

# Patient Preparation

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## 6.2 General Information

The patient should be assured that CT is a noninvasive diagnostic procedure and that it does not take long to perform the examination. The short duration of the CT examination (about 15 min in the scanner room) and the comfortably wide and short gantry (in contrast to the narrow, claustrophobia-inducing bore in MRI) are major advantages of CT over MRI and should be stressed while talking to the patient. On the one hand, clearly explaining these aspects before the patient enters the scanner room reduces psychological stress and may relax the patient as well as reduce heart rate in some cases. On the other hand, the patient must also be given explicit information about the radiation exposure, which is the most important disadvantage of cardiac CT. As it does not mean much to a layperson that the effective exposure of a typical retrospectively gated exam is approximately 10–20 mSv, meaningful comparisons should be used, such as “the radiation exposure of cardiac CT angiography is five to ten times the annual background radiation” or “the effective radiation dose is the same as that of 100–200 chest X-rays.” Using prospective gating (“step-and-shoot”) will dramatically reduce the effective dose of cardiac CT to below 5 mSv in nearly all patients with low and stable heart rates (Chap. 7). Such effective doses are lower than necessary for nuclear myocardial perfusion imaging (about 8–12 mSv) and conventional coronary angiography (about 8 mSv). Thus, in patients with low and stable heart rates, the radiation exposure of CT is lower than that of alternative diagnostic tests. Nevertheless, especially in younger patients with a higher lifetime risk of cancer induced by CT, it is essential to carefully consider alternative imaging tests that might yield the same clinical information without radiation exposure.

### Abstract

Patient preparation is the key to success in cardiac CT, and the relevant aspects of this step are discussed in detail in this chapter. Standardized information sheets should be used to make every patient understand the nature of the procedure. Informed consent is pivotal to ensure that patients avoid movements that can cause artifacts and that no patients with contraindications undergo cardiac CT.

## 6.1 Patient Information Sheets

As patient preparation is the cornerstone of a successful cardiac CT, a well-trained nurse, physician assistant, technician, or a physician (according to state and/or federal legal regulations) should discuss the entire procedure with the patient and obtain written informed consent. Patient education can be facilitated by sending the patient an information sheet and questionnaire before the appointment (Figs. 6.1 and 6.2). The information asked in the questionnaire also serves to verify the patient’s clinical indication for cardiac CT (Chap. 5) and exclude possible clinical contraindications to the examination.



## Patient Information

### Cardiac CT

Dear Ms./Mr. ....,

Your doctor has referred you for an examination of your heart vessels (coronary arteries) to look for narrowings (stenoses) and deposits (plaques). The examination is performed on a computed tomography (CT) scanner. CT identifies stenosis in the coronary arteries with a reliability of over 90% and we expect that the information gained by the examination will help improve your further treatment.

You should fast for four hours before the examination (most importantly, you should not drink coffee or tea) and should continue to take your usual medications. If you take the antidiabetic drug called metformin, you may have to stop taking this medication for 48 hours after cardiac CT if your renal function is impaired (calculated eGFR ranging from 30-60 ml/min). Please contact us in case of questions about eGFR and metformin ahead of time.

Please carefully complete the questionnaire provided with this information sheet (see **Fig. 6.2**). The details about your symptoms and other tests that you have had in the past will help us make the correct diagnosis by CT. A written report of the CT findings together with representative images will be sent to your doctor after the examination.

Please send the completed form to the address or fax number given below or bring it along when you come in for your examination on day: ..... at: .....

**Address:**

Charité  
Department of Radiology, CT  
Luisenstr. 7  
10117 Berlin

**FAX No.:**

+49 (0)30/450 527 911

**Phone:**

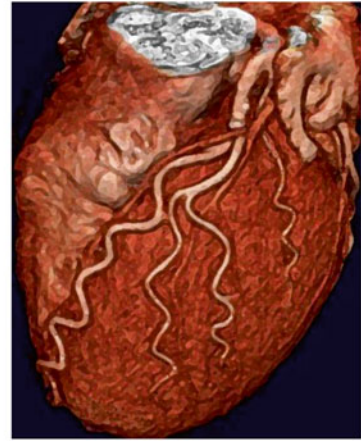
+49 (0)30/450 527 133

**Most patients with one of the following conditions cannot undergo a CT scan of the heart:**

1. Irregular heart beat (e.g., atrial fibrillation)
2. Severe bronchial asthma (if high heart rate is present)
3. Intake of certain erectile dysfunction pills (e.g., Viagra)
4. Reduced kidney function (creatinine level > 1.5 – 2.0 mg/dl)
5. Allergic reactions to X-ray contrast media
6. Manifest thyroid overactivity (hyperthyroidism)

If one of these conditions applies in your case, please contact us before the examination

■ **Fig. 6.1** Example of an information sheet that is sent out to the patient prior to the examination. Patients are asked to inform us in case contraindications to coronary CT angiography might be present that have been overlooked during the prior referral procedure (Chap. 5)



## Patient Questionnaire

Name: ..... Address: ..... Phone No.: .....

