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ORIGINAL ARTICLE

Coronary Artery Stent Stenosis Assessment in Coronary CT Angiography

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Abstract

Background: **Coronary artery stenting is the most important minimally invasive treatment for symptomatic coronary artery disease. But because in-stent restenosis occurs at a somewhat high rate, invasive angiography is now commonly utilised to assess stent patency.**

Objective: **The objective of the study is to examine how multi-detector CT scans can assist physicians in making decisions regarding the placement of coronary artery stents in patients who have chronic chest pain or who have myocardial ischemia.**

Method: **A total of 40 individuals had multislice CT angiography of the coronary arteries between February 2022 and August 2022 as part of this study. Such patients will be referred to the diagnostic radiology and medical imaging department of Al-Azhar University Educational Hospital from the cardiology department and private clinics.**

Results: **Only 4 (10%) of the 40 stents used in this study were deemed unintelligible after analysing MSCT images because of thin or thick struts that impede luminal evaluation. One of those non-interpretable stents had a diameter of 3.0 mm, while the other three had 2.5 mm diameters. Six stents were stenotic, four were non-interpretable, and thirty stents were patent.**

Conclusion: **For the purpose of assessing suspected coronary stents, particularly those with large diameters, multi-detector CT is thought to be a practical and trustworthy non-invasive imaging method.**

Keywords: Assessment, Coronary artery stent, Coronary CT angiography, Stenosis

1. Introduction

The most crucial minimally invasive treatment for symptomatic coronary artery disease is coronary artery stenting. However, due to a high risk of in-stent restenosis, invasive angiography is being used more frequently to evaluate stent patency.[1]

Some categories of lesions, such as lengthy stenosis, bifurcation lesions, or lesions in tiny coronary arteries, may have a greater clinical incidence of restenosis after the implantation of a coronary stent. For bare metal stents, the clinical incidence of restenosis varies from 20 to 35% to 5–10%.[2] Neointimal hyperplasia may still show and result in partial or total stent obstruction, despite the fact that the use of recently developed drug-eluting stents has considerably reduced restenosis and in-stent thrombosis.[3]

Coronary angiography, a highly successful diagnostic method, is the clinical gold standard for identifying this type of in-stent restenosis. Even so, coronary angiography is unquestionably a dangerous, intrusive operation that carries a risk of both morbidity and mortality.[4] For follow-up, a non-invasive, less expensive method to identify in-stent

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restenosis would be highly beneficial.[5] Magnetic resonance imaging is a flexible tool for imaging the heart, but due to susceptibility artefacts caused by the stent itself, it is difficult to see coronary artery stents.[6] The study's objective was to investigate how coronary artery stents are assessed with multi-detector CT scans in those with persistent chest discomfort or whose test results indicate myocardial ischemia.

2. Patients and methods

Analytical cross-sectional research was used in this study. A total of 40 individuals had multislice CT angiography of the coronary arteries between February 2022 and August 2022 as part of this study. Those patients will be directed to the Al-Azhar University Educational Hospital's diagnostic radiology and medical imaging department from the cardiology department and private clinics.

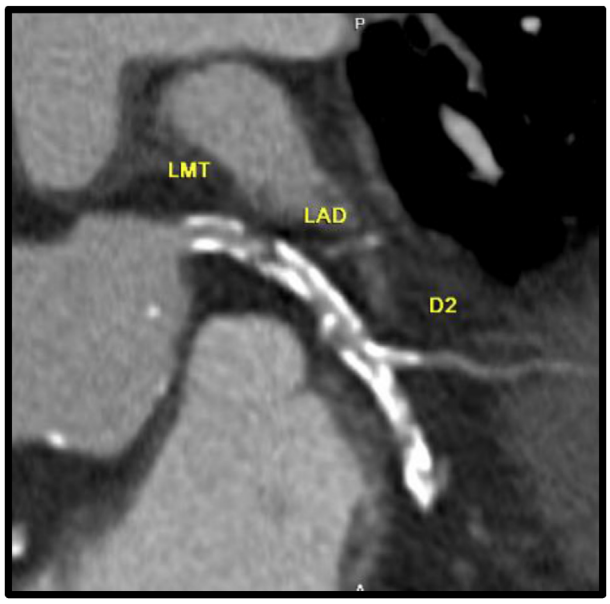
Inclusion criteria: After prior coronary artery stenting, the patient is experiencing recurrent chest pain. During routine follow-up, an asymptomatic patient who has previously undergone coronary stenting exhibits favourable outcomes for myocardial ischemia.

