ORIGINAL RESEARCH ARTICLE

Study of Young Indians with ST Elevation Myocardial Infarction: Risk Factors, Clinical Presentation, Angiographic Profile and Short-Term Prognosis

Tejas Pandya[1], Manohar J. Suranagi[2], K. Subramanyam[3], K. H. Srinivasa[4]

[1]Assistant Professor, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bannerghatta Road, Bangalore, [2]Associate Professor, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bannerghatta Road, Bangalore, [3]Associate professor, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bannerghatta Road, Bangalore, [4]Professor, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bannerghatta Road, Bangalore, India

Corresponding author: Manohar J. Suranagi, Associate Professor, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bannerghatta Road, Bangalore, India-560069.

DOI: http://dx.doi.org/10.21276/ijcmsr.2020.5.4.2

How to cite this article: Tejas Pandya, Manohar J. Suranagi, K. Subramanyam, K. H. Srinivasa. Study of young Indians with ST elevation myocardial infarction: risk factors, clinical presentation, angiographic profile and short-term prognosis. International Journal of Contemporary Medicine Surgery and Radiology. 2020;5(4):D7-D13.

ABSTRACT

Introduction: Coronary artery disease is certainly a catastrophic condition as a healthy person in the prime of life may die or become disabled without warning. When the victims are under the age of 45, it will lead to miserable consequences for family, friends and also have a great impact on occupational life. The present study aimed to evaluate the risk factors, clinical presentation, angiographic profile, and short term prognosis in young patients (*≤45 years*) with ST elevation myocardial infarction (STEMI).

Material and methods: This prospective, observational study involved 300 young (≤45 years) patients with STEMI during the period of January, 2016 and August, 2017. All patients were evaluated for risk factors, clinical presentation, angiographic profile, and short term prognosis.

Results: The mean age of patients was 38.4±4.7years; the most common age group was 36-40 years. The STEMI was highly predominant in males (93.3%).The major risk factor for STEMI in young patients was smoking followed by dyslipidemia. The most common anatomical location for MI was anterior wall (AW). Most of the patients had single vessel disease (SVD), and left anterior descending artery (LAD) was the most common vessel. In-hospital mortality occurred in only one patient.

Conclusion: STEMI in young patients is more frequent in male, mainly due to smoking. AWMI owing to LAD artery involvement was the most common presentation. In Indian young patients, it is characterized by earlier onset, delayed presentation, severe and more co-morbidities but with least in-hospital mortality. Timely diagnosis, modification of risk factors and treatment can prevent complications and mortality.

Keywords: Coronary Artery Disease (CAD), ST Elevation Myocardial Infarction (STEMI), Young Adults, Percutaneous Coronary Intervention (PCI), Coronary Angiogram (CAG)

INTRODUCTION

Worldwide, coronary artery disease (CAD) is the major cause of mortality and morbidity in developed as well as in developing countries. In India, the burden of non-communicable diseases has been emerging rapidly due to globalization, urbanization, ageing of society and an increased event of chronic diseases.[1,2] The frequency of CAD in rural and urban populations has differed throughout the Indian subcontinent. Existing data from multiple epidemiologic studies shaded light on a higher prevalence in urban population (7-13%)[3] than rural populations (2-7%).[4] Acute myocardial infarction (MI) is the typical presentation of CAD. ST-segment elevation myocardial infarction (STEMI) is a serious form of acute MI in which a coronary artery is completely blocked and a large part of the heart muscle is unable to receive blood. However, individuals younger than 40 years of age represent only 3% of total cases with MI.[5] Additionally, CAD has a great impact on psychological consequences, especially in younger age groups.[6] Another concern is that, the CAD in young age results into financial burden on affected individuals and their family, because this age is considered as a productive age. By far the most commonly associated risk factors are conventional, which include age, sex, hypertension, smoking, diabetes mellitus, dyslipidemia and obesity.[7] Several genes such as apolipoprotein B (Apo B), apolipoprotein E (Apo E), hepatic lipase gene, lipoprotein lipase, and proprotein convertase subtilisin/kexin type 9 (PCSK 9) also contribute in pathogenesis of CAD, which are referred as the newest

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

risk factors.[8] Besides, dietary habits as well as unplanned urbanization coupled with sedentary but significantly stressful lifestyle are proposed as the additional risk factors for CAD. In the very young (≤ 30 years) patients with STEMI, drug abuse is also apparent as a major risk factor apart from smoking.[9] Proper care of young patients with STEMI and probable outcomes are still not well defined. Correspondingly, the mechanism and disease course of AMI are believed to be more distinct in young patients than older patients.[10] In literature, there is a lack of evidence based study from India[11] as well as western countries[12] that focus on the clinical data in young patients with STEMI. This study outlines the conventional risk factors, clinical presentation, angiographic profile and short-term prognosis in young patients with STEMI to characterize this medical condition.

MATERIAL AND METHODS

This was a prospective, observational study conducted between January, 2016 and August, 2017 after obtaining ethical approval from the institutional ethical committee. Written informed consent obtained from all the patients before enrollment. The study was conducted in accordance with the Declaration of *Helsinki*.

The inclusion criteria in this study are as follows: patients with acute STEMI with age ≤45 years without any gender bias; patients with a history of previous MI presented with re-MI; MI diagnosed by detection of a rise and/or fall in cardiac biomarkers values preferably cardiac troponin (cTn), with at least one value above the 99th percentile of the upper reference limit and with at least one of the following mentioned: symptoms of ischemia, new or presumed new significant ST-T wave changes or new left bundle branch block, development of the pathologic Q wave in the electrocardiography (ECG), imaging evidence of the new loss of viable myocardium or new regional wall motion abnormality and identification of an intracoronary thrombus by angiography or autopsy.

Patients with MI having age >45 years and <18 years, patients with unstable angina or non-ST-elevation myocardial infarction (NSTEMI), patients with previous MI, patients with history of percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) were the main exclusion criteria.

Methods

A total of 300 patients were included in the study as per the mentioned inclusion and exclusion criteria. After taking detailed history and demographic details, all patients were subjected to thorough clinical examination. Routine biochemistry (complete hemogram, urea, creatinine, blood sugar, TSH, fasting lipid profile, viral markers such as hepatitis B surface antigen (HBsAg), hepatitis C virus (HCV) and human immunodeficiency virus (HIV), urine examination, including routine and microscopy-active sediment, ECG and echocardiography were done as a part of routine practice. The risk factors which were included in the study were hypertension, diabetes mellitus, smoking habits, dyslipidemia, obesity (BMI of >30 kg/m2), and a past history of myocardial infarction, cerebrovascular accident and peripheral vascular disease. A family history of ischemic heart disease was considered (in first degree relatives < 55 years in men and < 45 years in women).

Anthropometric and clinical examinations including blood pressure estimation were performed for each patient. Body mass index (BMI) was also calculated using Quetlet's formula, and overweight was considered as BMI>25 kg/m^2. *Notably,* clinical presentation, window period as well as complications were reported. Every patient was subjected to invasive coronary angiography either as a part of primary PCI or before discharge if the patient was already thrombolysed or conservatively managed. Data regarding TIMI flow, severity of lesion, calcification of vessel wall and presence of thrombus was recorded. All patients were treated according to latest MI management guidelines. In hospital short term prognosis in terms of death was also noted.

Obstructive CAD was defined as ≥70% lesion in the major epicardial arteries, or ≥ 50% lesion in left main coronary artery. Intermediate disease was defined as 50% to 69% stenosis of major epicardial arteries, whereas minimal disease was defined as ≤50% lesion and together they were combined and classified as having non-obstructive disease.[18] Culprit artery was diagnosed on the angiographic finding.

STATISTICAL ANALYSIS

Statistical analyses were performed using the SPSS for windows (version 17.0, SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean and standard deviation, whereas categorical variables were presented as numbers and percentages.

