Heart failure can be caused by different cardiac malfunctions, such as damages to the cardiac tissue or increased blood pressure. In order to detect these conditions and issuing an effective treatment, it’s crucial to use reliable diagnostic methods. Felicia Seemann, a PhD student in Biomedical Engineering at the Lund Cardiac MR Group, Department of Clinical Physiology, develops algorithms and models which are designed to indicate various conditions of the heart by analyzing magnetic resonance (MR) images.

Felicia Seemann published an algorithm designed to track the cardiac valve movement in MR images last year. The algorithm could track the valves with similar accuracy as manual analysis, and was validated in 113 study participants.

“Although the technology behind algorithm development have gotten really far today, there is still too much manual work being done when evaluating cardiac MR images. We need better algorithms for a more optimal, reliable, and faster analysis”, says Felicia Seemann.

Recently, Felicia has finalized a research exchange at Yale University, New Haven, Connecticut, USA, where she, together with Dr. Dana C. Peters and Dr. Lauren A. Baldassarre, has looked into the use of algorithms to evaluate the diastolic function, which is when the ventricle fills with blood.

Echocardiography is the method normally used for analyzing diastolic function, while there is a lack of tools to do the evaluation from MR images. If MRI could be used for the same purpose, research projects could be simplified and some patients would not need to have both an MRI and an echocardiographic examination. This was the focus of Felicia Seemann’s project at Yale. Patients who had left atrial tissue characterization examinations by MRI at Yale New Haven Hospital between 2012-2016 were enrolled in the project, with a total of 105 patients being included.

“Today, we have to use echocardiography for determining the diastolic function, and MRI to detect changes in cardiac tissue characteristics. Instead of using two separate methods we asked ourselves if we couldn’t use only one but still obtain the same information”, says Felicia Seemann.

The designed method for the analysis of the MRI images provided reliable measurements of the maximum velocity of both the blood flow through the mitral valve (E) and of the cardiac tissue (e') when compared to values obtained from echocardiographic examinations. In combination, these values correlate to the left atrial pressure, and can be used to tell if a patient is suffering from diastolic dysfunction.

“The aim is not to replace echocardiography with MRI, but rather to use MRI as a compliment to echocardiography”, says Felicia Seemann.

Algorithms hold the ability to make otherwise time-consuming work more efficient and also provide an equal, if not better, level of quality compared to manual analysis. Felicia Seemann believes that algorithms will be a great asset in the future of scientific research by obtaining as much information as possible from one set of images, but also in the clinics when determining a patient’s condition. Having completed her project at Yale University, Felicia Seemann is now setting her sights on her
next project, where she is developing a model capable of calculating pressure-volume loops from MR images.

“As more reliable algorithms become available, the analysis process of patient examinations will speed up. This will allow for a quicker diagnosis and treatment which, ultimately, might lead to a better prognosis”, says Felicia Seemann.

- Joakim Hising

Links

Time-resolved tracking of the atrioventricular plane displacement in Cardiovascular Magnetic Resonance (CMR) images: