CINE Images of a Beating Rodent Cardiac Phantom

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Aim

Cardiac imaging of small animals using MRI remains a challenging area.[1] A beating cardiac phantom would facilitate image development, assist in understanding imaging problems, allow independent verification of functional measurements and reduce the usage of live animals.

Methods

A phantom was built consisting of a single walled chamber with similar axial dimensions to a rat left ventricle. The phantom wall is made from polyvinyl alcohol cryogel (PVAC).[2] The phantom is housed in a sealed polypropylene tube in a water bath. An inlet/outlet hose is used to drive expansion of the phantom, a second outlet allows space for this expansion. The phantom is expanded by a gear pump located 1.2m from the magnet bore, driven by a sinusoidal waveform from an arbitrary waveform generator. A triggering pulse was also produced to trigger signal acquisition. The magnitude of the driving waveform was calibrated using ultrasonic M-mode images to give a cross-section ejection fraction of 60%.

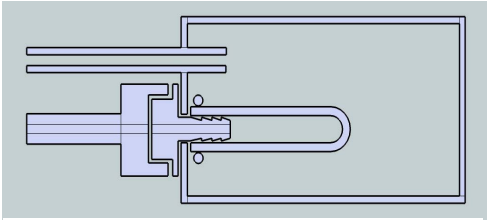

Figure 1) Phantom in housing.

Results

The phantom was imaged with a 7T Varian scanner. It was first tested statically without the pump present, and with the pump running to assess any artifacts introduced by the pump. A slight banding was observed in what should be homogenous material, at >20dB below the signal level. The phantom was imaged with a CINE sequence with ES and ED frames shown in Fig. 2 below.

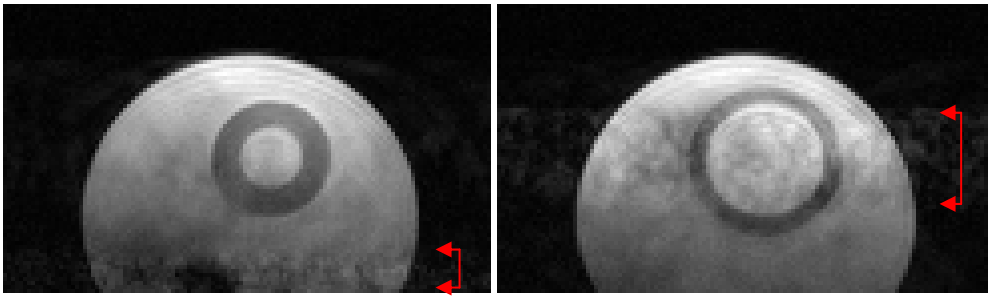

Figure 2) CINE images of beating phantom, ES and ED frames. Arrow shows position of flow artefact.

The images show a good clean representation of the phantom wall, showing the triggering works well and motion is reproduced accurately cycle to cycle. The image however shows strong flow artifacts. These artifacts are also present in in-vivo imaging (shown below) but are stronger in the phantom. The phantom could thus be a useful tool for testing flow compensation methods for the reduction of these artifacts.

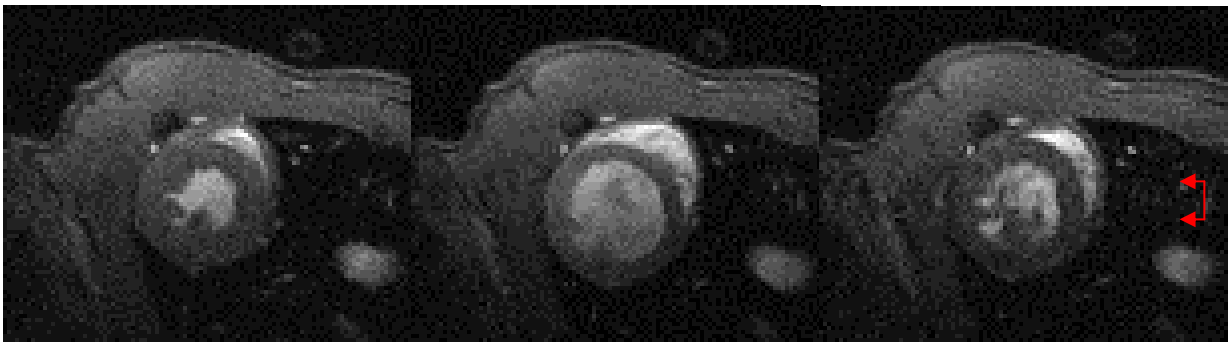

Figure3)CINE images of rat heart.

Conclusions

A rodent cardiac phantom which mimics the dynamic behavior of the rat heart has successfully been built and imaged. Motion of fluid within and surrounding the phantom causes strong flow artifacts.

References:

[1] Valee et al. (2004) MAGMA17: 149–156 [2] Chu et al. (1997) Mag. Res. in Med. 37: 314-319