

# ROLE OF COMPUTED TOMOGRAPHY IN VISUALIZATION AND ASSESSMENT OF GRAFTABILITY OF TOTALLY OCCLUDED LEFT ANTERIOR DESCENDING ARTERY BEFORE CORONARY ARTERY BYPASS GRAFTING

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## ABSTRACT:

### INTRODUCTION:

Coronary artery disease (CAD) is one of the main cause of death worldwide. Chronic total occlusions (CTOs) are identified in up to one-third of patients referred for coronary angiography (CA) and its incidence increases with age. In some patients coronary angiography cannot visualize LAD artery after totally occluded segment. Computed tomography coronary angiography (CTCA) could identify the flow distal to total occlusion better than conventional coronary angiography so that LAD graftability can be established before planning coronary artery bypass grafting (CABG).

### AIMS & OBJECTIVE:

To assess the graftability of LAD on CT angio before CABG.

### MATERIAL & METHODS:

This study was conducted in cardiovascular imaging department of P.I.C. Lahore over a period of 1 year, from 06-01-19 to 31-12-19. All patients with ACS regardless of age and gender were included who had occluded LAD on coronary angiography and distal LAD was not visualized. Patients with previous history of Ischemic heart disease, coronary artery bypass grafting, allergies to contrast medium and chronic kidney disease were excluded. Coronary angiography was done in 310 patients with acute coronary syndrome (ACS). These patients underwent CTCA to see LAD and its graftability as conventional coronary angiography could not visualize LAD artery distal to site of total occlusion.

### RESULTS:

Total 310 patients with ACS were enrolled in the study where 257 patients were male (83%) and 53 patients were females (17%). Minimum age was 27 years and maximum age was 75 years, mean age was 51.25 + 5 years out of which in 303 patients (97.7%) LAD was visualized on CTCA and in 185 patients (81%) LAD was graftable, 156 (60.7%) were males and 29 (54.2%) were females. Regarding risk factors 110 (42%) male patients and 39 (73%) female patients had hypertension. 86 (33%) male patients and 24 (45%) female patients had diabetes mellitus. 105 (33.8%) males were smokers. 83 (32%) males and 19 (35%) females had family history of ischemic heart disease. 18 (7%) males and 3 (5%) females had hyperlipidemia. Minimum body mass index was 16.9 and maximum was 66.0 and mean body mass index was 27.48 + 5.2.

With advances in computed tomography technique, computed tomography coronary angiography (CTCA) has become an established diagnostic method for detection of coronary arteries distal to occluded segment to plan for coronary artery bypass grafting (CABG). Hypertension is a major risk factor for coronary artery disease in both genders more so in females, while smoking is a major risk factor in male patients.

**CONCLUSION:**

*CT coronary angio is a valuable diagnostic tool in visualization of totally occluded LAD. It has high diagnostic accuracy. Moreover it is also helpful in establishing the graftability of the vessel before CABG. Hypertension is a major risk factor in this subset of patients particularly in females while smoking is the major risk factor in males.*

**KEY WORDS:**

*Computed tomography, occluded left anterior descending artery visualization, coronary artery bypass grafting*

