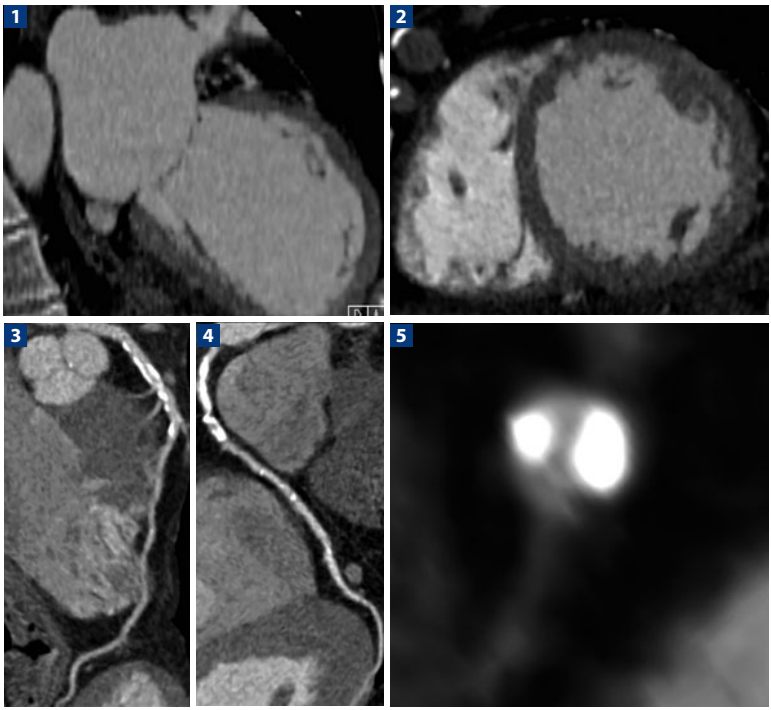
HEART – Dilated Cardiomyopathy



A 67-year-old patient with ischemic dilated cardiomyopathy. **1** Vertical long-axis and **2** short-axis MPR images of the heart show ventricular dilatation with wall thinning. **3**, **4** Curved MPR images show diffuse and severe vascular disease of the coronary arteries. **5** MPR image in a plane orthogonal to the longitudinal axis of the vessel identifies diffuse calcified plaques along the vessel. (Reproduced with the kind permission of Dr. Gorka Bastarrika, University Clinic of Navarra, Pamplona, Spain)

A. Laghi (ed.), *MDCT Protocols,* © Springer-Verlag 2012

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. Contraindications to the administration of negative chronotropic drugs and nitrates should be carefully investigated. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). Control of HR should be decided according to the technology used. For a 64-slice CT scanner, the HR should be < 65 bpm. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol with injection time = scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Gating: Retrospective or prospective (according to patient's HR and the technology available).
Scan region: From the ascending aorta to the heart apex.

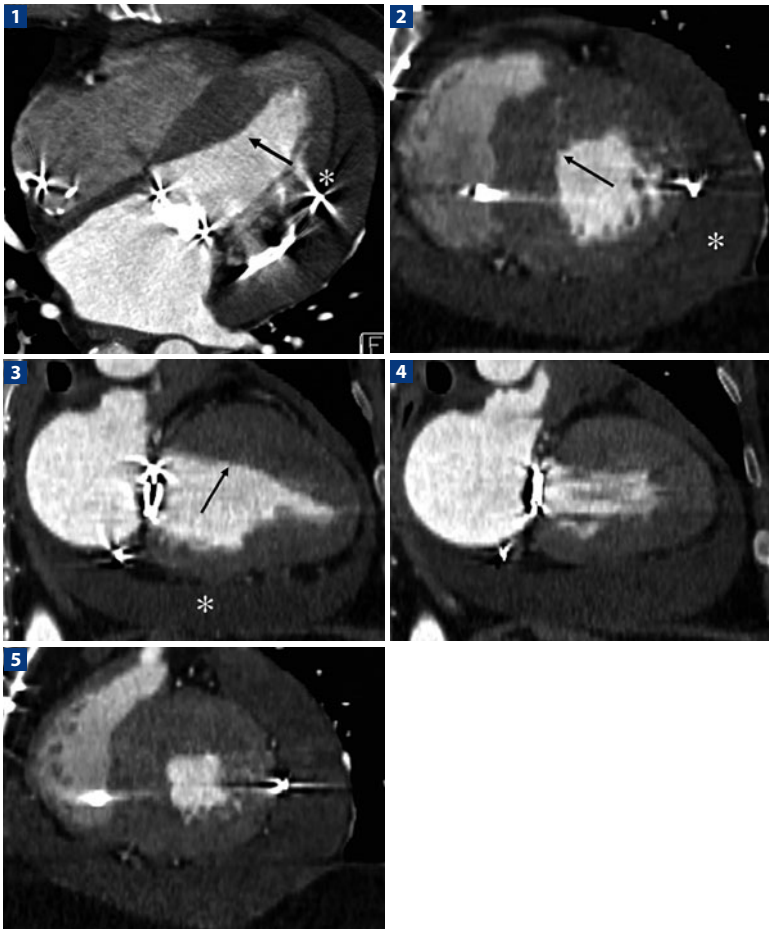
References

Andreini D, Pontone G, Pepi M et al (2007) Diagnostic accuracy of multidetector computed tomography coronary angiography in patients with dilated cardiomyopathy. J Am Coll Cardiol 49:2044-2050

Butler J (2007) The emerging role of multi-detector computed tomography in heart failure. J Card Fail 13:215-226

Williams TJ, Manghat NE, McKay-Ferguson A et al (2008) Cardiomyopathy: appearances on ECG-gated 64-detector row computed tomography. Clin Radiol 63:464-474

HEART – Hypertrophic Cardiomyopathy



A 52-year-old patient with hypertrophic cardiomyopathy treated with mitral valve replacement and pacemaker implantation. **1-3** Four-chamber, short-axis and vertical long-axis MPR images, respectively. In diastole, note the marked eccentric hypertrophy of the interventricular septum (*arrow*), with associated hypertrophy of the remaining cardiac segments resulting from systemic hypertension. Marked concentric pericardial effusion can also be appreciated (*asterisk*). **4**, **5** Short-axis and vertical long-axis MPR images, respectively. In systole, note the concentric hypertrophy and the overall reduction in heart-wall motion. The ventricular diameters should be measured in diastole. (Reproduced with the kind permission of Dr. Gorka Bastarrika, University Clinic of Navarra, Pamplona, Spain)

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. Contraindications to the administration of negative chronotropic drugs and nitrates should be carefully investigated. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). Control of HR should be decided according to the technology used. For a 64-slice CT scanner, the HR should be < 65 bpm. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol with the injection time = scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

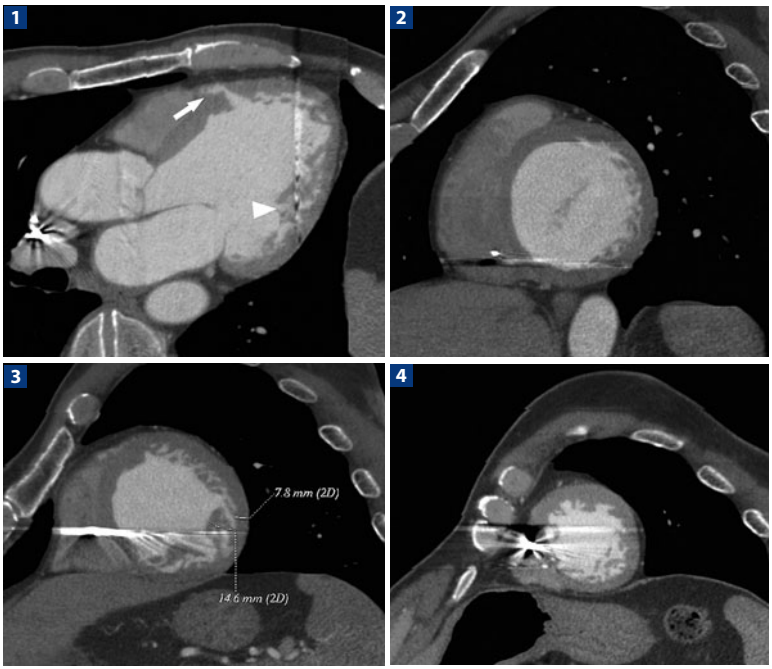
References

Ghersin E, Lessick J, Litmanovich D et al (2006) Comprehensive multidetector CT assessment of apical hypertrophic cardiomyopathy. Br J Radiol 79:e200-204

