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*Original Research Article.*

# Coronary Artery Disease in Young Indians: A Different Entity

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## ABSTRACT

**Objective:** To study the angiographic profile, treatment and outcome of Coronary Artery Disease (CAD) in young (< 45 years) individuals in India.

**Methods:** Consecutive 132 young adults with CAD reporting to two tertiary care centres over a period of 1 ½ years were enrolled as a case control observational study. Subjects who presented with acute coronary syndrome (ACS), chronic stable angina (CSA), Heart failure or Asymptomatic Electrocardiogram (ECG) abnormalities but confirmed CAD on Coronary Angiogram (CAG) were included. Angiographic profile, treatment and outcome were analysed with a follow up of one year.

**Results:** Risk factors of abdominal obesity, lipoprotein (a) [Lp(a)] and tobacco consumption were significantly higher in study group. ST elevation Myocardial Infarction (STEMI) was the commonest presentation (71.21%). Single vessel disease (56.06 %) was the commonest angiographic profile with Left Anterior Descending Artery (LAD) involvement (40.91%). Primary Angioplasty in Myocardial Infarction (PAMI) was done in 42.5% of STEMI and Thrombolysis in 48.9%. Three types of coronary involvement were noticed with Type I having discrete lesions/thrombus and Type III having multiple segment/artery involvement with differing risk factor profile and outcome. Diffuse and more severe CAD was associated with tobacco use, abdominal obesity and elevated Lp (a). Late presentation, diffuse disease and persistence of smoking predicted poorer outcome.

**Conclusions:** CAD in Young commonly presents with Acute MI and single vessel LAD involvement. Less than half have access to PAMI. Most require stenting although selected patients do well with intracoronary thrombolysis. Delayed treatment and failure to modify risk factors portend bad prognosis.

**Key words:** Coronary Artery Disease, Young, Risk Factors, Lipoprotein (a), Abdominal Obesity.

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## INTRODUCTION

Coronary artery disease (CAD) has become an epidemic in India.[1] It is the leading cause of death worldwide.[2] Hospital discharges with diagnosis of Coronary Heart Disease (CHD) are decreasing in the west.[3] The burden of cardiovascular disease (CVD) is increasing in India[4] and Indians have higher proportion of mortality due to CAD.[5] Age above 45 years is considered a conventional risk factor for CAD and hence, the disease occurring in patients aged < 45 years is considered CAD in Young.[6] Indians as a community are prone to CAD at a much younger age. About 5-10 % of CAD occurs in individuals < 45 years in India.[7,8] CAD occurs 5-10 years earlier in Indians compared to other populations.[9] Indians are at increased risk of Myocardial Infarction at younger age (<40 years).[10] The risk of CAD in Indians is 3-4 times higher than White-Americans, 6-times higher than Chinese and 20 times

higher than Japanese.[11,4] Traditional risk factors do not completely explain the premature and aggressive nature of CAD in Indians. Various factors like higher visceral adiposity, smoking, higher small dense LDL, higher lipoprotein (a) and metabolic syndrome in Indians have been suggested to contribute to CAD.[10,11] The magnitude of patients < 45 years suffering from Acute Myocardial Infarction (AMI) in India has been reported to be as high as 25-40%.[12] Recanalysed arteries are a common finding in young who receive thrombolysis and left anterior descending artery is commonly involved.[13] Very often, young CAD patients with aggressive disease have been found to lack conventional risk factors. However, very few studies have analysed the angiographic profile, treatment modalities and outcome of complete spectrum of CAD in young adults in India in relation to their traditional and novel risk factors. Hence we studied CAD in Young Indians ≤ 45 years of age with respect to their risk factors, angiographic profile, treatment and outcome.

## METHODS

We studied 132 consecutive young adults with CAD presenting to two tertiary care centers in India over a period of one and half years after approval from Institutional Ethical Committees. All subjects were followed up for 12 months. It was a prospective observational case control study.

We recruited our study subjects who presented with Acute Coronary Syndrome (ACS), Chronic Stable Angina (CSA), dyspnea/ heart failure or Asymptomatic ECG abnormalities. Asymptomatic individuals had incidentally detected ECG abnormality during routine medical examination or pre-anesthetic checkup and subsequently diagnosed to have CAD.

### Inclusion Criteria

(a) Age group 18-45 years

(b) Patients with diagnosis of CAD established unequivocally by one or more diagnostic tests – ECG, Cardiac enzymes, Echocardiography, Myocardial Perfusion Imaging and Coronary Angiography (CAG).

### Exclusion Criteria

Those who refused to give informed consent and expressed inability to report for follow up were excluded from the study.

### Control Group

During the same period, 33 young adults ≤ 45 years, who presented with chest pain or asymptomatic ECG abnormalities and had positive stress test but normal coronary angiogram were taken as controls for comparison and analysis of coronary risk factor profile. They did not receive any treatment for CAD.

### Consent, Screening and Evaluation

All subjects were counseled and informed consent was obtained. All were given a general questionnaire, which included detailed family, past and present medical history. They underwent a thorough evaluation. Details of physical examination like vitals, anthropometric data and systemic examination findings were noted. 2 D Echocardiography was done at baseline and subsequently at the time of discharge from the hospital. Follow up 2D Echocardiography was carried out at 3, 6 and 12 months. We divided the patients in to mild, moderate and severe LV dysfunction based on Left Ventricular Ejection Fraction - LVEF (mild LV Dysfunction: LVEF 45-54%; moderate LV Dysfunction: LVEF 31-44%; severe LV Dysfunction: LVEF ≤30%) and normal LV function where LVEF was ≥ 55%.[14]

All underwent CAG. The diagnosis of significant CAD was made in cases having ≥ 50% stenosis in coronary lumen on CAG. In cases where CAG was normal or had < 50% of lesion, to make a diagnosis of CAD, they required to have unequivocal evidence of ACS with symptoms, ECG changes, cardiac enzymes or Echocardiographic abnormalities of wall motion. Such cases were labelled non obstructive CAD/ Recanalysed CAD. Incidental detection of minor coronary plaques were not considered as CAD. After the CAG, the details of angiogram like vessel and segments involved, intervention done in terms of placement of drug eluting stent (DES) or bare metal stent (BMS) or only plain old balloon angioplasty (POBA) were noted. Those patients who underwent Coronary Artery Bypass Grafting [CABG] or received only medical treatment were also noted. All patients in the study underwent estimation of lipoprotein (a), and serum homocysteine levels at the time of first visit. Patients were followed up at end of first month followed by at the end of 3, 6 and 12 months.