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**INTRODUCTION:**

Coronary artery disease (CAD) is considered as one of the major causes of death globally. Chronic total occlusion (CTO) is defined when a coronary artery remains occluded at least more than three months, estimated from the clinical events (TIMI 0) flow on conventional angiography.<sup>1</sup> CTO have been found in about one-third of cases referred for conventional coronary angiography. Significant coronary artery disease (defined as more than 70% stenosis) with an incidence increasing with age, CTOs are found in half of those.<sup>2,3</sup> On conventional angiography, distal segment of the vessel after CTO can be visualized through ipsilateral or contralateral collaterals supply. These collaterals can provide adequate supply of blood at rest to retain myocardial viability, but during stress may become inadequate to meet the demands of distal myocardial area. This turns into development of ischemia and anginal symptoms.<sup>4,5,6</sup> Computed tomographic coronary angiography (CTCA) has become as a precise diagnostic technique for the detection of coronary arteries. To bypass the left anterior descending (LAD), use of the left internal memory artery (LIMA) is the "gold standard" of coronary artery revascularization. Evaluation of graftability of the LAD artery is a vital factor before doing CABG. In some patients, LAD distal to the occluded segment cannot be visualized on conventional coronary angiography due to poor collateral flow while it can be seen properly on CTCA. In this way, the patients in which LAD is not visualized on coronary angiography can get benefit by CTCA so that they can undergo CABG if LAD is visualized on CTCA. It is a great help for those patients in fact.<sup>7</sup> Therefore our study was carried out to see the beneficial effects of if CTCA in deciding the

graftability of LAD artery in patients with occluded LAD on coronary angiography.

**MATERIAL AND METHODS:**

This study was conducted in cardiovascular imaging department of PIC, Lahore over a period of 1 year, from 06-01-19 to 31-12-19. All patients with ACS regardless of age and gender were included who had occluded LAD on coronary angiography and distal LAD was not visualized. Patients with previous history of Ischemic heart disease, coronary artery bypass grafting, allergies to contrast medium and chronic kidney disease were excluded. Coronary angiography was done in 310 patients with acute coronary syndrome (ACS). These patients underwent CTCA to see LAD and its graftability as conventional coronary angiography could not visualize LAD artery distal to site of total occlusion.

MDCT Protocol: CTCA was done on 64 slice Multi Detector Computed Tomography (MDCT) VCT GE Healthcare, Milwaukee, WI (USA), and using electrocardiographic-triggered X-ray tube modulation having 64 detectors allow the z-axis. The scan parameters were a tube current of 400-650mA, tube voltage of 120Kv, a gantry rotation of 0.35 seconds per rotation, a matrix size of 0.625 mm.

An intravenous line was taken in antecubital vein and intravenous cannula of 18-gauge was inserted. Patients were given nitrates (Angised) at dose 0.5 mg. After 2 localization scans of the heart was done for coronary calcium detection and scoring. A bolus dose of 60-80ml of nonionic contrast Ultravist (iopromide 370mg/ml) depending upon the BMI and length of the scan was given through the IV cannula. The contrast was given at flow rate of 5-6 ml/sec followed by 50 ml of normal saline. Bolus tracking of contrast was performed with region of

interest placed in ascending aorta.

CTA analysis: Coronary CTA data was analyzed on dedicated GE advantage workstation 4.4. The best phase on R-R interval mostly 70-80 during diastole was analyzed for the assessment of coronary artery. The systolic phase was analyzed in case patients heart rate was more than 90/min. The data was analyzed in axial, sagittal and coronal planes and Multi Planned Reconstruction (MPR), Maximum Intensity Projection (MIP) and Volume Rendering (VR). Images were reconstructed for analysis.

LAD was defined as graftable segment if it was visible in MPR and VR images and measured after occlusion at least > 1.5 mm in oblique plane in min and distal third of LAD. LAD was defined as non-graft able if it was visible in MPR or VR images but measured < 1 mm in oblique plane. <sup>8</sup>

Ethical approval of the study was obtained from institutional review board. Chi Square and Fischer’s exact test were applied to check the significance of

outcome variable with age, gender and risk factors. P-value of > 0.05 was considered significant. Data was analyzed on SPSS-23.

**RESULTS:**

During the study period, 310 patients, overall there was male dominance, males 257(83%) and females 53 (17%) were subjected to CTCA (Table 1). Minimum age was 27 years and maximum age was 75, mean age was 51.25 years (Table 2).