Exclusion criteria: Patients who cannot bear the required breath holding time for the examination or who are clinically too unstable to undergo the full CT scan (10 s), Patients having a history of severe IV contrast material allergies, compromised renal function, or BMI greater than 40.

2.1. Methodology

Every patient was subjected to the following:

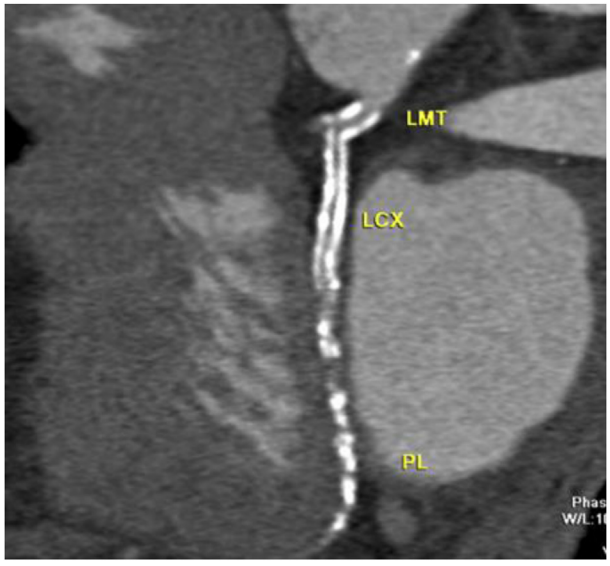
Radiological assessment, clinical examination, and proper history taking preparing the patient for a multislice CT angiography of the coronary arteries: a procedure explanation and assurances to allay fears. Heart rate control: ideal H.R. is less than 65 bpm. Injection of contrast material: A 50 cc saline flush was performed after injecting non-ionic contrast material (Ultravist 370 mgI/ml) through a peripherally placed IV cannula using a dual head powered automatic injector. CT scan procedure: A 126-row multi-detector CT scanner was used to scan each patient (Aquilion). One, Toshiba Medical Systems, Otawara, Japan) installed at the educational hospital of al-Azhar University.



63-year old male patient exhibits chest pain with past history of PCI setting and LAD stent application. By CT coronary angiography:

2.2. LAD

Long artery that reaches the apex. The LAD supplies three diagonal branches and many septal perforators. The proximal segment of the LAD shows an eccentric, partly calcified lesion causing severe stenosis. The **mid segment of the LAD** shows a stent with intra-luminal hypo-densities suggestive of in-stent restenosis.

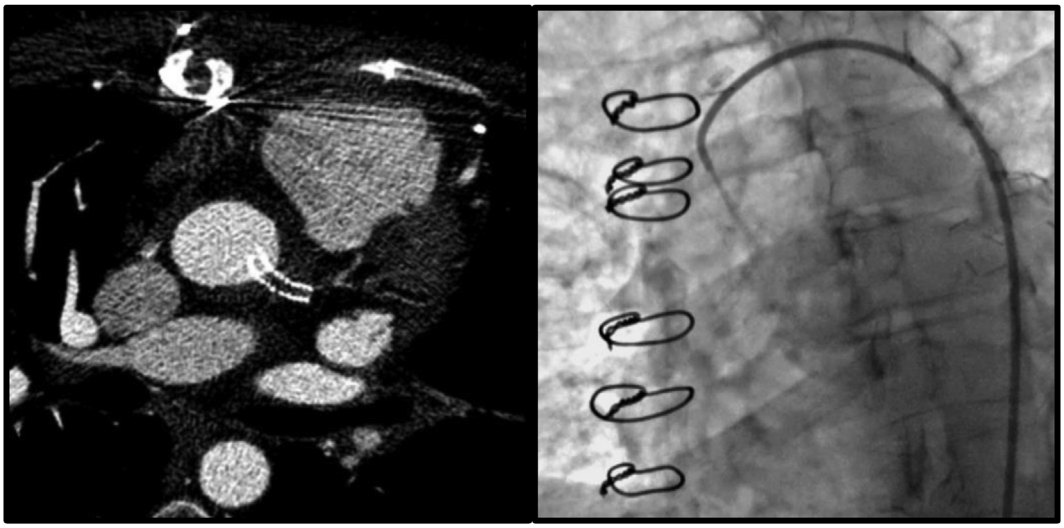


66-year-old male patient exhibits chest pain with past history of PCI setting and LCX stent application.

