Journal of Cardiovascular Magnetic Resonance

Meeting abstract

111 Detection of changes in myocardial blood flow and volume: a CMR study in a canine model of coronary artery stenosis

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from 11th Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 1–3 February 2008

Published: 22 October 2008

Journal of Cardiovascular Magnetic Resonance 2008, **10**(Suppl 1):A12 doi:10.1186/1532-429X-10-S1-A12

This abstract is available from: http://jcmr-online.com/content/10/S1/A12

Introduction

Quantification of both myocardial blood flow (MBF) and myocardial blood volume (MBV) may provide critical information on coronary artery diseases. We have recently developed fast mapping techniques for quantifying both perfusion parameters with the CMR first-pass dynamic imaging approach and an intravascular contrast agent. The purpose of this study is to evaluate the techniques in the assessment of changes in MBF and MBV that occur with differing severities of coronary artery stenosis during Dipyridamole or Dobutamine induced hyperemia.

Methods

25 dogs were divided into six groups (Table in Figure 1). Stenosis was created by using an occluder in the proximal left anterior descending coronary artery (LAD) in an open-chest model. First-pass CMR perfusion scans were performed at rest and during the pharmacologically induced hyperemia for all dogs. Gadomer (Schering AG, Berlin), an intravascular contrast agent, was injected (0.015 mmol/kg) as a bolus during each perfusion. CMR images were pre-denoised with a wavelet method [1]. A validated perfusion quantification method designed in our lab [2] was applied to obtain MBF (Figure 2) and MBV maps (Figure 3). The regional data from both LAD perfused anterior and left circumflex artery (LCX) perfused inferior myocardial beds were determined.

Results

The percentage changes of MBF and MBV before and after the hyperemia are presented in Table in Figure 1. For the normal dogs, global MBF and MBV values are given. In normal dogs, Dipyridamole increases MBF more than Dobutamine, whereas MBV increases more with Dobutamine hyperemia. As expected, in stenotic dogs, increased MBF values during the hyperemia were proportionally attenuated with the stenosis degrees (negative correlation) in the LAD region (Figure 4). Interestingly, the flow reserve in the normal region decreased with stenosis severity as well, which agrees with other studies [3-6]. The same finding was observed in MBV during Dobutamine hyperemia. However, Dipyridamole vasodilation showed slight increases in blood volume reserve with increased stenosis severity in both the LAD and LCX regions (Figure 5). This may reflect adaptive auto-regulation, but further study is needed on this observation.

Conclusion

First-pass perfusion CMR allows for fast evaluation of MBF/MBV changes during pharmacologically induced hyperemia. Measurements of both MBF and MBV may allow for more comprehensive diagnoses of coronary artery stenosis and better treatment planning.

References

1. Goldstein TA, *et al.*: *Magn Reson Med* 2006, **56:**439-45.
2. Goldstein TA, *et al.*: *Proceedings of the International Society of Magnetic Resonance in Medicine, Seattle, WA* 2006:3573.
3. Sambuceti G, *et al.*: *Am J of Cardiol* 1993, **72:**538-43.
4. Sambuceti G, *et al.*: *Circulation* 1994, **90:**1696-1705.
5. Wu JC, *et al.*: *J Nucl Cardiol* 2000, **7:**43-52.
6. Pacella JJ, *et al.*: *Circulation* 2006, **114:**1940-7.

Table 1. Dog groups and results.

Group (*n*)	Stenosis (Area)	Hyperemia	MBF(ANT)	MBF (INF)	MBV(ANT)	MBV(ANT)
1 (8)	normal	Dipyridamole	137%		28%	
2 (4)	normal	Dobutamine	80%		42%	
3 (4)	70%	Dipyridamole	29%	185%	19%	31%
4 (3)	90%	Dipyridamole	13%	136%	25%	50%
5 (3)	50%	Dobutamine	55%	145%	69%	46%
6 (3)	70-90%	Dobutamine	40%	126%	25%	20%

Figure 1
Table of dog groups and results. A quantitative CMR perfusion technique was performed in a canine stenosis model during Dipyridamole or Dobutamine-induced hyperemia to assess changes in both myocardial blood flow and volume. Hyperemia caused different responses in stenotic and normal vessel perfused myocardial regions.

