (29 ± 9 vs $40 \pm$

14% , $P < 0.001$) than patients with < 5 dysfunctional but viable segments.

Conclusions: Nearly half of patients with CHF of ischaemic origin have a substantial volume of myocardium that is viable but dysfunctional on DE CMR. About one third of all dysfunctional segments are partly viable with $\leq 50\%$ scar extent.

314. MYOCARDIAL VIABILITY: AN INTRAINDIVIDUAL COMPARISON OF MR IMAGING AT 3.0T AND 1.5T

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Introduction: Myocardial viability determined by delayed enhancement MR imaging (DE MRI) is of increasing relevance in patients with coronary artery disease. Recently, whole body applications of 3.0T systems including cardiac MRI have become available.

Purpose: Aim of this study was to investigate the potential benefit of DE MRI at 3.0T compared to 1.5T.

Methods: In this ongoing intra-individual comparative study cardiac MRI is performed in 20 patients with proven myocardial infarction at 3.0T and 1.5T (Magnetom Avanto and Magnetom Trio, Siemens, Erlangen, Germany). The second MR-examination follows within 3–30 days. Myocardial function is assessed using cine trueFISP sequences (Avanto: TR 3.14, TE 1.57, flip angle 70° , matrix 200×256 , Trio: TR 3.4, TE 1.7, flip angle 50° , matrix 127×192) acquired in long and short axes views. DE images are obtained after 15 minutes (0.1 mmol Gadobenate dimeglumine/kg body weight, Multihance, Altana, Konstanz, Germany) using a segmented inversion recovery prepared Turbo FLASH sequence (Avanto: TR 11, TE 4.4, flip angle 30° , matrix 160×256 , slice thickness 6, bandwidth 140, Trio: TR 9.9, TE 4.91, flip angle 30° matrix 154×256 , slice thickness 6, bandwidth 140). Image analysis includes standardized measurements of signal to noise (SNR) and contrast to noise (CNR) ratios in infarcted and remote normal myocardial regions. In addition, image quality is rated on a 4-point scale (0 = poor, 3 = excellent) by two independent observers.

Results: High quality diagnostic images were constantly obtained at both field strengths. Initial results of our first patients revealed significantly higher scores of image quality at 3.0T (score 2.1 ± 0.2 at 1.5T versus 2.6 ± 0.3 ($p < 0.05$)). SNR of myocardial infarction was 28.2 ± 6.7 at 3.0T versus 18.4 ± 4.4 at 1.5T ($p < 0.05$). CNR was 24.1 ± 6.5 at 3.0T and 14.7 ± 4.2 at 1.5T ($p < 0.001$).

Conclusions: DE MRI of myocardial viability at 3.0T turns out to be the superior approach compared to conditions at 1.5T. Assessment of myocardial viability yields significantly higher SNR and CNR using identical contrast doses. Faster acquisition

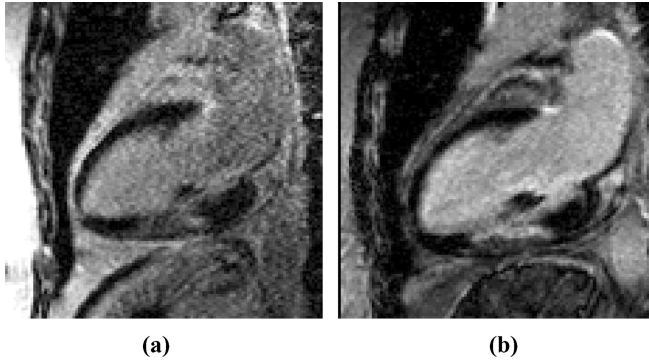


FIG. 1. DE MR image of a patient with myocardial infarction of the inferior wall. (a) image at 1.5T, (b) image at 3T.

techniques like parallel imaging, increase of spatial resolution or dose reduction of contrast media are potential options to take advantage from DE MRI at 3.0T

315. PROGNOSIS OF PATIENTS WITH ST ELEVATION MYOCARDIAL INFARCTION INVOLVING MORE THAN 40% OF THE LEFT VENTRICLE

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Introduction: Early experimental studies in dogs reported that significant loss of left ventricular (LV) myocardium invariably led to cardiogenic shock and death. Autopsy studies demonstrating a high rate of cardiogenic shock in patients with large infarcts provided further support to the concept that patients with ST elevation myocardial infarction (STEMI) involving more than 40% of the left ventricle would likely not survive. Since then, significant advances in reperfusion techniques and medical therapy have been made. Additionally, contrast-enhanced cardiac magnetic resonance imaging (CMR) allows patients with large infarcts to be identified prospectively.

Purpose: We sought to determine the contemporary survival and incidence of heart failure in patients with ST elevation myocardial infarction (MI) involving more than 40% of the left ventricle measured by CMR.

Methods: We prospectively enrolled 76 patients (mean age 58 ± 11) among 415 consecutive patients admitted to the coronary care unit for STEMI. All patients were acutely reperfused by percutaneous coronary intervention (PCI). We did not recruit patients with known history of prior MI, PCI, or coronary artery bypass surgery. We also excluded patients with unstable hemodynamics or contraindications to CMR. All patients were imaged using standard cine and contrast-enhanced CMR within 7 days of STEMI (mean 3 ± 2 days). Infarct and LV mass were planimtered on short axis images acquired every 10 mm from LV base to apex. Clinical follow up was performed by chart review, telephone, clinical office visit or at the time of repeat imaging.

Results: Seventeen patients (22%) had infarcts larger than 40% of the LV. The infarct size in this group ranged from 41 to 66% of the LV (mean $52 \pm 9\%$). The mean EF was $30 \pm 9\%$ and mean LVEDV was 173 ± 41 cc. The infarct related artery was left anterior descending in 12, left circumflex in 3, and right coronary artery in 2 patients. The median length of clinical follow up was 405 days (range 150 to 1375 days). During this period, there were no deaths. Five of the seventeen patients were readmitted for symptoms of New York Heart Association Class II or greater heart failure with a mean time to presentation of 14 ± 4 months. Medication usage was: beta blocker 95%, ACE inhibitor 79%, statin 90%, aspirin 95%.

Conclusions: Patients can survive large acute myocardial infarctions with current reperfusion and medical therapy. However, there is a high incidence of subsequent admission for congestive heart failure.

316. PRE-CONTRAST INVERSION RECOVERY TRUEFISP IMAGING DETECTS ACUTE AND CHRONIC MYOCARDIAL INFARCTION

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Purpose: We sought to evaluate the ability of a single MR pulse sequence having both T1 and T2 contrast properties to identify and characterize myocardial infarction (MI) without the use of a contrast agent. Resulting images were compared with delayed hyperenhanced imaging and clinical information.

Methods: Forty subjects (mean age: 61 yrs; range = 42–84) suspected of having an MI (mean infarct age: 9 yrs; range = 10 days–31 yrs) participated in the study. A 2D multiphase inversion recovery TrueFISP sequence (“TI Scout”) was used prior to Gd contrast administration using a 1.5T clinical scanner (Siemens Sonata, Erlangen, Germany). A single breath-hold yielded 19–24 images with increasing inversion times at intervals of 37 ms. Delayed hyperenhanced (DHE) imaging was performed after injection of 0.2 mmol/kg of Omniscan (GE Healthcare). Pre-contrast images were blindly evaluated for hypo- and hyper-intense myocardial regions at each inversion time. Patterns of regional lesions were compared qualitatively and quantitatively with DHE images and clinical information.

Results: Three distinct types of regions ($n = 29$) were identified in the pre-contrast images.

1. ($n = 19$) Hypo-intense changing to hyper-intense as the inversion time increased.
2. ($n = 8$) A hyper-intense hazy region across all inversion times.
3. ($n = 2$) A circumscribed region with changing intensity of the center.

There were three subjects without DHE and none had regions on the pre-contrast images. All subjects with Precontrast Type 1 had MIs older than 6 mos. (mean = 13.8 yrs). The area was

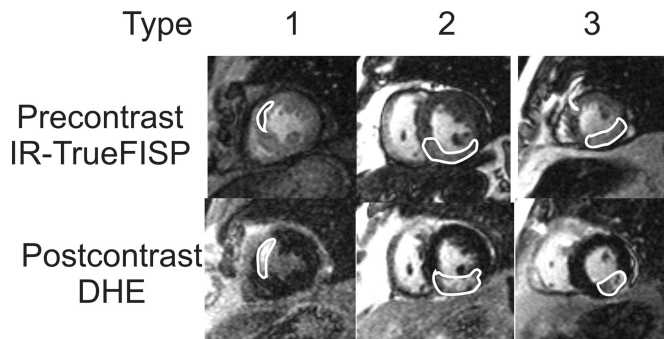


FIG. 1.

significantly smaller (mean = 55%) in the pre-contrast images when compared to the DHE images ($p < 0.0001$). All patients with a hyper-intense hazy region (Precontrast Type 2) had MIs within the last 6 mos. (mean = 0.48 yrs). The precontrast detection was presumably due to the long T2 of edema. Two subjects with circumscribed regions had recent MIs and DHE consistent with microvascular obstruction. Each segment identified using the pre-contrast images correlated to a region of DHE.

