Use of multislice computed tomography angiography in percutaneous coronary intervention

The introduction of multislice computed tomography angiography (MSCT) has provided new information for percutaneous coronary intervention (PCI), especially in complex lesions. It provides valuable adjustments about coronary lesions, which are predictors of procedural success, for example, in chronic total occlusions, in bifurcations and recently in aorto-ostial lesion PCI. In multiple fields, tomographic coronary analysis facilitates decision making by providing data that is unobtainable from conventional coronary angiography. The aim of this article is to assess the contribution of MSCT in PCI.

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Coronary artery disease is the leading cause of death and disability in the USA and other Western countries. Coronary angiography (CA) is currently the reference test for coronary artery stenosis assessment, and its use has been steadily increasing over the last decade [1,2]. Although CA is mandatory for percutaneous coronary intervention (PCI), the interpretation of CA in this field has limitations, providing only bi-dimensional luminal projections, not considering atheroma location, plaque composition and tridimensional structure.

The recent technical developments in multislice computed tomography angiography (MSCT), with ECG retrospective-gated image reconstruction, have elicited great interest in the possibility of accurate noninvasive imaging of the coronary arteries. MSCT seems to respond adequately to the need for a noninvasive and reliable assessment of the coronary artery lesions. Several studies have already shown that the contribution of MSCT has become relatively well established in the diagnosis of coronary disease [3]. The introduction of MSCT provides new information and impacts multiple facets of PCI.

When planning a PCI, MSCT has shown to be of interest in complex lesions. It provides valuable measurements about coronary lesions, which are important predictors of procedural success such as in chronic total occlusions (CTOs), in bifurcations and recently in aorto-ostial lesion PCI. In multiple areas, tomographic intravascular analysis facilitates decision making by providing data unobtainable from CA.

The aim of this article is to assess the contribution of MSCT in PCI.

Pre-PCI patient selection
Because of its excellent specificity and good sensitivity, MSCT has become one of the routine explorations for coronary artery disease diagnosis.

■ Diagnosis
The traditional patient evaluation paradigm employs nuclear or echocardiographic stress testing to identify patients who are candidates for PCI by evidencing >10% ischemic area. The sensitivities and specificities for these modalities (86 and 67% for nuclear and 85 and 75% for echocardiographic stress testing, respectively [4]) are considerably less than for 64-slice MSCT (90 and 95%, respectively [5]), suggesting that MSCT is the preferred initial test, especially when ruling out coronary disease.

Moreover, nuclear in particular is problematic in situations where accurate evaluation is most important: 40% of patients with triple vessel disease will have normal (12%) or low-risk single vessel ischemia images (28%) [6]. In patients with left main disease, 15% will have normal (10%) or low-risk (5%) exploration [7]. Stress testing is complementary to MSCT in determining the functional significance of 50–75% of stenoses, in which case significant ischemia would justify PCI, and the absence therefore would suggest medical treatment.

■ Identification of significant lesions
Multislice computed tomography, by imaging the vessel wall as well as the lumen from a 360° perspective, offers distinct advantages compared with CA despite the superior temporal and spatial resolution of CA (~20 ms and 0.2 mm,

respectively) compared with MSCT (75–165 ms and 0.4–0.5 mm, respectively). MSCT can achieve a temporal resolution of 50 ms with some reconstruction methods:

- Insufficient sampling error: the 360° perspective provides an infinite number of viewing angles to ensure the stenosis is captured in its narrowest dimension, compared with the insufficient sampling error inherent in the limited number of acquisitions of CA (six to seven for the left, and two to four for the right coronary arteries);

- Overlap: overlapping vessels, which frequently complicate CA, are never an issue for CTA; each vessel is tracked independently;

- Foreshortening: the least foreshortened view of each vessel is readily determined by available algorithms;

- Remodeling and reference areas: accurate calculation of percent diameter stenosis is predicated on identification of appropriate proximal and distal reference areas, a task complicated by the inability of CA to identify areas of positive and negative remodeling. MSCT is ideally suited for this purpose and remodeling index is an easily measurable parameter [8], thereby facilitating the appropriate choice of reference areas. Quantitative MSCT should always be employed; 'eyeballing', with its inherent overestimation, is not an acceptable method of analysis, despite being the standard of care for CA;

