Multiple Mouse Cardiac Imaging

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Introduction Multiple mouse magnetic resonance imaging has recently been introduced for high-throughput imaging of large numbers of mice [1]. The initial feasibility of this technique for cardiac imaging was studied and retrospective gating was shown to provide comparable image quality to prospective gating for three-dimensional imaging in mice [2]. In this abstract we present the first retrospectively gated cardiac images obtained from multiple mice in parallel.

Materials and Methods Three normal mice were anaestheized with ~1.0% isofluorane gas and imaged with a four-channel 7 Tesla MRI scanner (Varian Unity^{INOVA}, Palo Alto CA) and a large bore gradient coil (Tesla, 12 G/cm, 867 usec rise time). The three ECG's were monitored with commercial hardware (SA Instruments Inc, Stoneybrook, NY), and recorded along with time stamp pulses from the scanner on a storage oscilloscope. Double-oblique angles for short-axis views were prescribed with prospectively gated localizer images obtained sequentially in each of the mice, and a set of angles was selected to give the best overall match with the individual variation in heart axes. Given the constraints on minimum TE/TR with the large-bore coil, black-blood preparation [3] was chosen for consistent blood pool contrast throughout the heart. Three-dimensional gradient-echo imaging parameters were TR/TE = 70/5 ms, matrix=120x120x8, and voxel size = 200x200x750 um^3.

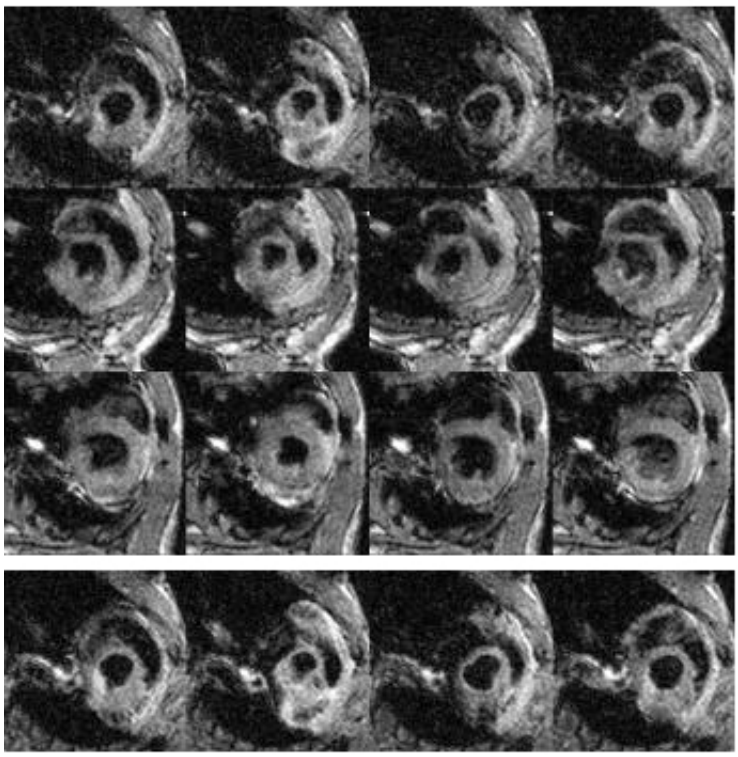

Figure 1. Each row shows four temporal frames from the cardiac cycle. Rows 1-3 show mice 1-3 imaged in parallel. Row 4 shows mouse 1 re-imaged by itself.

For each phase encoding value, 50 temporal samples of the cardiac cycle were obtained. Total scan time was about 60 minutes. At the completion of the multiple mouse scan, mice 2,3 remained in the scanner with RF transmission off while mouse 1 was re-imaged with identical scan parameters. For each mouse, data were reconstructed at 10 temporal phases, and 5 sets of images were averaged for improved SNR. In this experiment, respiration gates were not used in the reconstruction.

Results In figure 1, each row shows one slice of the acquisition volume at four temporal phases (1,4,7,10 of 10) of the cardiac cycle. Rows 1-3 show mice 1-3 imaged in parallel, while row 4 shows mouse 1 re-imaged by itself. Although the combination of long TE and black-blood preparation results in less than ideal SNR even after 60 minutes of scanning, it can be seen that image quality in mouse 1 is similar whether imaged in parallel or singly.

Conclusions We have shown preliminary images of the cardiac cycle obtained from three mice in parallel. Further advancement of this technique will require a gradient coil selected for improved performance and prescan localization that is at least partially parallelized and automated.

References

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