By CT coronary angiography

2.3. LCX

Non-dominant artery that supplies two OM branches and ends as a PL artery. The proximal segment of the LCX shows a stent with intraluminal hypo-densities suggestive of instant restenosis. The mid and distal segments of the LCX and its first and second OM branches are diffusely diseased.



67-year-old male patient exhibits chest pain with past history of CABG operation, he underwent CT coronary angiography for evaluation of patency of coronary bypasses grafts and native arteries.

LM: is atherosclerotic vessel bifurcates into LAD and LCX branches. LM shows previously deployed stent protruding into the aorta, the stent shows total occlusion along LM length, flashing into ostial LAD and LCX Ostia.

The previous finding was confirmed later by the coronary angiography.

3. Results

This study was a Cross-sectional analytic study done at the radiology department Al-Azhar hospital during the period from February 2022 till august 2022, including 40 patients who underwent CT coronary angiography for assessment of coronary artery stent.

The statistical package for the social sciences (SPSS) version 28 was used to code and enter the data (IBM Corp., Armonk, NY, USA). Quantitative data were summarised using the mean, standard deviation, minimum and maximum, while categorical data were summarised using frequency (count) and relative frequency (%) Table 1 (see Table 2).

3.1. Description of all patients

This study was conducted on 40 patients, 30 patients (75%) have positive symptoms (chest pain) and the remaining 10 patients (25%) were asymptomatic, 22 patients (55%) have elevated cardiac enzymes and 67-year-old male patient exhibits chest pain with past history of CABG operation, he underwent CT coronary angiography for evaluation of patency of coronary bypasses grafts and native arteries. LM: is atherosclerotic vessel bifurcates into

Table 1. Demographic data.

	Mean	Standard Deviation	Minimum	Maximum
Age	59.53	5.84	48.00	69.00
BMI	35.62	2.90	31.00	39.00

Table 2. Patients (gender, symptoms and labs).

	Count (%)
Sex	
Male	24 (60.0%)
Female	16 (40.0%)
symptoms	
Positive	30 (75.0%)
Negative	10 (25.0%)
labs	
Positive	22 (55.0%)
Negative	18 (45.0%)

LAD and LCX branches. LM shows previously deployed stent protruding into the aorta, the stent shows total occlusion along LM length, flashing into ostial LAD and LCX Ostia. The previous finding was confirmed later by the coronary angiography.

40 patients included in this study, 30 patients (75%) have positive symptoms (chest pain) and the remaining 10 patients (25%) were asymptomatic, 22 patients (55%) have elevated cardiac enzymes and the remaining 18 (45%) their labs were normal Tables 3 and 4.

Only 4 (10%) of the 40 stents used in this study were deemed unintelligible after analysing MSCT images because of thin or thick struts that impede luminal evaluation. One of those non-interpretable stents had a diameter of 3.0 mm, while the other three had 2.5 mm diameters. Six stents were stenotic, four were non-interpretable, and thirty stents were patent Table 5.

Table 4. Stent assessment.

	Count	%
Visualization		
Seen	36	90.0%
Not seen	4	10.0%
diameter		
2.5 mm	6	15.0%
3 mm	11	27.5%
3.5 mm	11	27.5%
4 mm	2	5.0%
4.5 mm	6	15.0%
5 mm	4	10.0%
Patency		
Patent	30	75.0%
Not patent	6	15.0%
Non-interpretable	4	10.0%
Degree of stenosis		
Mild	1	2.5%
Moderate	2	5.0%
Severe	3	7.5%
Non-interpretable	4	10.0%
Patent	30	75.0%

4. Discussion

Conventional coronary angiography has been deemed the gold standard for assessing coronary artery stents and coronary artery bypass grafts. The main downsides of this treatment, however, are its invasiveness, the discomfort it causes patients, the high radiation dose, and the possibility of consequences. For the examination of patients with in-stent restenosis or occlusion as well as those with suspected coronary artery bypass graft stenosis or occlusion, a less intrusive imaging modality is preferred.[7]

Table 3. Distribution of stents within the arterial segments.