- Minimum lumen area (MLA) calculation: MLA is a far more important physiologic parameter than minimum lumen diameter, and can be reliably derived by tomographic intravascular analysis of cross-sectional images, with correlation with intravascular ultrasound (IVUS) measurements [9,10]. MLA cannot be derived from CA;

- Diffuse narrowing: segments with relatively uniform diffuse lumen reduction will be angiographically unapparent on CA since there is no appropriate reference point, and MLA calculations are not available. The absence of a reference area is not problematic for MSCT since the MLA can be determined.

■ Post-catheterization complementary information

MSCT may be used to resolve questions left unanswered by CA, impacting directly on PCI in situations where complete delineation of coronary or graft anatomy is crucial for therapeutic strategy.

Failure of image acquisition

The most common situations are inability to selectively cannulate a vessel, including anomalous coronary arteries, native coronaries originating from an aneurysmally dilated aortic root, right internal mammary grafts, and vein grafts originating from unanticipated aortic locations. Occasionally, severe pressure damping of the left main or right coronary artery may preclude safe contrast injection. MSCT may provide the necessary information, showing obstructive atheroma.

Requirement for additional information

Even after successful selective CA, there may be unresolved questions for which MSCT is invaluable. These include differentiating ostial disease from coronary spasm unrelieved by intracoronary nitroglycerin, determining the potentially malignant anterior versus the benign posterior course of anomalous coronaries, establishing the relationship of mammary and vein grafts to the sternum to avoid transection during repeat bypass surgery, distinguishing venous bypass aneurysms from pseudoaneurysms, and demonstrating the path and length of CTOs.

Myocardial infarction imaging

Early PCI has improved the prognosis of patients after myocardial infarction (MI). Nevertheless, patency of the epicardial coronary artery after primary PCI does not guarantee reflow at a microvascular level or functional recovery. Knowledge about myocardial perfusion and transmural infarct size after MI has prognostic value and therapeutic consequences. The ability of cardiac magnetic resonance (MR) imaging to help assess both of these parameters is well documented, and MR imaging is often regarded as the clinical standard [11]. Contrast material-enhanced computed tomography can help visualize infarcted myocardium during early and delayed imaging. MSCT allows imaging of early and late myocardial hypoenhancement after reperfused MI, with good correlation with MR imaging, although imaging of delayed hyperenhancement at MSCT has inferior contrast-to-noise ratio. Nevertheless, delayed hyperenhancement at MSCT correlates well with that at MR imaging [12].

Procedure planning

After proving its relevance in the diagnosis of coronary artery disease, MSCT has recently emerged as a useful tool in PCI, especially in treating complex lesions such as CTOs, ostial lesions and bifurcations including those affecting the left main trunk.

■ Chronic total occlusion

Chronic total occlusions can be found in a third of patients referred for diagnostic invasive CA [13]. They are angiographically defined as an obstruction of a native coronary artery with no luminal continuity and interruption of anterograde flow, with thrombolysis in myocardial infarction grade 0 or 1 and occlusion periods exceeding 3 months.

Chronic total occlusions are a common reason for referral to bypass surgery owing to the relatively high failure rates when attempting a PCI.

Unlike conventional CA, cardiac MSCT provides an accurate assessment of the length and composition of the occluded segment, which are important predictors of procedural success. Preprocedural MSCT guidance therefore has the potential to identify which patients are most likely to benefit from attempted PCI.

Multislice computed tomography can be utilized to directly guide the procedure in the catheterization laboratory. While segments of the totally occluded vessel may not be visualized by CA, they are always apparent on MSCT, and their visualization will facilitate passage of the guidewire. In particular, attempted opening of flush occlusions may result in fruitless attempts to locate the entrance to the CTO without the guidance provided by MSCT mapping (Figure 1).

Chronic total occlusions appear as a complete lack of contrast opacification of the artery lumen in MSCT images and 3D reconstructions. The distal vessel lumen is often opacified, although less intensely, via filing of the collaterals. In fact, lack of contrast in the distal segment should raise the suspicion of an acute of sub-acute occlusion, which is usually associated with higher success rates of PCI. The occluded segment usually has a different attenuation from the surrounding nonvascular tissue and can be readily identified. Nonetheless, differentiation between total and subtotal occlusions is not reliable with MSCT, in part due to its limited spatial resolution. Longitudinal sections and cross-sectional images of the occluded segment may reveal varying degrees and patterns of calcifications. 3D volume rendering images allow proper visualization of the orientation of the different segments of coronary arteries in space since they can be rotated around any axis. This provides better understanding of the characteristics of the vessel as well as the occluded segment, especially length, tortuosity, angles with side branches, blunt stumps and distal vessel diameter.

Multislice computed tomography is more sensitive in detecting, quantifying and localizing calcification in nonoccluded vessels when compared with CA [14,15]. In occluded vessels, MSCT has been shown to be the best available alternative for characterization of the composition of the plaque (soft, mixed or fibrocalcified) in the missing segment.

Calcifications determined by CA are associated with a lower success rate of CTO PCI. This observation and the increasing utility and availability of MSCT have inspired operators to investigate whether MSCT better than CA at characterizing CTOs and predicting success of PCI. Mollet *et al.* were the first to point out the value of preprocedural MSCT [15]. Soon *et al.* explored the association between the degree of MSCT calcification length and the degree of CTO PCI success in 43 CTO lesions with 16-slice MSCT [16]. The degree of transluminal calcification was defined as the area of luminal calcification in relation to the total vessel cross-sectional area at the point in the occlusion showing the greatest extent of calcification. A more than 50% transluminal calcification was the only predictor of unsuccesful PCI. Thus, CTOs with >50% transluminal calcification were ten times less likely to be treated successfully. MSCT
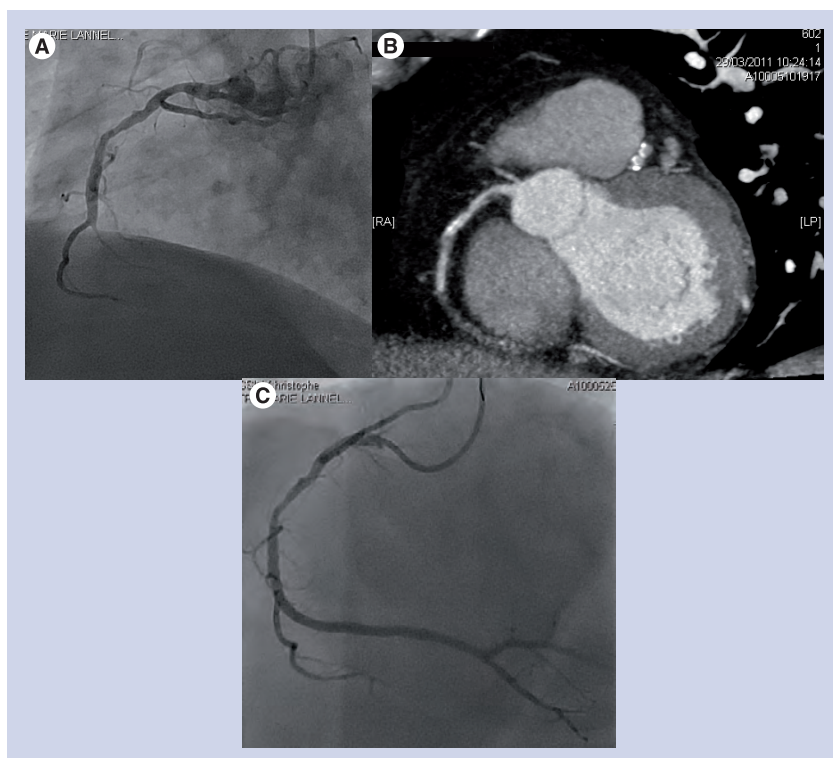