Among 310 patients who underwent CTCA, LAD artery was visualized in 303 patients (97.7%) (Table 3). Among 303 patients (97.7%) in which LAD was visualized, LAD was graftable in 185 patients (61%), 156 (60.76%) males and 29 (54.72%) females. (P-Value 0.44) (Table 4) Regarding risk factors, 110 (42%) male patients and 39 (73%) female patients had hypertension. 86 (32%) male patients and 24 (35%) female patients had diabetes mellitus. 105 (40%) males were smokers. 83 (32%) males and 19 (35%) females had family

Table-1: Demographic variables of patients		
Variable	Statistics	
Gender	Male	257(83%)
	Female	53((17%)
Age (years)	27 - 75	51.25± 8.0 (mean)
BMI	16.90 - 66.00	27.48 ± 5.22 (mean)

Table 2: LAD visualized on CT Coronary angiography	
Variables	Frequency (%)
Visualized	303 (97.7%)
Not Visualized	7 (2.3%)

Table 3: Graftability of occluded LAD on CTCA			
Patients	Graftable	Non Graftable	P value
Male	156(60.70%)	101(39.30%)	0.44
Female	29(54.72%)	24(45.28%)	
Total	185 (59.7%)	125 (40.3%)	

Table 4: Risk Factors of Patients undergoing CT Coronary Angiography				
Variable	Male	Female	p-value	Total
Hypertension	110(42%)	39(73%)	0.00	149
Diabetic Mellitus	86(32%)	24(35%)	0.12	110
Smoking	105(40%)	0(0%)	0.00	105
Family History	83(32%)	19(35%)	0.36	102
Hyperlipidemia	18(7%)	3(5%)	0.50	21

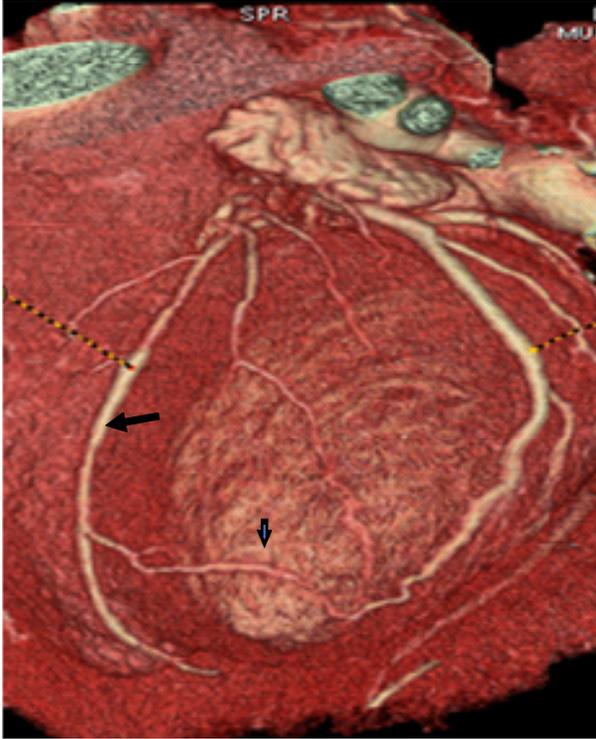


Fig-1. Volume Rendered (VR) image of a patient referred for LAD visualization showing a graftable good sized LAD(Arrow) with a visible collateral from obtuse marginal branch (arrow Head)