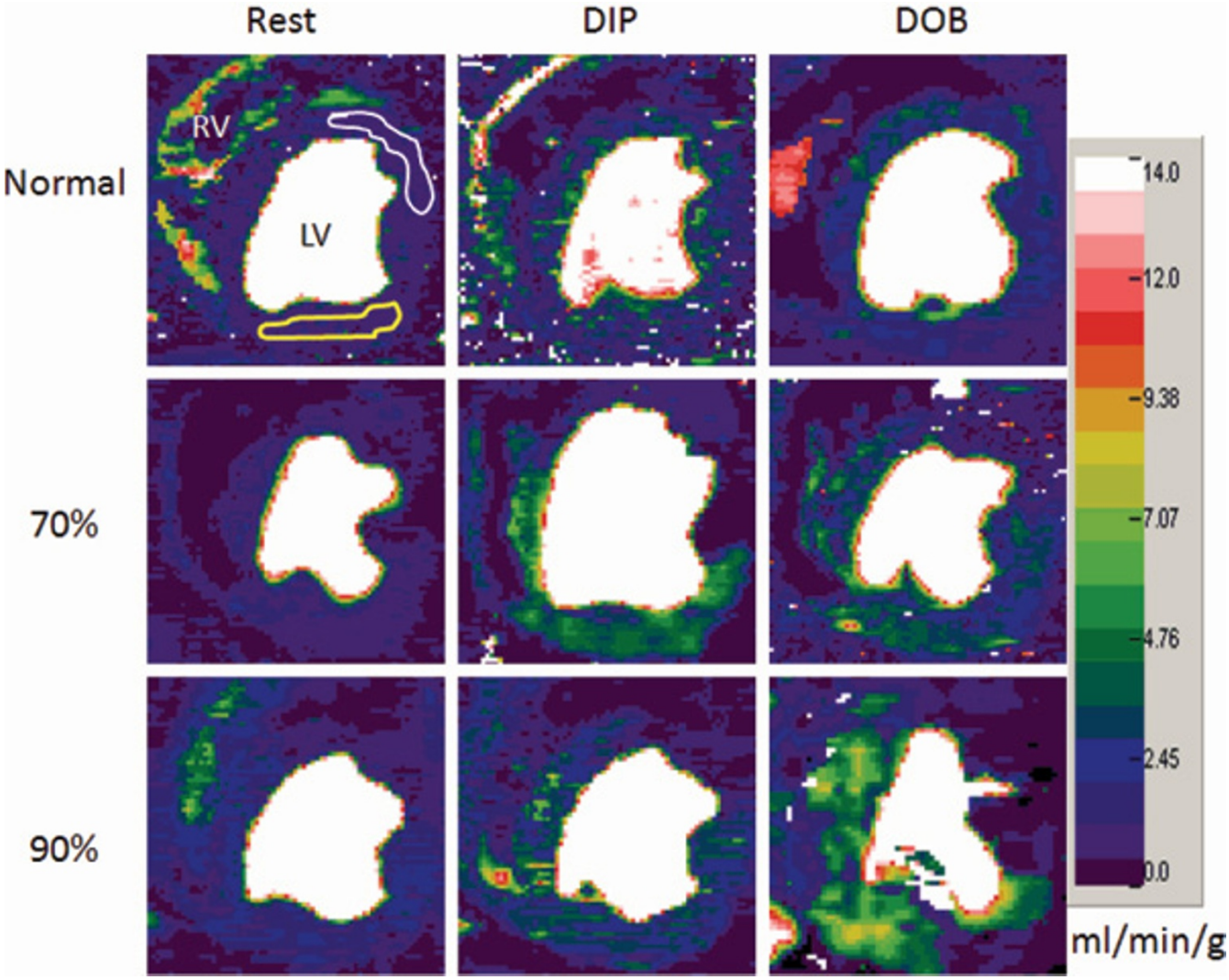

Figure 2
Myocardial blood flow maps from different dogs. Short axis images showing the left ventricle, right ventricle, and myocardial ring with example regions of interest in the LAD bed (white) and LCX bed (yellow).