Figure 1. Right coronary artery chronic total occlusion percutaneous coronary intervention guided by 64-slice dual source multislice computed tomography angiography. (A) Coronary angiography of a right coronary total chronic occlusion. **(B)** Multislice computed tomography angiography of the same lesion. Total length occlusion is assessable. Noncalcified plaque and no angulation are predictors of percutaneous coronary intervention success. Distal segment was visualized on the same image in contrast to coronary angiography.
(C) Coronary angiography after percutaneous coronary intervention and three drug-eluting stent implantation.

calcification length in the occluded segment did not show association with PCI success, whereas CTO lesion length showed a weak association. This study confirmed that MSCT angiography is better at quantifying calcification in CTOs than conventional CA and added that the distribution of calcium within the lumen had a great impact on PCI success. By studying 84 CTOs *de novo* with 64-slice MSCT, Hsu *et al.* demonstrated that heavy calcification was a strong independent parameter that not only influenced technical success but also procedural success and that a calcification length ratio of >0.5 remains to be the independent negative predictor of both technical and procedural success [17].

To better evaluate the best predictive characteristics of CTO calcification in PCI success, Cho *et al.* compared calcium volume, calcium concentration, calcium equivalent mass and calcium score, and occlusion length from images acquired with 64-slice MSCT in a group of 64 patients with 72 CTO lesions [18]. All calcium parameters were higher in patients with procedural failure. The percentage cross-sectional calcium area was an independent predictor, confirming results from earlier studies. Additionally, a cutoff value of 53.86% was found to have excellent sensitivity and specificity to predict failure.

The site of calcification along the length of the lesion is also important. In fact, occurrence of calcification at the entry site of the occlusion as opposed to the exit site makes the anterograde approach of recanalization more difficult [14]. This may be a reason for the increasing success rates of wiring the occlusion from the distal cap via collaterals in the retrograde approach [19].

Recently, Ehara *et al.* studied patients with calcification both on the inside and at both extremities of the occluded site with severe transluminal calcification quantified as high density plaques of >500 Hounsfield unit (HU) [20]. A 64-slice MSCT was performed in 110 patients with the same number of CTOs. Severe calcification was again an independent predictor of wiring success. The other MSCT, derived morphological features that determined CTO PCI success in this study were shrinkage and bending of the target vessel.

Shrinkage in the vessel, identified as abrupt narrowing or severe tapering of the distal portion to less than 1 mm in cross-sectional diameter, is probably an age effect of the CTO. This may explain why the guidewire often tracks outside the vessel wall close to the distal cap, producing a perforation.

Bending, that is, an angle of >45° in the trajectory of the vessel, either the occluded site or proximal vessel, was the most prominent predictor of the three morphological features (the other two being severe calcification and shrinkage). Moreover the presence of binding and the trajectory of the missing segment can be also appreciated by MSCT.

These five studies and the MSCT-derived parameters that showed predictive value for PCI success are summarized in TABLE 1.

The 3D nature of MSCT provides more information for vessel anatomy visualization and lesion location, than the invasive 2D

Table 1. Assessment of the predictive value of multislice computed tomography angiography-derived parameters for chronic total occlusion percutaneous coronary intervention.

Study	MSCT	Patients (n)	CTO lesions (n)	Success rate (%)	PCI failure characteristics	PCI failure independent predictors	Ref.
Mollet *et al.*	16-slice	45	47	55	Lesion length Ca>50% Blunt stump	Lesion length Ca>50% Blunt stump	[15]
Soon *et al.*	16-slice	39	43	56	Ca>50%		[16]
Cho *et al.*	64-slice	64	72	76	Lesion length R Ca volume R score R equivalent mass % Ca area/CSA	% Ca/CSA	[18]
Garcia-Garcia *et al.*	16-slice 64-slice	139	142	62.7	Ca at entry Ca>50% % angulation	Ca>50%	[14]
Ehara *et al.*	64-slice	110	110	85	Bending Shrinkage Severe Ca	Bending Shrinkage Severe Ca	[20]

Ca: Calcium; Ca>50%: Percentage of calcium occupies more than the half of cross-sectional area at the point of maximal calcification in the occluded segment; CSA: Cross sectional area; CTO: Chronic total occlusion; MSCT: Multislice computed tomography angiography; PCI: Percutaneous coronary intervention; R: Regional.

angiography. Suboptimal projections with fore-shortening, vessel overlap and problems with sizing from conventional CA often do not provide the clear picture required to plan an interventional or surgical procedure on the coronary tree. CTOs occurring in the left main or other ostial locations or in patients with anomalous coronary arteries are better visualized by MSCT and are often better treated by bypass grafting.