	Count	%
Site		
LCx	4	10.0%
LAD	15	37.5%
OM2	2	5.0%
RCA	13	32.5%
Left main	2	5.0%
D2	2	5.0%
OM1	2	5.0%
site		
Left main	2	5.0%
Proximal RCA	5	12.5%
Mid RCA	4	10.0%
Distal RCA	4	10.0%
Proximal LAD	5	12.5%
Mid LAD	9	22.5%
Distal LAD	1	2.5%
Proximal LCX	2	5.0%
Mid LCx	2	5.0%
Proximal D2	2	5.0%
Proximal OM1	2	5.0%
Distal OM2	2	5.0%

Patients with BMIs above 40 kg should not be scanned.[8] The mean BMI range for the scanned individuals in this study was 31–39, with a mean of 35.62. Since the BMI of the patients who were chosen was still acceptable for performing coronary CTA, Due to picture noise, no scan that had been completed could be read.

The effective dose was significantly higher in patients with higher heart rates due to the need to collect data over multiple cardiac cycles to increase temporal resolution, emphasising the significance of -blockade, according to a pilot study by Dewey et al. on 30 patients who underwent coronary angiography and coronary CTA. g Metoprolol or ivabradine, two oral medicines, were used in this trial to regulate heart rate. We were able to scan the patients utilizing prospective gating when heart rate control was at its best, only exposing 70–80% of the ©R–R© interval for those with coronary stents (65 bpm). Only four (16.7%) of the instances had heart rates that were still higher than 70 beats per minute throughout the scan and did not improve with oral treatment.

As a result, for patients with coronary stents, we had to use two beats of volume scanning and widen the scanning window to include 30–80% of the ©R–R© interval. The acquired picture quality was poor, and it was difficult to distinguish some of the native coronary arteries. Additionally, fast heartbeats can lead to problems with coronary stent lumen assessment due to cardiac motion artefact and make it difficult to interpret bypass graft components close to the heart.[9]

As indicated by Carbone et al.,[10] a 64-locator column CT had responsiveness, explicitness, positive

Table 5. According to stent patency and diameter, the results of luminal assessment with MSCT.

	Diameter											
	2.5 mm		3 mm		3.5 mm		4 mm		4.5 mm		5 mm	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Patency												
Patent	3	50.0%	8	72.7%	8	72.7%	2	100.0%	6	100.0%	3	75.0%
Not patent	0	0.0%	2	18.2%	3	27.3%	0	0.0%	0	0.0%	1	25.0%
Non-interpretable	3	50.0%	1	9.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

prescient worth, and negative prescient worth of, separately, 75%, 86%, 71%, and 89% when used to assess the coronary corridor stent patency on 55 successive patients (age range, 45–80 years). Nonetheless, 10 of the 23 fragments estimating 2.75 mm in distance across and nine of the 12 stented portions estimating 2.5 mm in breadth that were viewed as because of blossoming relic were barred from the review. Nine of the coronary stents in an alternate examination by Oncel D et al.[11] on thirty patients with 39 coronary stents were viewed as totally obstructed during ordinary angiography. Utilizing CT angiography, the discouraged stents were all effectively found. CT angiography had the option to effectively show 19 out of 20 patent stents. In-stent restenosis impacted ten stents, and eight of them had exact CT analysis. Responsiveness, explicitness, positive prescient worth, and negative prescient worth all had matching upsides of 89%, 95%, 94%, and 90%. The typical stent width was 3.1 0.4 mm, in spite of the way that stents with a breadth of under 2.5 mm were excluded from their examination. Here are the results (The responsiveness 89 and particularity 94).