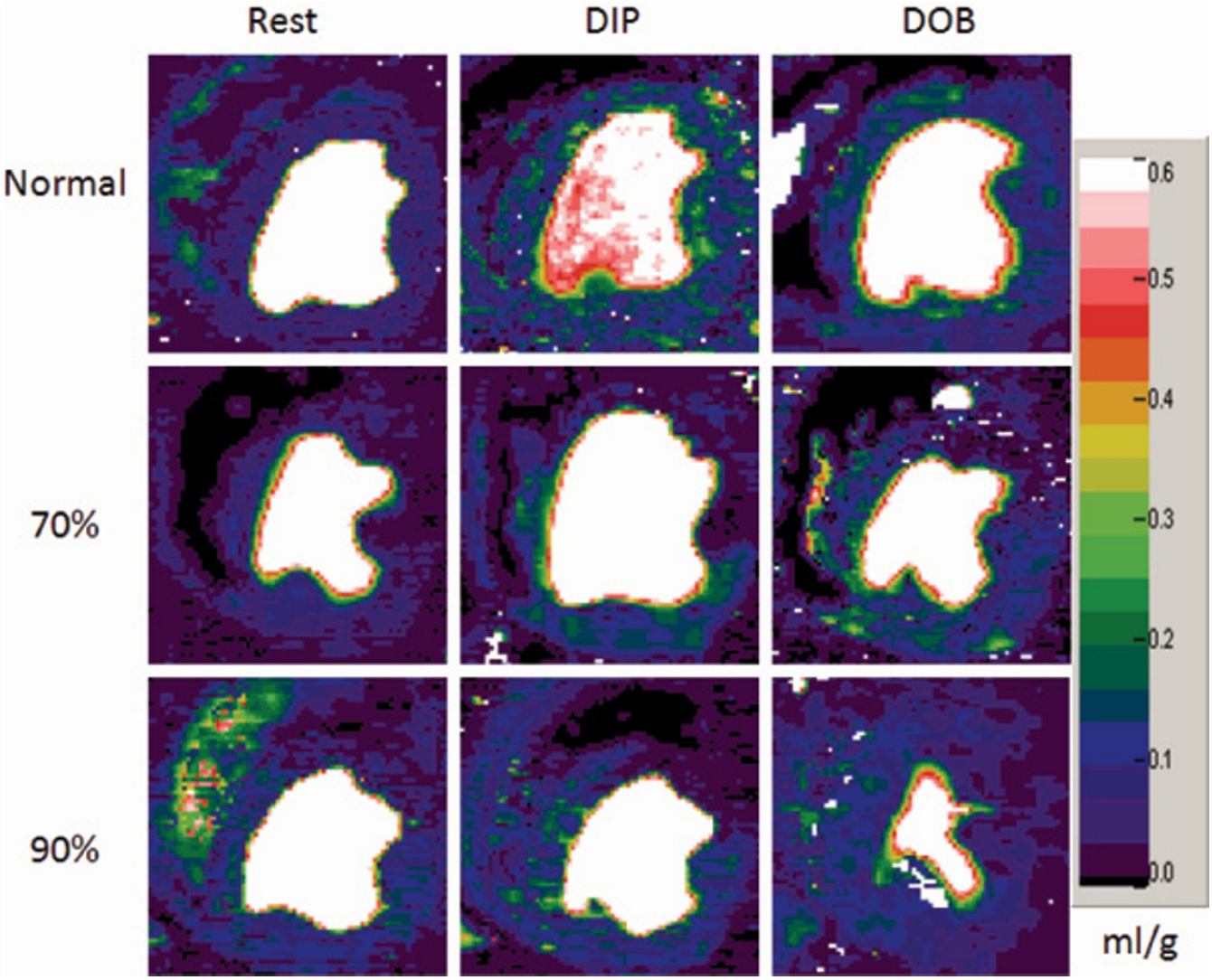

Figure 3
Myocardial blood volume maps from different dogs.