Therefore, for planned PCI, preprocedure MSCT of CTOs provides a roadmap. Devices can be selected according to the nature of the occluding plaque, that is, either soft (lipidic) or hard (fibrocalcic). Moreover, the use of such images during the procedure can provide a visual landmark that can be used to steer the guidewire in the proper direction. The utilization of intra procedural MSCT data is a subject of much interest and is currently being explored.

■ Intraprocedural use of MSCT data

Coronary angiography images can be coupled in the offline MSCT workstation, allowing superimposition of MSCT data. This superimposition allows the operator to visualize the trajectory and the borders of the missing segment, and to localize soft and calcified spots identified from the MSCT images in the invasive counterpart. A specific application for this is in the use in ostial occlusions, which are most challenging on lumenography, and where MSCT overlay might be helpful. Initial software is limited to still frames, and a substantial amount of operator interaction is necessary. However, it has the potential to reduce the fluoroscopy time and contrast that would otherwise be necessary to regularly check the position of the guidewire in relation to the distal vessel. In addition, in the long term this could eventually result in lower procedure time.

Multislice computed tomography reveals the anatomy of CTOs and offers predictive value for the success rate of this high-risk PCI. Its incremental value over CA in this respect allows better risk evaluation that should lead to an informed choice of the best treatment option for the patient.

Ostial lesions

Ostial lesion management is challenging regarding either diagnosis and intervention. Because of their position, the diagnostic angiography catheter crosses the lesion, limiting a precise evaluation of the severity and the exact location of the atheroma, originating or not from the aorta. The complexity of the analysis of such lesions lies in the fact that CA contributes less information in some cases.

Differentiation between aorto-ostial and ostial lesion appears to be warranted to make a proper decision regarding angioplasty [21].

Unlike IVUS, MSCT has shown the ability to detect and classify calcified and noncalcified coronary plaques [7,22,23].

Pesenti-Rossi *et al.* analyzed 40 aorto-ostial lesions in 38 patients who underwent both MSCT and CA. Two independent observers analyzed MSCT and CA images independently in comparison to an expert consensus analysis [24]. Using MSCT in addition to CA permitted observers to obtain a strong agreement for assessment of calcified lesions (κ value 0.75), and a good agreement for aortic plaque location and ideal stent position in aorto-ostial coronary stenosis. In fact, MSCT associated with CA allows for a better assessment of aorto-ostial plaque morphology and was able to identify different types of coronary aorto-ostial stenosis depending on plaque location (aortic or exclusively coronary) and the degree of calcification with a better reproducibility than CA [25,26]. Moreover, the best stent position could be determined with a better reproducibility than CA alone (κ value >0.75) **(Figure 2)**.

Percutaneous coronary intervention of aorto-ostial lesions is associated with lower success and higher complication rates especially in-stent restenosis, which could be due to stent misplacement. Mavromatis *et al.* reported that distal stent misplacement in ostial angioplasty may have contributed to increased rates of restenosis [21]. Pesenti-Rossi *et al.* demonstrated that the use of MSCT by observers provides better visualization of both the angle formed by the
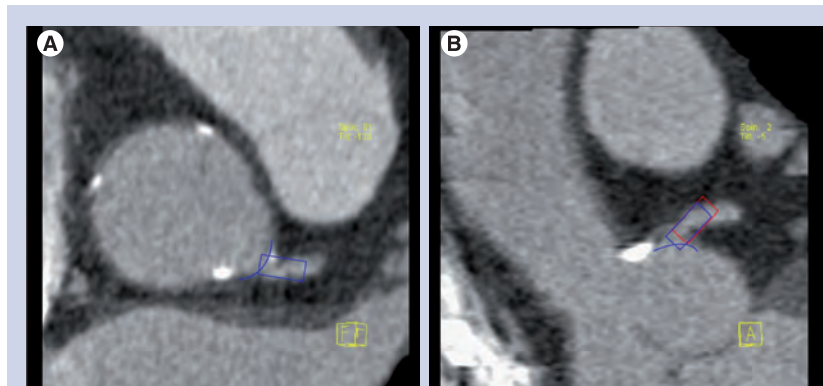

