

Original article:

A study of pattern of coronary artery disease in young south Indian population

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Abstract

Introduction: Coronary Artery Disease (CAD) in young individuals represents a special subset that clinical profile and angiographic findings are different from older population. Better understanding of CAD in the young will lead to further improvement in prevention and management. However, there are few data regarding coronary artery disease in young south Indian population. So this study was aimed to analyze the clinical profile and angiographic pattern of CAD in young people undergoing Coronary Angiography (CAG).

Methods: A total of 1017 consecutive individuals (men-735, women-282) aged < 50 years who underwent CAG were included in the retrospective study. Clinical features, risk factors for CAD and angiographic findings were analyzed.

Observations and results: Majority (72%) of the subjects were males and more than half (57%) were between 35 to 45 years of age. Hypertension was the most prevalent risk factor (14.8%) followed by diabetes (10.5%), smoking (2.8%) and dyslipidemia (2.4%). Diabetes, HT and dyslipidemia were more common in patients with significant CAD compared to those without significant CAD (36.4% Vs 22.5, 39.5% Vs 35.2%, 12.3Vs 11.1% respectively). Most common indication for CAG was ST elevation MI (35%). Single vessel disease (24.5%) and normal coronaries (26%) were frequent findings in CAG.

Conclusions: Hypertension and diabetes were the common risk factors for CAD in young south Indians. They frequently presented with ST elevation MI and atypical chest pain. Single vessel disease and normal coronaries were common findings in angiography.

Key words: Coronary Artery Disease, Young south Indians, Angiographic pattern

Introduction

Coronary artery disease (CAD) is one of the leading causes of death worldwide. CAD in the young, although uncommon, is an emerging and important health problem because of its devastating effect on the active lifestyle of these individuals. They represent a specific subset and require special attention as the clinical profile, risk factors and prognosis are different from that in older patients with CAD (1-3). Acute coronary syndrome

(myocardial infarction or unstable angina) is the first manifestation of CAD in majority of the young patients as compared to older individuals(4, 5).

Among individuals with documented CAD, about 10% are below 45 years of age (6). Registries on Myocardial infarction (MI) shows that 2% to 6% of all infarctions occur in individuals below the age of 45 (7), but intimal atherosclerosis was observed in 50% of autopsies done in young individuals under the

age of 34 (8). Patients from the Indian subcontinent present relatively early and may have more extensive CAD compared to their counterpart from other ethnic groups (9, 10). However, there is paucity of data regarding coronary artery disease among younger adults in south Indian population groups.

Aims & objectives

The current study was aimed to analyse the clinical profile, risk factors and angiographic pattern of Coronary Artery Disease (CAD) in young south Indian population undergoing Coronary Angiogram (CAG).

Materials & methods

A retrospective study was done at Chettinad Hospital and Research Institute, Chennai in young patients below the age of 50 years who underwent coronary angiography (CAG) during the period from January 2009 to December 2013. After obtaining approval from the institutional ethics committee, case records of patients satisfying the requisite selection criteria were critically analyzed for age, sex, clinical presentation, and presence of traditional risk factors for CAD namely diabetes mellitus (DM), hypertension (HT), dyslipidemia, smoking, alcohol intake and family history. Coronary angiographic findings and initial treatment advised by cardiologist were recorded.

Both the sexes were included in the study. The clinical presentation and indications for CAG were divided into the following subsets: Unstable Angina(UA), Non-ST Elevation Myocardial Infarction(NSTEMI), ST Elevation Myocardial Infarction(STEMI), Atypical chest pain, typical effort angina or dyspnea with or without positive TMT and others i.e. which did not fit into any of the aforementioned categories. The "others" category mainly included patients with CAG done as a part of