### Statistical Analysis

It was a prospective observational case control study. Statistical analyses were performed by using Epi info 7 software (CDC Atlanta). Frequency of various risk factors were noted. Means and standard deviation (SD) of continuous quantitative data were calculated. Proportions were calculated for discrete data. Proportions were compared using chi square test and means were compared using student t test. A P value of < 0.05 was taken as significant. Risk ratio and 95% Confidence Interval were estimated wherever relevant.

## RESULTS

Over a period of one and a half years, 1432 CAD patients were treated out of which 132 (9.21%) were young (< 45 years). Among 132 CAD patients ≤ 45 years studied, 116 (87.87%) were males and 16 (12.13%) were females. During the same period, age and sex matched 33 young adults who presented with symptoms of possible CAD but CAD was ruled out after CAG were also studied as controls for analysis of risk factors. The youngest was a 20-year-old male. Frequency of CAD increased with age, initially linearly up to 30 years and thereafter exponentially with maximum number of patients (47%) being in 40 to 44-year age group. In each age group males were more commonly affected.

Base line characteristics of the subjects and controls are shown in Table 1. Traditional risk factors like overweight/obesity, Hypertension, Dyslipidemia, family history of CAD were similar in the two groups ($P > 0.05$). However, tobacco use and abdominal obesity were significantly more common in the CAD group ($P < 0.05$). The frequency of obesity was not high when western standards were applied. Eight patients were obese with Body Mass Index (BMI) more than 29.99 kg/m$^2$ (6.06%). However, overweight was more common with 33 patients (25%) having BMI >25 kg/m$^2$. Further, when cut off for normal BMI was reduced to 22.99 kg/m$^2$ as recommended by expert committee of API for Indians[15], 118 patients (89.39%) had either overweight or obesity. Eighty-six (65.15%) of them had their waist circumference > 90 cm (abdominal obesity). Abdominal obesity (65.15%) and elevated lipoprotein (a) [25%] were significantly more common in CAD group than controls.

**Table 1: Baseline Characteristics**

| Characteristics | Young CAD Subjects Number (%) | Young non-CAD Controls Number (%) | P value [95% Confidence Interval (CI)] |
|---|---|---|---|
| **Total number** | 132 | 33 | |
| **Mean Age ±SD** | 38.19±5.58 | 37.03±5.79 | 0.29(-3.32 to 1.00) |
| **Males (%)** | 116 (87.9%) | 26 (78.8%) | 0.18(-3.36 to 26.24) |
| **Females (%)** | 16 (12.1%) | 7 ( 21.2%) | 0.18(-3.35 to 26.25) |
| **Family h/o CAD** | 14 (10.6%) | 3 (9.09%) | 0.80(-13.56 to 10.26) |
| **HT** | 04 (3.03%) | 2 (6.06%) | 0.41(-3.25 to 16.7) |
| **DM** | 10 (7.58%) | 3 (9.09%) | 0.77(-6.80 to 16.39) |
| **Past h/o CAD** | 04 (3.03%) | 2 (6.06%) | 0.41(-3.25 to 16.70) |
| **HT** | 30 (22.73%) | 5(15.15%) | 0.34(-9.41 to 19.16) |
| **DM** | 20 (15.15%) | 3(9.09%) | 0.37(-9.3 to 15.32) |
| **Tobacco use** | 50 (37.88%) | 4 (12.12%) | 0.0049(8.66 to 36.97) |
| **BMI > 25 kg/m²** | 72 (54.55%) | 13 (39.39%) | 0.12(-3.78 to 32.02) |
| **BMI > 23 kg/m²** | 118 (89.39%) | 27 (81.82%) | 0.23(-3.95 to 24.3) |
| **Waist > 90 cm (Males)** | 70 (53.03%) | 5 (15.15%) | 0.0001(19.98 to 49.77) |
| **> 80 cm (Females)** | 16 (12.12%) | 7 (21.21%) | 0.18(-3.38 to 26.24) |
| **Dyslipidemia** | 109 (82.58%) | 29 (87.88%) | 0.46(-10.88 to 15.67) |
| **LDL > 160 mg/dl** | 6 (4.55%) | 1 (3.03%) | 0.69(-11.01 to 7.12) |
| **TC > 200 mg/dl** | 40 (30.30%) | 8 (24.24%) | 0.49(-12.19 to20.17) |
| **TG > 150 mg /dl** | 50 (37.88%) | 11 (33.33%) | 0.63(-14.22 to 20.58) |
| **HDL < 40 mg/dl (Males)** | 66 (50%) | 17 (51.52%) | 0.88(-16.82 to 19.58) |
| **< 50 mg/dl (Females)** | 14 (10.61%) | 6 (18.18%) | 0.23(-3.95 to 24.31) |
| **Lipoprotein (a) > 30 mg/dl** | 83 (62.87%) | 2 (6.06%) | <0.0001(40.82 to 65.73) |
| **Mean Lp(a) ±SD** | 31.39±22.8 | 15.79±6.71 | 0.0002(-23.54 to - 7.66) |

**Table 2: Coronary artery involvement in Young**

| Artery involved | Number (Percentage) |
|---|---|
| **SVD** | 74(56.06%) |
| **LAD** | 54(40.91%) |
| **LCX** | 8 (6.06%) |
| **RCA** | 12 (9.09%) |
| **DVD** | 18 (13.64%) |
| **TVD** | 12 (9.09%) |
| **Non Obstructive CAD** | 24 (18.18%) |
| **"NORMAL" Coronaries** | 04 (3.03%) |