FAX: ..... Email: .....@.....

1. **D.O.B.:** . . . **Height:** . m/inches **Weight:** ..... kg/pounds **male**  **female**
2. Do you have **pain** in the chest? yes  no  , If yes, please describe the location and type of pain:  
.....  
Does the pain increase when you **exercise**? yes  no  How long does the pain last? .....  
Does the pain decrease **at rest or after nitro spray**? yes  no
3. Do you **smoke**? yes  no  If yes, for how long? .... years, how many cigarettes per day? .....
4. **Did you smoke**? yes  no  If yes, for how long? .... years, how many cigarettes per day? .....
5. Do you have **high blood lipid levels** (hyperlipidemia)? yes  no   
**Total cholesterol:** .....(p≥200 mg/dl) **LDL:** ..... (p≥120 mg/dl) **TG:** .....(p≥200mg/dl)
6. Do you take **statins** or other drugs to lower cholesterol? yes  no  - for how long? ..... years
7. Do you have **high blood sugar** (diabetes mellitus)? yes  no
8. Do you have **high blood pressure** (hypertension)? yes  no
9. Do you take **beta blockers** to lower blood pressure? yes  no  - for how long? ..... years
10. Have you had a **heart attack** (myocardial infarction)? yes  no  , If yes, please bring the report with you.
11. Do you have **stents** that keep the heart vessels open? yes  no  , If yes, please bring the report with you.
12. Have you had **widening of a vessel** with a catheter? yes  no  , If yes, please bring the report with you.
13. Do you have any cardiac **bypasses**? yes  no  , If yes, please bring the report with you.
14. Have you had an **electrocardiogram** (ECG)? yes  no  , If yes, please bring the report with you.
15. Have you had an **exercise (treadmill) ECG**? yes  no  , If yes, please bring the report with you.
16. Have you had an **echocardiogram**? yes  no  , If yes, please bring the report with you.
17. Have you had a **stress echocardiogram**? yes  no  , If yes, please bring the report with you.
18. Have you had **myocardial scintigraphy**? yes  no  , If yes, please bring the report with you.
19. Have you had a **cardiac catheter examination**? yes  no  , If yes, please bring the report(s) with you.
20. Have you had a **CT scan/MRI** of the heart? yes  no  , If yes, please bring the reports with you.
21. Which **medications** are you taking? Please list, **with doses**:  
- .....  
- .....  
- .....

■ **Fig. 6.2** Example of a medical history questionnaire that is also sent out to the patient prior to the examination. This questionnaire elicits information about the patient's entire cardiovascular medical history and is very valuable for diagnostic procedures in the outpatient setting

Patients should know that lower heart rates (<60 beats per min) are associated with longer cardiac rest periods and thus improve image quality and diagnostic accuracy while they also help to reduce radiation dose. Informing them about the entire procedure prevents inadvertent reactions to unexpected events that might increase their heart rate. Hence, patients should be informed that they might experience a sensation of warmth when the contrast medium is injected and should also be told beforehand about the expected duration and number of breath-hold periods. Patients who are aware that the target structures are just a few millimeters in size will better understand that any motion during the breath-hold periods may severely degrade the images and may even result in a nondiagnostic scan. They also need to be informed that they should hold their breath after submaximal inspiration (ca. 75% of maximum inspiration), a maneuver that should be taught either prior to the examination or during scanning as part of the training related to the breath-hold commands (Chap. 8). The submaximum depth of inspiration is important, because maximal inspiration may increase intrathoracic pressure (Valsalva maneuver) and reduce inflow of the contrast medium.

The length of the breath-hold periods varies between 3 and 30 s, depending on the scanner used and the examination performed (Chap. 2). Breath-hold training on the scanner table is therefore also important to determine whether a patient is able to hold his or her breath for the required duration, or whether oxygen administration is needed to improve compliance. Preoxygenation is rarely required when the examination is performed on a 64-row CT scanner, with scan times of only 8–12 s. Using wide-volume scanning (320-rows) or fast prospective spiral acquisitions with second-generation dual-source CT, the scanning time is greatly reduced to just a single heart beat and breath-hold time is about 3–5 s (Chap. 2).

### 6.3 Contraindications

When informing the patient about cardiac CT, the examiner should make sure that the patient is in sinus rhythm. This assessment is most easily accomplished by feeling the radial pulse when meeting the patient. In the case of patients with atrial fibrillation or frequent extrasystoles (at least one or two within the expected scanning period), the per-patient diagnostic accuracy is still unsatisfactory; for this reason, it is advisable that the

examination be performed at a later time, for example after medical or electrical cardioversion.

