INTRODUCTION

Despite all the progress made in diagnosis and treatment, cardiovascular diseases remain the main cause of death worldwide. The total cost of health care and lost productivity is estimated at $200 billion annually, making cardiovascular disease one of the most significant medical problems in our society. With recent advances in technology, cardiac multidetector row computed tomography (MDCT) and cardiac MR imaging (CMR) open up new avenues in diagnosis and are being increasingly utilized to manage patients with cardiovascular diseases. Cardiac imaging is a very interesting and rapidly growing field for radiologists who now consider this old specialty with renewed interest. However, because these new technologies offer a wider choice of examinations for the same patient, there is also the potential increase in cost to consider, so we must therefore be familiar with the technical advances and the recognized indications in order to ask for the appropriate examination. This paper will give a brief overview of technical skills involved in cardiac MDCT and CMR and a review of the clinical applications and indications of cardiac MDCT and CMR imaging in the assessment of coronary artery disease.

CARDIAC MDCT

A. TECHNICAL ASPECT

Because of the nature of its target, the continuously moving heart, cardiac CT in general and coronary MDCT in particular are technically more challenging technologies than other CT applications. A current state of the art MDCT scanner acquires 64 channels of data with a detector width of 0.5 or 0.6 mm. The fastest rotation time is 330 ms, which results in a temporal resolution of 165 ms. The scan time has decreased from 40 s for the first MDCT generation to less than 10 s with the 64-slice technologies. Despite substantial progress in temporal resolution, β-blockers are often used to reduce cardiac motion artifacts. Recently, dual-source CT (DSCT) was introduced, with an improvement in temporal resolution (83 ms). Scanners with more detectors that cover the entire heart are now being developed and this may abolish the need for a moving table.

Image Acquisition

We see the patients referred for a coronary MDCT in a peaceful room with subdued lighting. Apnea is mandatory during scan time and the patients must be informed and shown how to hold their breath; their heart rate will be checked during apnea. Intravenous (IV) access is required to inject iodinated contrast media at a high rate (4 to 6 ml/s), an 18G angiocath needle should be used for this purpose. A clear ECG signal, with a positive R wave, is absolutely necessary for gated acquisitions. ECG leads should be taped to the skin after shaving the hair and adding conductive gel if necessary. The heart rate can be controlled using β-blocker therapy administered IV or orally. The administration of β-blockers decreases and stabilizes the heart rate over time resulting in less motion artifacts. Investigators usually prefer to have a heart rate around 60 bpm. With the use of DSCT, temporal resolution decreases to 83 ms, decreasing the need for this treatment. The other advantage of a heart rate around 60 bpm is the possibility to use ECG dose-modulation. Using this approach the nominal tube output is only applied during the diastolic phase during which the heart is less mobile if the heart rate is equal or below 60 bpm [1].

Scanning Parameters, Contrast Injection and Image Reconstruction

Coronary MDCT is a technical challenge because image acquisition must be synchronized with the heart rate as well as with the bolus injection; furthermore, radiation doses must be decreased to a minimum. The scanning parameters should be adapted to the patient’s heart rate and morphology to achieve perfect image quality with the lowest radiation dose. Consistent, high vessel enhancement is essential for a good quality coronary MDCT. Investigators claim that exceedingly high contrast enhancement may interfere with the visualization of calcifications, but this has not been confirmed in the literature [2]. Cademartiri et al. [2] showed that the highest contrast enhancement level in the coronary tree increases the sensibility and specificity of the examinations. Injection protocols must be adapted to the short acquisition time

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(<10 s), to achieve the same vascular enhancement level compared with a longer acquisition: the bolus must be injected at a faster rate and the contrast media must be more concentrated [3]. Investigators showed that a dual injection protocol using first a pure iodine contrast injection flushed with saline provided the same enhancement level in the coronary tree with less venous streak artifacts and a smaller injected dose [4]. Triphasic injection (i.e. pure iodine contrast media, followed by a 50% mix of contrast media and saline, followed by pure saline injection) have the advantage of enhancing the coronary tree as well as the right heart. Investigators prefer to use automatic bolus tracking to synchronize the bolus and acquisition; others prefer to measure the individual delay time using an injection of 20 ml of iodine as a bolus test. The starting point of image reconstruction is defined as a certain percentage of the cardiac cycle (i.e., 60% RR or 65% RR). For the assessment of cardiac and coronary anatomy, a phase of minimal cardiac motion is preferable for the placement of the image reconstruction. The diastolic phase (from 55% to 75% RR) and the late systolic phase (form 30% to 40% RR) are usually the most suitable time points for image reconstruction. A complete MDCT scan will add from 2000 to 3000 DICOM images to your workstation, raising real concerns in terms of work-flow and archiving. Several visualization tools are available to display the coronary, myocardial and valvular anatomy; volume rendering provides a nice, informative picture of the coronary anatomy. MPR reconstruction is a robust tool that permits visualization of the coronary tree anatomy and plaque burden.

B. CLINICAL APPLICATIONS

Calcium Scoring
Coronary artery calcium scoring (CAS) had been used in 1) to assist in coronary artery disease (CAD) risk assessment in asymptomatic patients and 2) to assess the likelihood of the presence of CAD in patients who present with atypical chest pain which could be consistent with myocardial ischemia. Scan acquisition for calcium scoring assessment is performed without injection of contrast media and requires only a small radiation dose. Recently a clinical expert consensus document on CAS stated that it may be reasonable to consider CAS in intermediate risk persons to select patients for a more aggressive lipid lowering therapy [5]. This clinical scenario is not based on clear evidence [6-7].

Detection of Coronary Artery Stenosis
Technical developments have gradually improved the diagnostic performance of coronary MDCT. Compared with conventional catheter angiography, the sensitivity and specificity of 64-slice MDCT to detect significant stenosis range from 82% to 99% and 94% to 98% respectively on a per-segment analysis [8-13] (Figure 1). These numbers are subject to caution because the study population was somewhat preselected. Hoffmann et al. [14] performed a coronary MDCT in a non-selected population (103 patients hospitalized for chest pain) and found significant coronary stenosis in 17 patients that could not be excluded because of the presence of calcifications, stent or tachycardia. Among these 17 patients six had a proven acute coronary syndrome. In this paper the specificity of
coronary scan was measured at 82% and the positive predictive value (PPV) was low estimated at 47%. The limitations of MDCT are (1) the accurate quantification of coronary stenosis is limited by the spatial resolution of MDCT, (2) calcification and stent cause streak artifacts, (3) motion artifacts are present at a high heart rate, (4) patients with arrhythmia and contraindication to iodinated contrast media are not suitable. The high negative predictive value (NPV = 95-99%) of coronary MDCT was noted in several studies, showing the value of MDCT to exclude coronary disease and thereby avoid cardiac catheterization.

After Bypass Surgery
Before scanning a patient after coronary bypass surgery it is essential to have full details of the procedure. Anatomic coverage will be driven by the type of bypass (venous or mammary graft). With 64-slice technology, 20 s of apnea is sufficient to cover the entire chest. It is easier to diagnose the patency of a graft than a native coronary because the vascular structures are larger and there is less motion artifact. Assessment of the native coronary tree is more difficult because of the severity of the coronary lesions in these patients [15-17].

Intra-Stent Patency Assessment
Metal stents cause high density artifacts. Assessment of intra-stent patency on MDCT is highly dependent on the material and diameter of the stent. Visualization of intra-stent patency can be improved by using appropriate image techniques filtering for image reconstruction. MDCT has been successfully used to check for intra-stent restenosis of the left main coronary artery, thus avoiding coronaryography [18-20].

Patient with Chest Pain
Patients with intermediate pre-test probability of CAD and no evidence of myocardial ischemia on ECG would benefit from a coronary MDCT [7]. In such patients a normal CT angiogram would eliminate or confirm the diagnosis of CAD (Figure 2). Collinson et al. [21] showed that a non negligible amount (6%) of patients with chest pain discharged from the Accident & Emergency department had myocardial infarction. Such patients would benefit from a noninvasive test with a high negative predictive value such as coronary MDCT. Rubinshtein et al. [22] showed that calcium scoring alone is not enough to exclude CAD in patients suffering from chest pain; in this study among 125 patients who had a 0 calcium score 7% had a significant coronary stenosis on noninvasive coronary MDCT. Hoffmann et al. [14] showed that coronary MDCT in acute chest pain patients improved early triage of such patients. Goldstein et al. [23] showed that the use of coronary MDCT for acute chest pain patients could lower medical costs compared with standard care.

