Artifacts

Stairstep artifacts

Stairstep artifacts are associated with heart rate variability. With irregular heart rates, phase misregistration can occur when data from different cardiac phases are used for reconstruction. A stairstep appearance results from the data reconstructed from different cardiac phases.

Stairstep artifact: Volume-rendered CT image demonstrates "stairstep" artifact. This is a phase-misregistration artifact that is typically secondary to an irregular heartbeat. Beta blockers are helpful in reducing heart rate variability and avoiding stairstep artifacts. Manual ECG editing can also be helpful. With 256- and 320-slice CT, stairstep artifacts should not be seen if the heart is scanned in one heartbeat.

Coronary artery motion artifacts

Artifacts from motion of the coronary arteries result in image blurring. The right coronary artery is often most affected by motion artifact.

Coronary artery motion: Axial CT images reconstructed at 90% (A) and 70% (B) of the R-R interval demonstrate the importance of imaging during the phase of least cardiac motion. General strategies to decrease motion artifact are to increase the time during the cardiac cycle where there is the least motion and to image as quickly as possible (increase temporal resolution).

Motion can be minimized by reconstructing the data during a phase where there is minimal motion. Choosing the optimal phase of the R-R cycle to reconstruct the data is discussed in the image reconstruction section, below. Decreasing the heart rate with beta blockers has the advantages of decreasing the motion velocity of the coronary arteries and increasing the relative and absolute duration of the diastolic rest period in the cardiac cycle.
Temporal resolution can be increased in 2 ways. Dual-source CT scanners have substantially higher temporal resolution. With a single-source scanner, one way to increase temporal resolution, typically used in patients with higher heart rates, is to use a multiple-segment reconstruction technique. In this technique, the data required for image reconstruction are selected from multiple sequential heart cycles. This technique requires retrospective gating and a regular heart rate. For data from several cardiac cycles to be used for image reconstruction, the same position has to be covered by the detector during consecutive cardiac cycles. Thus, the pitch must be lowered, which will increase radiation dose. Multi-segment reconstruction is only effective in improving temporal resolution at specific heart rates (the heart rate and gantry rotation time need to be desynchronized).

**Arrhythmias**

Arrhythmias present a challenge for CCTA because of both high and irregular heart rates, and both stairstep and motion artifacts can be seen. Atrial fibrillation has sometimes been considered a relative contraindication to the performance of CCTA. However, in recent studies, CCTA has been successfully performed in patients with atrial fibrillation by using dual-source CT and endsystolic reconstruction and by using single-source 64-slice CT with ECG-editing and middiastolic reconstruction.

**Respiratory motion artifacts**

Most patients can breath-hold for the time necessary to complete a CCTA study. A Valsalva maneuver should be avoided, as this can decrease inflow into the right atrium and decrease contrast enhancement. Respiratory motion artifact can be recognized on the lung windows and is most prominent on coronal and sagittal images.

**Streak artifacts**

Streak artifacts from beam hardening can be seen secondary to metal clips. Streak artifact in the superior vena cava and right atrium from dense contrast can limit evaluation of the right coronary artery. This can be mitigated by the use of a saline bolus chaser. However, a saline bolus chaser can result in poor contrast opacification of the right heart lumen, which may limit morphologic and functional evaluation. Protocols that utilize an admixture of saline and contrast are helpful in maintaining right heart opacification without streak artifact.

**Blooming artifacts**

Blooming artifacts can cause small high-contrast structures such as stents and calcium to appear larger than they are. Edge-enhancing kernel filters can decrease blooming artifacts and may be helpful for evaluating a stent lumen, although image noise is increased.
Blooming artifact: Multiplanar reconstruction (MPR) CT image demonstrates blooming artifact from a left anterior descending (LAD) artery stent. The stent lumen is poorly visualized secondary to this artifact.