SVD – Single Vessel Disease; DVD – Double Vessel Disease; TVD – Triple Vessel Disease;
LAD – Left Anterior Descending Artery; LCX – Left circumflex artery; RCA - Right Coronary Artery

**Table 3: Patterns of CAD with differing risk factors, treatment and outcome**

| Characteristics | Type I CAD | Type II CAD | Type III CAD |
|---|---|---|---|
| **Number (%)** | 84 (63.63%) | 24 (18.18%) | 20 (15.15%) |
| **Mean Lp(a) micro mol/L** | 28.19±18.90 | 29.33±16.89 | 70.55±30.17 |
| **Mean waist (cm± SD)** | 92.3 ± 3.82 | 93.4 ± 4.12 | 95.2 ± 5.82 |
| **Mean BMI (kg/m²±SD)** | 24.6 ± 2.12 | 24.1± 2.37 | 24.7± 3.11 |
| **Tobacco Use [Number(%)]** | 16(19%) | 18 (75%) | 16 (80%) |
| **Treatment** | | | |
| **PCI** | 80 (95.23%) | 21 (87.5%) | 11 (55%) |
| **CABG** | 0 | 3 (12.5%) | 5 (25%) |
| **Only Medical management** | 4 | 0 | 4 (20%) |
| **Recurrence** | 1(1.19%) | 3 (12.5%) | 10 (50%) |
| **Stent Thrombosis** | 0 | 1 | 1 |

Type I CAD: Single discrete lesion / Single segment involvement; Type II CAD: Two discrete lesions/ Two segment involvement; Type III CAD: Multiple discrete lesions/ multiple segment involvement; Four patients had Recanalysed arteries. Another Four patients had non critical lesions (lesion 50-60%); managed only medically.

**Table 4: Treatment of CAD in Young**

| Treatment | Number (%) |
|---|---|
| **PAMI** | 40 (30.31%) |
| **Elective CAG ± PCI/Medical Management/CABG** | 92 (69.69%) |
| **PCI** | 76(57.57%) |
| **Medical Management** | 8 (6.06%) |
| **CABG** | 8 (6.06%) |

PAMI: Primary Angioplasty in Myocardial Infarction; CAG: Coronary Angiography;
PCI: Percutaneous Coronary Intervention; CABG: Coronary Artery Bypass Graft Surgery

**Table 5: Complications/Events**

| Complication/Outcome | Number (%) |
|---|---|
| **In-stent Re-stenosis (ISR)** | 06 (4.6%) |
| **De novo lesion** | 08 (6.06%) |
| **Stent Thrombosis** | 02 (1.51%) |
| **Cerebro Vascular Accident (CVA)** | 01 (0.77%) |
| **Local Vascular Complication** | 04 (3.03%) |
| **Death** | 02 (1.51%) |
| **Arrhythmias** | 04 (3.03%) |

**Table 6: Impact of treatment on Left Ventricular Ejection Fraction (LVEF)**

| LVEF | BASELINE | AFTER ONE YEAR |
|---|---|---|
| | Number (%) | Number (%) |
| **NORMAL (≥55%)** | 76 (57.57%) | 90 (68.18%) |
| **Mild LV Dysfunction (45-54%)** | 26 (19.69%) | 27 (20.45%) |
| **Moderate LV Dysfunction (31-44%)** | 26 (19.69%) | 13 (9.71%) |
| **Severe LV Dysfunction (≤30 %)** | 04 (3.03%) | 2 (1.49%) |

**Presentation and Coronary Artery Involvement**

Out of 132 patients, 80.3 % presented with AMI (71.21% - ST elevation MI and 9.09% - Non ST Elevation MI), 10.6% presented with Unstable Angina (UA), 4.54% presented with CSA and asymptomatic ECG abnormality (silent CAD) was also noted in 4.54%. During study period three patients were "brought-in dead" after a variable period (2 h to 16h) of chest discomfort followed by collapse who were confirmed to have CAD on autopsy.

Precipitating factor was undue physical exertion in eight patients (like long distance running, competitive sports). Rest had no identifiable immediate precipitating factors.

Coronary artery involvement is shown in Table 2. Seventy-four patients (56.06%) were detected to be having single vessel disease (SVD). Left Anterior Descending artery (LAD) was the commonest vessel affected with 54 patients out of 74 (40.91% of total CAD) being affected. Next frequently affected single vessel (9.09%) was Right Coronary Artery (RCA). Double vessel disease (DVD) was noted in 18.18% and 9.09% had triple vessel disease (TVD). Among TVD, two patients also had Left Main Coronary Artery (LMCA) involvement. Non obstructive CAD was noted in 24 (18.18%). Four patients (3.03%) had normal coronaries/completely reanalyzed vessels despite having unequivocal evidence of UA/MI on ECG and enzyme studies. Three subjects who had presented with sudden cardiac death (SCD) had left main (1) or proximal LAD (2) involvement on autopsy

We noticed three patterns of coronary artery disease in young with distinct risk factor profile, angiographic involvement and outcome (Table 3). It was noticed that individuals with single discrete lesions or single segment involvement (Type I) had fewer coronary risk factors and better prognosis. Individuals with multiple discrete lesions or multiple segment involvement had more number of coronary risk factors, both conventional (truncal obesity, tobacco use) and novel risk factors especially elevated Lp(a), elevated homocysteine. They also had recurrence of symptomatic coronary lesions over one year. This classification was useful for further evaluation of risk factors and for prognostication of patients with Type III CAD.

**Type I CAD:** Single discrete lesion / Single segment involvement: There were 84 subjects in this category. Their mean Lp (a) was 28.19±18.90 micro mol/L. No patient in this category required Coronary Artery Bypass Graft surgery (CABG). All were managed with PCI or only medical therapy. Recurrence rate of CAD (both ISR and de novo lesions) was low with only 1.19%.

**Type II CAD:** Two discrete lesions/ Two segment involvement. There were 24 subjects in this group. They were more frequent smokers with mean Lp (a) 29.33±16.89 micro mol/L. Three out of 24 (12.5%) required CABG. Recurrence rate of CAD was 12.5%.

