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Subendocardial to subepicardial absolute myocardial blood flow at rest and hyperaemia determined by first pass-cmr and fermi deconvolution modelling

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Introduction

Currently PET, SPECT and echocardiography are used to estimate myocardial blood flow, however with limited ability to evaluate transmural flow difference [1]. With its higher spatial resolution CMR is particularly suited to assess transmural variation in myocardial blood flow [2]. Only one previous CMR study reported differences in subendocardial and subepicardial (3).

Purpose

To compare subendocardial and subepicardial estimates of absolute myocardial blood flow (AMBF) based on first pass perfusion CMR at rest and hyperaemic stress.

Methods

10 volunteers (7 male, mean age 38 years) were studied on a 1.5 T Philips Intera system during adenosine induced hyperaemia (140 mcg/kg/min for 3 minutes, 0.05 mmol/kg Gd-DTPA) and at rest. A pulse sequence optimised for acquisition of a single midventricular slice at systole was used (saturation recovery segmented gradient echo, 2 × SENSE TR/TE/flip 2.7 ms/1.0/15°, typical FOV 380 × 380 mm, matrix 160 × 160, slice thickness 10 mm, preparation pulse delay 150 ms, shot duration 130 ms). Endo and epicardial contours were drawn and the slice segmented into 6 equidistant sectors. These were further subdivided into epicardial, mid-myocardial and endocardial thirds. Based on LV and blood pool time intensity curves, an in-house mathematical Fermi Function deconvolution algorithm was implemented to estimate absolute myocardial blood flow [2].

Results

All results are in ml/g/min. The 6 myocardial segments yielded mostly comparable values (Fig 1), except for hyperaemic AMBF (Fig 1B). The mean AMBF of all 6 segments at rest was lower in the subendocardium than the subepicardium (1.70 ± 0.13 vs. 2.00 ± 0.16 p = 0.005), Fig 1A. The mean AMBF during hyperaemia was 4.41 ± 0.33 (subepicardium) and 3.93 ± 0.13 (subendocardium), $P < 0.001$, Fig 1B. The mean AMBF Reserve Index between stress and rest was 2.83 ± 0.18 for the subepicardium and 2.12 ± 0.12 for the subendocardium, $P < 0.00001$, Fig1C. The ratio of endocardial to epicardial AMBF was 1.22 (+/-0.07) at rest and 0.91 (+/-0.09) during hyperaemia, $P < 0.00001$, Fig 1D.

Conclusion

1. Differences in endocardial and epicardial AMBF gradients can be detected with CMR in vivo.

2. In all myocardial segments the subendocardial layer has a higher resting perfusion than the subepicardial layer.

3. The subepicardium has a higher hyperaemic AMBF and perfusion reserve than the subendocardium. Unlike previ-

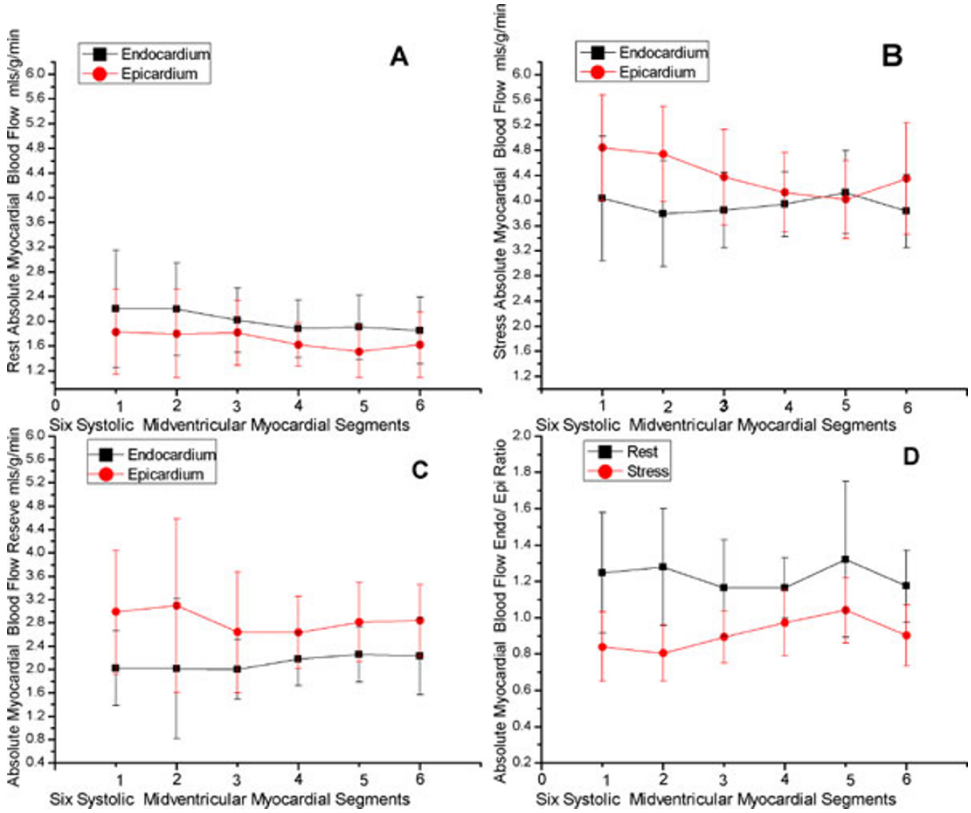

Figure 1

ous studies, we acquired all AMBF data in systole, which may explain this novel finding.

References

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