Mitsutake R, Miura S, Sako H et al (2008) Usefulness of multi-detector row computed tomography for the management of percutaneous transluminal septal myocardial ablation in patient with hypertrophic obstructive cardiomyopathy. Int J Cardiol 129:e61-63

Sparrow P, Merchant N, Provost Y et al (2009) Cardiac MRI and CT features of inheritable and congenital conditions associated with sudden cardiac death. Eur Radiol 19:259-270. PMID: 18795295

HEART – Non-compaction Cardiomyopathy



A 49-year-old patient with a history of cardiac arrest and automatic defibrillator implantation underwent CT coronary angiography to rule out the presence of coronary artery disease. The examination showed no significant alterations of the coronary arteries. **1** Three-chamber MPR image shows an accentuation of the trabecular meshwork of the ventricular myocardium (*arrowhead*). A deep intratrabecular recess (*arrow*) seems to cross the interventricular septum up to the right ventricle. **2**, **3**, **4** Short- and long-axis MPR images. An accentuation of the trabecular meshwork of the entire ventricular myocardium can be appreciated at the **2** valvular, **3** middle, and **4** apical levels. The "non-compact" trabecular myocardium is thicker than the "compact" nontrabecular myocardium. Such beam-hardening artifacts are caused by the automatic defibrillator catheter

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G catheter in the right antecubital vein. Contraindications to the administration of negative chronotropic drugs and nitrates should be carefully investigated. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). The control of HR should be decided according to the technology used. For a 64-slice CT scanner, the patient's HR should be < 65 bpm. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol with injection time = scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

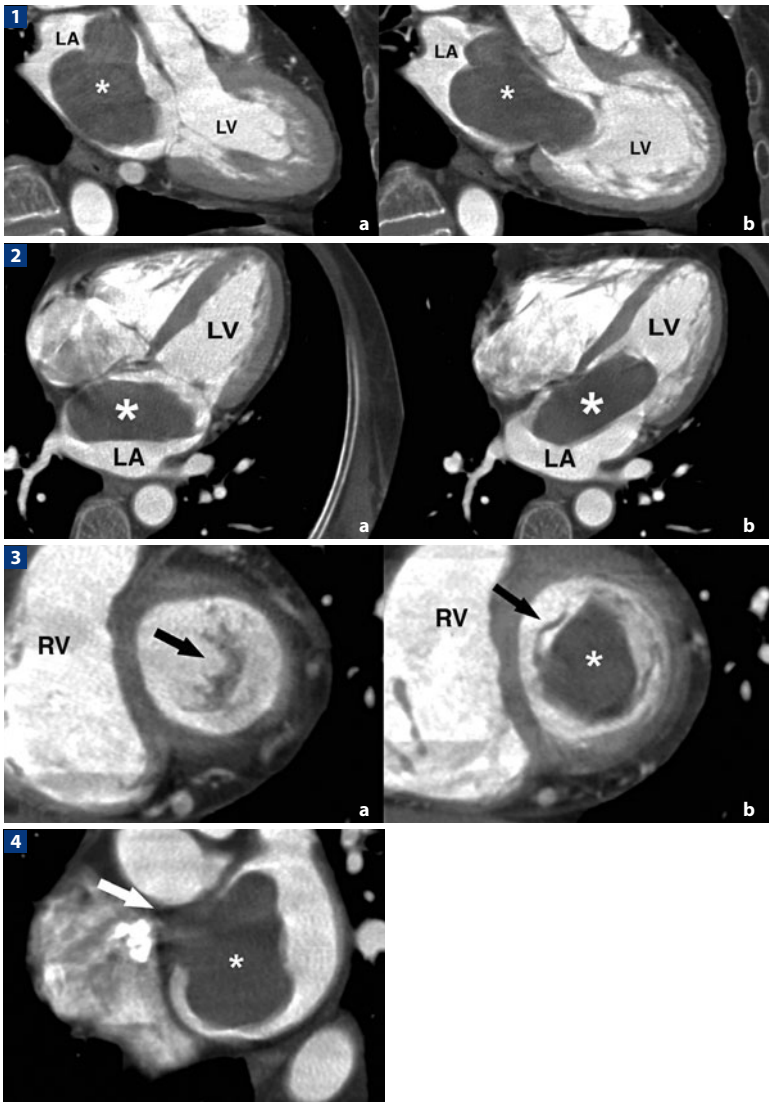
References

Eilen D, Peterson N, Karkut C et al (2008) Isolated noncompaction of the left ventricular myocardium: a case report and literature review. Echocardiography 25:755-761

Jacquier A, Revel D, Saeed M (2008) MDCT of the myocardium: a new contribution to ischemic heart disease. Acad Radiol 15:477-487

Orakzai SH, Orakzai RH, Nasir K et al (2006) Assessment of cardiac function using multidetector row computed tomography. J Comput Assist Tomogr 30:555-563

HEART – Atrial Myxoma



A 77-year-old patient with dyspnea, palpitations, and chest pain but with no ECG or enzymatic changes underwent echocardiography, which revealed the presence of a mobile mass within the atrium. As the relationship of the mass with the heart chamber could not be correctly visualized, an MDCT examination was requested. **1**, **2** Three- and four-chamber MPR images of the heart during systole (**a**) and ▶

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. Contraindications to the administration of negative chronotropic drugs and nitrates should be carefully investigated. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). The control of HR should be decided according to the technology used. For a 64-slice CT scanner, the HR should be < 65 bpm. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol is calculated with injection time = scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

References

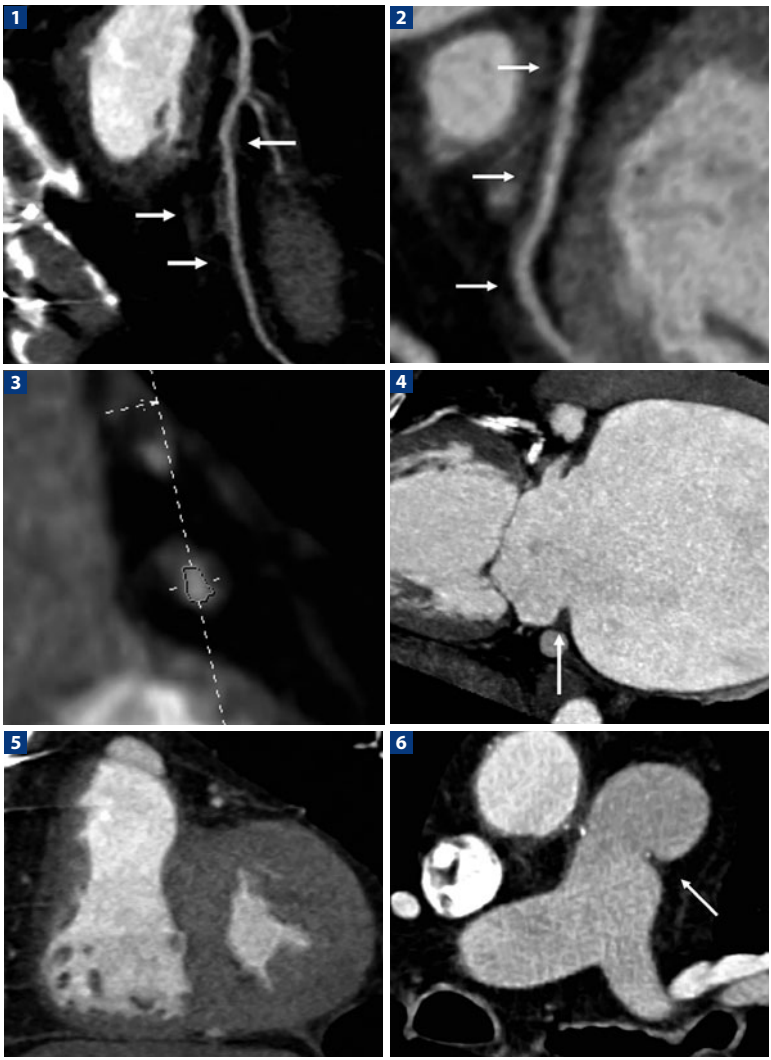
Grebenc ML, Rosado-de-Christenson ML, Green CE et al (2002) Cardiac myxoma: imaging features in 83 patients. RadioGraphics 22:673-689