**Type III CAD:** Multiple discrete lesions/ multiple segment involvement (Fig 1 A & B): There were 20 patients in this category. Mean Lp(a) was 70.55±30.17 micro mol/L. Recurrence rate of CAD was 50 % in this pattern of CAD.

**Treatment Received**

There were 94 patients with STE MI. Forty patients (42.45% of STEMI) underwent Primary Angioplasty in Myocardial Infarction (PAMI) and 92 patients of total 132 (69.69%) underwent elective CAG ± PCI (Table 4). All ST elevation MI patients (40 young patients) who presented to study centers directly within window period (< 12 hours from onset of chest pain) were subjected to PAMI. Thirty-two patients received Stents (40 Drug eluting stents,

one Bare Metal Stent). Large thrombus filled lesions despite thrombo -suction in eight patients precluded stenting. They were administered intra coronary thrombolysis and check angiography after 3 to 5 days showed completely recanalized vessels in six (Fig 2 A & B).

Other two patients required drug eluting stents. Optical Coherence tomography done in some of these recanalized patients showed plaque erosion as the pathophysiology behind these ACS (Fig 3A) but diffuse fibrocalcific lesions in Type III CAD (Fig 3B). Fifty-four patients of STEMI were treated at peripheral hospitals (Non – PCI capable) and subsequently referred to our hospital. Forty-six (48.9% of STEMI) of them received thrombolysis. Eight did not receive thrombolysis. Four had presented out of window period. Four had missed diagnosis. After angiography, these patients were managed by placement of Drug Eluting Stents (DES) or Bare metal Stents (BMS). Eight patients (6.06%) underwent coronary artery bypass surgery as treatment due to extensive and multi vessel disease.

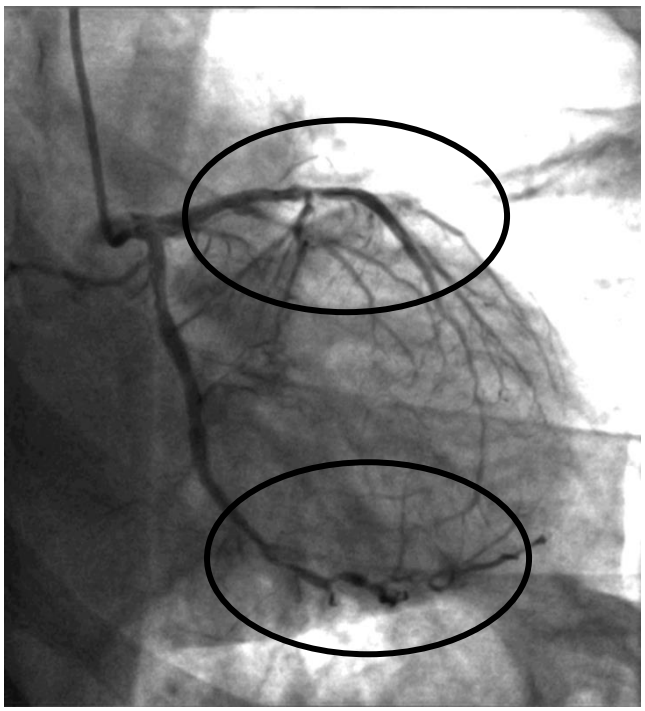

**Figure 1 A: Left coronary Angiogram (RAO-CAUDAL) of a 42-year-old male with no conventional risk factors. BMI was 24.91kg/m$^2$, Waist 92 cm. BP 130/80 mmHg. No DM/tobacco use. However, Lipoprotein (a) was 272 mg/dl which was very high**

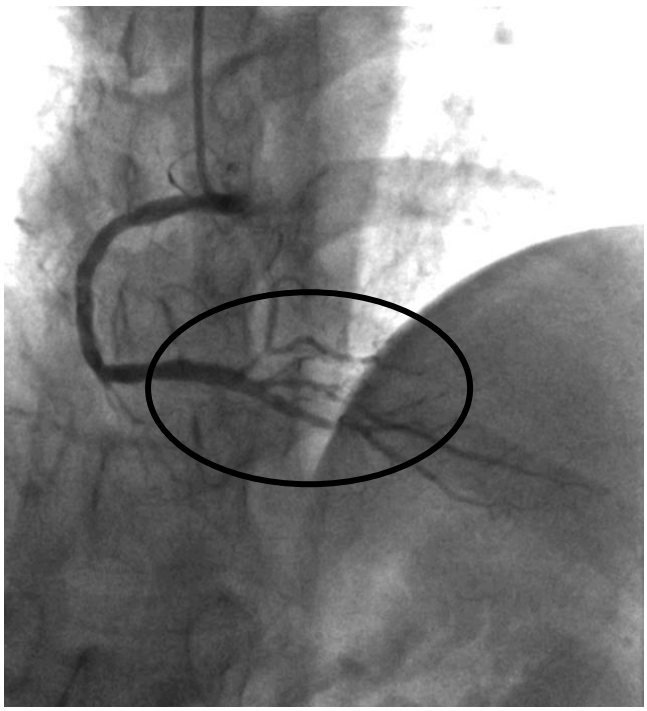

**Fig 1B: Right coronary angiogram of same young patient as in figure 1A which shows diffuse lesions in Posterior Descending Artery- branch of Right Coronary Artery**