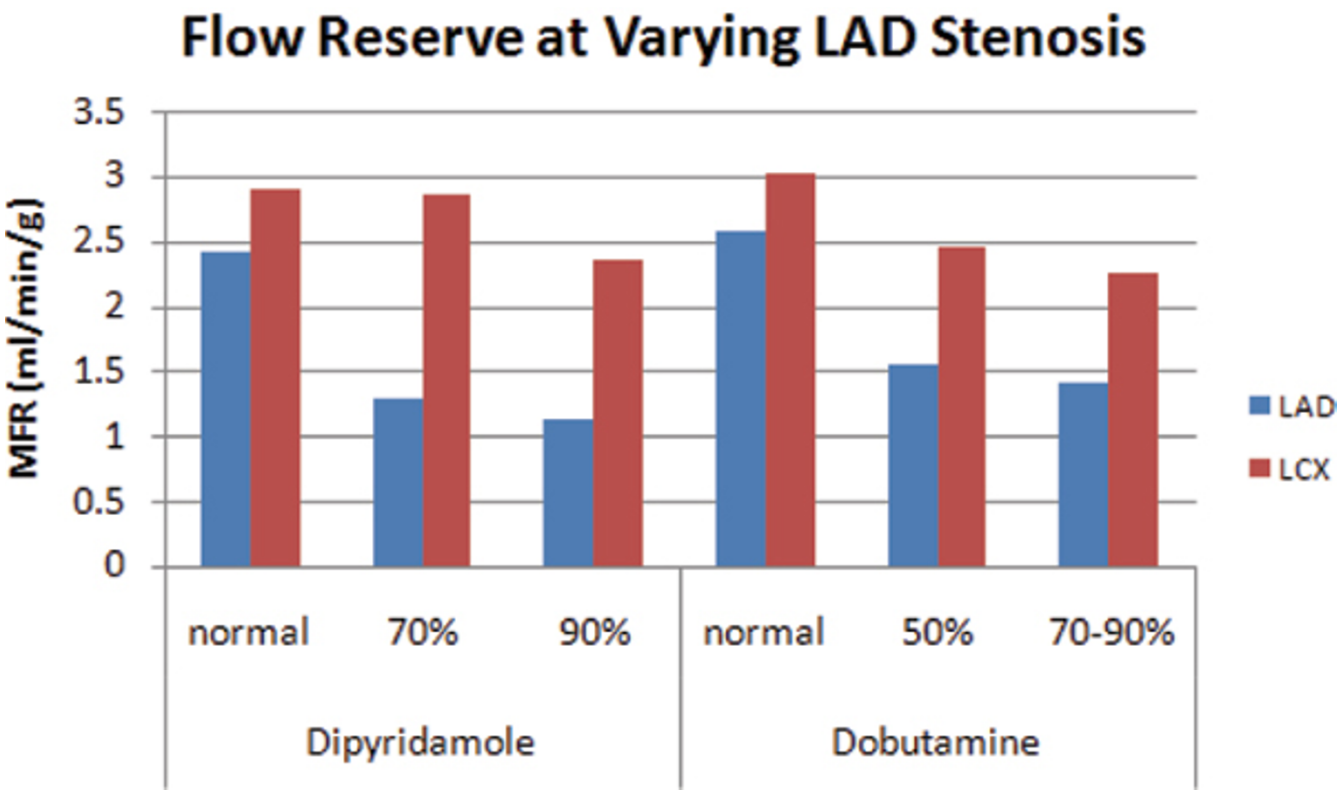

Figure 4
Myocardial flow reserve during Dipyridamole or Dobutamine for varying stenosis severities.