Neragi-Miandoab S, Kim J, Vlahakes GJ (2007) Malignant tumours of the heart: a review of tumour type, diagnosis and therapy. Clin Oncol (R Coll Radiol) 19:748-756

Yuan SM, Shinfeld A, Lavee J et al (2009) Imaging morphology of cardiac tumours. Cardiol J 16:26-35

◀ diastole (**b**). Note the presence of a mass (*asterisk*) within the left atrium (*LA*) that during diastole (**b**) migrates within the left ventricle (*LV*). **3** Short-axis MPR image of the heart. The reconstruction shows the relations between the mass (asterisk) and the mitral valve (*arrow*). **4** Axial MPR image shows the insertion (*arrow*) of the atrial mass (*asterisk*) at the level of the interatrial septum

HEART – Transplant (Postoperative Study)



A 62-year-old patient underwent an orthotopic heart transplant with biatrial technique 7 years earlier. **1**, **2** Curved MPR image shows transplant vasculopathy and rejection, with diffuse thickening of the vessel wall due to intimal hyperplasia. The finding can be distinguished from classic atheromatous disease by the concentric thickening, beginning from the distal vessels and progressing proximally (*arrows*). **3** MPR image in a plane orthogonal to the longitudinal axis of the vessel shows diffuse concentric thickening of the vessel wall. **4** Vertical long-axis MPR image ▶

Study Protocol

Patient preparation: A 6-h fast prior to the examination. 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs is useless because of the denervation of the transplanted heart.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Unnecessary.

Post-contrast scan:
CM injection protocol with injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

References

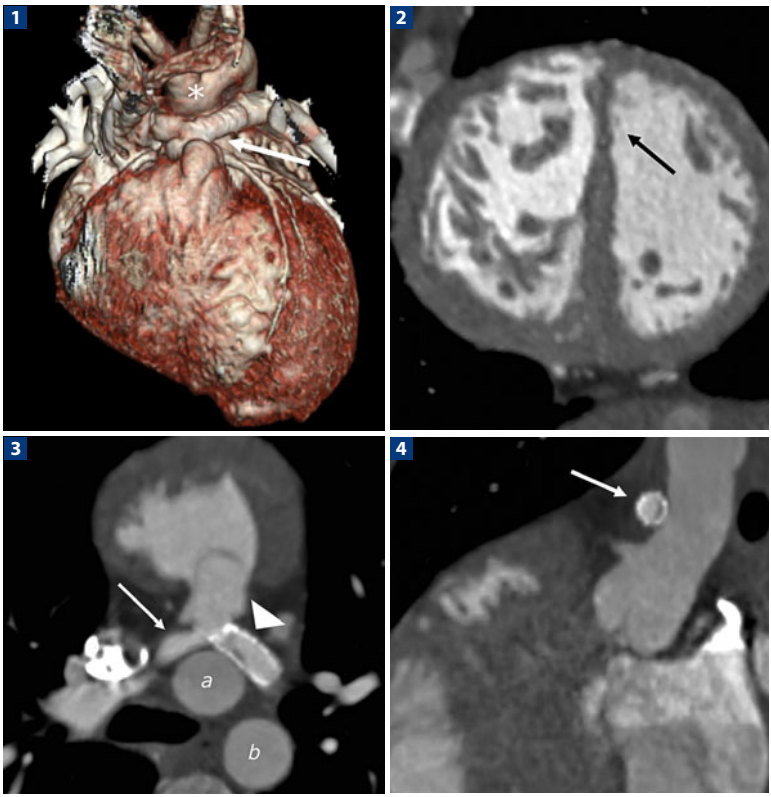
Ferencik M, Gregory SA, Butler J et al (2007) Analysis of cardiac dimensions, mass and function in heart transplant recipients using 64-slice multi-detector computed tomography. J Heart Lung Transplant 26:478-484

Gregory SA, Ferencik M, Achenbach S et al (2006) Comparison of sixty-four-slice multidetector computed tomographic coronary angiography to coronary angiography with intravascular ultrasound for the detection of transplant vasculopathy. Am J Cardiol 98:877-884

Iyengar S, Feldman DS, Cooke GE et al (2006) Detection of coronary artery disease in orthotopic heart transplant recipients with 64-detector row computed tomography angiography. J Heart Lung Transplant 25:1363-1366

◀ of the heart: massive left atrial dilatation, characteristic of the transplant particularly when done with biatrial technique. Note the site of the anastomosis (*arrow*). **5** Short-axis MPR image of the heart identifies concentric ventricular hypertrophy; this finding is common in transplant patients and results from the immunosuppressive treatment and systemic hypertension. **6** Axial MPR image shows anastomosis of the pulmonary artery (*arrow*). (Reproduced with the kind permission of Dr. Gorka Bastarrika, University Clinic of Navarra, Pamplona, Spain)

HEART – Transposition of the Great Vessels (Postoperative Study of the Great Vessels)



Evaluation of a left pulmonary artery stent due to frequent stenosis after the procedure. Following the Jatene procedure, the coronary arteries were excised from the aorta, which was sectioned and then inverted together with the pulmonary artery. Before the vessels are anastomosed, the pulmonary artery is positioned in front of the aorta. This maximizes the length of the neo-aorta and minimizes the risk of kinking or compression of the coronary arteries. The coronary arteries are then re-implanted on the neo-aorta. In patients undergoing the arterial switch procedure, there is a substantial risk of early or late coronary stenosis or occlusion. **1** VR reconstruction shows the pulmonary artery (*arrow*) running in front of the aorta (*asterisk*). **2** Short-axis MPR image of the heart highlights concentric hypertrophy of the right ventricle with thinning of the interventricular septum (*arrow*). **3** Axial MIP reconstruction shows the left pulmonary stent with initial intimal hyperplasia (*arrowhead*). Note the pulmonary artery running in front of the aorta (*arrow*) and the anomalous position of the ascending aorta (**a**) with respect to the descending aorta (**b**). **4** On oblique MPR image, the left pulmonary stent with initial intimal hyperplasia (*arrow*) is seen. Note the compression of the ▶

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. Contraindications to the administration of negative chronotropic drugs and nitrates should be carefully investigated. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). The control of HR should be decided according to the technology used. For a 64-slice CT scanner, the HR should be < 65 bpm. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Unnecessary.

Post-contrast scan:
CM injection protocol with injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Gating: Retrospective or prospective (according to patient HR and technology available.
Scan region: from the ascending aorta to the heart apex.

