

A Siemens CT scanner is shown from a low angle, looking into the gantry. A patient is lying on the table, and a technician in blue scrubs is adjusting their head. A small monitor on the gantry displays a heart rate graph and the text 'Heart CRT'. The Siemens logo is visible at the top of the gantry.

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How to reduce dose in Cardio CT

SOMATOM Definition Flash
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The SOMATOM Definition Flash features the industry's highest heart-rate independent temporal resolution of 75 ms to freeze cardiac motion for sharp and crisp image appearance.

General

Coronary CT Angiography (CTA) is one of the more challenging CT acquisitions in your daily practice. The main reason is cardiac motion, which usually requires additional scan data, of which only a fraction is deemed motion free and can be used for image reconstruction. This can result in high radiation dose exposure if no preventive measures are taken. The tips below apply to all cardiac modes:

Use 100 kV tube voltage for all patients up to 80 kg/175 lbs (or BMI 25 kg/m²). Reserve 120 kV for heavier patients. Enable CARE Dose4D for all patients! Reference values for voltage and current are: 370 mAs/rot at 100 kV, 320 mAs/rot at 120 kV.*

Use the axial images from the calcium scoring scan for an optimization of the scan range in the upcoming CTA. Easily save up to 15% dose!



Position the patient in the iso-center of the scanner, to guarantee optimal use of the cardiac shaped filter.



Remove all metal objects from the patient and ensure a tidy layout of the ECG cables.

Rule of thumb dose ranking (low to high):

1. Flash Spiral Cardio – lowest dose possible!
2. Flash Cardio Sequence – low dose with increased flexibility!
3. Cardiac Spiral – for the more challenging patients!

* Depending on your institute's preference, these values may be adapted.

Flash Spiral Cardio

The Flash Spiral Cardio is suitable for all patients with a stable heart rate of 62 ± 2 bpm and below. Expect sub-mSv dose values at 100 kV for your average size patients.



The Flash Spiral Cardio is prospectively triggered and requires a steady heart rate to ensure a proper cardiac phase. Carefully monitor patient's ECG reaction when the breathing command is given.



Even if the Flash Spiral Cardio mode is very fast, a standard CTA amount of contrast is needed to build up a good iodine concentration. If you are using a Test Bolus, add 5 s to the measured time-to-peak for good enhancement. If you use Bolus Tracking, you might need to lower your threshold by 25% – 50% due to the delay longer than 5 s of this scan mode.

Use the FlashCheck multiple times if the patients heart rate is changing e.g. due to extra beta-blockage or if you are uncertain about the variability.



Although the Flash Spiral Cardio is a low dose mode, you still can scan patients above 80 kg/175 lbs at 120 kV as in all other cardio modes.

You can also scan bypass patients. Just ensure a caudo-cranial scan direction for a proper scan trigger.

Flash Cardio Sequence

A wide variety of patients are suitable for the Flash Cardio Sequence in FlexPadding mode. The scan window can be extended to the systolic part of the cardiac cycle enabling scans for patients with an heart rate up to 90 bpm. The variability should not exceed 5 bpm. ECG pulsing is also possible, allowing a functional evaluation based on sequence data.

The stack overlap is fixed to 10% in a 3D Sequence which enables a near-optimal dose utilization in comparison to any standard cardiac spiral scan.



Look out for ectopic beats in the ECG of the patient. The sequence scan reacts automatically, however the total exam time might be prolonged and influence your contrast media requirement.



Heart rates above 70 bpm can benefit from an additional systolic image reconstruction. Extend the scan window on the trigger card to 30% – 70% and set the pulsing menu to “auto” in these cases.

The total scan time in sequence scans is mainly defined by table speed and scan length. Heart rates above 75 bpm can result in an accelerated contrast washout, yielding a reduced contrast. Increase the amount of contrast accordingly!



The Flash Cardio Sequence has a built-in fully automatic Arrhythmia Compensation. It is therefore the mode of choice for patients with ectopic heartbeats.

Cardiac Spiral

The well established Cardiac Spiral mode is your fallback for the more difficult patients. It can handle a high degree of heart-rate variability and allows ECG editing in challenging cases.



Always enable the available options for dose control, like CARE Dose4D, CARE kV, pitch adaptation, automatic pulsing and MinDose. Disable only if clinically necessary!

The spiral pitch is completely determined by the heart rate of the patient. This is the main inherent dose disadvantage of the Cardiac Spiral.



Always use MinDose if there is no functional evaluation required. On average you can save around 30% of dose compared to the normal ECG pulsing setting.



Challenging patients with a very high heart-rate variability, e.g. 40 – 110 bpm, can be scanned in end-systole by setting the pulsing window to milliseconds (e.g. 250 ms – 450 ms after the R-peak). The reconstruction has to be in milliseconds as well in the BestPhase settings.

A possible reconstruction option for patients with atrial fibrillation or atrioventricular block is -100 ms (100 ms before the R-peak). Adjust pulsing to enable this possibility.

Reconstruction

Carefully chosen reconstruction settings are mandatory for good clinical images with high quality.

Optimize the field of view according to the size of the heart in the case of coronary reconstructions and ensure the organ of interest to be nicely centered.

Coronary thin-slice images are ideally reconstructed with isotropic voxels. Suitable settings are B26f or B36f kernel, 0.75 mm slice thickness and 0.4 mm reconstruction increment. In the case of stents or a high calcium burden, do an extra reconstruction series with a B46f kernel 0.6 mm slice thickness and 0.3 mm increment. Use matching Iterative Reconstruction kernels instead if available!

For functional analysis reconstruct with a B26f kernel, 1 mm slice thickness and 0.7 mm reconstruction increment, 256 matrix size and in 10% intervals.

For quantitative evaluation, the kernels B22f or B23f have to be used. B23f includes a dedicated iodine beam hardening correction algorithm.



If your system is equipped with Iterative Reconstruction, use the kernels I26f, I36f and I46f instead of the B-kernels. Iterative Reconstruction is a very powerful tool that allows the reduction of dose while maintaining image quality. The reference values for the tube current can be lowered by approximately 30% if you apply Iterative Reconstruction.

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Glossary



Observe patient reaction carefully, because it is important for your scan.



Have a careful look at the ECG now – it may help you in deciding the next step.



Be careful! Your contrast protocol might be influenced.



By taking these points into consideration you can significantly reduce dose.



Action required by user. Something needs to be changed in the scan protocol.



This is a technical fact with some extra explanation here.



This is a special tip for solving a difficult problem.



Carefully assure an optimized patient positioning.

How to reduce dose?