NOVEL RESULTS FROM CARDIAC MAGNETIC RESONANCE IMAGING IN A SPIDER SPECIES

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Target Audience: Cardiovascular scientists, preclinical MRI researchers, physiologists.

Purpose

The use of Magnetic Resonance Imaging (MRI) has traditionally been limited to only a handful of model species, whereas the range of species useful to biomedical research is expanding. We investigated whether a modern preclinical MRI scanner was flexible enough to evaluate a novel species. To test this we scanned spiders which possess physiological parameters atypical to such scanners usual biological parameter set. We were also interested to see if such scans would yield any new information on the subjects themselves and if this had any potential biomedical utility.

Methods

Live spiders (Grammatosla species) were anaesthetised and restrained for scanning. Each spider underwent a full cinematic heart scan in a dedicated 7T animal MRI scanner. Scans were acquired using a retrospectively self-gated Flash-based MRI pulse sequence (TR=8ms, TE=3.3ms, FOV = 30mm x 30mm, Matrix = 128 x 128) [1] and a 4-channel phased array coil designed for rodent cardiac imaging. Manual contouring methods were then carried out (ImageJ) on the resulting images to obtain quantitative measurements of cardiac function.

Results

Scans ran successfully (n=7) (Fig. 2) producing the first *in vivo* cine MRI scans of spider hearts. Heart rates (Fig. 3), volumes and ejection fractions (EF) were obtained from the resulting data. Mean heart rates (~20bpm) were broadly in line with expectations from the literature obtained with alternative methods. In a new finding ejection fraction was shown to increase with animal weight (Fig. 4), which substitutes as a rough proxy for age in spiders. One subject did not follow this trend and also exhibited marked differences in weight, behavior and rearing history. All animals survived the procedure.

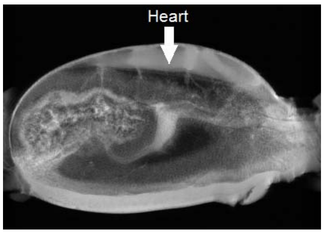

Fig. 1 – T1-weighted sagittal anatomical slice showing spider abdomen.

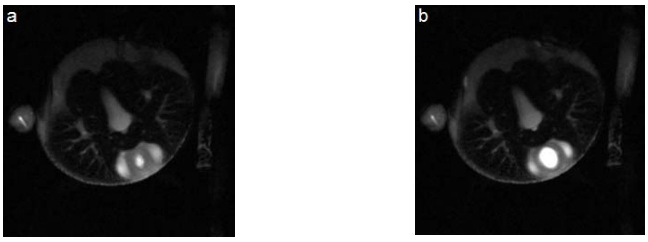

Fig. 2 – Example axial slices of cardiac data, a) diastolic and b) systolic. Hearts are near the bottom of slice due to positioning inside coil.

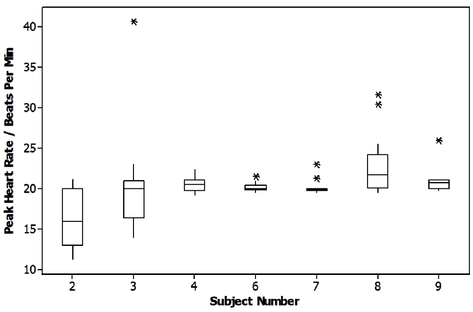

Fig. 3 – Heart rate data. Spider #4 onwards had improved restraints to prevent body movement without interfering with heart motion.

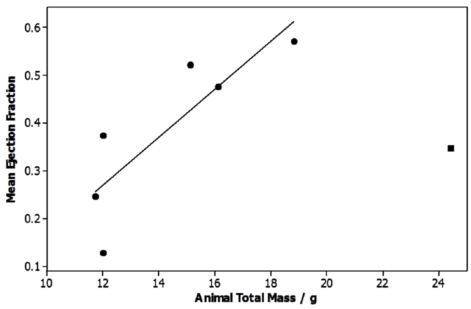

Fig. 4 – Ejection fraction data showing correlation between EF and animal mass.

Conclusion

MRI can obtain useful information from a novel species, suggesting the utility of the technique and current technology for a wider range of species. The spider heart changes basic mechanical output with age in contrast to both rodent and human hearts. This indicates a potential novel area of cardiac investigation. The anomalous subject suggests the potential for assessing familiar physiological stresses in a novel biomechanical and biochemical environment.

Reference [1] Heijman E, et al. NMR Biomed. 2007; 20 : 439-447.