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Feasibility study of motion pre-analysis method for whole-heart magnetic resonance coronary angiography (WH MRCA)

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Introduction

WH MRCA [1] examinations are usually performed during free breathing, and the Realtime Motion Correction (RMC) coefficient is important for obtaining good image quality. However, this coefficient differs in each patient, which may result in image degradation. We have developed the Motion Pre-Analysis Method to determine the appropriate RMC coefficient before WH MRCA and have conducted feasibility studies to investigate the appropriate method for using an abdominal band.

Methods

2D SSFP coronal cine images were obtained using a 1.5-T MRI scanner. The scanning conditions were TR/TE = 3.4/1.7, matrix = 128, and one image per R-R. Scanning was performed for a total of 1-3 minutes during free breathing in 15 healthy volunteers. A Motion Pre-Analysis Tool was developed to extract the amplitude of motion by calculating the cross-correlation on three ROIs placed on the diaphragm, upper heart, and lower heart. The RMC coefficient was obtained by dividing the mean amplitude of heart motion by diaphragm motion. To investigate the appropriate method for using an abdominal band, an active breathing level control method [2] was employed. In this method, the breathing level is controlled using an air bladder placed between the upper abdomen and the abdominal band. The motion and RMC coefficient were measured with the air bladder inflated to various pressures (0, 10, 20, and 30 mmHg).

Results and Discussion

The measured RMC coefficient in 15 volunteers was 0.59 ± 0.22 at 0 mmHg, with greater variability expected in patients. The amplitude of diaphragm motion was reduced as the air pressure was increased up to 30 mmHg. On the other hand, heart motion was increased at 30 mmHg. These findings suggest a change in the breathing pattern from abdominal breathing to costal breathing.

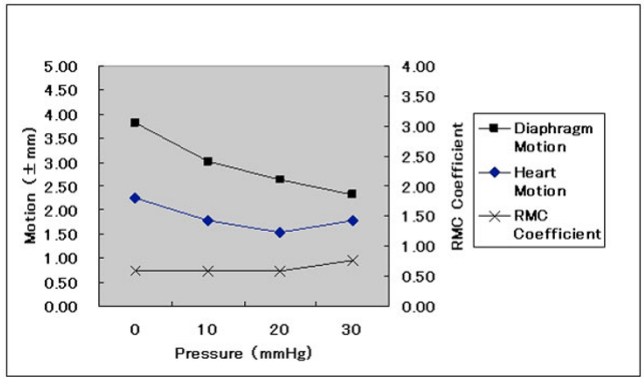

Figure 1
Pressue vs motion and RMC coefficient.

The RMC coefficient remained nearly constant up to 20 mmHg, but was increased at 30 mmHg (0.77 ± 0.51), suggesting that the abdominal band should be used less than the pressure of approximately 20 mmHg and that the RMC coefficient changes when the pressure exceeds 20 mmHg.

Conclusion

The results of this study suggest that the RMC coefficient may change to a greater degree in patients, even if the method for using an abdominal band is changed. It is therefore concluded that this Motion Pre-Analysis Method should be very useful for clinical WH MRCA examinations.

References

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