Figure 2. Example of ostial stent positioning using multislice computed tomography angiography. Sagittal **(A)** and long axis view **(B)** of an ostial left main stenosis. Multislice computed tomography provides an accurate 3D analysis. A calcified element is present in the aortic wall but is not involved in the obstruction. Location of the obstructed atheroma is within the coronary artery. However, because of angulation, and to have a sufficient coverage of the stenosis, the stent needs to protrude partially into the aorta (blue modelization).

junction between the ostial coronary artery and the aortic wall, as well as aortic plaque position, which can decrease the difficulty of stent placement and the possibility of restenosis (Figure 2) [24]. With this information, it is suggested that a reduction of incorrect stent placement using MSCT may improve long-term results.

The use of MSCT with CA has enabled the classification of 'massive' or 'moderate' calcified lesions. This was useful for selecting patients to undergo rotational atherectomy.

Ostial lesions are therefore a real challenge, especially in terms of PCI, and that is where MSCT has a privileged place in the management of such complex lesions, by refining lesion analysis. However, the use of MSCT can only be strengthened with further studies on a larger scale.

Bifurcation lesions

A bifurcation lesion is known to be technically challenging and is also associated with a high restenosis rate, particularly in true bifurcation lesions (since the beginning of the bare-metal stent era) [27,28].

Figure 3. Left circumflex suspected in-stent restenosis in 64-slice dual source multislice computed tomography angiography. Multislice computed tomography image of a 3.5 colbalt-chromium alloy stent **(A)** in the left circumflex. Stent lumen is filled by black tissue, suspecting in-stent restenosis. **(B)** Coronary angiography confirms in-stent restenosis. **(C)** Coronary angiography after a new drug-eluting stent implantation.

Bifurcation lesions are well known as a challenging situation for stent deployment owing to their lower procedural success and higher chronic restenosis rate [27,28]. As a result, drug-eluting stents have recently become aggressively used for the treatment of bifurcation lesions owing to their reduced chronic restenosis and target lesion revascularization rate. Various bifurcation stent techniques have been reported. Among these techniques, the crush stent technique described by Colombo et al. has attracted a great deal of attention because it can cover the side-branch ostium with no gap, thereby reducing the side-branch restenosis in comparison to traditional two-stent techniques [29–31]. Recent studies, however, have disclosed limitations regarding the relationship between the degrees of bifurcation angle and stent distortion, incomplete stent apposition and stent expansion in the crush stent technique [32–34]. These findings highlighted the fact that the understanding of the bifurcation geometry and bifurcation angle plays a very important role in selecting the optimal strategies for bifurcation stenting.

Recent MSCT technology provides 3D data sets of the coronary arteries, and information regarding the bifurcation geometry and bifurcation angle can be measured correctly with reproducibility using a 3D image, even if it is measured in arbitrary directions. Kawasaki et al. demonstrated the natural bifurcation geometry in humans while also evaluating the validity of the crush stent technique in the treatment of bifurcation lesions using MSCT [35]. They demonstrated that 3D reconstruction using MSCT has a lower inter-observer variability than CA, thus permitting more accurate measurements of the coronary bifurcation angles, the geometry and bifurcations lesions.

Bifurcation study using MSCT can clarify the 3D structure of natural coronary bifurcation geometries in humans and highlights the limitations of the traditional 2D model analysis. Moreover, information concerning the specific bifurcation geometry may provide useful strategic information for the performance of bifurcation stenting.