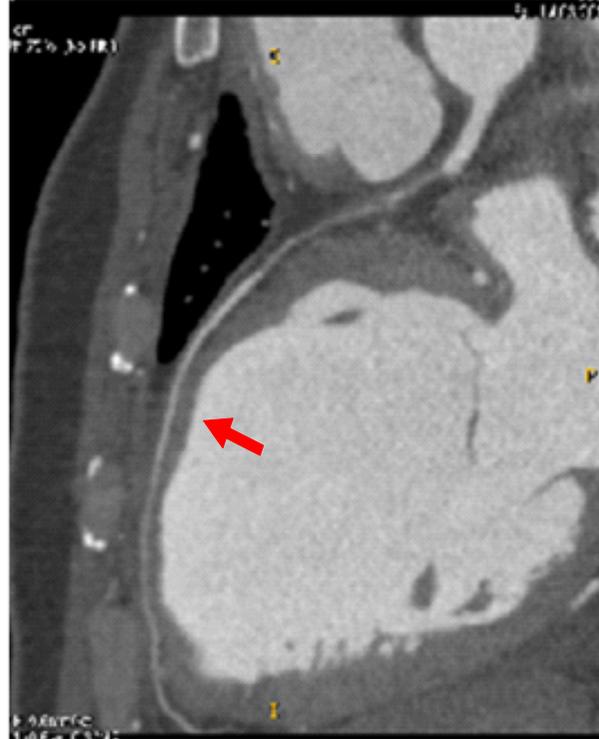


Fig-2. Multiplaner Reformation (MPR) curved image showing graftable LAD after subtotal proximal occlusion(red arrow) in a patient with anterior wall myocardial infarction referred for LAD visualization. The LV is dilated with thinned out anterior wall.

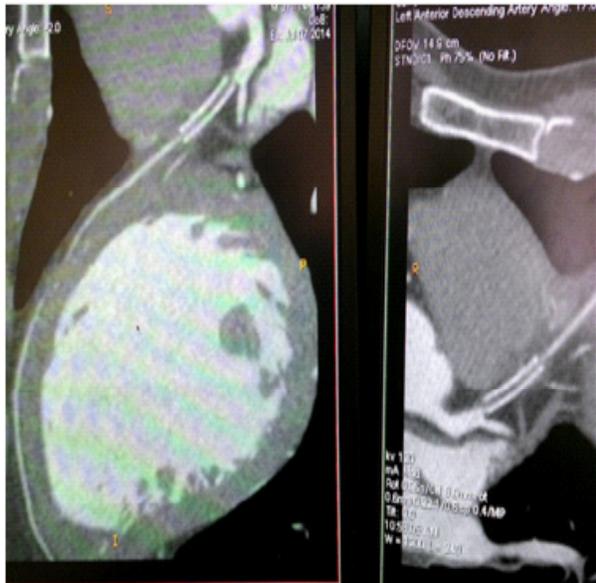


Fig-3. MPR(curved image of a patient with post PCI total proximal occlusion of LAD ,showing graftable LAD in mid and distal segments.

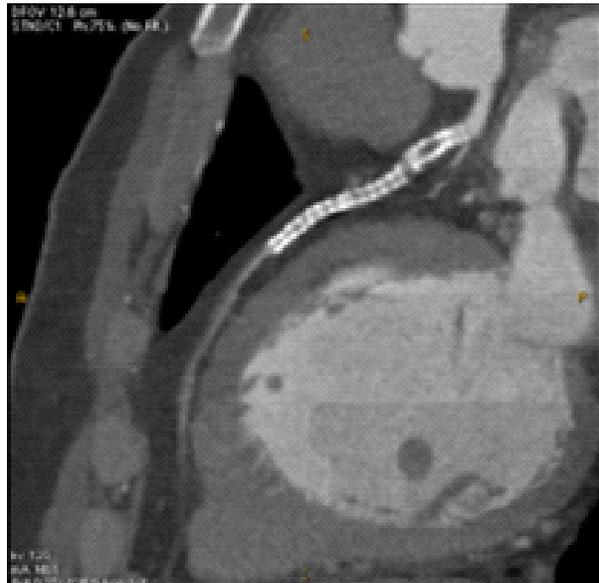


Fig-4. MPR Curved image of LAD in a patient with post PCI total occlusion of stent in proximal LAD due to ISR.



**Fig-5. MPR (curved) image of LAD showing graftable vessel after total occlusion due to mixed plaque (Yellow arrow) in proximal LAD followed by myocardial Bridging (red arrow)**

history of ischemic heart disease. 18 (7%) males and 3 (14%) females had hyperlipidemia (Table 5). Average volume of contrast used was  $75 \pm 7$  ml in every patient. Average heart rate was  $70 \pm 5$  beats/minute.