References

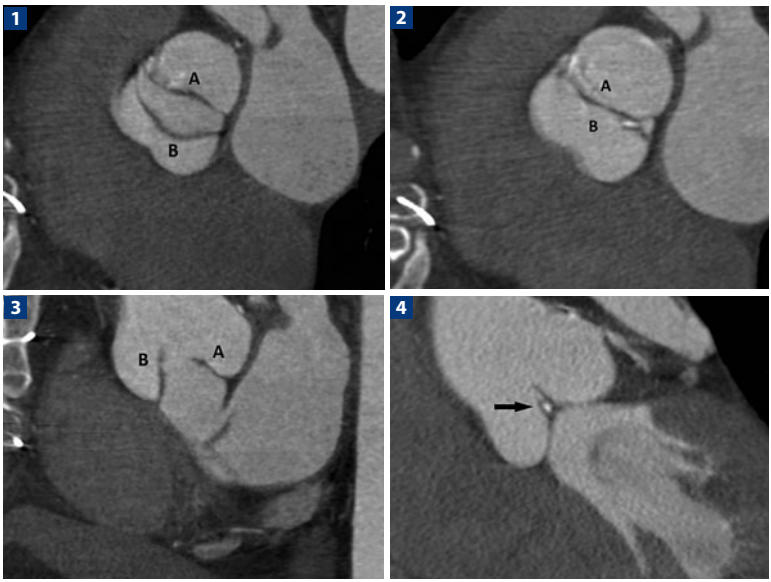
Eichhorn JG, Long FR, Hill SL et al (2006) Assessment of in-stent stenosis in small children with congenital heart disease using multi-detector computed tomography: a validation study. Catheter Cardiovasc Interv 68:11-20

Lee T, Tsai IC, Fu YC et al (2006) Using multidetector-row CT in neonates with complex congenital heart disease to replace diagnostic cardiac catheterization for anatomical investigation: initial experiences in technical and clinical feasibility. Pediatr Radiol 36:1273-1282

Leschka S, Oechslin E, Husmann L et al (2007) Pre- and postoperative evaluation of congenital heart disease in children and adults with 64-section CT. RadioGraphics 27:829-846

◀ pulmonary artery on the ascending aorta, which predisposes the pulmonary arteries to stenosis. (Reproduced with the kind permission of Dr. Gorka Bastarrika, University Clinic of Navarra, Pamplona, Spain)

HEART – Bicuspid Aortic Valve



A 64-year-old patient underwent CT coronary angiography after an episode of chest pain. CT examination reveals the presence of a bicuspid aortic valve. **1**, **2** MPR images in a plane parallel to the valve in the systolic and diastolic phases. The aortic valve consists of only two leaflets, the right (**b**) and the left (**a**). In systole, reduced excursion of the valve leaflets can be appreciated (stenosis). **3**, **4** MPR images on an axis perpendicular to the valve in the systolic and diastolic phases. Note the presence of calcifications (*arrow*) on the valve leaflets (**a**, **b**), which have a slightly thickened appearance

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

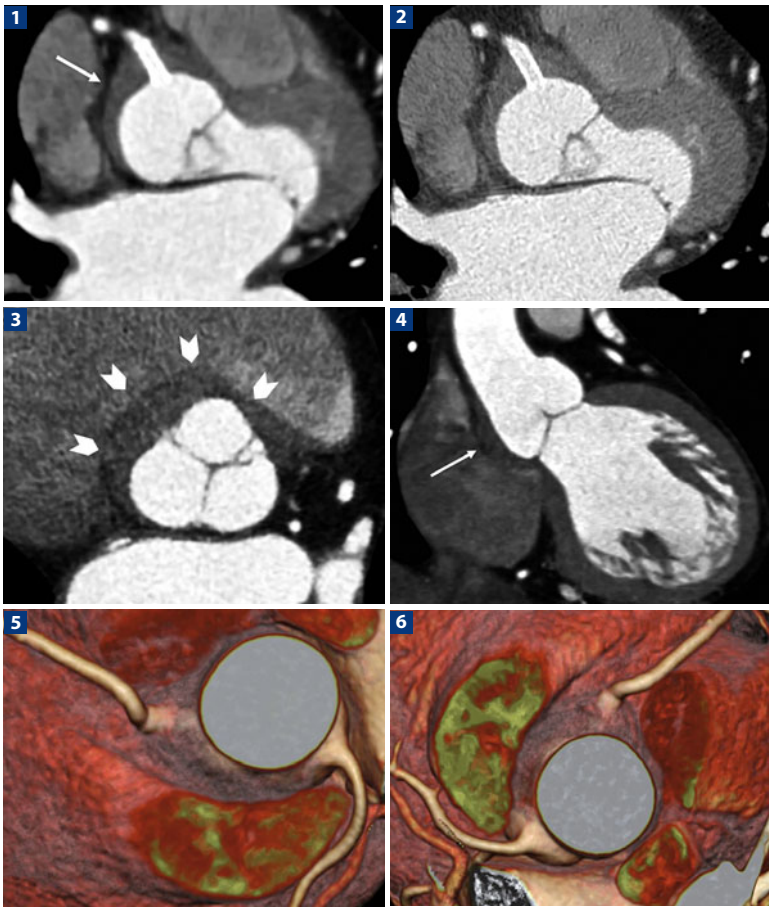
Post-contrast scan:
CM injection protocol with injection time= scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

References

Gilkeson RC, Markowitz AH, Balgude A et al (2006) MDCT evaluation of aortic valvular disease. AJR Am J Roentgenol 186:350-360

Ryan R, Abbara S, Colen RR et al (2008) Cardiac valve disease: spectrum of findings on cardiac 64-MDCT. AJR Am J Roentgenol 190:W294-303

HEART – Iatrogenic Coronary Dissection



A 54-year-old patient underwent coronary angiography prior to aortic valve replacement. Following iatrogenic dissection and perforation of the right coronary artery with stent deployment, a second CT coronary angiography was performed the day after the procedure to evaluate the stent and the hematoma. **1** Axial MPR image shows the well positioned stent. Note the peri-coronary hematoma (*arrow*) surrounding the proximal tract of the right coronary artery. **2** Axial MPR image with reconstruction using the Bf46 filter better evaluates stent patency. **3** MPR image in the aortic valve plane reveals the hematoma, concentrically surrounding the aortic valve (*arrowheads*). **4** Coronal MPR image demonstrates the coronary hematoma (*arrow*) located along the coronary sinus for its entire length. **5**, **6** On VR reconstruction, the peri-coronary hematoma appears as a thin band of intermediate density involving the origin of both coronary sinuses. (Reproduced with the kind permission of Dr. Gorka Bastarrika, University Clinic of Navarra, Pamplona, Spain)

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Unnecessary.

Post-contrast scan:
CM injection protocol with injection time = scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

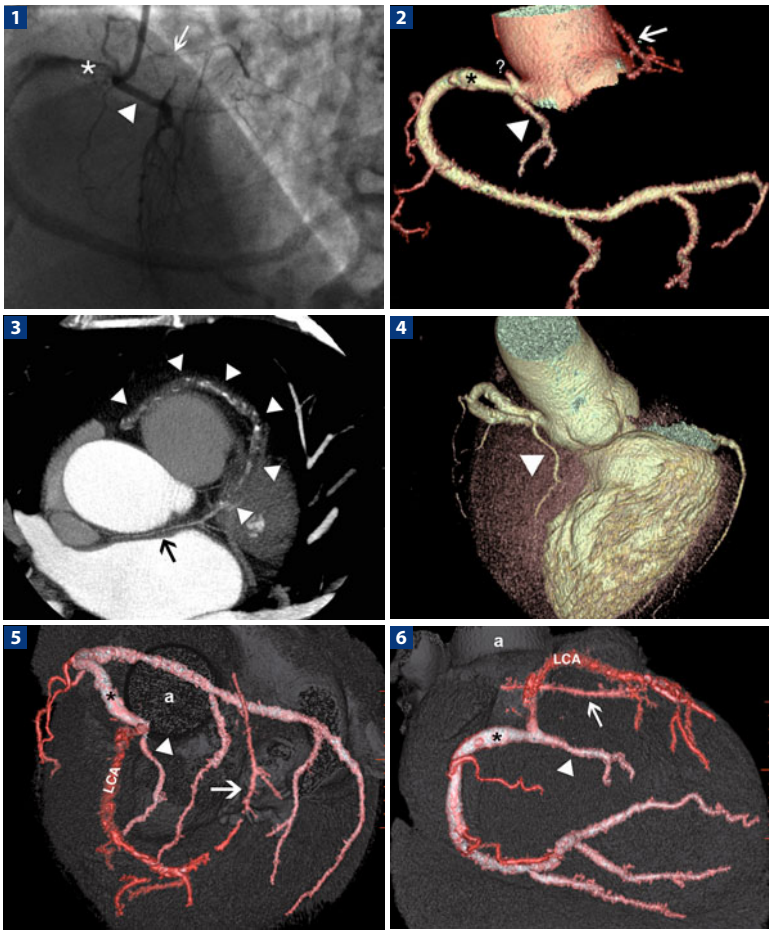
References

Cheng CC, Tsao TP, Tzeng BH et al (2008) Stenting for coronary intervention-related dissection of the left main coronary artery with extension to the aortic root: a case report. South Med J 101:1165-1167