Stent follow-up after PCI

The role MSCT remains questionable when monitoring stents after implantation.

Most patients who have undergone PCI will need diagnostic CA again at some point in time. Recurrent symptoms may be caused by in-stent restenosis or disease progression (Figure 3).

Employing consecutive MSCT technology, numerous studies have been published that investigated the diagnostic performance of
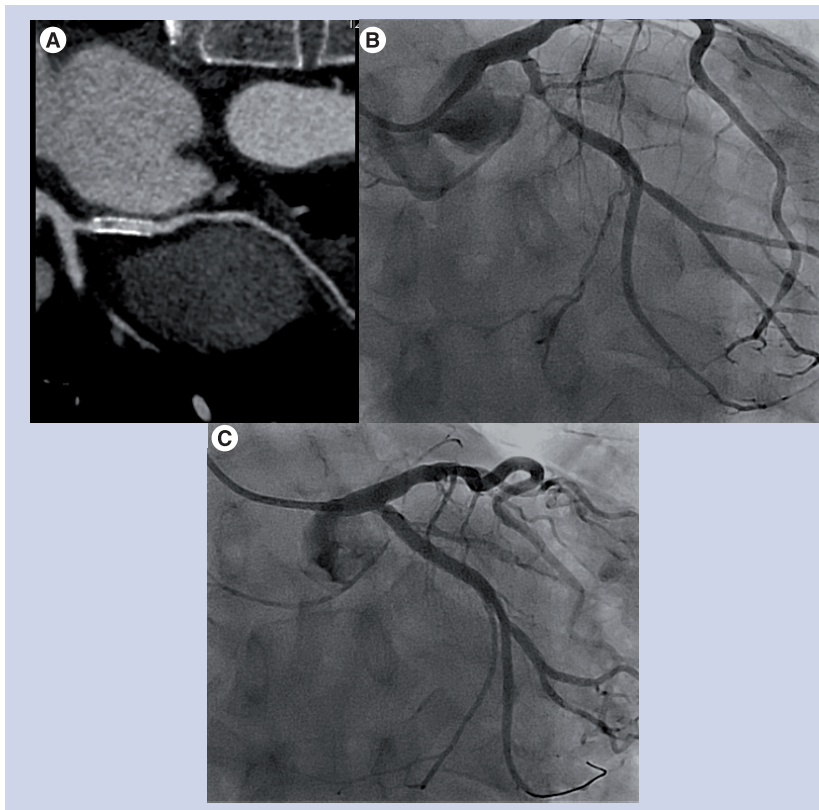
MSCT after previous coronary stenting [36–52]. Insufficient image quality required exclusion of up to 46% of the imaged stents. Sensitivity for the detection of restenosis varied between 67 and 100%, with specificity between 74 and 100%.

The heterogeneous results of these studies can at least in part be explained by differences in stents type and size, the relatively small populations studied and the variable prevalence of disease. Different authors reported better image interpretability and diagnostic performance in stents with larger diameters and thinner struts [36,37,40,44–46,48,51]. Stents smaller than 3 mm in diameter are difficult to evaluate. Stents made of tantalum and those containing gold are less interpretable compared with stents made of stainless steel and cobalt alloys [40].

Including a number of recent 64-slice and dual source MSCT studies, the results summarized in TABLE 2, suggest that the sensitivity of 64-slice MSCT has improved >90%. While the prevalence of in-stent restenosis varies between 6 and 49%, the proportion of complete occlusion is often high (24–59%). Stent occlusion is more easily recognized than in-stent restenosis.

Because of blooming artefact, a minimal amount of neointimal hyperplasia has to be present for a good visualization by MSCT. This minimal amount was found to be 1 mm in a study comparing MSCT with IVUS [43].

Although the diagnostic performance of current MSCT technology is improving, results are still considered insufficient for positive recommendations of unrestricted use of MSCT in patients with coronary stents [53].

In stent follow-up, stent fracture (another complication), which is hardly recognized by CA, can be easily recognized by MSCT especially through image reconstruction, however, less than severe stent malapposition is beyond the reach of current MSCT technology [54,55].