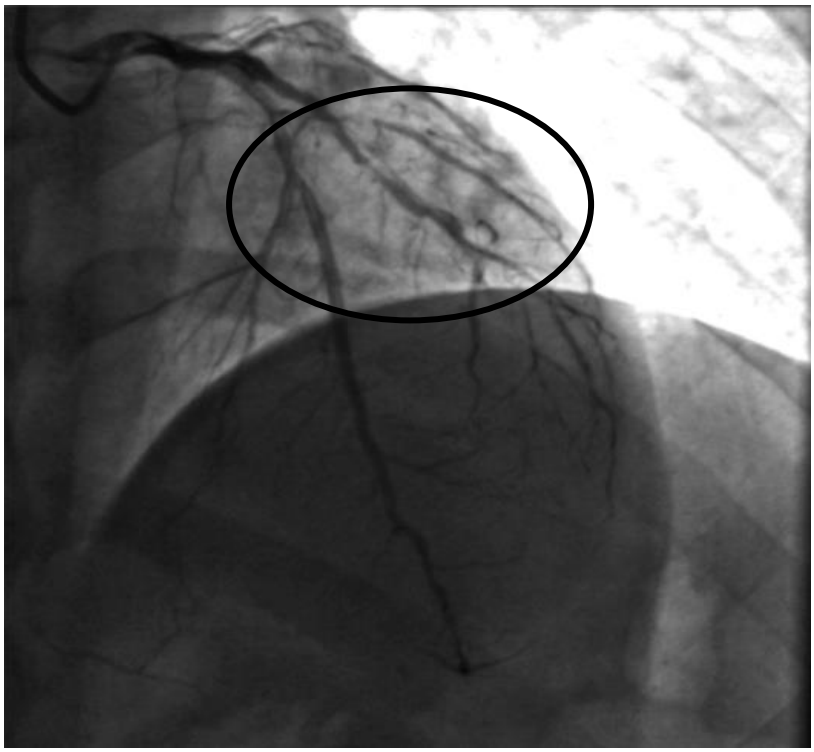

**Fig 1C: Left coronary Angiogram (AP- Cranial) of the same 42-year-old male with no conventional risk factors showing Type III CAD (Multiple diffuse lesions- TVD).**

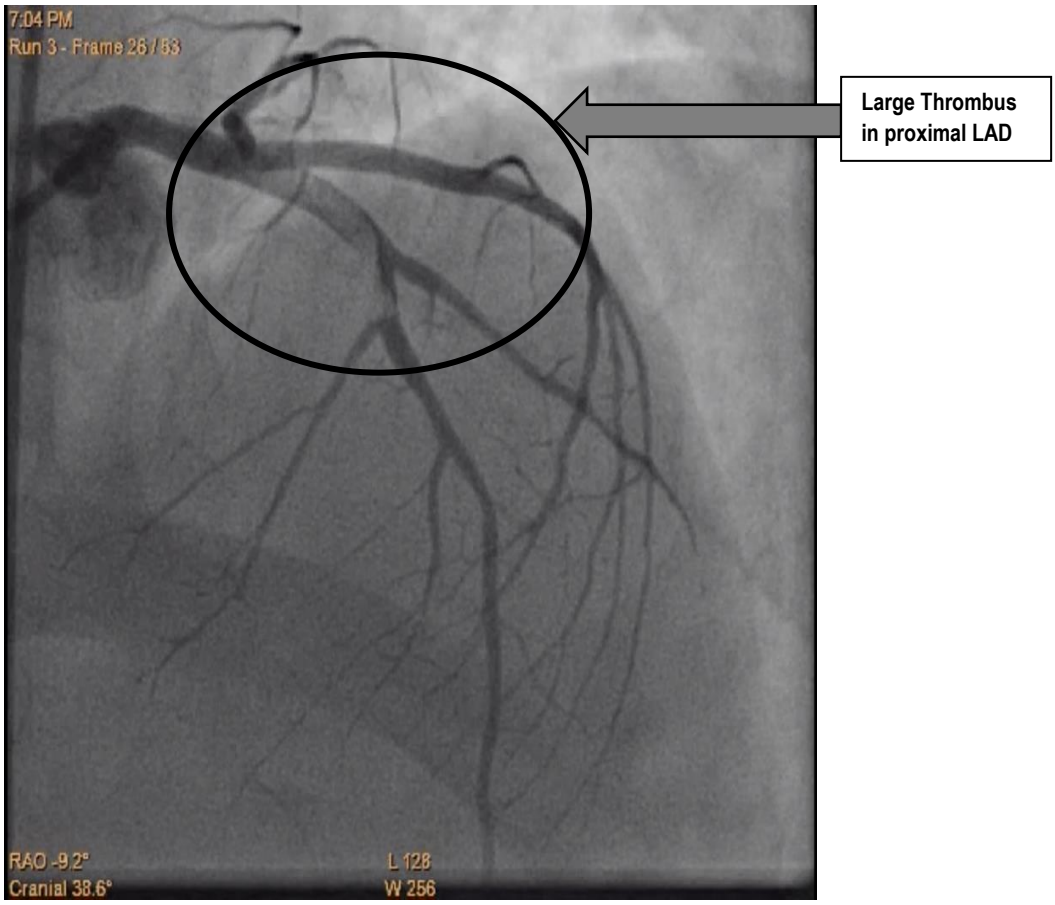


**Fig 2 A: Coronary angiogram showing Large thrombus in Proximal LAD in a 32 yr old male with STE AWMI (AP CRANIAL view)**

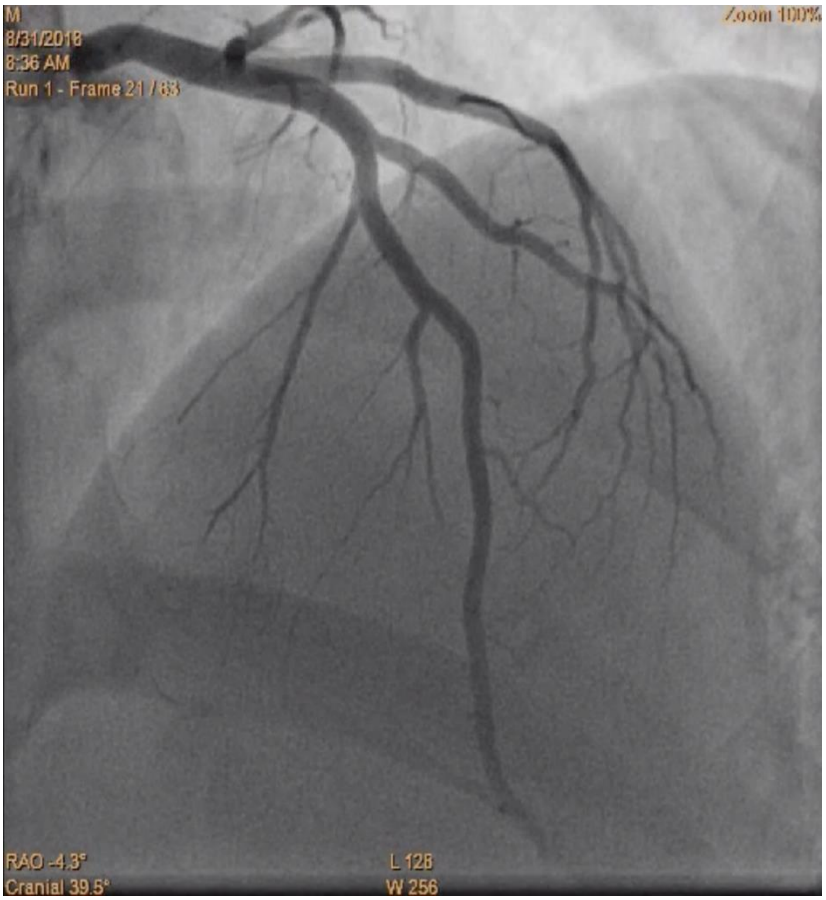


**Fig 2 B: Coronary angiogram after one week showing complete resolution of large thrombus in Proximal LAD after thrombosuction and intracoronary Tenecteplase (same patient as in fig 2A).**

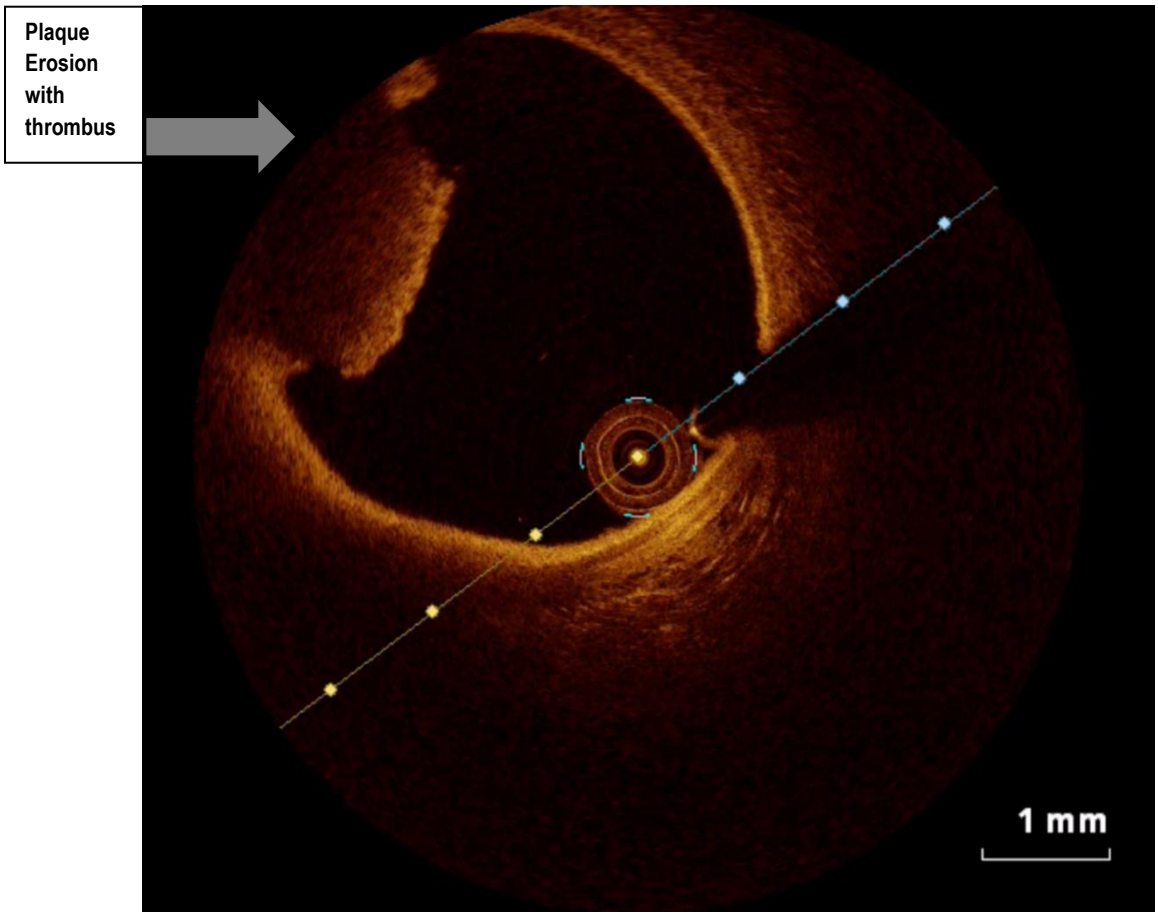


**Fig 3 A: Coronary Optical Coherence Tomography showing plaque erosion as the cause of ACS in a relatively healthy artery in a 32 yr old male.**

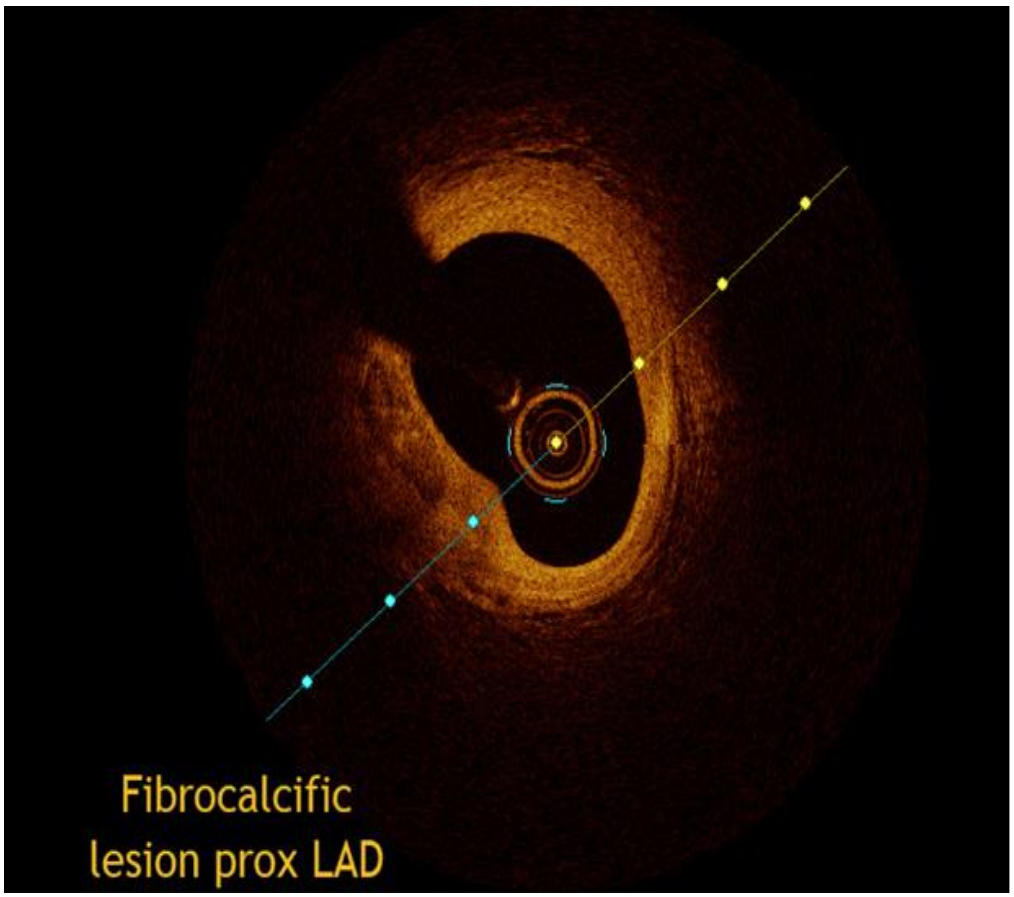


**Fig 3 B: Coronary Optical Coherence Tomography showing fibrocalcific lesion in proximal LAD in a 28-year-old lady (Patient had raised Lipoprotein (a), small dense LDL, homocysteine and had Type III CAD. She received multivessel PCI)**

**Complications Observed During the Follow Up**

Study subjects were followed up for 12 months for outcome and complications (Table 5). Recurrence of CAD with new vessel involvement (de novo lesions) was noticed in 08 patients (6.06%) and in stent re-stenosis (ISR) in 06 patients (4.6%). Stent thrombosis was noted in 02 patients and Cerebro Vascular Accident (CVA) in one patient. Left Ventricular Failure (LVF) was noted in two (1.51%) patients. Ventricular tachycardia was seen in two and there were two deaths. Local vascular complications in the form of hematoma were noted in 04 patients (3.03%). There were no pseudoaneurysms.

**Left Ventricular Function**

At baseline, 76 patients (57.57%) were having normal LVEF (Table 6), 26 patients (19.69%) each moderate and mild LV dysfunction. Four (3.1%) patients had severe LV dysfunction. After 12 months of follow up with intervention, the percentage of subjects in normal LVEF increased from 57.57 % to 68.18% and there was reduction in number of patients having moderate and severe LV dysfunction with slight increase in that of mild LV dysfunction. With intervention, there was improvement in LV function and patients moved from severe and moderate LV dysfunction categories to mild LV dysfunction or normal LV function category. Forty-four patients out of 56 (78.57%) who had LV dysfunction, improved in their LV function after revascularization.

Improvement in LV function was noted only in STEMI group. Out of 12 Non-STEMI patients, 10 had normal LV function, one each had mild and moderate LV dysfunction. After 12 months there was no change in their LV function.

## DISCUSSION

We studied 132 young patients with CAD over one and half years with at least one year of follow up in each. CAD in Young constituted 9.21% of 1432 cases of CAD treated during the same period. Males constituted 87.9% and females, 12.1%. Yadav P et al studied 200 patients of age 31 to 80 years.[16] In their study 8% of male patients and 2 % of female patients belonged to age group 31- 40 yrs and 17 % male patients and 4% female patients belonged to age group 41 -50yrs. In a study by Schoenenberger AW et al[17], males constituted 85.1% and female constituted only 14.9%. In Thai ACS registry[18], Wiwun Tungsubutra et al studied 9373 patients of CAD. They divided the study group into <45, 45-54 and >54 yrs. They found that 85.3% in <45 yrs age group were males. In CAD in Young, males are 5 to 7 times more commonly affected than females.

In our study, tobacco use, abdominal obesity and elevated lipoprotein (a) were significantly more common in CAD group than controls with RR of 1.25, 1.35 and 1.59 respectively. Abdominal obesity as a risk factor had a RR of 2.43 for CAD in INTERHEART study.[11] Various studies have implicated lipoprotein (a) as an independent risk factor for premature CAD.[19,20] In our study, Type III CAD i.e., multi vessel /diffuse CAD was associated with significantly elevated Lp(a) and more frequent recurrence of symptoms/ACS. Some studies have suggested that elevated Lp(a) is associated with more recurrence of MI and multi vessel CAD.[20-22]

**Coronary Artery Involvement**

Andreas W.S et al showed that young patients had less diffuse atherosclerotic lesions as compared to patients of the older age group. In their study, 75% had one-vessel CAD and 23.2% two- or three-vessel CAD in younger patients, whereas among older patients 38.6% had one-vessel and 59.2% two- or three-vessel CAD (P < 0.001). The proportion of young patients with normal coronary arteries was 1.8%[16]. In our study, 92 patients (69.70%) were having SVD (Table 2). Among the SVD, LAD was involved in 72 patients (78.26%), LCX in 08 (8.70%) and RCA was involved in 12 (13.04%) patients. Total number of DVD was 24 (18.18%), and TVD was 12 (9.09%). Indians have more extensive CAD at a younger age than western population. Non obstructive CAD was noted in 24 (18.18%). Non obstructive CAD was mostly due to resolution of thrombus following thrombolysis (Recanalization). Four patients (3.03%) had normal initial coronary angiogram (Reanalysed artery). However these patients had unequivocal evidence of CAD on ECG /enzyme studies and Echocardiography. Three subjects who had presented with sudden cardiac death had left main (1) or proximal LAD (2) involvement on autopsy. They possibly succumbed to ischemic arrhythmia since severe ischemia is poorly tolerated in young due to lack of ischemic preconditioning or absence of collaterals.