Kantarci M, Ceviz N, Sevimli S et al (2007) Diagnostic performance of multidetector computed tomography for detecting aorto-ostial lesions compared with catheter coronary angiography: multidetector computed tomography coronary angiography is superior to catheter angiography in detection of aorto-ostial lesions. J Comput Assist Tomogr 31:595-599

Yoshikai M, Ikeda K, Itoh M et al (2008) Detection of coronary artery disease in acute aortic dissection: the efficacy of 64-row multidetector computed tomography. J Card Surg 23:277-279

HEART – Coronary Artery Anomaly



Following an episode of angina due to myocardial ischemia, a 49-year-old patient underwent conventional coronary angiography, which was unable to identify the left coronary ostium. CT coronary angiography was performed to search for an anomalous origin of the left coronary circulation. **1** Angiography examination reveals the right coronary ostium as the origin of the right coronary artery (*asterisk*), a large branch (*arrowhead*) running anteriorly, and another smaller branch running posteriorly (*arrow*). **2** VR reconstruction reveals the same findings as seen on conventional coronary angiography and an additional vessel of which only the origin can be appreciated (*question mark*). **3** Axial MIP reconstruction highlights the anastomotic circulation anterior to the origin of the pulmonary artery (*arrowheads*). This circulation apparently consists of the branch identified at coronary angiography (*arrow*) and a larger branch originating ▶

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the evaluation of the coronary anatomy in case of anomalous origin.

Post-contrast scan:
CM injection protocol with injection time = scan time + 7-s trigger delay.
Trigger delay: 7 s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

References

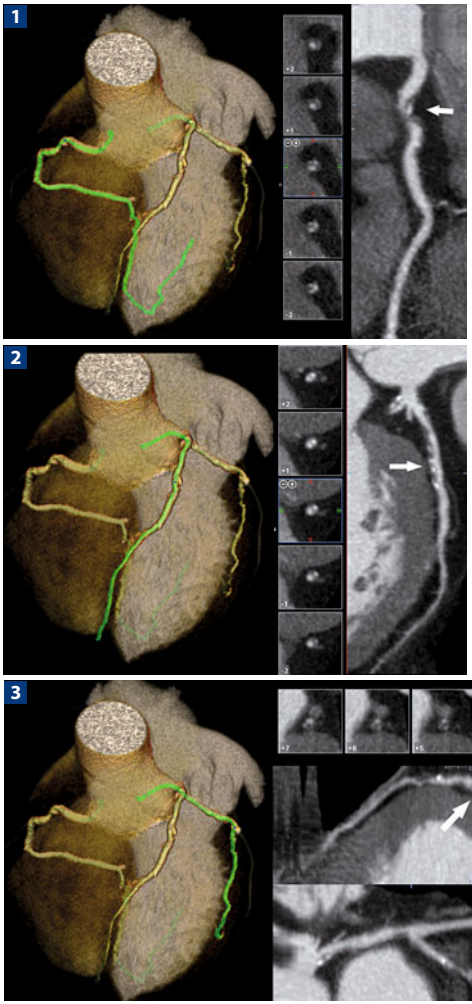
Cademartiri F, Runza G, Luccichenti G et al (2006) Coronary artery anomalies: incidence, pathophysiology, clinical relevance and role of diagnostic imaging. Radiol Med 111:376-391

Dodd JD, Ferencik M, Liberthson RR et al (2007) Congenital anomalies of coronary artery origin in adults: 64-MDCT appearance. AJR Am J Roentgenol 188:W138-146

Kacmaz F, Ozbulbul NI, Alyan O et al (2008) Imaging of coronary artery anomalies: the role of multidetector computed tomography. Coron Artery Dis 19:203-209

◀ from the right, and appears completely occluded (*arrowheads*). **4** VR reconstruction shows the branch (*arrowhead*), arising from the right coronary ostium and running towards the apex, with an intramyocardial course within the interventricular septum. **5**, **6** VR reconstructions identifies a single coronary ostium on the right, from which arises the right coronary artery (*asterisk*), an interventricular branch (*arrowhead*), the left coronary artery (LCA), and a small branch that anastomizes anteriorly with the left coronary artery (*arrow*)

HEART – Three-Vessel Disease



A 63-year-old patient with no family history or risk factors for coronary artery disease reported an episode of angina; ECG signs of myocardial ischemia were absent. VR reconstruction and curved MPR image show: **1** a fibrocalcific plaque at the level of the proximal segment of the right coronary artery (*arrow*); **2** a large fibrocalcific plaque extending for the entire length of the proximal tract of the left anterior descending coronary artery (*arrow*); **3** an extensive fibrocalcific plaque at the level of the circumflex artery (*arrow*) and corresponding with the first marginal branch

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize heart rate (HR). The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

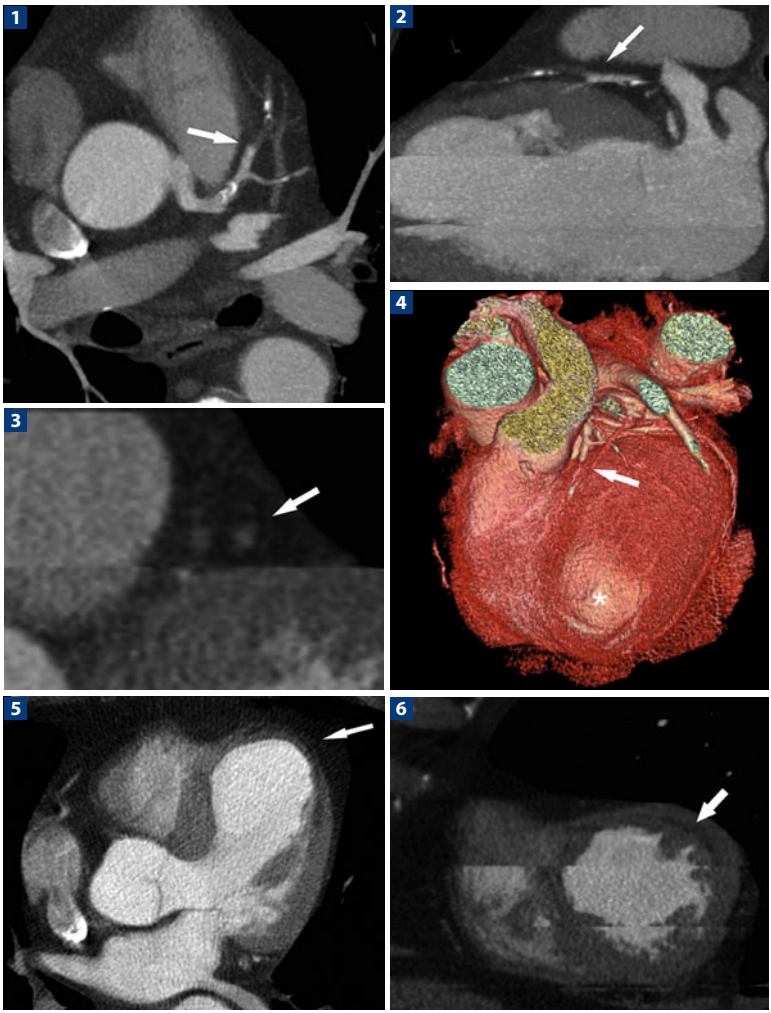
References

Cademartiri F, Romano M, Seitun S et al (2008) Prevalence and characteristics of coronary artery disease in a population with suspected ischemic heart disease using CT coronary angiography: correlations with cardiovascular risk factors and clinical presentation. Radiol Med 113:363-372

