How to optimize a cardiac CT examination?

Dott. A. Depaoli

S.C.D.U.- Radiodiagnostica Universitaria, Direttore Prof. P. Fonio
Azienda Ospedaliera Universitaria Città della Salute e della scienza di Torino

Diagnostic exam following the «As low as Reasonably Achievable» (ALARA) principle» !!!

2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes

Use of diagnostic imaging tests in the initial diagnostic management of symptomatic patients with suspected coronary artery disease

Recommendations	Class[a]	Level[b]
Non-invasive functional imaging for myocardial ischaemia[c] or coronary CTA is recommended as the initial test to diagnose CAD in symptomatic patients in whom obstructive CAD cannot be excluded by clinical assessment alone.[4,5,55,73,78–80]	I	B
It is recommended that selection of the initial non-invasive diagnostic test is done based on the clinical likelihood of CAD and other patient characteristics that influence test performance,[d] local expertise, and the availability of tests.	I	C
Functional imaging for myocardial ischaemia is recommended if coronary CTA has shown CAD of uncertain functional significance or is not diagnostic.[4,55,73]	I	B
Invasive coronary angiography is recommended as an alternative test to diagnose CAD in patients with a high clinical likelihood, severe symptoms refractory to medical therapy or typical angina at a low level of exercise, and clinical evaluation that indicates high event risk. Invasive functional assessment must be available and used to evaluate stenoses before revascularization, unless very high grade (>90% diameter stenosis).[71,72,74]	I	B
Invasive coronary angiography with the availability of invasive functional evaluation should be considered for confirmation of the diagnosis of CAD in patients with an uncertain diagnosis on non-invasive testing.[71,72]	IIa	B
Coronary CTA should be considered as an alternative to invasive angiography if another non-invasive test is equivocal or non-diagnostic.	IIa	C
Coronary CTA is not recommended when extensive coronary calcification, irregular heart rate, significant obesity, inability to cooperate with breath-hold commands, or any other conditions make obtaining good image quality unlikely.	III	C
Coronary calcium detection by CT is not recommended to identify individuals with obstructive CAD.	III	C

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National Guideline Centre

Final version

Chest pain of recent onset

Assessment and diagnosis of recent onset chest pain or discomfort of suspected cardiac origin (update)

NICE guideline CG95

Methods, evidence and recommendations

November 2016

7.2.2.5 Recommendations

1.3.4.3 Offer 64-slice (or above) CT coronary angiography if:

- clinical assessment (see recommendation 1.3.3.1) indicates typical or atypical angina, or
- clinical assessment indicates non-anginal chest pain but 12-lead resting ECG has been done and indicates ST-T changes or Q waves. [new 2016]

1.3.5.1 Offer non-invasive functional imaging (see the section on non-invasive functional imaging for myocardial ischaemia) for myocardial ischaemia if 64-slice (or above) CT coronary angiography has shown CAD of uncertain functional significance or is non-diagnostic. [2016]

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Guidelines

SCCT guidelines for the performance and acquisition of coronary computed tomographic angiography: A report of the Society of Cardiovascular Computed Tomography Guidelines Committee Endorsed by the North American Society for Cardiovascular Imaging (NASCI)

CrossMark

Suhny Abbara [a,*], Philipp Blanke [b], Christopher D. Maroules [a], Michael Cheezum [c], Andrew D. Choi [d], B. Kelly Han [e], Mohamed Marwan [f], Chris Naoum [g], Bjarne L. Norgaard [h], Ronen Rubinshtein [i], Paul Schoenhagen [k], Todd Villines [j], Jonathon Leipsic [b]

Pre-test

No caffeine products for 12 hours prior to exam in the non-acute setting, because they might hinder efforts to reduce the heart rate before scanning. This includes coffee, tea, energy drinks, energy pills, diet pills and most soda.

Instructions should also include information of the potential administration of pre-procedure medications (i.e. beta-blockade and nitroglycerine) in order to prevent patient irritation, as patients may not associate the performance of a coronary CTA with the necessity of potential medication administration.

Pre-test instructions

Breath-hold training

1. to ensure appropriate quality of the breath-hold (patient should not perform a Valsalva maneuver),
2. to ensure adequate timing of the breath-hold
3. to observe fluctuations in heart rate and rhythm during the breath-hold exercise

Heart rate control

1. Optimal image quality is reliably achieved when the patient has a low heart rate and a regular cardiac rhythm during the scan

2. A target heart rate for coronary CTA set at 60 bpm or less is usually appropriate. However, depending upon the scanner parameters listed above, scanning at a higher heart rate may be acceptable if a target heart rate of 60 bpm cannot be reached

3. Beta-blockers are considered first-line for achieving short-term heart rate reduction for the purpose of coronary CTA and protocols may utilize oral, intravenous or both routes of drug administration.

4. The most common approach uses oral metoprolol with staggered dosage based on the presenting resting heart rate ranging from 50 to 100 mg given 1 hour prior to the scan followed by supplemental intravenous doses immediately prior to the CT scan if the target heart rate.