Prognostic Value of Coronary MDCT
Gallagher et al. [24] showed that in a population with low pre-test risk or probability of CAD, the accuracy of coronary MDCT was comparable to stress SPECT imaging for the detection and exclusion of CAD. Kipsler et al. [25] explored 56 patients with atypical chest pain with MDCT and stress SPECT. The authors found that the sensitivity, specificity and NPV for MDCT alone were 96%, 63%; 99% respectively; when stress SPECT was added to MDCT the sensitivity, specificity and NPV were 96%, 95%, 99% respectively. MDCT assesses the coronary anatomy but does not give a hemodynamic assessment of the stenosis.

Assessment of Global Left Ventricular (LV) Function
A wide range of imaging modalities is available to assess LV function but MRI is considered as the gold standard technique for assessment of global and segmental contractility. The use of MDCT in LV function assessment entails the use of an injected contrast medium and therefore exposure to radiation, which is why it should not be considered as a first line investigation for this purpose. However, it does provide accurate information on the measurement of LV function and could prove to be inter-

**Figure 2.** DSCT coronary angiography in a 44-year-old man with atypical acute chest pain without any change in ECG and cardiac enzymes. MPR reconstruction show perfect permeability of the right coronary artery (a), the left descending artery (b) and the circumflex artery (c), without any atheromatous lesions of the coronary tree.
testing in this respect. LV volumes and mass can be assessed using Simpson’s method, or the threshold-based volumetric method. The threshold-based method is based on a pixel-by-pixel method for making end-diastolic and end-systolic measurements. This method must be validated but seems promising with regard to the high spatial and contrast resolution between the cavity and the myocardium [26]. To assess volumes and mass the end-diastolic and end-systolic phases must be measured; this could be performed by visual analysis of the short axis view reconstructed every 5% of the cardiac cycle or by automatic selection of the end-diastolic and end-systolic phase [27].

There are two limitations that must be addressed to use MDCT in the assessment of LV function. First, a temporal resolution below or equal to 50 ms is essential for precise LV function assessment. SPECT and MRI provide this level of resolution, but not MDCT. Double source CT (DSCT) has a temporal resolution of 83 ms in a single segment reconstruction and will potentially overcome this limitation. There is another limitation in the use of β-blocker therapy to decrease the heart rate because it also has an impact on cardiac physiology and contractility [26]. On the other hand, Van der Vieuten et al. [28] showed that the functional parameters acquired on 16-slice MDCT are interchangeable with those obtained by MRI. In this study the mean difference between 16-detector MDCT and MRI for LVEF was -0.10 ± 1.72.

Assessment of Myocardial Perfusion and Viability
The pharmacokinetics of intravenously administered iodinated contrast media are similar to those of an extracellular MR contrast medium [29]. This class of contrast agent spreads rapidly from the intravascular compartment to the extracellular compartment, but cannot enter the intracellular compartment because of its hydrophilicity and molecular weight [29]. Discrimination between viable and non viable myocardium depends on the regional concentration of contrast media. After coronary arterial occlusion, ischemic changes occur in the jeopardized myocardium, including edema, loss of cellular membrane integrity and microvascular obstruction. The magnitude of myocardial enhancement is a function of (1) local myocardial perfusion and vascular integrity, (2) local distribution volume of the contrast agent, and (3) relaxivity of the contrast agent [30-31]. The differential enhancement of infarcted myocardium on delayed MDCT imaging is a result of (1) an increased distribution of the contrast medium in damaged myocytes [32-33], and (2) slow wash-in and wash-out [34]. The ability of CT to show the infarct area as an enhanced territory after coronary occlusion was described in the late 70s [35]. The first studies were performed on excised animals hearts. This method found a second wind or upsurge with the arrival of MDCT technology and several authors described the ability of MDCT to assess myocardial viability both in animals [36] and humans [37-38]. The MDCT viability assessment method is based on the same principle as MRI delayed enhancement. Ten minutes after injection, a cardiac gated acquisition is made, usually at a low radiation dose (kev = 80) and in thick slices (1.5 mm) [37]. MDCT viability assessment requires a larger dose of iodinated contrast medium (140 ml) compared to the dose used in coronary assessment (70 to 80 ml for 64-slice technology). The results are comparable with MRI delayed enhancement in terms of the infarct area and no-reflow characterization but the...
contrast-to-noise ratio provided by MDCT is three times lower when compared with MRI (Figure 3). MDCT was successfully used to assess myocardial perfusion during an adenosine stress test [39]. George et al. [39] instrumented the LAD to create a 50% or more vessel stenosis. A 64-slice MDCT acquisition with cardiac gating was performed after injection of 4 ml/kg of an iodinated contrast medium. The results showed a significant linear association between regional myocardial density and myocardial blood flow measured using microspheres.

