

CT AND MRI IN IMAGING HEART DEFECTS AND THE IMPROVEMENTS IN ITS TECHNICAL CAPABILITIES

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Introduction

Due to the issues of heart abnormalities in people of all ages, it is imperative to discover these issues and figure out a treatment plan. With computed tomography and magnetic resonance imaging, the ability to visualize these issues and develop a diagnosis has become easier and faster. These rapid advances in technology with MRI and CT has improved the visualization of complex cardiac anatomy in the evaluation of congenital heart disease (Bonnichsen & Ammash, 2016, p. 1). It is important to choose the correct modality and this becomes possible by knowing the disadvantages and advantages of each, when CT and MRI should be used, and keeping up-to-date with the newer technology.

The Pros and Cons of CT and MRI

For MRI, the main advantages are:

- ❖ Imaging that does not use ionizing radiation
- ❖ Great soft tissue contrast and temporal resolution
- ❖ Functional imaging made possible with the use of contrast
- ❖ The use of Magnetic Resonance Angiography (MRA)

For MRI, the disadvantages are:

- ❖ Hard for patients with claustrophobia and uncomfortable with loud noises
- ❖ Need the patient to remain still and hold their breath for long periods
- ❖ The presence of metal and cardiac devices could create a dangerous situation
- ❖ Contrast Allergies with the use of MRA

For CT, the main advantages are:

- ❖ Cooling Systems that keep the machine from overheating
- ❖ High speed exams while still maintaining spatial resolution
- ❖ Very precise in localizing anatomy
- ❖ The use of Computed Tomography Angiography (CTA)

For CT, the main disadvantages are:

- ❖ High radiation dose due to the amount of ionizing radiation
 - ❖ This occurs in the intervention period
- ❖ Potential contrast allergies with the use of CTA

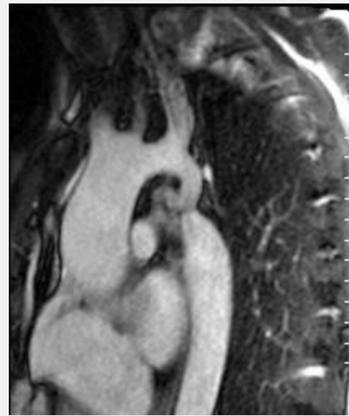


Figure 1: This is an image displaying aortic coarctation of a 22-year-old man using MRI.

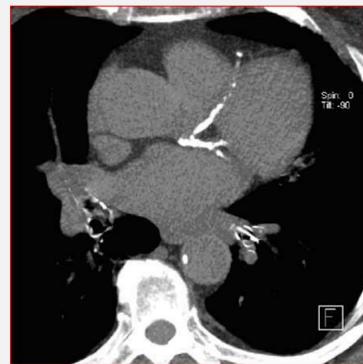


Figure 2: This is an image of heavily calcified coronary vessels using CT.

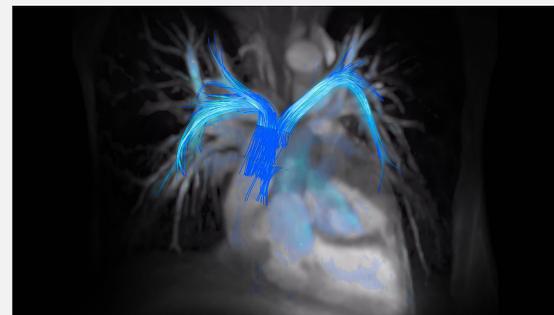


Figure 3: This is a visualization of a complex congenital heart disease using 4D Flow.

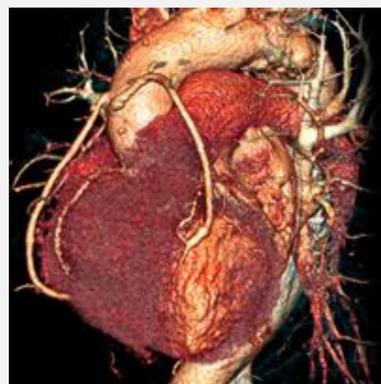


Figure 4: This image is an example of the uses of CTA with image reconstruction.

Defects Best Imaged With CT and MRI

Congenital heart disease is the most common type of heart defect that reflect abnormalities in size, connections, or communications of the chambers of the heart or the surrounding arteries and veins (Vasanawala et al., 2015, p. 870).

Cardiomyopathy which is a disease of the heart muscle that creates issues in blood circulation and makes the heart work harder to pump blood to the rest of the body.

Aortic coarctation is the stenosis of aortic walls, which can create an obstruction within the aortic arch and hypertension (refer to Figure 1).

Calcifications are a build-up of calcium that can create a clot in the heart and obstruct blood flow in the heart (refer to Figure 2).

Plaque morphology is a fatty build-up that obstructs blood flow which causes high blood pressure and irreversible damage. It can even lead to a myocardial infarct, which is tissue death due to the lack of oxygen.

Advancements in CT and MRI

The advancements in MRI:

- ❖ Uses of 4-D flow, which can yield a velocity, volume, and path of the blood flow in the heart. As well as post processing techniques that provide a different plane to view the heart (refer to Figure 3).
- ❖ Cardiac magnetic resonance (CMR) is an imaging technique that provides myocardial characterization and the assessment of biventricular volumes and function (Bucciarelli-Ducci et al., 2016, p. 1-4).

The advancements in CT:

- ❖ Multi-detector computed tomography evaluates the cardiovascular system and the aorta while providing excellent anatomical detail and the option of multiple planes (Karaosmanoglu et al., 2015, para. 16).
- ❖ CTA improves the visualization of complex cardiac anatomy and the evaluation of small vascular structures by injecting contrast agents (Bonnichsen & Ammash, 2016, p. 1-2) (Refer to Figure 4).

Conclusion

CT and MRI have created new opportunities in helping patients with heart defects due to the advancements in technology and providing a wider range of options for the physician and the patient to choose from. By understanding the qualities of CT and MRI, when each modality should be used, and the advancements made in CT and MRI, a health care provider can provide optimal care to a patient with a heart abnormality.

References

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