Conclusions: Data suggests that pre-contrast imaging may have the capability of detecting as well as dating myocardial infarcts. Inversion recovery TrueFISP imaging can show infarction without the use of a contrast agent due to its inherent T1 and T2 contrast.

317. THE CLINICAL IMPACT VALUE IN ROUTINE HIGH-VOLUME CLINICAL SETTING; CMR'S EFFECT ON PATIENT MANAGEMENT

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Introduction: In the clinical setting, cardiovascular MRI (CMR) is rarely utilized as the primary diagnostic test and is typically utilized in cases where multiple modalities have failed to yield a definitive diagnosis. Obtaining the correct diagnosis is the dominant factor affecting the optimal treatment plan, reducing patient return, minimizing morbidity and mortality while reducing costs. In difficult to diagnose patients, the clinical impact value (CIV) of CMR is unknown despite a considerable body of knowledge surrounding the efficacy of the modality. Here, we report on the CIV of CMR, applied in a population where several prior diagnostic tests were equivocal, failing to provide a definite diagnosis. Herein, we define CIV as the ability for the imaging tool to effect diagnosis and/or alter patient management and the extent thereof.

Hypothesis: We hypothesize that CMR can provide a definitive diagnosis in patients despite many previously equivocal results by other conventional modalities with a very high CIV.

Methods: Reports of 650 consecutive patients from Jan 04–Feb 05 referred to a high volume CMR center were reviewed and

clinical findings categorized: 1) clinical suspicion confirmed, 2) clinical suspicion rejected, 3) significant new diagnosis made, 4) new life-altering diagnosis made.

Results: The majority of patients had ≥ 2 imaging tests, such as TTE, TEE, cardiac catheterization or CT. In 98% of cases, CMR rejected or confirmed the primary suspicion; confirming initial suspicions in 56%, rejecting referring diagnoses in 42%, with the remaining 2% being technically difficult. The frequency with which additional significant diagnoses were made was 22% and diagnoses of life-threatening conditions were made in 1 out of every 6 patients (16%); i.e., an atypical chest pain converted to a Type-A dissection, suspicion of arrhythmogenic right ventricular dysplasia (ARVD) converted to sarcoid or a pulmonary embolism converted to a definitive pulmonary angiosarcoma.

Conclusion: In patients where conventional diagnostic tests are equivocal, the physical principles of CMR are such that imaging can proceed without difficulty in the majority of cases, providing a definitive diagnosis. Thus, CMR has high clinical impact value, adding complementary, confirmatory, and often life-changing diagnostic information in a wide variety of cardiovascular presentations. Wherever CMR is available, it is a valuable community resource and can be used to better direct health care resources, reduce patient and physician anxiety while improving healthcare delivery, with potentially far reaching socioeconomic benefits.

318. DETERMINATION OF CARDIAC VOLUMES AND MASS WITH FLASH AND SSFP CINE SEQUENCES AT 1.5 VERSUS 3 TESLA: A VALIDATION STUDY

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Introduction: Currently, the preferred technique of choice for the assessment of ventricular volumes and mass in clinical practice is steady state free precession imaging (SSFP) at 1.5 Tesla (T). Recently, there has been a proliferation of cardiac imaging at high field (3T) MR systems because 3T is rapidly becoming the favourable field strength for brain MR imaging, and as the signal-to-noise (SNR) in the CMR examination increases with the magnetic field, high field (3T) MR systems are being installed to benefit those CMR applications, such as perfusion, BOLD imaging or spectroscopy, that are currently limited by low temporal and spatial resolution at 1.5T. Prior to the introduction of SSFP into clinical practice, a cine gradient echo sequence (fast low angle shot, FLASH) was used which had inferior border definition, thus overestimating left ventricular (LV) mass and underestimating LV volumes. However, for theoretical reasons, FLASH should show improved signal-to-noise at 3T compared with 1.5T, without the disadvantages of low sensitivity to detection of turbulent flow or the high radio