Meijboom WB, van Mieghem CA, Mollet NR et al (2007) 64-slice computed tomography coronary angiography in patients with high, intermediate, or low pretest probability of significant coronary artery disease. J Am Coll Cardiol 50:1469-1475

Meijboom WB, van Mieghem CA, van Pelt N et al (2008) Comprehensive assessment of coronary artery stenoses: computed tomography coronary angiography versus conventional coronary angiography and correlation with fractional flow reserve in patients with stable angina. J Am Coll Cardiol 52:636-643

HEART – Chronic Total Occlusion of the Left Anterior Descending Artery with Associated Apical Infarction



A 73-year-old patient with a prior episode of chest pain (3 years earlier) was treated pharmacologically but undergoes CT coronary angiography at the return of symptoms. **1** Axial MPR image shows the occluded left anterior descending artery (*arrow*) distal to the origin of the first diagonal branch. **2** Vertical long-axis MPR image of the heart shows the extension of the occlusion (*arrow*), which involves the entire vessel. **3** MPR image in a plane orthogonal to the ▶

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol: Injection time= scan time + 7-strigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

References

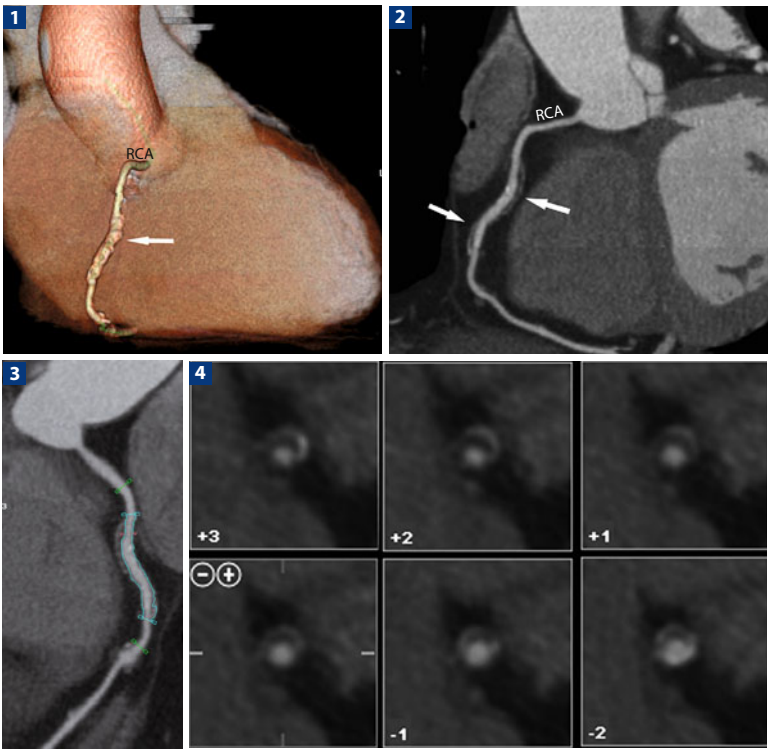
Hecht HS (2008) Applications of multislice coronary computed tomographic angiography to percutaneous coronary intervention: how did we ever do without it? Catheter Cardiovasc Interv 71:490-503

Otsuka M, Sugahara S, Umeda K et al (2008) Utility of multislice computed tomography as a strategic tool for complex percutaneous coronary intervention. Int J Cardiovasc Imaging 24:201-210

Yokoyama N, Yamamoto Y, Suzuki S et al (2006) Impact of 16-slice computed tomography in percutaneous coronary intervention of chronic total occlusions. Catheter Cardiovasc Interv 68:1-7

◀ longitudinal axis of the vessel. Note the complete absence of contrast material within the vessel (*arrow*). **4** VR reconstruction demonstrates complete occlusion of the vessel (*arrow*). **5**, **6** Three-chamber short-axis MPR images show diffuse hypoattenuation indicating the ischemic area, which resulted from the occlusion of the left anterior descending artery. (Reproduced with the kind permission of Dr. Nico R. Mollet, Erasmus Medical Center, Rotterdam, Netherlands)

HEART – Plaque with Positive Remodeling



A 68-year-old hypertensive patient with a history of smoking and hypercholesterolemia reported chest pain after intense physical activity. The ECG was normal and there were no enzymatic changes. **1** VR reconstruction shows the right coronary artery (*RCA*) all along its course, with diffuse irregularities in the middle part of the vessel (*arrow*). **2**, **3** Curved MPR reconstruction highlights the extensive low-density plaque (*arrows*) at the middle third of the RCA. The caliber of the lumen is constant all along its course. **4** MPR reconstruction perpendicular to the longitudinal axis of the vessel identifies a plaque that is eccentric, with centrifugal growth (positive remodeling) but without causing stenosis of the lumen

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

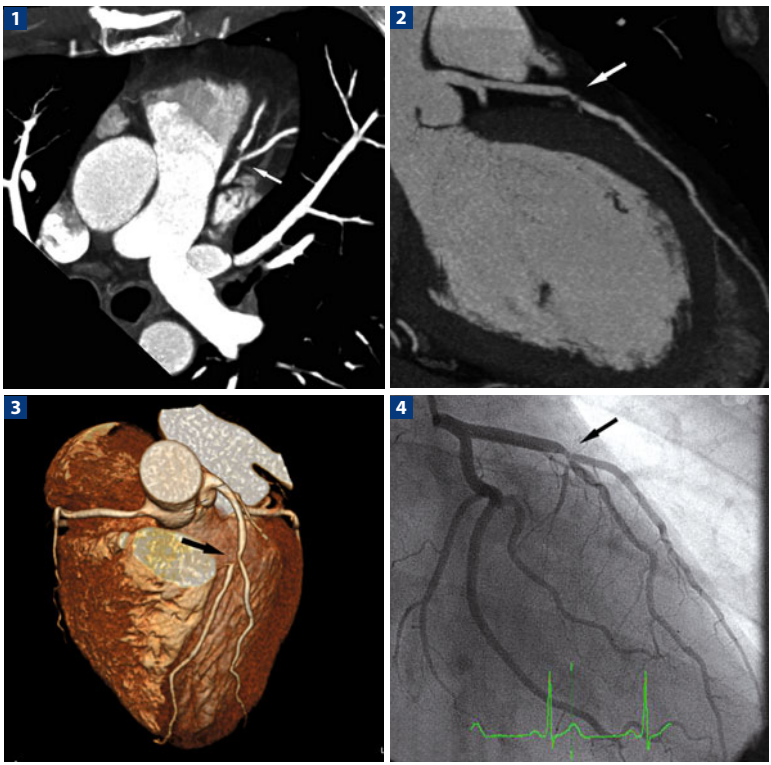
References

Mowatt G, Cummins E, Waugh N et al (2008) Systematic review of the clinical effectiveness and cost-effectiveness of 64-slice or higher computed tomography angiography as an alternative to invasive coronary angiography in the investigation of coronary artery disease. Health Technol Assess 12(17):iii-iv, ix-143

Narula J, Garg P, Achenbach S et al (2008) Arithmetic of vulnerable plaques for noninvasive imaging. Nat Clin Pract Cardiovasc Med (5 Suppl) 2:S2-10

Schmid M, Pflederer T, Jang IK et al (2008) Relationship between degree of remodeling and CT attenuation of plaque incoronary atherosclerotic lesions: an in-vivo analysis by multi-detector computed tomography. Atherosclerosis 197:457-464