C. INDICATIONS FOR CARDIAC MDCT

Two recent reports (AHA statement and ACCF, ACR, SCCT, SCMR, ASNC, NASCI, SCAI, SIR appropriate-ness criteria [6-7] reviewed the indications for coronary assessment by MDCT. In this paper we will briefly state the main appropriate indications for MDCT [7]. Appropriate indications for noninvasive coronary and or cardiac MDCT are (1) assessment of coronary, cardiac or great vessel malformations, (2) acute chest pain in patients with intermediate pre-test probability of CAD with normal cardiac enzyme levels and ECG, (3) patients suffering from CAD with an uninterpretable stress test, (4) coronary and internal mammary artery mapping prior to repeat surgery for coronary revascularization, (5) cardiac mass and pericardial disease in patient with limited images from echocardiography and MRI, (6) assessment of pulmonary vein anatomy prior to radiofrequency treatment, (7) assessment of coronary vein anatomy prior to placement of bi-ventricular pacemaker.

CARDIAC MR IMAGING (CMR)

A. CMR TECHNICAL ASPECTS

CMR offers a wide range of radiation free imaging possibilities with high spatial resolution and is therefore increasingly used to manage patients with cardiovascular diseases. CMR has the capability of measuring many important myocardial parameters. MRI combines the delayed enhancement sequence to delineate irreversibly injured myocardium [40], cine images to quantify LV end-diastolic, end-systolic volumes and ejection fraction [41], and perfusion sequences to detect rest or stress perfusion defects. CMR has the same cardiac imaging constraints in terms of temporal resolution as MDCT. Every CMR sequence must be adapted to each patient in terms of heart rate, duration of apnea, and indication of the examination. In our institution CMR is performed by trained radiographers or by the radiologist. Cardiac gating is a prerequisite in a CMR study, ECG leads have to be MR compatible and positioned to provide a clear, loud ECG signal. The nurse must shave and clean the patient’s chest with alcohol when necessary before the examination. But 2 to 6% of patients suffer from claustrophobia when they are in the bore of the magnet and require additional anxiolytic drugs or sedation before or during the scan. Peripheral vein access must be available to inject contrast medium or other drugs during the scan session, oxygen saturation and arterial blood pressure can also be recorded if needed. The principle of cardiac gating is to synchronize image acquisition with the heart rate in order to avoid motion artifact. Most of the acquisitions are made during apnea but this can be adapted to the patient’s status.

Defining Cardiac Imaging Planes

Cardiac imaging planes do not match with classical anatomic planes due to the triple obliquity of the heart. If specific cardiac imaging planes are defined, the heart can be imaged along its long axis or perpendicular to it; these specific cardiac imaging planes are also used in other non invasive imaging modalities (Echocardiography, PET, SPECT, MDCT). The cardiac imaging planes are shown in figure 4. The long axis passes through the middle of the mitral valve and the LV apex, four-chamber view, two-chamber view and left ventricular outflow tract (LVOT) are the most important long axis views. The short axis view is perpendicular to the long axis. A double obliquity images is often required to define the cardiac imaging plane accurately and must always be adapted to suit the patient. Axial, sagittal and coronal planes are useful for complex cardiac malformations or assessment of the great vessels.

Figure 4. SSFP (Steady State Free Precession cine sequences) images showing reference or standard cardiac imaging planes: four-chamber view (a), two-chamber view (b), left ventricular outflow tract (LVOT) (c), and short axis view (d).
Pulse Sequences

The rationale for selection of a pulse sequence depends on what the physician needs to know. A pulse sequence is a combination of radiofrequency pulses, magnetic gradient field switches, and timed data acquisition. The basic design of each pulse sequence (spin echo, gradient echo, etc.) depends on the structures, and other components (fat saturation, black blood imaging, etc.) can be added to provide specific information or to increase temporal resolution. We will briefly review the main pulse sequences used in cardiac MR.

- Steady State Free Precession cine sequences (SSFP) are considered by most investigators as the reference sequences to assess LV volume and ejection fraction (EF) and chamber anatomy [41-43]. SSFP sequences are marketed as: TrueFISP (Siemens Medical Solutions, Germany), FIESTA (General Electric Healthcare, USA) or Balanced FFE (Philips Medical Systems, The Netherlands). The contrast between the myocardium (low signal) and the blood (high signal) on SSFP is excellent and gives an accurate delineation of the endocardial wall (Figure 4). Temporal resolution is also excellent, allowing for high temporal resolution cine sequences, covering the whole chest in the axial plane in one or two breath-holds. These sequences also pick up bright signals from the liquid with less flow artifact compared to the old gradient echo cine sequences; de-phasing artifacts are clear enough to show valvular insufficiency or stenosis.

