

Research Promises: What Can We Expect in the Future?

Nael F. Osman

Johns Hopkins University

The main function of the heart is to pump the blood throughout the body, which is done by the contraction of the cardiac muscle (myocardium) in a synchronous way to achieve the mechanical pumping. It is important then to determine the damage to the heart based on the damage to its ability to pump the blood. Moreover, the progression of diseases is expected to impact the function in some way at early stages, whether the disease progression is reversible or not. However, this progression suffers from two things: First, it is possible that it will be focal, i.e. affecting some part of the muscle. Second, the changes in regional contractility of the muscle could be subtle and their impact is too little to cause a significant change in the global function of the heart, let alone becoming symptomatic.

This can be resolved by the use of quantitative assessment of regional function. The quantification is crucial in order to detect the changes in regional function, provided that the quantification method is sensitive enough. Therefore, the use of such methods have the great potential to improve the timing of detecting of future problems in the heart (or improvement).

The Role of MRI

MRI is the gold standard modality for the assessment of the function of the heart. More importantly, MRI has the most sensitive methods for measuring the regional function of the heart. It is important, however, to understand:

- The existing MR methods for measuring the regional function of the heart;
- Their limitations and advantages; and
- The amount of evidence collected so far of the methods on their value and future impact.
Because of these applications, regional assessment of cardiac function of MRI has been used to:
 - Measure regional changes in patients that are symptomatic for better understanding of the impact of the disease on the muscle,
 - Quantify some mechanical behavior of the heart such as dyssynchrony that is not well defined qualitatively,

- Determine early indicators of diseases in populations with higher risk of developing certain diseases (for example, breast cancer women with increased chances of developing heart failure due to chemical treatment), or
- Determine the improvement in regional function as a result of treatment, such as in the use of stem cells or pharmaceutical interventions.

Challenges

The advantages of using MRI for the quantification of regional function will be demonstrated. However, it is important to understand the challenges for a wider clinical usage. These challenges are due to a number of reasons:

- First, it could be related to MRI itself and its limitation of use in certain diseases of the heart,
- It could be related to the feasibility or ease-of-use of the quantification methods themselves to image and produce the measurements,
- But perhaps the most significant reason is the lack of large studies that demonstrate the impact of using this measurements of regional function on improving the healthcare of patients.

The last challenge is in a way dependent on the first two, and interestingly vice versa. Without the proper tools to obtain the measurement from the heart, it will be very difficult to conduct studies with large populations. Moreover, without the evidence of the value in large studies, it is very hard to dedicate the resources to develop the solution for the first two challenges.

We will discuss these challenges and how progress is partially made in this direction.

Conclusion

Measuring regional function of the heart is an important point of strength of MRI. Moreover, it has a great value for the treatment and management of disease, as well as the development of medications that impact the heart (whether in a positive way as a new treatment or in a negative way as an adverse effect due to treatment). It is important to know the state of the art in this area, and how it is progressing in achieving the full potential of regional function quantification.