#### **DISCUSSION:**

CAD is a main reason of morbidity and mortality in both genders and chronic total occlusion (CTO) has an incidence almost 30% of all coronary angiograms.<sup>9,10,11</sup> CTO has been defined as complete interruption of antegrade flow (thrombolysis in myocardial infarction [TIMI-0] flow) of more than three months duration.<sup>5</sup> In most of the total occlusions, distal vessels can be seen through the collateral circulation during injection in conventional coronary angiogram. The distal flow; antegrade or retrograde clarifies whether we are dealing with a real occlusion or a functional sub occlusive lesion. Sometimes, non-intraluminal bridging collaterals may give antegrade flow to the vessel after the occlusion. The examination of the occlusions in different views defines the extra luminal course of these collaterals. In the majority of cases, intraluminal channels are demonstrated pathological, yet they often remain below the resolution of angiography ( $100 \mu\text{m}$ ) and, by definition, have no continuity throughout

the occluded segment.<sup>12</sup>

In those patients in which distal segment of totally occluded LAD is not visible on conventional angiogram. CTCA is a precise method for visualization of distal coronary artery and suitability of LAD graft is a vital step before going for CABG.<sup>7</sup>

In our study, 310 patients who had coronary angiography done and had totally occluded LAD artery and distal segment of LAD was not visualized on coronary angiography, were subjected to computed tomography coronary angiography. In this study, 83% patients were male (257) and 17% patients were female. This signifies the percentage of male patients is high in our study so coronary artery disease is still higher in male population.<sup>13</sup> Minimum age was 27 years and maximum age was 75 years. Mean age was 51.2 years. In our study, out of 310 patients, LAD was visualized in 303 patients (97.7%) and it is a quite high percentage delineating the use of CTCA. Among 303 patients in which LAD was visualized on CTCA, again 185 patients had Graftable LAD (61%) which is a very significant number, who were benefited with coronary artery bypass grafting (CABG). This is comparable to a study (H. Alshehri)<sup>7</sup> in which 11 patients underwent CTCA for visualization of LAD and all patients went under CABG after LAD visualization on CTCA. But in our study, total number of patients were significantly higher and a high percentage had graftable LAD and underwent coronary artery bypass grafting.

Out of 257 male patients, 105 (40%) were smokers. No female patient had history of smoking. In our society smoking is more common among males so this risk factor might put them into added risk of ischemic heart disease.<sup>14</sup> 110 male patients (42%) and 39 female patients (73%) were hypertensive indicating hypertension as major risk factor for ischemic heart disease in both genders and particularly in females, strongest risk factor for ischemic heart disease.<sup>15,16</sup> 86 male patients (33.4%) and 19 female (35%) had diabetes mellitus. It again signifies diabetes as a risk factor affecting both male and female genders for ischemic heart disease.<sup>18</sup> 83 male patients (32%) and 19 females (35%) had family history of ischemic heart disease.<sup>19</sup> Regarding hyperlipidemia, 18 male patients (7%) and 3 female patients (5%) had history of hyperlipidemia.<sup>20</sup> Highest body mass index was 66 and minimum was 16.9. Mean body mass index was  $27.48 \pm 5.22$ .<sup>21</sup> Which is again a risk factor affecting both genders. So this study

has significant role of CTCA in visualizing LAD distal to total occlusion. So that those patients can be beneficial with CABG in which distal LAD is not visualized on conventional coronary angiogram.

**CONCLUSION:**

LAD visualization for graftability is an important factor before going for CABG. In patients with totally occluded LAD, if distal LAD is not visualized

on conventional coronary angiogram then computed tomography coronary angiography (CTCA) can describe the flow distal to the total occlusion as compared to conventional coronary angiography. Hypertension is a major risk factor for coronary heart disease in both genders particularly in female patients, while smoking is a major risk factor in male patients.

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