At the same time, the patient should also be questioned about general contraindications to contrast agents (**List 6.1**), as well as contraindications to nitroglycerin (**List 6.2**) and beta blockers (**List 6.3**). The considerable radiation exposure involved precludes coronary CT angiography in young and pregnant women. It is usually safe to administer nitroglycerin and/or beta blockers for the CT scan to patients who are taking these two medications on a regular basis without problems. Whether CT can be performed without nitroglycerin and/or beta blocker administration in patients with contraindications must be decided on an individual basis and depends on the clinical question and the patient's heart rate. It is generally desirable to administer nitroglycerin because of the beneficial vasodilatory effect. The CT scan should be postponed by at least 24 h in patients who have taken phosphodiesterase inhibitors (**List 6.2**).

#### List 6.1. Contraindications to iodinated contrast agents

1. Renal insufficiency (creatinine level >1.5–2.0 mg/dl, absolute contraindication unless evidence-based measures to prevent contrast-induced nephropathy can be taken)
2. Intake of metformin-containing medications (metformin needs to be discontinued for 48 h after contrast injection)<sup>a</sup>
3. Prior allergic reactions to iodinated contrast agents (switching to a different contrast agent and antiallergic premedication may enable imaging in those patients)
4. Manifest hyperthyroidism

<sup>a</sup> In patients with abnormal renal function, metformin also needs to be discontinued for 48 h prior to elective examinations, according to the ESUR guideline.

#### List 6.2. Contraindications to nitroglycerin

1. Intake of phosphodiesterase inhibitors (such as sildenafil, tadalafil, and vardenafil)
2. Arterial hypotension (systolic blood pressure below 100 mmHg)
3. Severe aortic stenosis
4. Hypertrophic obstructive cardiomyopathy
5. Nitroglycerin intolerance (e.g., severe headache)

**List 6.3. Contraindications to beta blockers**

1. Severe asthma
2. Severe obstructive lung disease
3. Bradycardia (below 50 beats per min)
4. Second or third degree atrioventricular block
5. Beta blocker intolerance (e.g., psoriasis)

**Recommended Reading**

- Achenbach S (2006) Computed tomography coronary angiography. *J Am Coll Cardiol* 48:1919–1928
- Achenbach S, Rost C, Ropers D, Pflederer T, von Erffa J, Daniel WG (2007) Non-invasive coronary angiography: current status and perspectives. *Dtsch Med Wochenschr* 132:750–756
- Dewey M, Hamm B (2007) CT coronary angiography: examination technique, clinical results, and outlook on future developments. *Fortschr Röntgenstr* 179:246–260
- Dewey M, Hoffmann H, Hamm B (2006) Multislice CT coronary angiography: effect of sublingual nitroglycerine on the diameter of coronary arteries. *Fortschr Röntgenstr* 178:600–604
- Einstein AJ, Henzlova MJ, Rajagopalan S (2007) Estimating risk of cancer associated with radiation exposure from 64-slice computed tomography coronary angiography. *JAMA* 298:317–323
- Hoffmann U, Ferencik M, Cury RC, Pena AJ (2006) Coronary CT angiography. *J Nucl Med* 47:797–806

Mahabadi AA, Achenbach S, Burgstahler C, Dill T, Fischbach R, Knez A, Moshage W, Richartz BM, Ropers D, Schröder S, Silber S, Möhlenkamp S, Working Group “Cardiac CT” of the German Cardiac Society (2010) Safety, efficacy, and indications of beta-adrenergic receptor blockade to reduce heart rate prior to coronary CT angiography. *Radiology* 257(3):614–623

Maurer M, Maurer MH, Zimmermann E, Schlattmann P, Germershausen C, Hamm B, Dewey M (2012) Indications, imaging technique, and reading of cardiac computed tomography: survey of clinical practice. *Eur Radiol* 22:59–72

Pannu HK, Alvarez W Jr, Fishman EK (2006) Beta-blockers for cardiac CT: a primer for the radiologist. *AJR Am J Roentgenol* 186:S341–S345

Schoepf UJ, Zwerner PL, Savino G, Herzog C, Kerl JM, Costello P (2007) Coronary CT angiography. *Radiology* 244:48–63

Schönenberger E, Schnapauff D, Teige F, Laule M, Hamm B, Dewey M (2007) Patient acceptance of noninvasive and invasive coronary angiography. *PLoS ONE* 2:e246

Schuetz GM, Zacharopoulou NM, Schlattmann P, Dewey M (2010) Meta-analysis: noninvasive coronary angiography using computed tomography versus magnetic resonance imaging. *Ann Intern Med* 152:167–177

Weigold WG (2006) Coronary CT angiography: insights into patient preparation and scanning. *Tech Vasc Interv Radiol* 9:205–209

**Further Recommended Websites**

The ESUR guideline on contrast media can be accessed at: <http://www.esur.org/esur-guidelines/contrast-media-70/>