- Tagging sequences: Gradient echo cine was the old sequence used for cine sequences; nowadays these sequences can be used for valve assessment or with tagging grid for the qualitative assessment of regional contractility. Quantitative assessment of regional contractility (LV wall shear stress and strain) is also possible but requires specific software [44].

- Myocardial perfusion imaging: Gradient echo, SSFP, echo-planar imaging based sequences can be used to assess myocardial perfusion imaging. These sequence are T1-weighted, with a high temporal resolution allowing for imaging on three or four different slice levels (usually three different short axis views, and one long axis) in one RR interval. These MR techniques are used to measure myocardial perfusion [45-46] and perfusion reserve after pharmacologic stress testing [47-48].

- Late enhancement: Gradient echo with inversion recovery in 2D and more recently in 3D is the reference sequence to assess delayed contrast enhancement [40]. This sequence must be performed 10-20 min after the administration of an extracellular contrast medium and is a very accurate technique for the detection of myocardial infarcts [40, 42, 49-50]. With gradient echo inversion recovery, inversion time must be set to null normal myocardium before each acquisition to provide a high contrast-to-noise ratio [40]. The recent introduction of phase sensitive inversion recovery images now permits the assessment of late enhancement without the need to set inversion time [51] (Figure 5).

- Spin echo images, fast spin echo: These sequences are very useful in characterizing soft tissue composition and anatomy delineation. They are mainly used in great vessel imaging and soft tissue mass characterization. These sequences are very sensitive to flow artifact and a...
black blood pulse is usually performed before acquisition to null the signal of flowing blood. These sequences can be used with a fat saturation pre pulse.

- **Velocity encoding sequence:** In these sequences image intensity reflects velocity rather than tissue composition. These sequences are used to quantify transvalvular flow and valvular insufficiency.

### B. CLINICAL APPLICATIONS

#### Contraindications to the CMR Examination

The contraindications to CMR are identical to those for MR examinations of the other organs such as presence of a pacemaker, ferromagnetic implants or an intracranial aneurysm clip. Some investigators performed MRI at 1.5T in patients with pacemakers with no side effects but the safety of this procedure is still debated in the literature.

#### Left Ventricular (LV) Function

Steady state free precession sequences are considered by most of the investigators as the gold standard sequences for assessing LV volume and ejection fraction (EF) [42]. The contrast between the myocardium and the blood on SSFP is excellent, giving an accurate delineation of the endocardial wall. To measure LV volume and LVEF, short axis cine sequences are performed from the base of the LV through the apex. Short axis cine sequences can be performed with a gap between slices equal to the slice thickness without decreasing the accuracy of the measurement. The short axis plane must be prescribed very precisely to avoid measurement error. One can select the first ventricular slice at the basal and apical levels and on each slice level between the base and the apex, the end-diastolic and end-systolic images using commercially available software. The software defines the endocardial and epicardial LV border to calculate LV volumes and LVEF semi-automatically. Segmental LV function can also be assessed quantitatively using tagged cine sequences, but this is not widely used in clinical practice. Tagged cine sequences can also be used to improve imaging quality since they have shown increased sensitivity to wall motion abnormality during stress imaging.

#### Late Enhancement & Characterization of Infarcted Area

CMR has been increasingly used as a tool for the characterization of various myocardial injuries such as (1) reversible (stunned or hibernating) and irreversible myocardial injuries [40, 49, 52-53], (2) transmural and non-transmural infarcts [50] and (3) acute and chronic (scar) infarcts [54]. A recent study showed that T2 abnormality depicts the area at risk, which is the area of reversibly and irreversibly injured myocardium [55]. Furthermore, the combination of T2-weighted and contrast enhanced T1-weighted sequences can be used to detect and discriminate intramyocardial hemorrhage from microvascular obstruction [56]. First pass perfusion MR imaging delineates microvascular obstruction (MO) zone in acutely revascularized patients [45, 57-58]. Wu et al. [45] showed that presence of MO lesion is a predictor of adverse outcome.