TABLE 1
Left ventricular measurements using SSFP and FLASH techniques at 1.5 T and 3 T in healthy volunteers

	SSFP		FLASH		p value		
	1.5 T	3 T	1.5 T	3 T	Sequence	Field strength	Interaction
LV ejection fraction (%)	63 ± 9	60 ± 8	66 ± 8	62 ± 12	0.499	0.320	0.970
LV mass (g)	108 ± 29	109 ± 30	128 ± 31	142 ± 37	0.011	0.472	0.507
LV end-diastolic volume (mL)	157 ± 37	149 ± 37	128 ± 30	133 ± 31	0.041	0.865	0.573
LV end-systolic volume (mL)	57 ± 18	59 ± 16	44 ± 12	51 ± 21	0.058	0.423	0.662
LV stroke volume (mL)	100 ± 32	91 ± 28	85 ± 24	82 ± 24	0.169	0.478	0.671

SSFP = steady state free precession; FLASH = fast low angle shot; All data are mean ± standard deviation.

Univariate general linear model with fixed effects for sequence and field strength was used. Non-significant p values for interaction confirm that differences between sequences were independent of field strength.

frequency (RF) power deposition in tissue required for SSFP sequences.

Purpose: We aimed to compare cardiac cine MR imaging using SSFP and FLASH techniques at 1.5 and 3 T on the same day, and to establish their variabilities for cardiac volume and mass determination in volunteers.

Methods: Ten healthy volunteers (5 male and 5 female, mean age 28 ± 5 years) with no history of cardiac disease, hypertension or cardiac risk factors and a normal baseline electrocardiogram (ECG) were recruited. All CMR examinations were performed using a 1.5T (Sonata, Siemens Medical Solutions, Erlangen, Germany) and a 3T MR system (Trio, Siemens Medical Solutions) on the same day with anterior phased array surface coils, and posterior phased array surface coil (3T) or 2 elements of the integrated spine coil (1.5T), retrospective electrocardiographic gating and the subject in the supine position. The protocol at both 1.5 and 3T involved localization of the short-axis followed by SSFP frequency pilots in the mid-ventricular short-axis and horizontal long-axis orientations with selection of the

optimal frequency offset. FLASH and SSFP short-axis slices covering the entire ventricle were then acquired.

Results: For both SSFP and FLASH, field strength had no effect on the quantification of left and right ventricular volumes, masses or function ($p > 0.05$ for field strength for all parameters, Fig. 1). At both 1.5T and 3T, SSFP yielded smaller LV mass (e.g. at 3T 109 ± 30 g versus 142 ± 37 g, $p = 0.011$) and larger LV volume (e.g. at 3T end-diastolic volume 149 ± 37 mL versus 133 ± 31 mL, $p = 0.041$) measurements than FLASH, Table. Measurement variabilities for LV parameters were small for both field strength and sequences, ranging between 0.8 and 5.4 % for observer variability for ejection fraction.

Conclusions: Compared to 1.5T, cardiac cine-MR imaging at 3T, using either FLASH or SSFP sequences, is feasible and highly reproducible. Field strength does not have an influence on cardiac volume or mass quantification, but the systematic overestimation of LV mass and underestimation of LV volumes by FLASH compared to SSFP is present at both 1.5 and 3T. Normal values for cardiac volumes and mass established at 1.5T can be applied to scans obtained at 3T.

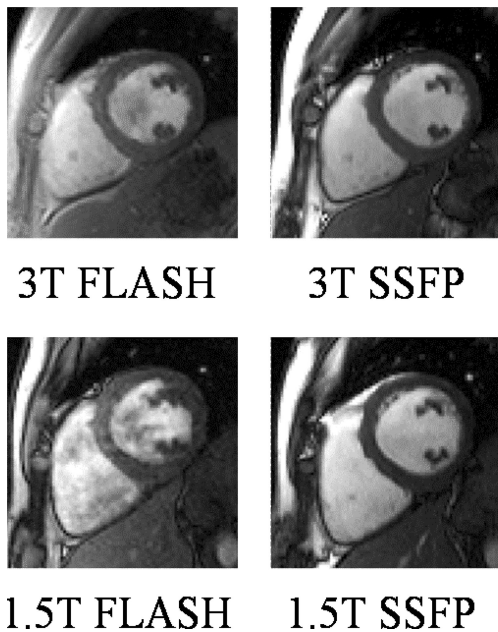


FIG. 1.

