Surface Coil Intensity Correction and Non-linear Intensity Normalization Improve Pixel-Resolution Parametric Maps of Myocardial MRI Perfusion

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Abstract. We present a systematic approach to generate pixel-wise parametric maps from contrast-enhanced MR myocardial perfusion images. A surface coil intensity correction algorithm is used to compensate the myocardial intensity inhomogeneity. Non-linear intensity normalization is applied to color encode the pixel intensity. The preliminary result shows our technique is valuable in differentiating perfusion defects within myocardial regions of interest.

1 Introduction

MRI first pass myocardial perfusion analysis is based on time-dependent signal intensity changes. A variety of semiquantitative measurements have been proposed [1], [2]. The current project proposes methods to allow near pixel resolution mapping of these perfusion parameters.

2 Methods and Results

Normal volunteers were recruited and Gd-DTPA was utilized for myocardial perfusion study using a hybrid echo-planar gradient echo sequence. A reference image was used to compute intensity variation due to surface coil reception. Signal intensities of myocardial region of interest (ROI) are corrected using a quadratic polynomial intensity surface on the reference image. Respiratory motion was compensated by translating each image to align the centers of the myocardial ROI. Contrast enhancement ratio (CER), upslope (SLP), upslope integral (INT), and maximum intensity (IMax) maps were calculated on the upslope part of the time signal intensity defined by the baseline (BAS) and early peak (EPK) images.

A non-linear intensity normalization scheme is used to color encode all parametric maps such that normal regions are shown in color orange and abnormal in green, while suspicious areas are displayed from color purple to blue (Figure 1). Statistical analysis of the myocardial ROI (n=30) was performed on EPK, Imax, SLP, INT, and CER images (Figure 2). In general, surface intensity correction (SCIC) reduces the

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coefficient of variation (SD/mean) of all maps except CER, which by definition already includes normalization to the baseline signal intensity. Non-linear intensity normalization (NLIN) further improves the coefficient of variation for all parameters, including CER, except for EPK.

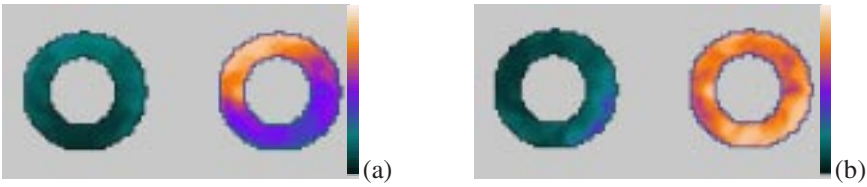

Fig. 1. BAS (left) and EPK (right) parametric maps of a normal case (a) before and (b) after SCIC and NLIN.

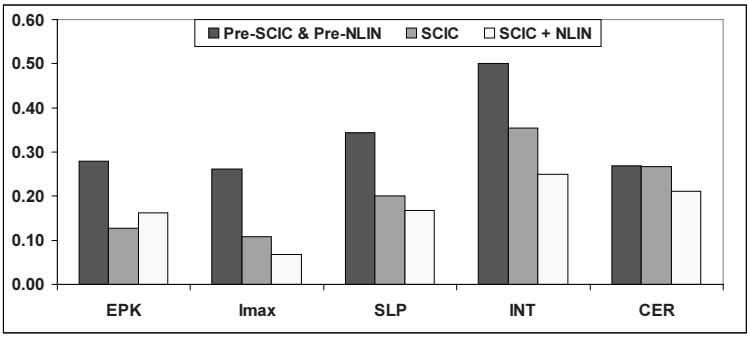

Fig. 2. SCIC and SCIC+NLIN improve coefficient of variation of all parametric maps.

3 Conclusions

We demonstrate a practical approach to generate comprehensive pixel-wise parametric maps for high resolution qualitative visualization of MRI first pass perfusion images. The clinical effectiveness of these parametric maps in assisting the detection of myocardial ischemia is under study.

References

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