pre-operative evaluation for cardiac valvular and non-cardiac surgeries. Coronary angiographic findings were analyzed for the presence of lesion in each of the major epicardial coronary arteries namely left anterior descending artery (LAD), left circumflex artery (LCX), right coronary artery (RCA) and ramus intermedius (RI). Angiographic videos were reviewed again if details were inadequate or unavailable. In this study, significant CAD was defined as presence of >70% stenosis of luminal diameter in at least one of the major epicardial coronary arteries, and based on the number of vessels involved they are classified as having single vessel disease (SVD), double vessel disease(DVD) and triple vessel disease(TVD). Patients having less than 70% stenosis were categorized as having non-obstructive CAD/minimal CAD. If CAG showed no lesion and had less than TIMI III (thrombolysis in myocardial infarction) flow, they were categorized as having microvascular dysfunction (MVD). Presence of Left main (LM) coronary artery disease was noted with specific attention and significant LM disease was defined as at least >50% stenosis of luminal diameter by visual assessment in the LM vessel. Initial treatment plan advised by cardiologist were recorded.

Patients aged 50 years or above were not included in the study. Patients with inadequate clinical and angiographic details were excluded from the study. All statistical analyses were performed using SPSS17 software and *p* value <0.05 was considered statistically significant.

Observations & results

A total of 1017 (males-735, females-282) patients below the age of 50 years were found eligible for the study and were included in the analysis. A total of 100 (10%) patients were below the age of 35 years,

582 (57%) patients were between 35 to 45 years and 335(33%) patients were above 45 years of age. (table.1). Seventy two percent of the patients studied were males and 28% were females with a male: female ratio of 2.6:1 (table 1). Among the traditional risk factors for CAD, diabetes mellitus, hypertension traditional risk factors (Table 1).

Risk factors were compared between men and women. DM, HT and Dyslipidemia were present in 31.7%, 38.2% and 12.1% of males and 32.6%, 37.9% and 11.3% of females respectively (table 2). Risk factors were assessed in patients with angiographically documented CAD (table 3) and DM, HT and dyslipidemia were present in 36.4%, 39.5%, and 12.3% of patients with significant CAD and in 22.5%, 35.2%, and 11.1% of patients without significant CAD respectively. These three risk factors were more frequently present in patients with significant CAD than those without significant CAD. Coronary angiogram was done for unstable angina, NSTEMI and STEMI in 81(8%), 40(3.9%) and 352(35%) of the subjects respectively. A total of 228(22%) individuals underwent CAG for chronic stable angina or for positive TMT while 194(19%) patients had undergone CAG for atypical chest pain and 122(12%) for other reasons (table 1).

and dyslipidemia were present in 10.5%, 15% and 2.5% of the individuals respectively. Twenty eight (2.8%) patients were smokers and 5(0.5%) patients were alcoholics. More than one risk factor was observed in 329(32.4%) subjects and 373(36.7%) subjects showed no Coronary angiogram showed SVD in 249(24.5%) patients, DVD in 127(12.5%) patients and TVD in 117(11.5%) patients. Non-obstructive/minimal lesions were observed in 203(20%) patients and normal angiographic findings or MVD were found in 267(26%) of patients. The remaining patients (5.2%) had other findings like coronary ectasia or myocardial bridging. Left main CAD was present in 23(2.3%) patients. Based on clinical features and angiographic findings 565(55.6%) patients were advised medical management, 217(21%) were advised angioplasty and 166(16%) were advised CABG. A total of 28(2.8%) patients were advised EECF (Enhanced External Counter Pulsation) and 41(4%) patients were advised to undergo further studies like stress tests or viability studies before arriving at a final decision regarding the treatment modality.

