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Coronary Computed Tomography angiography (CTA) and Coronary Angiography (CAG) in the investigation of Coronary Artery Disease (CAD): A Retrospective study

Dr Kamal Aggarwal[1], Dr S.S. Bansal[2], Dr Siddhant Bansal[3]

[1]MD- Radio-diagnosis, Director Radiology, SSB heart and multispecialty hospital, Faridabad, Haryana
[2]MD, DM- Cardiology, Chairman Cardiology, SSB heart and multispecialty hospital, Faridabad, Haryana
[3]MD, DM – Cardiology, Sr. Consultant Cardiology, SSB heart and multispecialty hospital, Faridabad, Haryana

Abstract

Coronary angiography (CAG) is the conventional procedure, considered the gold standard for the examination of coronary arteries. Being a standardised procedure, CAG is comparatively safer but an invasive procedure. Therefore, it carries some amount of risk compared to Coronary computed tomography angiography (CTA). CTA is comparatively a new technique but is non-invasive and is reported to be as or moreaccurate and efficient as functional stress test in diagnosis of CAD and comparable to CAG. In this retrospective study, we have analysed data of 76 patients who underwent CTA. Further 18 patients from these 76, especially with higher percentage of stenosis underwent CAG. ThusCTA could be used as a screening (non invasive) method for examination of coronary arteries in patients with high risk of coronary artery disease (CAD).

Introduction

It is well-established standard protocol to perform coronary angiography (CAG) prior any heart surgery or intervention to investigate coronary artery stenosis (1-3). Being a standardised procedure, CAG is considered safe. However, there are certain demerits associated with this procedure as the procedure is invasive which would include short hospital stay thus increasing the discomfort of the patient. Moreover, CAG holds some potential threats especially with the CAD patients with comorbidities (4). The other technique that has emerged in last one decade and has been proven outstanding in the investigation of CAD is coronary computed tomography angiography (CTA) (5). CTA is a non-invasive procedure, which unlike functional stress test can also provide the cardiologist with information like perfusion with hyperemia, fractional flow reserve (FFR), high-risk plaque, plaque burden, myocardial scar and fibrosis, wall motion analysis, inflammation, risk scores such as the Leaman score and percent myocardium at risk (6-8). Since CAG is an age old standardised technique, based on the condition of the disease and intervention planned, patients are advised to undergo directly CAG or screened with CTA. For example, the patients having very high risk of CAD or life threatening condition who might need immediate treatment are advised to undergo CAG directly. Moreover, it is difficult to read results of CTA if the

patient has calcified plaques especially in older patients; in these cases, mostly CAG is recommended. Sometimes, after performing CTA, based on the result the patient is required to undergo CAG as it is still the gold standard especially in the patients who might need surgical or non-surgical intervention for treatment.

Methodology

This retrospective study includes the data of the patients, who either had symptoms or were suspected cases of CAD due to various risk factors, hence visited SSB heart and multispecialty hospital, Faridabad, Haryana between January 2021 to December 2022. Total 76 patients underwent CTA, out of which 18 patients further underwent CAG. The clinical data and patient demographics were collected from medical records (MR) of all patients. The decision of proceeding with CAG in selected patients was decided by the treating cardiologist based on the outcome observed after conducting CTA.The data of patients with acute kidney disorder, prior coronary artery bypass graft surgery (CABG), active arrhythmias or prior percutaneous coronary intervention (PCI) were excluded from analysis.

Informed consent was obtained from the patients before conducting CTA. The patients were kept on fast for at least 4 hours prior to the test and were not given caffeine before 12 hours of the test. Kidney function test was done prior to check for serum creatinine values and rule out kidney dysfunction. The preparation started with obtaining an intravenous channel in the right antecubital vein preferably using an 18-gauge catheter for speedy infusion of the contrast. Veins in the hands were avoided as it would require a 20-gauge or even smaller catheter which will slow the flow rate. Similarly, central lines were also avoided. 1-2 hours before the procedure, an oral beta-blocker or oral Ivabradine is administered to the patient depending on their resting heart rate. Metoprolol tartrate 50 mg to 100 mg or Ivabradine 5mg to 10mg was the oral pre-medications used to reduce heart rate during CTA since a heart rate of 60 beats per minute or less is ideal for CTA procedure (9). Then the CTA procedure was performed by injecting the dye and obtaining CT films before, during and after the perfusion of dye. A qualified and experienced radiologist did the CTA analysis and reporting.

The treating cardiologist would decide the further treatment for the patient by seeing the patient's CTA report, analysing risk factors and co-morbidities. Usually those with moderate to severe stenosis in one or more coronary artery on CTAor having multiple high risk factors for CAD would be advised to undergo CAG after an informed consent was obtained. The preparation of patients to undergo CAG was based on the individual and the characteristics of the disease and indications. However all the CAG patients were made well hydrated to reduce the risk of contrast medium-induced nephrotoxicity. CAG was performed via a medium or large sized artery depending on the procedure. Radial approach was used for the procedure in most of the patients. A suitable catheter was inserted through the access site with the help of guide wires. Further contrast medium was added to the catheter tip to outline the vasculature distal.