HEART – Stenosis of the Left Anterior Descending Artery



A 58-year-old patient with a family history of coronary artery disease reported an episode of angina. A stress test was carried out but was interrupted due to the patient's inability to complete the test. **1**, **2** Axial MIP reconstruction and curved MPR image show a low-density plaque in the middle segment of the left anterior descending artery and the first diagonal branch (*arrow*). **3** VR reconstruction identifies the presence of significant stenosis at the level of the middle segment of the left anterior descending artery (*arrow*), **4** which was confirmed on angiography (*arrow*). (Reproduced with the kind permission of Dr. Nico R. Mollet, Erasmus Medical Center, Rotterdam, Netherlands)

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

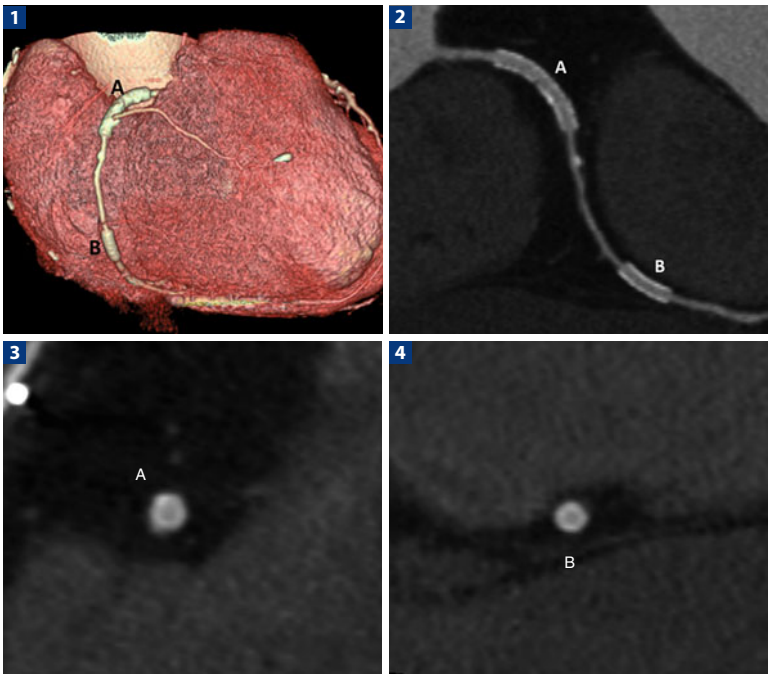
References

Foster G, Shah H, Sarraf G et al (2009) Detection of noncalcified and mixed plaque by multirow detector computed tomography. Expert Rev Cardiovasc Ther 7:57-64

Schmid M, Achenbach S, Ropers D et al (2008) Assessment of changes in non-calcified atherosclerotic plaque volume in the left main and left anterior descending coronary arteries over time by 64-slice computed tomography. Am J Cardiol 101:579-584

Schuijf JD, Jukema JW, van der Wall EE et al (2007) Multi-slice computed tomography in the evaluation of patients with acute chest pain. Acute Card Care 9:214-221

HEART – Right Coronary Artery Stent



A 73-year-old patient underwent double stenting of the right coronary artery. **1** VR reconstruction shows the presence of the 4-mm stent in the proximal segment (**a**) and the 3-mm stent in the distal segment (**b**) of the right coronary artery. Both stents show distal passage of the contrast material. **2** Curved MPR image obtained with the appropriate filter demonstrates the patency of both stents, which show no signs of intimal hyperplasia. **3**, **4** MPR images perpendicular to the axis of the vessel confirm the absence of intimal hyperplasia of both stents (**a**, **b**)

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the ascending aorta to the heart apex.

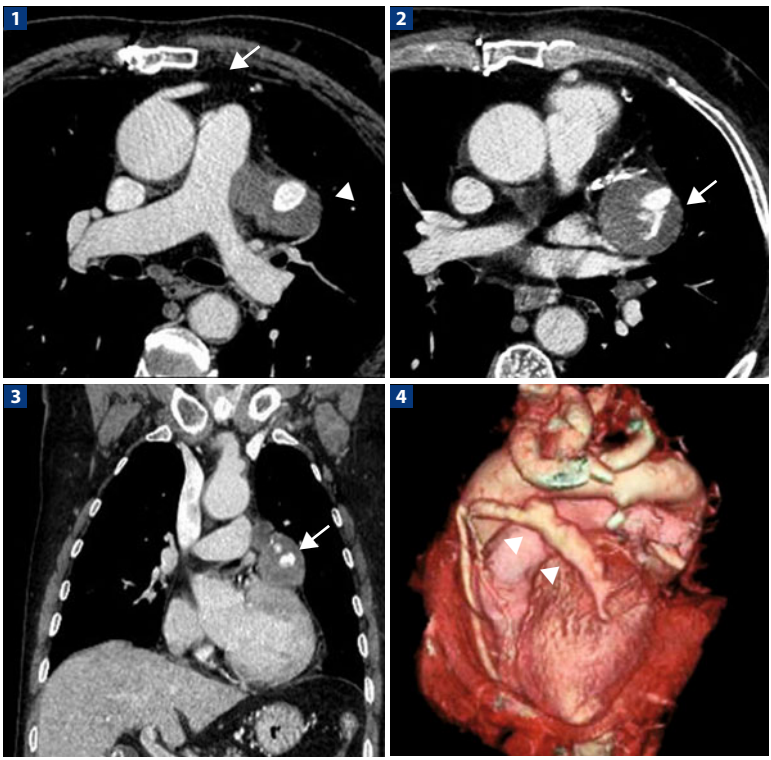
References

Maintz D, Seifarth H, Raupach R et al (2006) 64-slice multidetector coronary CT angiography: in vitro evaluation of 68 different stents. Eur Radiol 16:818-826

Mitsutake R, Miura S, Nishikawa H et al (2008) Usefulness of the evaluation of stent fracture by 64-multi-detector row computed tomography. J Cardiol 51:135-138

Pugliese F, Cademartiri F, van Mieghem C et al (2006) Multidetector CT for visualization of coronary stents. Radiographics 26:887-904

HEART – Aneurysm of an Aorto-coronary Venous Graft



A 73-year-old patient underwent triple bypass surgery. Revascularization was done with the left internal thoracic artery, anastomized with the left anterior descending artery (LAD), and three venous grafts (VG) anastomized with the circumflex (CX) and right coronary arteries (RCA). **1** Axial scan shows the origin of the aorto-coronary graft (*arrow*), in which a saphenous vein segment was used, and the cranial portion of the aneurysm (arrowhead). **2** Evidence of the maximum diameter of the by-pass aneurysm and the structural irregularity of the parietal thrombus. **3** Coronal MPR reconstruction shows the anatomic relationships of the aneurysm with vascular structures (pulmonary artery trunk) and the left ventricle. **4** VR reconstruction shows the course of the coronary artery bypass (*arrowheads*) and its aneurysmal lumen

Study Protocol

Patient preparation: A 6- h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Unnecessary.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the lungs apex to the heart apex.