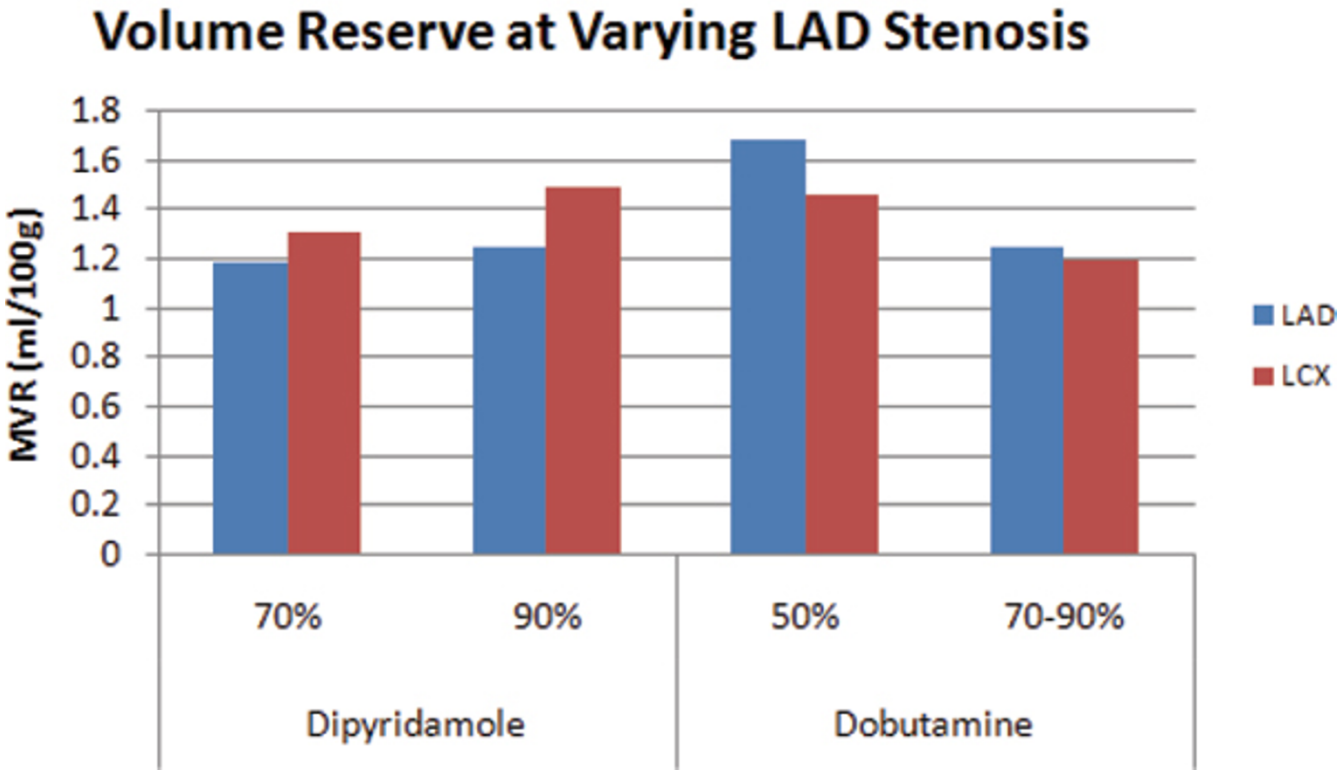

Figure 5
Myocardial volume reserve during Dipyridamole or Dobutamine for varying stenosis severities.