Heart rate control

- A low dose of metoprolol is helpful to reduce heart rate variability and improve image quality.
- IV beta-blocker alone can be used to shorten the overall preparation time required
- 5 mg of IV metoprolol is given as an initial dose (maximum dose of 20 25 mg) .
- In patients with contraindications to beta-blockers who present for coronary CTA, a bolus of IV ivabradine (10 or 15 mg) can be administered to rapidly and safely achieve target heart rate.

Nitrates

Should be administered prior to coronary CTA to achieve coronary vasodilatation and in order to enhance coronary evaluation.

Recommendations

The preferred patient position is supine with arms raised above the head and the heart centered within the gantry.

Special attention should be paid to ensure proper positioning and firm contact of ECG leads to ensure a high R-peak amplitude and low baseline noise

Contrast type, delivery, volume and rate

- contrast agents with high iodine concentrations are preferred (270-400 mg Iodine/cc). An injection rate between 5 and 7 cc/sec should be used for coronary CTA in most adults
- The injection duration should be as long as (or slightly longer than) the estimated scan duration
- A biphasic injection protocol consists of a first injection of contrast at a rate of 5-7 cc/sec (volume depends on scan duration) and subsequent injection of approximately 40-50 cc of saline.
- Iterative reconstruction techniques may permit imaging at lower kVp, potentially allowing for a decrease in contrast flow rate and hence contrast volume by enabling scanning at lower energies closer to the k-edge of iodine
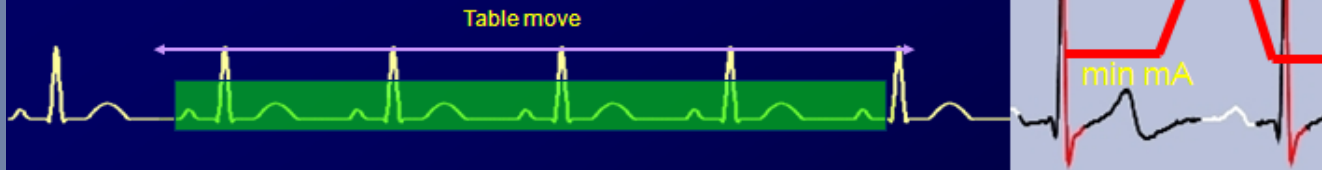- Test bolus vs. bolus tracking

Parameters that influence Dose Exposure

❖Tube Voltage - kV (BMI)

❖Tube Current - mA (BMI)

❖Automatic Dose Modulation along z-axis
 and x-y planes (anatomic modulation).

❖Overlapping (pitch)

❖ECG-Modulation (R-R % interval)
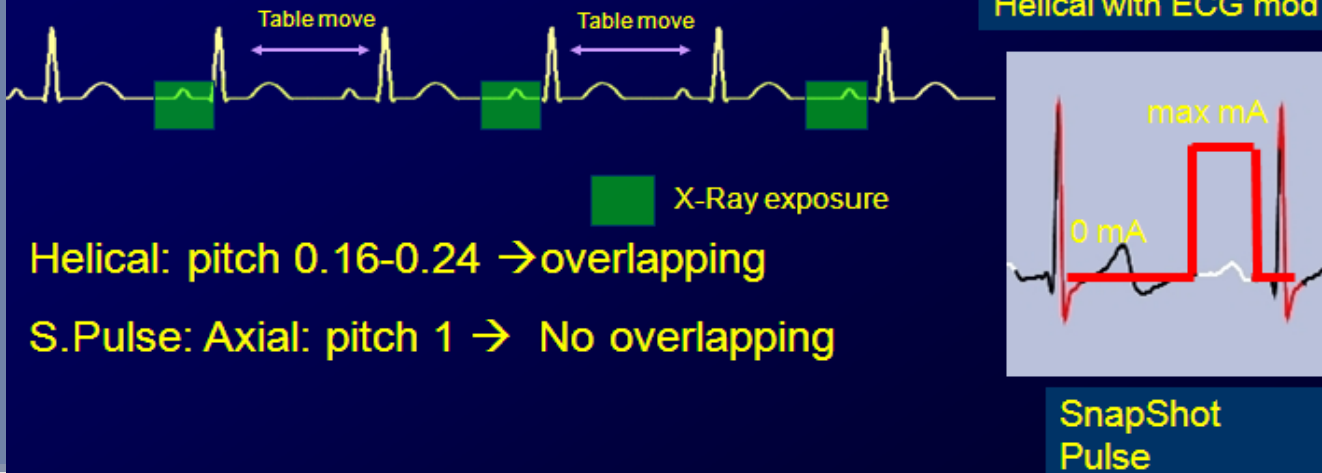
❖ECG prospective or retrospective Gating