Simonetti et al. [40] showed on the inversion recovery gradient echo sequences that after contrast injection and nulling of the normal myocardium, the infarcted area appeared bright and normal myocardium appeared dark, thus providing a high contrast-to-noise ratio between these two structures. These sequences must be performed 10 to 20 min after contrast injection [40]. Dendale et al. [59] found that patients with reperfused infarcts revealed a different temporal pattern of enhancement compared to patients with occlusive infarcts on delayed contrast enhanced images (acquired between 5-20 min after Gd-DTPA-BMA). They observed that reperfused infarcts are characterized by a faster rise and fall in signal intensity than occlusive infarcts. Functional recovery can be predicted [50] by measuring the spatial extent of these areas on delayed contrast enhanced MR images in both occlusive and reperfused infarcts. Choi et al. [60] showed that infarct area extent is a good marker for functional recovery after an acute infarct. This sequence is a very accurate technique in assessing infarct area in the acute phase and chronic phases of infarction [7, 31, 40, 42, 49-50]. Wagner et al. [61] showed that 50% of the subendocardial infarct seen on the CMR late enhancement sequence was not diagnosed using SPECT imaging due to the high spatial resolution provided by MRI. Late enhancement was also used to assess viability and predict segmental recovery after revascularization [50]. In this indication the adjunction of a low dose of dobutamine could be useful to increase diagnostic accuracy in predicting segmental function recovery [52].

The physiological basis of CMR with late enhancement is exactly the same as MDCT with late enhancement, and it is completely nonspecific. CMR late enhancement can be seen in areas of fibrotic tissue, with edema or cellular necrosis. The differential diagnosis between myocardial ischemia with an angiographically normal coronary artery and myocarditis is sometimes difficult and late enhancement CMR has shown a very good sensitivity and specificity in these cases. Laissy et al. [62] showed that late enhancement in patients with myocarditis was (1) subepicardial or transmural, (2) with no vascular segmentation, and (3) with no perfusion defect; however, the pattern of late enhancement in patients with myocardial infarct were (1) subendocardial or transmural, (2) with vascular segmentation, and (3) perfusion defects in some cases.

#### Stress Test During CMR

Stress tests are performed during CMR to detect hemodynamically relevant CAD. Stress tests can be performed using injection (1) of a vasodilator (adenosine or dipyridamole) that reveals ischemia by a perfusion defect during stress and normal perfusion during rest, an evaluation of coronary flow is also feasible after adenosine or dipyridamole injections, or (2) dobutamine injection ischemia
revealed by a decrease in contractility during stress (Figure 6). If stress-induced myocardial hypoperfusion due to coronary artery stenosis is detected, this indicates the need for revascularization therapy (endovascular or surgery). Koskenvuo et al. [63] showed that coronary flow reserve assessed using CMR and PET are comparable. Keijer et al. [64] showed that in single vessel disease patients there was a good correlation between stress CMR, Thallium SPECT and coronarography. Myocardial perfusion reserve can be established by assessing the signal intensity-time curves; the sensitivity, specificity, and diagnostic accuracy are 90%, 83%, 87% respectively for detection of stenosis greater than 75% [48]. Arterial spin labeling (ASL) is a direct quantitative method for measuring myocardial perfusion without contrast medium. ASL is now available for small animals imaging and currently being developed for clinical use [65]. The limitation of the technique is that there is no reference perfusion CMR sequence, and post-processing for quantification is time consuming.

C. INDICATIONS FOR CMR

A recent report (ACCF, ACR, SCCT, SCMR, ASNC, NASCI, SCAI, SIR appropriateness criteria [7]) reviewed the indications for coronary assessment by MDCT. In this paper we will briefly state the main appropriate indications for CMR [7].

CMR with a stress test (dobutamine or perfusion stress test) is indicated in the detection of CAD (1) in case of chest pain when there is an intermediate pre-test probability of CAD, and an uninterpretable ECG, or if the patient is unable to exercise, and (2) to characterize a stenosis of unclear significance. After an acute infarct CMR is indicated to determine the location and extent of myocardial necrosis including the MO zone.

Late enhancement CMR is indicated (1) to assess viability prior to revascularization and to establish the likelihood of recovery of function with revascularization or medical therapy, (2) to differentiate infarct from myocarditis.

CMR with structure and function assessment is indicated in (1) congenital heart disease, great vessel malformation, (2) evaluation of LV and RV mass and volumes in case of suboptimal image quality during transthoracic echocardiography, (3) in assessing cardiomyopathies, such as arrhythogenic right ventricular dysplasia, dilated or hypertrophic cardiomyopathy, (4) in the assessment of pericardial disease, such as constrictive pericarditis or pericardial mass, and (5) in case of cardiac mass or tumors.

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