Stardard Operating Procedure for Cardiac CT and CT Coronary Angiography

CT Coronary Angiography

Heart Rate Control

Prior to image acquisition, metoprolol or diltiazem (oral and/or intravenous) should be administered to target a heart rate of ≤65 beats per minute. Patients without contraindications (e.g. severe aortic stenosis, obstructive hypertrophic cardiomyopathy, phosphodiesterase type 5 inhibitor use), should also receive nitroglycerin (0.8mg) sublingually 3-5 minutes prior to image acquisition..

In the absence of contraindications (e.g. moderate or severe bronchospastic disease, high grade AV block) and if the patient has an acceptable blood pressure (systolic BP>100 mmHg), oral metoprolol may be titrated according to heart rate (example protocols below):

HR	Metoprolol (mg)
60-65	25
65-75	50
75-85	100
>85	150-200

HR	Metoprolol (mg)
60-70	50
70-80	100
80-90	150

Intravenous metoprolol may also be used to further tailor HRs. Patients with uncontrolled heart rates due to anxiety may benefit from receiving lorazepam 1 mg SL or midazolam 1 mg IV.

Contrast Selection

Contrast with the highest available iodine content should be selected (e.g. opamidol 370 mg I/ml, iodixanol 320 mg I/ml)

Timing Bolus or Bolus Tracking Method

Both a timing bolus and bolus tracking method will be permitted. For the timing bolus, a bi-phasic timing bolus (15-25cc contrast; 40cc saline; 5-9cc/sec) should be used to measure transit time (interval between intravenous contrast infusion and peak aorta opacification).

Contrast Administration

The volume and rate (5-9cc/sec) of contrast administration may be individualized according to scan time and patient body habitus. Flow rates of ≥ 8cc/sec may be reserved for patients with very large BMI and/or significant chest wall attenuation.

Triphasic or biphasic protocols may be used. Triphasic intravenous contrast administration protocol (100% contrast, 40%/60% contrast/saline (50cc), and saline (40cc)), can be initiated 2 seconds after the calculated transit time. The 1st phase is calculated as the product of the scan time +1 or 2 seconds and the rate of contrast infusion. The volume of the second phase (contrast/saline mix) may be increased if the assessment of right-sided structures is indicated. If using a biphasic protocol, the second phase of the triphasic protocol (constrast/saline mix) is omitted.

Image Acquisition

Calcium Score

For calcium scoring, a non-contrast enhanced, prospective ECG-gated image acquisition (400-800 mA, 120 kV) is performed and reconstructed at the 70 or 75% phase, with a 2.5 mm slice thickness and 25 cm field of view covering from the carina to the costodiaphragmatic angle.

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Retrospective or prospective ECG-gated data sets should be acquired with the thinnest available slice collimation and a gantry rotation to optimize temporal resolution, using a tube

voltage of 100-120 kVp and tube current optimized for image quality covering from the carina to the costodiaphragmatic angle. ECG-gated X-ray tube modulation is encouraged. Pitch (0.16-0.24) should be individualized according to heart rate. The CTA data sets will be reconstructed, at the 70%, 75% and 80% phases, using the thinnest slice thickness (e.g. 0.625mm) and increment of (< 67% of slice collimation; e.g. 0.4mm for a slice collimation of 0.625) and standard reconstruction kernels (e.g. B25 or B35 kernels). If significant cardiac motion is present additional phases should be reconstructed. An additional 10 phases (5-95%) should be reconstructed with 1.25mm slice collimation and an increment of 0.625mm to measure LV volumes.

Prospective ECG-gated CTA may be selected for patients with very low (≤ 55 bpm) and regular HRs. Rates between 55-60 bpm, padding is recommended so that additional reconstructions may be performed at the 70 and 80% phases.

CTA Image Analysis

ECG-gated CT images will be post-processed using a workstation enabling the assessment of the coronary artery lumen and plaque on axial images, oblique multiplanar reformations and window levels and widths optimized for each study to enable the identification of coronary atherosclerotic plaque.

A 17 segment model of the coronary arteries and 4 point grading score (normal, mild (<50%), moderate (50-69%), severe (≥70%)) will be used for the evaluation of coronary diameter stenosis. In segments that are not evaluable, forced reading will be performed and readers will provide their best educated guess. Patients will be categorized into 3 broad categories (normal, non-obstructive CAD, obstructive CAD). Patients with obstructive CAD will be further categorized as having high risk CAD (defined as having a left main stenosis (≥50%),

or 3 vessel disease (VD) (≥70%) or 2-VD (≥70%) involving the proximal left anterior descending artery) or non-high risk CAD. As well, patients with obstructive CAD (≥50% diameter stenosis) will be categorized as 1-, 2-, or 3-VD.

Left ventricular volumes will be measured at end-diastole and end-systole (end-systolic and end-diastolic phases are selected using the smallest and largest LV volumes) and LVEF will be calculated using automated or semi-automated cardiac software available on workstations.

Equipment

The minimum equipment requirements are: 64 slice CT with tube rotation time ≤ 400 msec and the vendor specific cardiac package and post-processing software and hardware.