In a concentrate by Mahmoud A. Dawoud et al.,[12] 63 patients were involved, and 6 (9.52%) of the not entirely settled to be uninterpretable after MSCT pictures were examined because of slim or thick swaggers that hinder luminal assessment. Nine (14.29%) of the 57 leftover stents, or 90.48% of them, showed huge in-stent restenosis (50%). 48 (76.19%) of these stents detailed as being patent without growing new intimal hyperplasia. In this examination, MSCT was useful in tracking down critical sickness at non-stented coronary courses and in deciding the sort of plaque present—delicate, calcified, or blended plaque—as well as in assessing the stent lumen to preclude in-stent restenosis. With the utilization of MSCT, it was possible for customary coronary angiography to miss significant coincidental extra-cardiovascular irregularities such a climbing aortic aneurysm.

Another charming finding was the site of the myocardial localized necrosis. Moreover, 4 (10%) of the 40 patients who were remembered for our review utilizing a 126-column CT scanner had stents that were judged uninterpretable after MSCT pictures were broke down due to a little width or thick swaggers that make it challenging to evaluate the luminal condition. The leftover 36 (90%) stents were proclaimed interpretable, and 30 (75%) of them were portrayed as patent without extra intimal hyperplasia, though 6 (15%) uncovered in-stent restenosis. Since the local coronary corridors could be completely surveyed in the very concentrates on that contain non-interpretable stent, the mean pulse of the stent bunch was 63 bpm, which is viewed as sluggish enough to deliver movement free pictures. Hence, cardiovascular movement relic was not a contributing variable in this study's difficult stent lumen assessment. Notwithstanding, different creators prompted that pulse be kept under 60 bpm while assessing occurrences with coronary vein stents to further develop picture quality.

4.1. Conclusion

For the purpose of assessing suspected coronary stents, particularly those with large diameters, multi-detector CT is thought to be a practical and trustworthy non-invasive imaging method.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

The authors declared that there were NO conflicts of Interest.

References

1. Thayssen P, Jensen LO, Lassen JF. The risk and prognostic impact of definite stent thrombosis or in-stent restenosis after coronary stent implantation. *EuroIntervention*. 2012;8:591–598.
2. Huang F. Application of 64-slice spiral computed tomography angiography in a follow-up evaluation after coronary stent implantation: a Chinese clinical study. *Int Radiat Res*. 2019;17: 471–476.
3. Jensen JK, Jensen LO, Terkelsen CJ. Incidence of definite stent thrombosis or in-stent restenosis after drug-eluting stent implantation for treatment of coronary in-stent restenosis. *Cathet Cardiovasc Interv*. 2013;81:260–265.
4. Jung JI, Multidector CT. Imaging of coronary artery stents: is this method ready for use©. *Korean Circ J*. 2007;37:521–529.
5. Truong Quynh A. Rationale and design of the dual-energy computed tomography for ischemia de termination compared to gold standard' non-invasive and invasive techniques (DECIDE-Gold): a multicenter international efficacy diagnostic study of rest-stress dual-energy computed tomography angiography with perfusion. *J Nucl Cardiol*. 2015;22: 1031–1040.
6. Murakami S. A standardized evaluation of artefacts from metallic compounds during fast MR imaging. *Dentomaxillofacial Radiol*. 2016;45:20160094.
7. Sun Z, Choo GH, Ng KH. Coronary CT angiography: current status and continuing challenges. *Br J Radiol*. 2012;85:495–510.
8. Abbara S, Arbab-Zadeh A, Callister TQ. SCCT guidelines for performance of coronary computed tomographic angiography: a report of the Society of Cardiovascular Computed Tomography Guidelines Committee. *J Cardiovasc Comput Tomogr*. 2009;3:190–204.
9. Dewey M, Zimmermann E, Deissenrieder F. Noninvasive coronary angiography by 320-row computed tomography with lower radiation exposure and maintained diagnostic accuracy: comparison of results with cardiac catheterization in a head-to-head pilot investigation. *Circulation*. 2009;120: 867–875.
10. Carbone I, Francone M, Algeri E. Non-invasive evaluation of coronary artery stent patency with retrospectively ECG-gated 64-slice CT angiography. *Eur Radiol*. 2008;18:234–243.
11. Oncel D, Oncel G, Karaca M. Coronary stent patency and in-stent restenosis: determination with 64-section multidetector CT coronary angiography-initial experience. *Radiology*. 2007; 242:403–409.
12. Dawoud Mahmoud A. Evaluation of coronary stents using multidetector CT. *Egypt J Radiol Nucl Med*. 2016;47:793–801.