1: Baseline characteristics of young south Indians undergoing coronary angiography

Characteristics	Percentage (%)	Number (Total = 1017)
Age group		
Less than 35 years	9.9	100
35 to 45 years	57.2	582
46 to 50 years	32.9	335
Sex		
Males	72	735
Females	28	282
Risk factors (RF)		
Diabetes mellitus	10.5	107
Hypertension	14.8	151
Dyslipidemia	2.4	24
Smoking	2.8	28
Alcohol consumption	0.5	5
More than one risk factors	32.4	329
No risk factors	36.7	373
Clinical presentation ^a		
Unstable angina	7.9	81
Non-ST elevation MI	3.9	40
ST elevation MI	34.6	352
Stable angina, dyspnea, + TMT	22.4	228
Atypical chest pain	19.1	194
Other indications ^b	12	122
Coronary angiographic findings		
Single vessel disease	24.5	249
Double vessel disease	12.5	127
Triple vessel disease	11.5	117
Left main disease	2.3	23
Non-obstructive lesion	20	203
Normal / MVD	26	267
Other findings ^c	2.3	23
Initial management advised		
Medical management	55.6	565
PCI	21.3	217
CABG	16.3	166
EECP	2.7	28
Others ^d	4.0	41

MI- myocardial infarction, TMT- tread-mill test, MVD- microvascular dysfunction, CABG- coronary artery bypass surgery, PCI- percutaneous coronary intervention, EECp- enhanced external counterpulsation

^a indication for coronary angiogram, ^b mainly before cardiac valve and non-cardiac surgeries, ^c coronary ectasia/myocardial bridging, ^d needed further studies before final decision e.g. viability study, stress tests

Table2: Prevalence of risk factors among males and females

Risk factors		Males		Females		P value
		No.	%	No.	%	
Diabetes	-	502	68.3	190	67.4	0.05
	+	233	31.7	92	32.6	
Hypertension	-	454	61.8	175	62.1	0.6
	+	281	38.2	107	37.9	
Dyslipidemia	-	646	87.9	250	88.7	0.05
	+	89	12.1	32	11.3	

p value of < 0.05 is considered significant

Table3. Prevalence of risk factors among patients with and without significant CAD

Risk factors		CAD		No CAD		P value
		No.	%	No.	%	
Diabetes	-	440	63.6	251	77.5	0.05
	+	252	36.4	73	22.5	
Hypertension	-	419	60.5	210	64.8	0.05
	+	273	39.5	114	35.2	
Dyslipidemia	-	607	87.7	288	88.9	0.10
	+	85	12.3	36	11.1	

CAD- coronary artery disease; + and – indicates presence or absence of risk factors in individuals with and without CAD *p* value of < 0.05 is considered significant.

Discussion

The burden of cardiovascular diseases (CVD) is rapidly increasing in developing countries, mainly due to lifestyle changes with sharp rise in the incidence of risk factors at a younger age. Prevalence of most of the cardiovascular risk factors including DM, HT, smoking, dyslipidemia etc. has increased markedly in India in the last three decades

(11, 12) especially in the younger population with increasing number of angiograms done for them.

Male sex is a clearly proven risk factor for CAD (13, 14) and majority of the subjects (72.3%) who underwent CAG in the present study were males with higher prevalence of dyslipidemia and HT among them. Smoking is a major modifiable risk factor for CAD among young adults. Smoking enhances the platelet activation leading to thrombosis and

myocardial infarction (15). In the Framingham Heart Study, Kannel *et al.* (16) reported the relative risk of CAD among young individuals is three times higher in smokers than non-smokers. In a study by Zimmerman *et al.* in patients less than 40 years with acute myocardial infarction, 73 to 90% of subjects were smokers (17) and similarly Hoit BD observed majority (80%) of his study population were smokers in the study of young MI patients (<45 years)(2). Jayachandra and colleagues reported positive smoking history in 22% of young subjects (<45 years) in Indian population (18) which is low compared to western population. In the current study smoking was surprisingly low (2.8%) and the reason could be patient selection from all subjects who underwent CAG for various presentation including coronary evaluation before valve surgeries. Also about 28% of our study population was women and smoking among them in India is very less compared to western women (19).