❖DSCT, 320-s CT

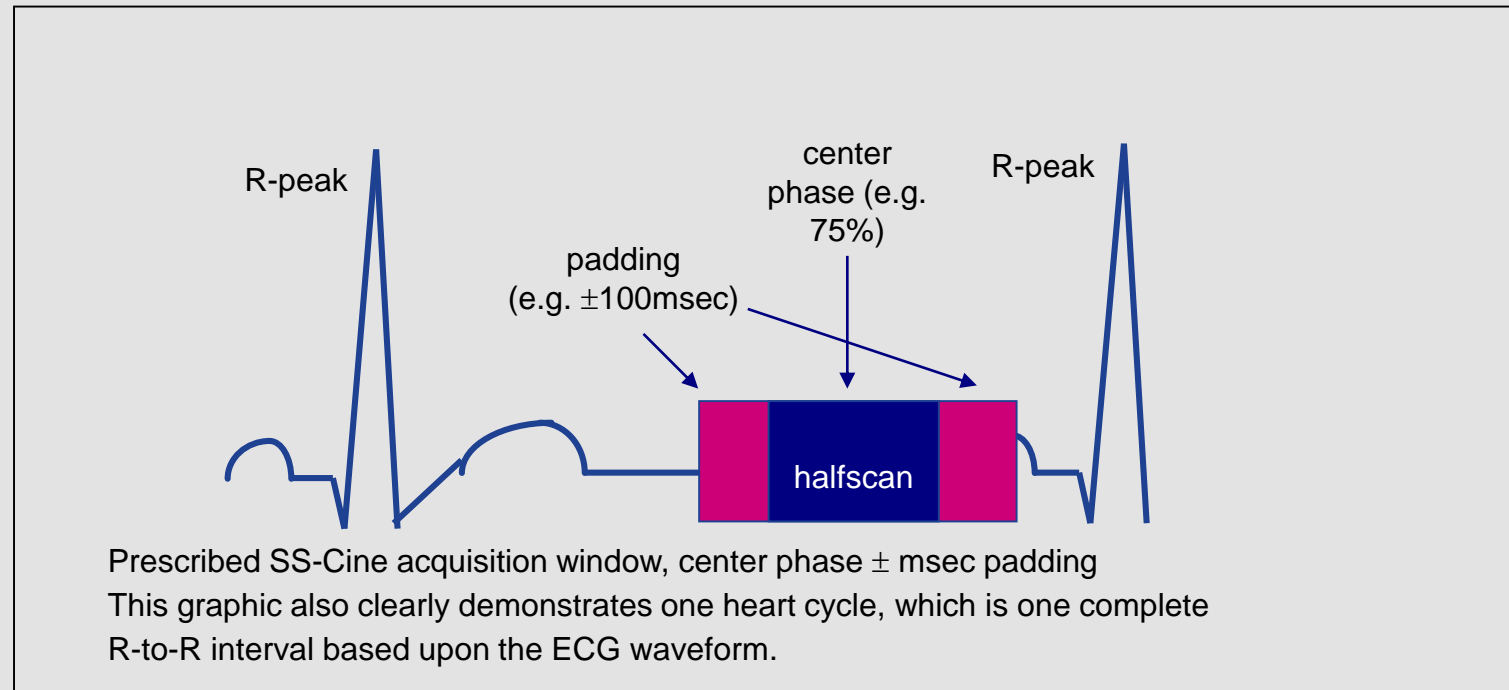• If HR<65 bpm: best phase for RCA and LCA is 70%-80%

• If HR> 65 bpm: 80% for LCA

       40% for RCA

SnapShot Pulse: Padding

The padding allows to make multiphase reconstruction

With 200 ms, centered at 60%, you can reconstruct from 40 to 80%
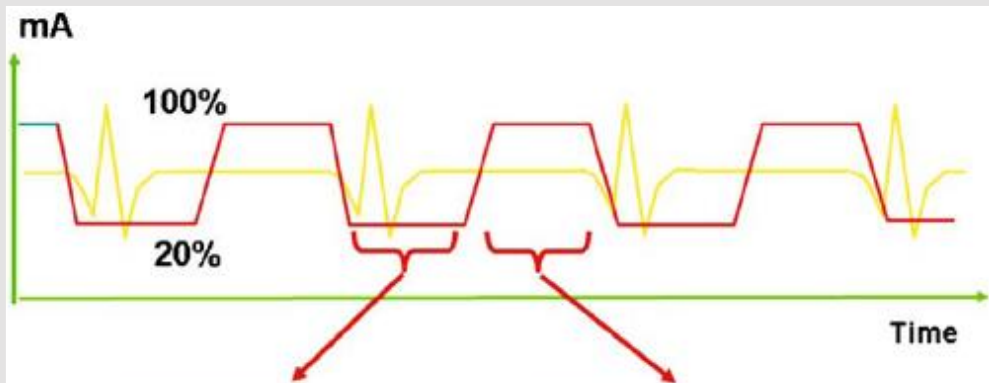
You can also use 0 padding to reconstruct only 75%

Prescribed SS-Cine acquisition window, center phase ± msec padding
This graphic also clearly demonstrates one heart cycle, which is one complete
R-to-R interval based upon the ECG waveform.

ECG-Modulation

Dose reduction 40%

- Dose modulation related to ECG
- Selectables Parameters
  - Min and Max mA
  - % R-R fase (range in the cardiac cycle)
- Data can be used for the functional analysis