Cardiac Arrhythmia: overcoming the unexpected

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Introduction

In routine clinical practice about 10 % of patients undergoing cardiac CT angiography experience arrhythmia during the scan. The Aquilion ONE virtually eliminates the challenge of imaging patients with cardiac arrhythmias. A sophisticated arrhythmia detection algorithm is incorporated into the acquisition software, taking full advantage of the system's volumetric scanning capabilities. The system monitors the cardiac rhythm in real time and aborts exposure if an arrhythmia is detected. Furthermore, the software is designed to recognize different arrhythmias and can adjust the exposure window to ensure a diagnostic scan.

## Arrhythmia detection software

If a patient receives a contrast medium injection for a cardiac CTA examination, the aim is to acquire a meaningful diagnostic image, no matter what the heart rhythm. This includes patients that are in cardiac arrhythmia or patients that have an anomalous heartbeat at the time of the scan. Therefore, a sophisticated arrhythmia detection algorithm that automatically adapts the exposure in real time in response to the patient's heartbeat is integrated into SURECardio software.

The arrhythmia detection software attempts to recognize an abnormal heartbeat and minimize exposure while achieving the specific scanning objective: to provide high quality diagnostic images. In the example below (Case 1), a single unexpected short heartbeat occurred during the scan. The system detected it and immediately terminated the exposure to acquire the scan in the next normal heartbeat. This particular patient was examined during the first week following installation of the Aquilion ONE. After completion of the scan, I knew immediately that this is a truly unique scanner because I know of no other CT system that could be used to perform coronary CTA in this patient with such ease and exquisite images.

Case 1: Ventricular Ectopy

A 61-year-old woman with recurrent ventricular ectopy presented with chest tightness. The patient experienced a premature ventricular contraction (PVC) at the time of the scan. PVC is characterized by a very short heartbeat that is followed by a compensatory long heartbeat. The software recognized this pattern and aborted exposure in the abnormal beat. To ensure a motion-free image a diagnostic scan was obtained in the next beat and the exposure window was extended to include the next R wave, ensuring the diastolic phase was captured. As a result, the examination is diagnostic and a failed examination with wasted X-ray exposure has been avoided.
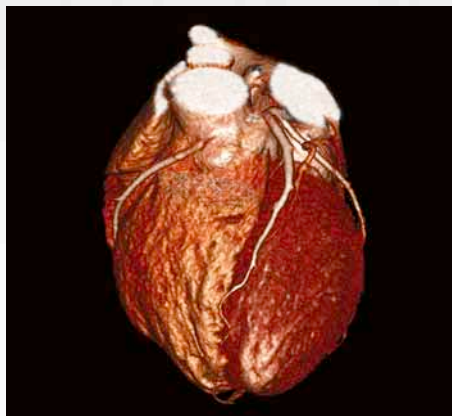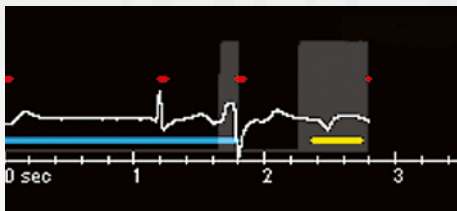
The RCA arises from the ascending aorta just above the right coronary sinus.

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Cardiac arrhythmias have a wide variety of presentations that make diagnostic scans in helical mode impossible. However, the arrhythmia detection software on the Aquilion ONE is designed to recognize arrhythmic beats and adjust the exposure timing in response to abnormal cardiac rhythm.

The arrhythmia detection software reacts to each clinical presentation as it occurs. In this second clinical example (Case 2) the patient experienced atrial fibrillation during the scan. Each beat is normal however the length of the second beat is shorter. Aquilion ONE recognized this and as a 2-beat scan was required the next, longer, beat was also acquired.

Summary

Over 5500 cardiac patients have been examined since the scanner was installed, with close to a 100 % success rate. The robust arrhythmia detection software installed on the Aquilion ONE allows us to perform cardiac CTA on all patients with confidence that the scan will result in diagnostic images every time without the necessity of repeat scanning.

Case 2: Atrial Fibrillation

This 71-year-old man presented with various risk factors for coronary artery disease, including diabetes, hypertension and symptoms of angina. The patient experienced atrial fibrillation while in the scanner, as seen in the irregular ECG trace recorded during this multi-segment 2-beat scan. The heart rate during the scan was 63−113 bpm.
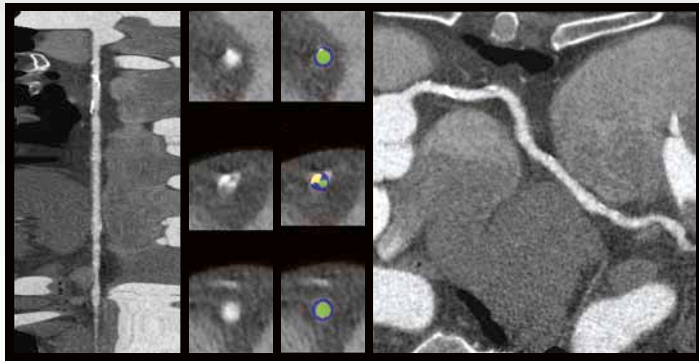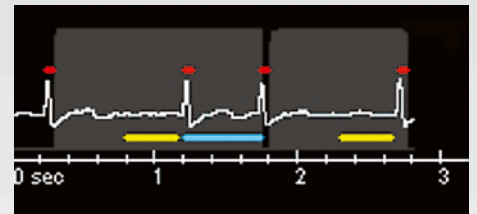
A mixed lesion is seen in the mid-RCA. The stenosis was considered to be greater than 50 % but not more than 70 %.
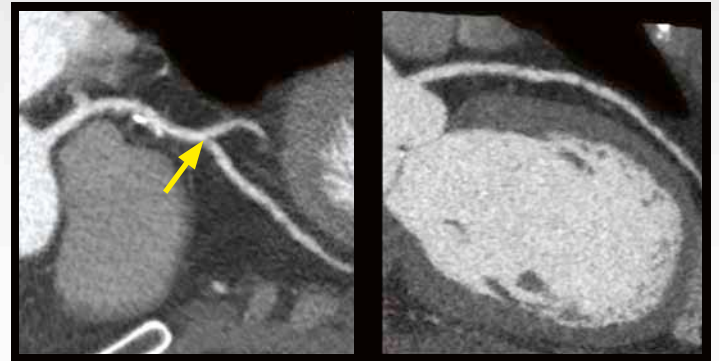
A stenosis is seen in the proximal LAD. It contains calcified and non-calcified regions. The lesion is causing less than 50 % stenosis. A second plaque is seen in the mid-LAD, distal to the 1st diagonal branch. This lesion is causing greater than 50 % stenosis (arrow).

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