Delayed Enhancement Cardiac Magnetic Resonance Imaging Can Quantify Disease Progression in Patients with Mitral Valve Disease and Atrial Fibrillation

Objective: Valvular heart disease is the most common etiology of chronic atrial fibrillation (AF), however the mechanisms by which it leads to AF remain poorly understood. Although, there are Class 1 recommendations to perform concomitant AF ablation in symptomatic patients undergoing mitral valve surgery (MVS), there is little known about the progression from lone MV disease (MVD) to MVD with AF. Delayed enhancement cardiac magnetic resonance imaging (DE-MRI) is a noninvasive tool that has assessed atrial fibrosis in lone AF prior to catheter ablation, however there have been no studies using DE-MRI to assess atrial fibrosis in patients with or without (+/-) AF undergoing MVS. This study evaluated the feasibility of DE-MRI to detect and quantify both left atrial (LA) volume, and atrial enhancement in degenerative MR +/- AF.

Methods: Between March 2018 to September 2022 35 subjects were enrolled; 15 age-matched controls, 11 lone MR, and 9 MR+AF. All had a DE-MRI, and patients were scanned within 30 days of lone MVS or concomitant MVS with CMP-IV. The DE-MRI gadolinium-based contrast protocol (MARREK Inc) and enhancement reports were provided for analysis of the LA wall and volume. A one-way analysis of variance with post-hoc Tukey's test was used to calculate significance in wall enhancement, a surrogate marker of fibrosis, in both the LA and left atrial posterior wall (LAPW). A p value less than or equal to 0.05 was significant.

Results: Compared to the controls LA volume (37.1 ± 10.6 ml), MR (75.8 ± 39.3 ml, p < 0.001), and MR+AF (99.3 ± 47.3 ml, p < 0.001) had a significant volume increase. Compared to the controls total LA enhancement (8.3 ± 3.8%), MR (8.7 ± 5.1%, p = 0.008) and MR+AF (16.7 ± 9.6%, p = 0.019) was higher. Furthermore, the LAPW enhancement of MR+AF (17.5 ± 8.7%) was significant to controls (9.2 ± 5.1%, p = 0.016) and increased to lone MR (10.3 ± 6.7%, p = 0.053). Overall, there was an association between LA volume (r = 0.446, p = 0.007) and LA enhancement.

Conclusion: LA wall enhancement can be detected using DE-MRI in patients with degenerative MVD +/- AF. The enhancement correlated to LA volume changes. Patients with MR+AF had a significantly greater amount of atrial fibrosis when compared to controls and lone MR. DE-MRI can quantify atrial enhancement, or fibrosis, as a marker of disease progression from lone MR to MR+AF. Further studies are needed to determine if DE-MRI can be used to determine the need for and guide lesion sets for concomitant ablation in MVD +/- AF.

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Figure 1: An example of LGE enhancement in a control patient (a), patient with MR (b) and patient with MR and AF (c). The fibrotic scar is blue/green.

Figure 2: Total LA volume.

Figure 3: Total LA enhancement.

Figure 4: Left atrial posterior wall (LAPW).

*One way ANOVA test used to determine significance between the 3 subject cohorts (controls, lone MR, and MR with AF). P value less than or equal to 0.05 is significant.