319. COMPARISON OF EPI, TRUEFISP AND FLASH SEQUENCES WITH PARALLEL ACQUISITION FOR MYOCARDIAL PERFUSION IMAGING

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Introduction: Much debate surrounds the optimal pulse sequence for myocardial perfusion imaging. To date there has been no direct comparison of the three main sequences for this application. Furthermore current perfusion sequences have limited spatiotemporal resolution and frequently do not provide sufficient myocardial coverage, particularly during pharmacological stress. Parallel acquisition techniques (PAT) may reduce acquisition time thereby permitting increased myocardial coverage, spatial resolution or a combination of the two, but at the

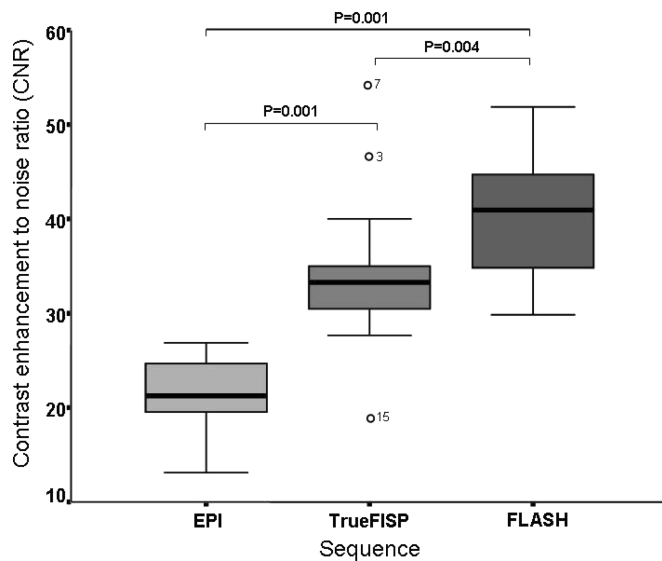


FIG. 1. Boxplot of contrast enhancement:noise ratios for each sequence. Within the TrueFISP data patients 3, 7 and 15 are outliers and excluded from the boxplot. However for statistical comparison they are included in the TrueFISP dataset.

expense of increased PAT artefacts and a reduced signal to noise ratio.

Purpose: To compare the three main perfusion sequences each with a PAT incorporated, TSENSE for EPI and TrueFISP, GRAPPA for TurboFLASH.

Methods: The three pulse sequences were standardised to approximately equivalent spatial resolution. Using a Siemens Magnetom Sonata scanner we acquired 45 scans in 16 subjects. Each subject underwent myocardial perfusion imaging on two to three

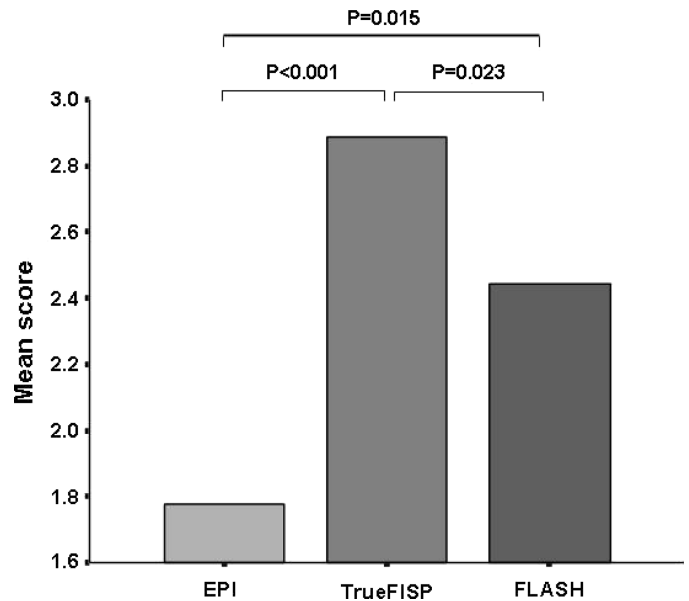


FIG. 3. Observer artefact scoring of each of the three sequences. A lower score represents less artefact. There is a significant difference between the sequences. The EPI sequence had significantly less artefacts scored compared to both the FISP and FLASH sequences.