Result

A total of 76 patients underwent CTA procedure which included 59 males (77.6%) and 17 females (22.4%). Out of 76 patients, 18 underwent CAG procedure and 16 were male (88.9%) and only 2 were female (11.1%) patients.

5 patients were diagnosed with stenosis (4 patients with <30% stenosis and 1 patient with 30-50% stenosis) in left main coronary artery using CTA whereas only 2 patients (1 with <30% and 1 with 30-50% stenosis) were diagnosed with same using CAG.

12 patients were detected with stenosis in left anterior descending artery (LAD) after undergoing CTA procedure. However, a point to be noted is that while only 2 patients were detected with 70-95% stenosis in LAD with CTA, whereas 4 patients were diagnosed with 70-95% stenosis in LAD after undergoing CAG. Similarly, after diagnosis with CTA, there was only 1 patient detected with 70-95% stenosis in LAD2 compared to 2 patients using CAG.

In the next set of analysis using CTA; 5, 2, 2,2 patients were diagnosed with <30%, 30-50%, 50-70% and 70-95% stenosis respectively in mid left circumflex artery (LCXA). Both CTA and CAG showed 2 patients with 50-70% stenosis in mid-LCXA. In contrary, 2 patients were diagnosed with 70-95% stenosis in mid LCXA using CTA, but the patient number increased to 5 with same condition when diagnosed with CAG.

2 patients were identified with 70-95% stenosis in each first obtuse marginal artery (OM1) and second obtuse marginal artery (OM2) using CAG compared to just 1 patient with 70-95% stenosis in each OM1 and OM2 using CTA. 8 and 4 patients were detected with 70-95% stenosis in RCA and PDA respectively using CAG. But these patients were not detected by CTA. There was a single patient diagnosed with 50-70% stenosis in PLV after undergoing CTA procedure but did not have such a finding on CAG. The results are described in Table 1.

Table 1: Diagnosis of stenosis using CTA and CAG.

	<30% stenosis		**(30-50)% stenosis**		**(50-70)% stenosis**		**(70-95)% stenosis**	
	CTA+CAG	**CTA**	**CTA+CAG**	**CTA**	**CTA+CAG**	**CTA**	**CTA+CAG**	**CTA**
Left Main	1 (5.56%)	4 (5.26%)	1 (5.56%)	1 (1.32%)	-	-	-	-
LAD	-	4 (5.26%)	-	2 (2.63%)	-	11 (14.47%)	4 (22.22%)	2 (2.63%)
LAD D1	-	2 (2.63%)	1 (5.56%)	1 (1.32%)	-	-	2 (11.11%)	1 (1.32%)
LAD D2	-	3 (3.95%)	-	-	-	-	-	-
mid LCXA	-	5 (6.58%)	-	2 (2.63%)	2 (11.11%)	2 (2.63%)	5 (27.78%)	2 (2.63%)
OM1	-	-	-	-	-	1 (1.32%)	2 (11.11%)	1 (1.32%)
OM2	-	1	-	1	-	-	2	1

		(1.32%)		(1.32%)			(11.11%)	(1.32%)
RCA	-	10 (13.16%)	-	-	-	-	8 (44.44%)	-
PDA	-	-	-	-	-	-	4 (22.22%)	-
PLV	-	-	-	-	1 (5.56%)	-	-	-

Discussion

In the last decade, coronary computed tomography angiography has played a vital role in investigation of CAD. It is considered to be an excellent technique for accurate detection and exclusion of CAD (10-13). Various recently conducted studies such as the SCOT-HEART trial have reported that CTA have reduced the cases of fatal and non-fatal myocardial infarction in patients suspected with CAD resulting to angina (14, 15). The outcome of a systematic review, which included meta-analysis of more than 20,000 patients, showed that patients who underwent CTA were more likely to undergo CAG and revascularization versus those who only underwent functional stress test. CTA was thus more likely to accurately and efficiently diagnose new CAD and to have initiated aspirin or statin therapy(16).

Our results emphasise the need for screening using CTA in patients with risk factors of CAD who either don't have indication for direct CAG or don't want to directly undergo invasive testing. However, we found that in certain cases, CAG detected more patients with severe stenosis i.e. with 70-95% stenosis compared to CTA. But in other cases, the detection of stenosis by both CTA and CAG were same. Thus, it can be concluded that being an invasive procedure, it is best to conduct CTA initially for investigation of CAD, which can be followed by CAG if needed. Also a large sample size multicentre study is needed to compare results of CTA and CAD.

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