accelerated adenosine stress first-pass contrast enhanced CMR perfusion imaging at 1.5T MRI. Absolute stress MBF was derived. Visual analysis of the dynamic perfusion series was undertaken by two expert CMR readers. Diagnostic accuracy was determined on presence of significant CAD as defined by ICA and FFR ≤ 0.80 using Area under the Curve (AUC) from receiver operator characteristic curves.

**Results** At the patient level, there was significantly lower MBF in patients with CAD compared to those without CAD (2.03 [1.82 - 2.37] vs 2.68 [2.31 - 2.93] ml/g/min, p<0.001). There was a high diagnostic accuracy for the detection of CAD for quantitative stress MBF with AUC 0.84 (95% confidence interval [CI] 0.68–0.94, p<0.001), and for visual analysis with AUC 0.89 (95% CI: 0.75 – 0.97), p<0.0001). These were not significantly different (p=0.52). The optimal threshold for MBF detection of CAD was ≤2.50 ml/g/min, with sensitivity of 100% (95% CI: 77%-100%) and specificity of 71% (95% CI: 49%-87%).

**Conclusion** High-resolution quantitative near whole-heart myocardial perfusion imaging shows good diagnostic accuracy for detection of significant CAD, with comparable accuracy compared to expert visual analysis. This technique could be considered for automated widespread clinical use without the need for expert analysis of visual dynamic perfusion images.

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### 5 CORRELATIONS BETWEEN CARDIAC MAGNETIC RESONANCE AND MYOCARDIAL HISTOLOGIC FINDINGS IN FABRY DISEASE

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**Introduction** Fabry disease (FD) causes cardiac left ventricular hypertrophy (LVH) thought to be due myocyte lipid storage and compensatory sarcomeric increase. Myocardial T1 in FD by cardiac magnetic resonance (CMR) demonstrates T1 lowering, with T1 falling until overt LVH, then normalizing as further LVH occurs. However no histological validation has been provided to date. Therefore, aim of the study was to correlate CMR myocardial values and histologic findings.

**Materials and Methods** Fifteen FD patients (49 years [IQR39–63], 60% females) undergoing CMR (cines, native T1 mapping, LGE) and either endomyocardial biopsy (EMB, n=11) or septal myectomy (n=4). Tissue specimens were analyzed with light/electron microscopy. Histomorphometric analysis measured myocyte vacuolization either as a percent of myocyte number (%VM) or area (%VMA).

**Results** Histological changes preceded imaging changes: myocyte hypertrophy preceded LVH and fibrosis preceded LGE. %VM and%VMA correlated with LVH either as maximal wall thickness (MWT r=0.780, p<0.001; r=0.859, p<0.0001) or left ventricular mass index (LVMI r=0.823, p<0.001; r=0.847, p<0.0001). LVH patients had high%VM (≥45%) and ≥80% by elevated MWT and LVMI respectively and high%VMA (≥18% and ≥22% respectively). At least 45% of VM and 10% VMA were needed for T1 lowering. In patients without increased LVMI (67%) T1 fell as%VMA increased (r=0.883; p<0.001). In patients with increased LVMI, no clear relationship was reported (r=0.501; p=0.389).

**Discussion** This study compared CMR with myocardial histology in FD patients focusing on storage (vacuolization), LVH and native T1 values. Main findings were:

1. Histological changes preceded imaging changes: myocyte hypertrophy pre detectable LVH, storage pre detectable T1 lowering and fibrosis LGE.
2. Myocyte size increased with storage and clinical LVH.
3. Significant storage was necessary for both clinical LVH and T1 lowering.
4. The relationships between storage and clinical LVH was non-linear.
5. Native T1 values fell with storage until the presence of overt LVH (i.e. increased LVMI), when the relationship trend was lost.

**Conclusion** In FD, histological changes precede imaging changes. LVH correlated with myocyte storage with 45% vacuolization (10% VMA) needed for detectable LVH. T1 lowering strongly correlates with myocyte vacuolization in early disease but not in advanced disease.

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### 6 CMR SERVICE IMPROVEMENT VIA DEPLOYED SERVICE-LEVEL RAPID CMR PROTOCOLS WITH INTEGRATED AI

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**Background** Demand for CMR has been increasing year on year, and has been exacerbated by the pandemic. The need...
for rapid, focused protocols to increase throughput, improve cost-effectiveness and reduce waiting lists is now essential. We designed and implemented two new rapid CMR protocols incorporating AI approaches in daily clinical practice and measured their impact.

**Methods**

As part of service level improvements, we implemented two protocols:

- **Protocol 1:** rapid Perfusion CMR for ischaemia/viability;
- **Protocol 2:** rapid non-contrast CMR for cardiotoxicity.

These protocols used inline perfusion mapping with AI analysis, and inline ventricular analysis using the Myocardium AI super-human analysis approach.

A total of 260 patients were recruited and allocated to either rapid or standard CMR. Scanning times (first to last image timestamp), and image quality (consensus of 2 observers) were assessed.

**Results**

- **Protocol 1:** Conventional stress imaging took an average of 36 minutes (range 24–52 minutes, n=80). Rapid perfusion CMR took an average of 23 minutes (range 14 to 31 minutes, n=120), an average saving of 13 minutes (p<0.001).
- **Protocol 2:** Conventional non-contrast CMR took 15.0 minutes (range 11 to 20 minutes). Rapid non-contrast CMR took 9.9 minutes (range 5–13 minutes), including inline analysis, an average saving of 5.1 minutes—but this shorter scan included the inline AI analysis, an additional reporting saving.

For both protocol 1 and 2, the scan quality was considered similar (3/3, good).

**Conclusion**

Rapid CMR protocols incorporating AI approaches permit major savings on scan duration without any apparent image quality penalties. Scans can consistently be performed in less than 25 minutes and less than 10 minutes for non-contrast. These can be implemented in NHS clinical services.

**Sequelae**

Following this trial, rapid CMR approaches have become routine for ~1/4 patients at our site and booking slots have been reduced to 50 minutes (from 1 hour) on all CMR booking diaries with a daily increase in activity of +3 patients a day with consequent benefits to waiting lists.

**REFERENCES**


**THE IMPACT OF WATER EXCHANGE ON ESTIMATES OF EXTRACELLULAR VOLUME CALCULATED USING CONTRAST ENHANCED T1 MEASUREMENTS IN PATIENTS WITH SEVERE AORTIC STENOSIS**

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**Introduction**

Extracellular volume (ECV) is an independent predictor of mortality and outcome in patients with severe aortic stenosis (AS). SCMR guidelines recommend measurement of ECV using T1 maps taken before and 10–30 minutes post contrast. These measurements use a conventional model (CM) which assumes rapid water exchange (WX) between the ECV and the myocytes which can underestimate ECV. The shutter speed model (SSM), which incorporates WX, requires T1 measurements at multiple time points post-contrast. The aim of this study was to investigate whether WX influences estimates of ECV in patients with severe AS.

**Materials and Methods**

25 patients with severe AS referred for AVR were recruited. T1 measurements were made on a 3T Siemens system using mSASHA prototype (a) before contrast, (b) 4 mins after a 0.05 mmol/kg Gadovist injection and (c) 4, (d) 10 and (e) 30 minutes after an additional 0.1 mmol/kg dose. Three CM-based ECV estimates were made using T1 measurements (a & b), (a & d) and (a & c) and were compared to SSM ECV estimates made using all 5 T1 measurements.