separate occasions, each time with a different sequence. At held end expiration 50 images of 3 short axis slices were acquired during intravenous adenosine infusion (140 mcg/kg/min for 4 minutes) and twenty minutes following for rest imaging. For stress and rest imaging a bolus of 0.1 mmol/kg gadolinium (Magnevist, Schering) was given via an 18 gauge cannula at 7 mL/s followed by 15 mL normal saline at 7 mL/s, using a power injector (Spectris, Medrad). Late enhancement images were also acquired to assess for the presence of myocardial infarction. The noise value

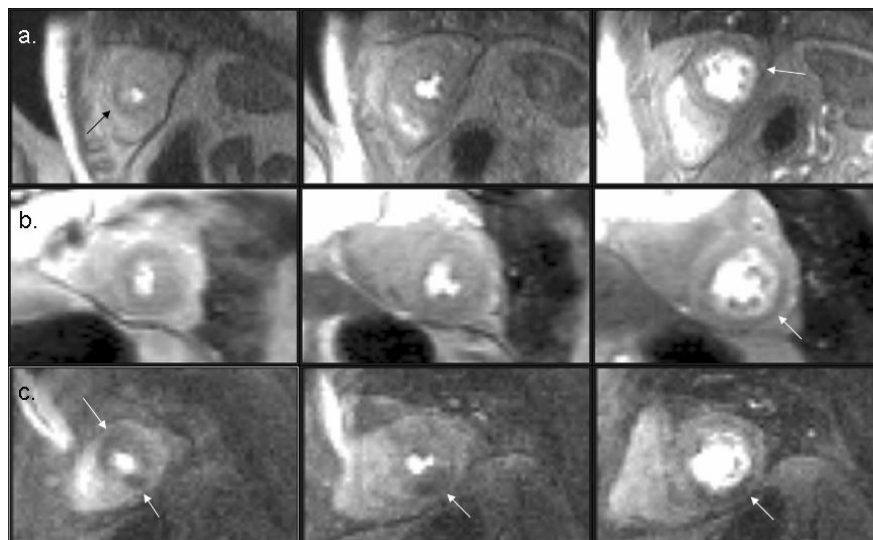


FIG. 2. Images from the TFLASH IPAT (a), TFISP TSENSE (b) and EPI TSENSE (c) sequences in a patient with significant triple vessel disease. Note the relative contrast and clarity of the circumferential inducible perfusion defect at the apical level of the EPI TSENSE image (arrowed). This was not identified by the remaining sequences at this slice level.

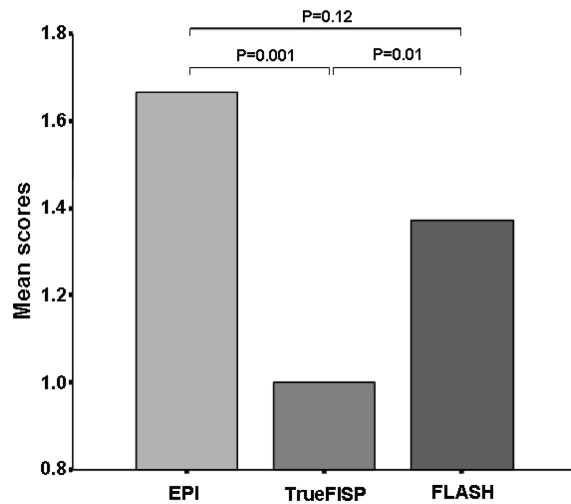


FIG. 4. Observer scoring of diagnostic confidence. A higher score represents a greater diagnostic confidence. There was a significantly higher confidence with the EPI and FLASH sequences compared to the FISP sequence. There was also a trend towards a higher confidence with the EPI sequence compared to the FLASH sequence however this did not reach statistical significance.

for each scan was calculated by switching off all radiofrequency pulses whilst acquiring 10 cardiac cycles of images with the perfusion sequence. Using standard formulae the myocardial baseline-peak contrast to noise ratio was calculated. Furthermore two blinded observers scored the presence and severity of dark subendocardial artifacts (1–4), diagnostic confidence (0–2), transmural and area of any inducible perfusion defect.