Hypertension was the most prevalent risk factor in our study and was present in 15% of the study subjects which is in agreement with other studies by Tamrakar *et al* (20) and Zimmermann and colleagues (17). Jayachandra and his colleagues observed hypertension among 20% of the young Indian patients admitted with acute coronary syndrome (18). Indians are genetically susceptible to type 2 diabetes mellitus and its incidence has increased in last decade from 32 million to 50 million in India (21). Accelerated atherosclerosis and premature coronary artery disease have been observed commonly in diabetic patients. Jayachandra *et al.* noted diabetes in 8% of men and 11% of women aged below 45 years with CAD which is comparable to 10.5% in our study (18). Tamrakar *et al.* reported diabetes in 15.6% of his study subjects with acute MI (20). Diabetes was

noted to be present in 26.4% of women and 8% of men in Jason's observation of young patients (<40 years) with CAD and he also observed that diabetics were likely to have hypertension, heart failure or Q wave infarction.

The significance of dyslipidemia in the pathogenesis of coronary artery diseases is well known (22) and Asian Indians have lower HDL levels compared to other ethnic populations which may be a reason for premature CAD among them. Isser *et al.* observed high triglyceride and lipoprotein (a) and low HDL levels in young subjects admitted with their first MI, compared with age- and gender-matched controls. Dyslipidemia was found in 8% and 9% of young and elderly patients respectively in Jayachandra's study in south Indian population (23). In a study by Mohan *et al.* south Indian population shows occurrence of CAD at much lower levels of total cholesterol and LDL cholesterol (23).

More importantly, no conventional risk factors were found in nearly one-third of our patients indicating that other risk factors may play an important role in pathogenesis of CAD in young Indian patients and further evaluation for novel risk factors like homocysteine, lipoprotein (a), inflammatory mediators, prothrombotic factors and genetic markers is necessary. Coronary angiogram was done in patients admitted for acute MI in most of the prior studies (2, 3, 5, 17), but in our study case selection was done from catheterization laboratory where CAG was performed for various reasons, including acute MI cases. A similar study done by Christus *et al.* among young 200 consequent patients who had undergone coronary angiogram but most of these patients were referred for CAG after acute coronary syndrome (ACS) (24). The major indications for coronary angiogram in our study were STEMI and

atypical chest pain. Importantly about 20% of patients had atypical chest pain, so high index of suspicion is needed while evaluating young patients for CAD.

Young individuals have been shown to have higher incidence of single vessel disease, normal coronaries and non-obstructive lesions as compared to older subjects (17) and the current study also observed single vessel disease and normal coronaries in nearly one-fourth of study population. Fournier reported angiographically normal coronaries in 20% of subjects underwent CAG within one month after acute MI (5). Jason et al observed single vessel disease in 60% of female patients and 55% of males under 40 years of age which was higher than observed in our study but he included only patients who were documented to have CAD in CAG in the study (3, 9). Normal angiographic findings in patients with documented MI could be due to complete recanalisation of infarct related vessel due dissolution of the thrombus either spontaneously or by fibrinolytic agents used in the management, or transient severe vasospasm causing MI (vasospastic angina). Triple vessel disease and left main coronary disease were less common in younger patients as

compared to older individuals and our observations are in agreement with previous studies (3, 17).

Limitations of the study: It is an observational study which might be influenced by confounding variables. Role of other risk factors like Lipoprotein (a), homocysteine, hypercoagulable state and emotional stress in causation of CAD in these young individuals were not analyzed. Eye balling and quantitative methods were used to assess the lesions in angiography, and Fractional Flow Reserve (FFR), Intravascular Ultrasound (IVUS) or Optical Coherence Tomography (OCT) were not used for analysis of borderline and complex lesions.

Conclusions

Hypertension and diabetes mellitus were the common risk factors for coronary artery disease in young south Indian population. They frequently presented with ST elevation myocardial infarction and atypical chest pain. Coronary angiography showed less extensive disease compared to older individuals and single vessel disease/non-obstructive lesions were frequently observed. Prevention of premature CAD among Indians needs control of conventional risk factors, lifestyle modification and further evaluation for novel risk factors.

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