**Treatment Options (PAMI/Thrombolysis & Elective PCI/CABG)**

In a study in Ireland population, Andreas WS et al, found that among patients with STEMI, 53.6% (75 out of 140) underwent primary PCI and 25.5% patients underwent thrombolysis.[15] Another study conducted in Thailand population by Wiwun T et al, reported that 41.9% patients (<45yrs group) underwent PCI, 4.0% underwent CABG and rest of the study population (54.1%) was managed with medical therapy.[16] In our study, 40 patients (42.55%) of 94 STEMI underwent primary PCI. These were the patients who directly reported to the tertiary centre within window period of 12 hours. Eight young MI patients (20%) had large thrombus burden. They were treated with intracoronary thrombolysis. Check angiography after 3 to 5 days showed completely recanalized culprit vessel in six patients. The other two patients required DES due to presence of stenotic lesions. Apart from this, 92 patients (69.69%) underwent elective CAG (46 Thrombolysed patients, 8 non Thrombolysed patients, Non STEMI, CSA and other stress test positive patients). Seventy six patients (57.57%) received elective PCI, 08 patients (6.06%) underwent CABG and similar number of patients received medical therapy. Primary angioplasty was performed in all STEMI patients presenting directly to tertiary centres (100%) within window period. Forty six patients of 94 with STEMI (48.93%) received thrombolysis. Four patients presented beyond window period of 12 h. Four patients (4.94%) with STEMI did not receive PAMI or thrombolysis despite presenting within window period due to missed diagnosis. All subjects underwent CAG sooner or later. Most (69.7%) received PCI (Primary + Elective) since there was no financial issue involved. Large number (21.21%) of recanalization was noted. Minimal number of CABG (6.06%) in our study is partly due to majority having single vessel disease and patients with TVD preferring multi vessel PCI to CABG.

**Analysis of Complications**

P.Yadav et all studied the pattern of ACS in Indian population in all age groups. They reported cardiac arrhythmias in 60%, cardiac failure in 35%, CVA in 2.5% and mechanical complications of MI (mitral regurgitation, ventricular septal rupture) in 2.5% of study.[15] Another study conducted in Thailand population by Wiwun T et all concluded that among <45 yrs age group, 25.6% (139 out of 544)

had congestive cardiac failure, 1.3 % of study population had CVA, 6.8% had cardiac death during the hospital stay.[17] In our study 02 out of 132 patients developed stent thrombosis after 03 months of PCI. There were 04 (3.03%) cases of cardiac arrhythmias- VT/VF during PAMI which were successfully reverted with prompt DC Shock. There were 03 cases of heart failure who had severe LV dysfunction. They had presented late due to atypical symptoms. Majority received relatively prompt treatment as per standard protocol at peripheral hospitals (Thrombolysis) as well as study centre (PAMI). There was no delay due to financial considerations since treatment is state sponsored and free. In our study, 08 patients (6.06%) developed new coronary lesions warranting intervention. ISR was noted in 6 (4.6%) patients. Out of 116 patients who received PCI, 2 had stent thrombosis (1.72%) and 01 had CVA (0.86%) during the follow up period. Complication rates are consistent with prevalent rates of PCI at this time. In our study we analysed the outcome of LVEF in whole population and STEMI vs NSTEMI patients. It was noted that there was improvement of LVEF in 10.61% of study population. There was no significant change in terms of LVEF among the NSTEMI patients. In STEMI patients 14.9% population showed improvement in LVEF after the coronary intervention/therapy.

## STUDY STRENGTHS AND LIMITATIONS

It is a prospective study. Follow up was good with 100% follow up due to relatively a captive population. Drug compliance was good. The complete spectrum of coronary artery disease including silent CAD was studied. Study population was representative sample of whole of India since subjects hailing from all parts of the country are positioned in a place. However, limitations are that it is a relatively small observational study and limited period follow up. The study population is mostly from a specific govt. sector. Hence relatively healthy people were the subjects due to which the frequency of risk factors and treatment received may not represent general population.

## CONCLUSIONS

Coronary Artery Disease in Young constitutes about 10% of all CAD. It is a different entity with different risk factor profile, clinical presentation, angiographic profile and response to treatment. While tobacco use is decreasing as a risk factor, abdominal obesity and overweight are increasing as most commonly prevalent conventional risk factors. Most of the patients are males in this age group since CAD in females below 45 years is rarer still. Lipoprotein (a) is associated with more severe form of CAD with more frequent recurrence. CAD in Young commonly presents with typical angina and STEMI. Single vessel disease is more common in young CAD and Left Anterior Descending artery (LAD) is the most common culprit vessel. Younger individuals receive PCI as the predominant modality of treatment and respond well with minimal complications. Large residual thrombus without stenotic lesions precluding stent placement do well with intracoronary thrombolysis. Late presentation (> 6h), not receiving thrombolysis or PAMI and persistence of tobacco use predict left ventricular dysfunction and worse outcome.

Subtle abdominal obesity (circumference > 90 cm) and BMI > 23 kg/ $m^2$ are ubiquitously prevalent in our population which escape detection and remedy. Elevated lipoprotein (a) levels was associated with more aggressive CAD. Hence Lp(a) assay should be done in all young CADs. Healthy life style should be promoted at all levels to newer targets to reduce CAD in Young.

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