Results: The greatest CNR (Fig. 1) was seen with the TFLASH-GRAPPA and the least by the EPI-TSENSE sequence ($p = 0.001$). Most artifacts (Fig. 3) were recorded in the TrueFISP-TSENSE and the least in the EPI-TSENSE sequence ($p < 0.001$). Observers were significantly more confident in reporting the EPI-TSENSE and FLASH-GRAPPA (Fig. 4) in comparison to the TrueFISP-TSENSE images ($p = 0.001$, $p = 0.01$). There was a high correlation (0.87) in the number of hypoperfused segments recorded by both observers. There was no significant difference in the transmural or area of inducible hypoperfused myocardium recorded with each sequence. There was no significant haemodynamic difference between each of the scans in subjects heart rate or blood pressure at rest and stress.

Conclusions: The higher CNR of the TFLASH-GRAPPA sequence in this study is likely to be due to the incorporation of coil reference data within the centre of k-space and the magnification of noise with TSENSE imaging from the unwrapping of aliased images. However the greater effective acceleration of TSENSE imaging and relatively short acquisition time per cardiac cycle of the EPI sequence (necessary to minimise off resonance errors) may have suppressed motion artefacts that would have lowered diagnostic confidence limiting the sensitivity and specificity of this sequence. Therefore the EPI-TSENSE sequence despite a lower CNR is more likely to accurately reflect the clinical utility

of this technique and appears likely to be the preferred perfusion CMR sequence.

320. DIAGNOSTIC PERFORMANCE OF COMPREHENSIVE CMR EXAMINATION THAT INCLUDES CINE, STRESS PERFUSION, DELAYED ENHANCED MRI AND WHOLE HEART CORONARY MRA FOR THE DETECTION OF SIGNIFICANT CORONARY ARTERIAL STENOSES

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Purpose: To evaluate the diagnostic performance of comprehensive cardiac MR study that includes cine, rest-stress perfusion and delayed enhanced MRI and whole heart coronary MRA for the detection of significant luminal narrowing in the coronary artery.

Methods: Eighty-seven patients with suspected coronary artery disease were enrolled in this study. Free-breathing whole heart coronary MRA was acquired by optimizing the acquisition window in the cardiac cycle in each patient. After acquiring steady state cine MR images, first-pass myocardial perfusion MR images were obtained in the resting state and during dipyridamole stress by using a saturation recovery TFE/EPI sequence. Delayed-enhanced MRI was performed to evaluate the presence of infarction. Total MR imaging time was approximately 60 minutes. All patients underwent catheter coronary angiography within 4 weeks of MR study, and significant coronary artery disease was defined as diameter stenosis of $\geq 70\%$ in any coronary artery or its branch with ≥ 2 mm diameter.

Results: All patients completed cine, stress perfusion and delayed enhanced MRI. Whole heart coronary MRA was successfully acquired in 75 (86.2%) of 87 patients. The sensitivity, specificity and accuracy of coronary MRA for detecting patients with significant coronary artery disease in 75 patients with successful acquisition was 80.8%, 79.6%, 80.0%, respectively. Visual evaluation of TFE/EPI stress perfusion MR images in 87 patients yielded the sensitivity of 66.7% and the specificity 75.9%. By combining stress perfusion MRI and coronary MRA, the sensitivity of MRI in 87 patients improved to 84.8%, with specificity of 66.7% and accuracy of 73.6%. When all components of the protocol were combined, the sensitivity, specificity and accuracy of MRI was 100.0%, 44.4% and 65.5%, respectively.

Conclusions: The comprehensive cardiac MR study that includes stress perfusion MRI and whole heart coronary MRA was successfully completed in 86% of the patients, with a total study time of approximately 60 minutes. Combined assessments of stress perfusion MRI and whole heart coronary MRA can provide reliable detection of significant coronary artery disease.

TABLE 1
Accuracy of CMR for the detection of significant stenosis in the coronary arteries

	Sensitivity	Specificity	Accuracy
(A) Stress Perfusion MRI (n = 86)	66.7% (22/33)	75.9% (41/54)	72.4% (63/87)
(B) Coronary MRA (n = 75)	80.8% (21/26)	79.6% (39/49)	80.0% (60/75)
Combination of A and B (n = 86)	84.8% (28/33)	66.7% (36/54)	73.6% (64/87)
Combination of A, B, and Delayed Enhanced MRI (n = 86)	100.0% (33/33)	44.4% (24/54)	65.5% (57/87)