Conclusion & future perspective

Multislice computed tomography has become a valuable tool for complex lesion PCI by providing interesting anatomical 3D information. Better analysis of the occluded segment, ostial or bifurcation lesion with MSCT probably increases the success rate of PCI by providing data that is unobtainable by CA. However, randomized studies are necessary to validate the use of MSCT for PCI.

Multislice computed tomography images that are fully integrated into the catheterization laboratory monitored and used as references for PCI will probably be one of the next steps in the field.

Table 2. Contribution of multislice computed tomography angiography to detect in-stent restenosis.										
Study (year)	Multislice computed tomography	Population (n)	Stents	Prev. (%)	Exclusion rate (%)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	NPV (%)	Ref.
Schuijf et al. (2004)	16	22	65	14	23	78	100	100	95	[36]
Gilard et al. (2005)	16	143	232	6	47	77	100	62	98	[37]
Gaspar et al. (2005)	40	65	111	24		74	83	59	91	[38]
Cademartiri et al. (2005)	16	51	76	8	1	83	99	83	97	[39]
Kitagawa et al. (2006)	16	42	61	12	31	100	100	100	100	[40]
Chabbert et al. (2007)	16	114	NR	23	13	92	67	43	97	[41]
Rist et al. (2006)	64	25	46	18	2	75	92	67	94	[42]
Van Mieghem et al. (2006)	64	64	162	6	21	100	91	67	100	[43]
Cademartiri et al. (2007)	64	182	192	11	7	95	93	63	99	[44]
Rixe et al. (2006)	64	102	12	42	42	89	98	86	98	[45]
Oncel et al. (2008)	64	30	39	49		89	95	94	90	[46]
Das et al. (2007)	64	53	110	28	9	97	88	78	99	[47]
Pugliese et al. (2008)	64 (DSCT)	100	178	39	5	94	92	77	98	[48]
Ehara et al. (2007)	64	81	125	20	12	91	93	77	98	[49]
Carrabba et al. (2007)	64	41	87	15		84	97	92	97	[50]
Hecht et al. (2008)	64	67	132	13		94	74	39	99	[51]
Manghat et al. (2008)	64	40	130	20	10	85	86	61	96	[52]

DSCT: Dual source computed tomography; NR: Nonrelated; NPV: Negative predictive value to detect in-stent restenosis (>50% lumen reduction); Prev.: Prevalence of in-stent restenosis.

Executive summary

Diagnosis & coronary lesion identification

- The excellent specificity and good sensitivity of multislice computed tomography angiography (MSCT) suggests that it is the preferred first test, especially when ruling out coronary disease.
- MSCT, by imaging the vessel wall as well as the lumen from a 360° perspective, offers distinct advantages compared with conventional coronary angiography (CA).

Chronic total occlusion percutaneous coronary intervention

- MSCT provides an accurate assessment of the length and composition of the occluded segment, which are important predictors of procedural success.
- Chronic total occlusion calcification is the most determinant independent factor for the success of percutaneous coronary intervention (PCI).
- MSCT is more sensitive in detecting, quantifying and localizing calcification in occluded vessels when compared with CA.
- The use of MSCT images during PCI can provide a visual landmark that can be used to steer the guidewire in the proper direction.

Aorto-ostial lesion PCI

- Differentiation between aorto-ostial and ostial lesion appears to be warranted to make a proper decision regarding PCI.
- The use of MSCT provides better visualization of both the angle formed by the junction between the ostial coronary artery and the aortic wall, as well as aortic plaque position, which can decrease the difficulty of stent placement and the possibility of restenosis.

Bifurcation lesions

- Bifurcation study using MSCT clarifies the 3D structure of coronary bifurcation geometries and suggests the limitations of the traditional 2D model analysis.
- Information concerning specific bifurcation geometry may provide useful strategic information for the performance of bifurcation stenting.

Stent follow-up

- In-stent restenosis is better detected by CA compared with MSCT.
- MSCT 3D reconstructions recognize stent fractures better than CA.

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