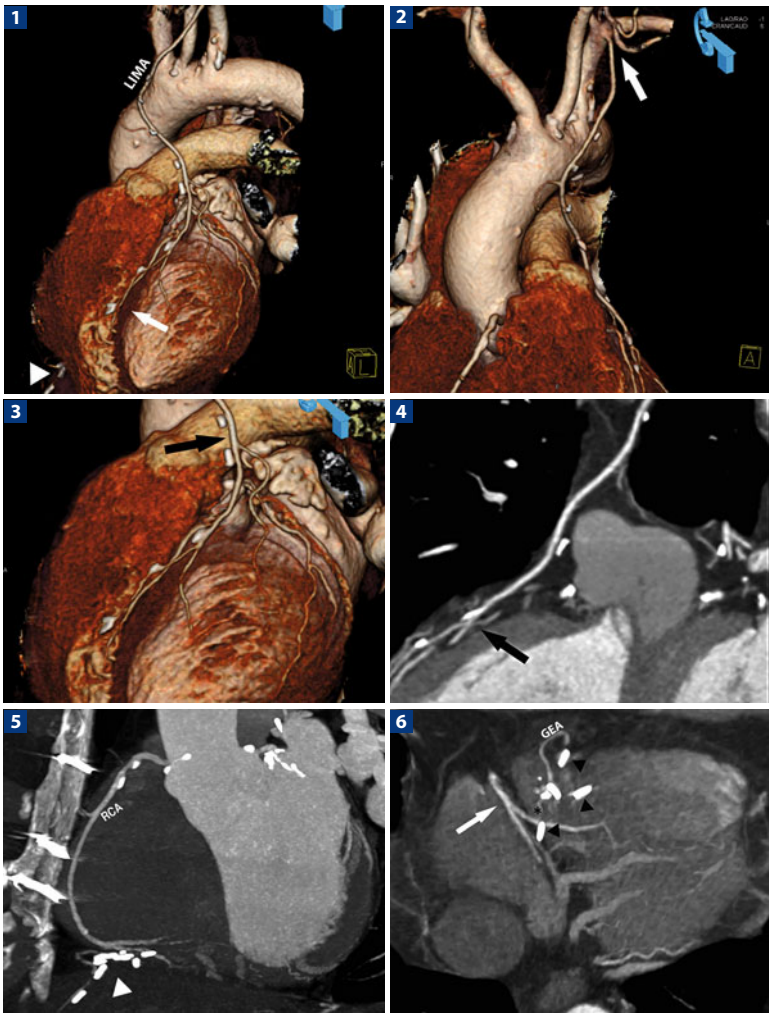
References

Abbasi M, Soltani G, Somali A, Javan H (2009) A large saphenous vein graft aneurysm one year after coronary artery bypass graft surgery presenting as a left lung mass. Interact CardioVasc Thorac Surg 8:691-693

Trop I, Samson L, Cordeau MP (1999) Anterior mediastinal mass in a patient with prior saphenous vein coronary artery bypass grafting. Chest 115:572–576

Williams ML, Rampresaud E, Wolfe WG (2004) A man with saphenous vein graft aneu- rysm after bypass surgery. Ann Thorac Surg 77:1815-1817

HEART – Double Bypass



An 85-year-old patient underwent double bypass surgery. Revascularization was done with the left internal thoracic artery (anastomized with the left anterior descending artery) and the right gastroepiploic artery (anastomized with the posterior descending artery). **1** VR reconstruction clearly shows the presence of an arterial graft (left internal mammary artery, *LIMA*) mobilized and anastomized at the level of the distal tract of the left anterior descending artery (*arrow*). Note the presence of the metal clips at the base, following the course of a vessel originating from the abdomen (*arrowhead*). **2** VR reconstruction shows the origin of the left internal mammary artery (*arrow*). **3** Distal anastomosis of the ▶

Study Protocol

Patient preparation: A 6- h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

CM concentration (mgI/mL)	Flow rate (mL/s)
300	6.7
320	6.2
350	5.7
370	5.4
400	5.0

CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Unnecessary.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the lungs apex to the heart apex.

References

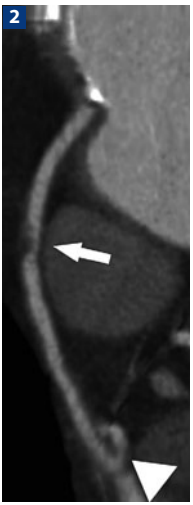
Jones CM, Chin KY, Yang GZ et al (2008) Coronary artery bypass graft imaging with 64-slice multislice computed tomography: literature review. Semin Ultrasound CT MR 29:204-213

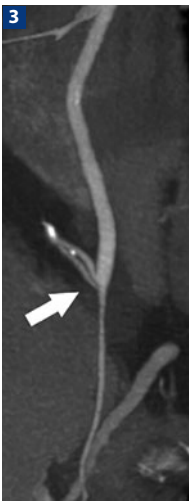
Marano R, Liguori C, Rinaldi P et al (2007) Coronary artery bypass grafts and MD-CT imaging: what to know and what to look for. Eur Radiol 17:3166-3178

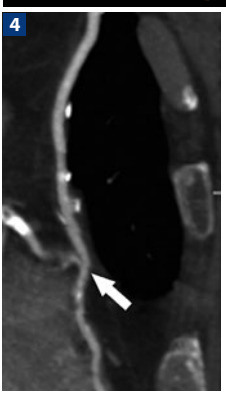
Nabuchi A, Kurata A, Okuyama H et al (2008) Three-dimensional images of extra-routine grafts in CABG by multi detector computed tomography. Ann Thorac Cardiovasc Surg 14:333-335

◀ arterial graft (*arrow*) is seen on VR reconstruction. Note the presence of multiple clips along the course of the vessel, necessary for the closure of side branches. **4** Curved MPR reconstruction along the course of the arterial graft shows the distal anastomosis of the graft (*arrow*), which appears patent. **5** MIP reconstruction shows the metal clips placed along the right gastroepiploic artery (*arrowhead*), mobilized and anastomosed with the posterior descending artery. **6** MIP reconstruction demonstrates the anastomosis (*asterisk*) between the posterior descending artery (*arrow*) and the gastroepiploic artery (*GEA*). The anastomosis cannot be assessed due to the presence of multiple metal clips (*arrowheads*)

HEART – Triple Bypass







A 75-year-old patient underwent triple bypass surgery. Revascularization was done with the left internal thoracic artery, anastomized with the left anterior descending artery (LAD), and two venous grafts (VG) anastomized with the circumflex (CX) and posterior descending arteries. **1** VR reconstruction shows the course of the native coronary arteries (LAD, CX and right coronary artery), which present diffuse calcifications and numerous stenoses. The three grafts used for the revascularization, i.e., left internal mammary artery (LIMA), and VG, can also be appreciated. **2** Curved MPR image allows evaluation of the left VG. A low-density plaque (*arrow*) causing significant stenosis of the lumen is seen at the level of the middle tract of the graft. The distal anastomosis of the graft (*arrowhead*) appears patent. **3** Curved MPR image, used to evaluate the right VG, shows no significant alterations in the graft and its distal anastomosis appears patent (*arrow*). **4** In this curved MPR image, the LIMA shows no significant alterations and the distal anastomosis of the graft appears patent (*arrow*)

Study Protocol

Patient preparation: A 6-h fast prior to the examination; 18G intravenous catheter in the right antecubital vein. The administration of negative chronotropic drugs, such as beta blockers and calcium antagonists, is mandatory to reduce and to stabilize HR. The administration of nitrates is recommended to dilate the coronary arteries.

Iodine flow rate: 2.0 gI/s.

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350	5.7
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CM volume: (Scan time + trigger delay)*flow rate.

Saline flush: 50 ml of saline or 10 ml of CM + 40 ml of saline at the same flow rate.

Pre-contrast scan (calcium score): Useful for the quantification of coronary calcium.

Post-contrast scan:
CM injection protocol: Injection time = scan time + 7-s trigger delay.
Trigger delay: 7s after the threshold of 100 HU is reached in the ascending aorta using a bolus-tracking technique.
Scan protocol:
Gating: Retrospective or prospective (according to patient HR and technology available).
Scan region: From the lungs apex to the heart apex.

References

Crusco F, Antoniella A, Papa V et al (2007) Evidence based medicine: role of multidetector CT in the follow-up of patients receiving coronary artery bypass graft. Radiol Med 112:509-525

Jabara R, Chronos N, Klein L et al (2007) Comparison of multidetector 64-slice computed tomographic angiography to coronary angiography to assess the patency of coronary artery bypass grafts. Am J Cardiol 99:1529-1534

Mueller J, Jeudy J, Poston R et al (2007) Cardiac CT angiography after coronary bypass surgery: prevalence of incidental findings. AJR Am J Roentgenol 189:414-419