RESULTS

Baseline characteristics

In total, 300 patients were included in the study with the mean age of 38.4±4.7 years. The maximum number of patients (39.3%) being within the age group of 36-40 years, whereas 1.7%of the patients being in the age group 21-25 years. 93.3% patients were males and 6.7% were females. Table 1 shows the demographic characteristics of younger patients with STEMI. The majority of patients were in the private sector (44%) followed by laborer (18%). Low physical activity group (65.7%) was more affected than high physical activity group (34.3%). STEMI was highly prevalent in urban population, which accounting for 65% of the total cases. Mean BMI was 23.5±2.3 kg/m^2 in our study population, and 18.3% of cases had BMI >25 kg/m^2.

Conventional risk factors

The most common risk factor for STEMI in young patients was found to be smoking (64.3%), followed by dyslipidemia (28.7%) and DM (21.3%)[Table 2].

Clinical characteristics

The clinical characteristics of the patients are depicted in Table 3. The most common symptom was chest pain (86.7%), followed by sweating (51%) and dyspnea (9.7%). The majority of patients (43%) had 3-6 hrs window period. Anterior wall MI (AWMI) was the most common type of MI in the study population in 181(60.3%) patients, whereas IWMI was seen in 113(37.7%) patients and LWMI in 6(2%) patients. At the time of admission, 278 patients (92.7%) were Killip's

class I, 6 in class II (2%), 7 in class III (2.3%) and 9 in class IV (3%) patients. Further, the estimation of left ventricular (LV) dysfunction was carried out by non-volumetric echocardiographic analysis, and findings revealed that 36 (12%) patients had a normal LV function (LVEF>60%), 54 (18%) patients had mid-range (LVEF=50-60%) LV dysfunction, 150 (50%) patients had mild (LVEF=40-49%) LV dysfunction, 60 (20%) patients had moderate (LVEF=30-39%) LV dysfunction. Severe LV dysfunction (LVEF< 29%), was not reported in any of the cases.

All patients were subjected to coronary angiogram through

Characteristics	n=300
Age (years), Mean±SD	38.4±4.7
Age groups (years), n(%)	
21-25	5(1.7)
26-30	25(8.3)
31-35	44(14.7)
36-40	118(39.3)
41-45	108(36)
Gender, n(%)	
Male	280(93.3)
Female	20(6.7)
Occupation, n(%)	
Business	38(12.7)
Farmer	30(10)
Government service	21(7)
Housewife	18(6)
Laborer	54(18)
Prisoner	1(0.33)
Private service	132(44)
Teacher	6(2)
Occupation Group, n(%)	
High physical activity	103(34.3)
Low physical activity	197(65.7)
Urban, n(%)	195(65)
Rural, n(%)	105(35)
‡SD, Standard deviation	

Table-1: Baseline demographic characteristics of young patients with STEMI(n=300)

Risk factors	n=300
Family history of IHD	12(4%)
Hypertension, n(%)	48(16%)
Diabetes mellitus, n(%)	64(21.3%)
Smoking, n(%)	193(64.3%)
Dyslipidaemia, n(%)	86(28.7%)
Total cholesterol (Mean±SD)	190.7±49.1
High-density lipoprotein (Mean±SD)	33.84±6.7
Low- density lipoprotein (Mean±SD)	111.5±36.4
Triglycerides (Mean±SD)	191.45±103.3
Mean BMI (kg/m2) (Mean±SD)	23.5±2.3
BMI >25, n(%)	55(18.3)
Past history, n(%)	
Myocardial infarction	12(4%)
Cerebrovascular accident	3(1%)
Peripheral vascular disease	2(0.7%)
‡SD, Standard deviation; BMI, Body mass index; IHD, Ischemic heart disease	

Table-2: Conventional risk factors

Clinical characteristics	n(%)
Clinical presentation	
Chest pain	260(86.7)
Sweating	153(51)
Dyspnoea	29(9.7)
Nausea/vomiting	27(9)
Arrhythmia	13(4.3)
Giddiness	6(2)
Pulmonary edema	3(1)
Window period	
<3	32(10.7)
3-6	129(43)
6-12	50(16.7)
12-24	51(17)
>24	38(12.7)
ECHO LVEF	
Less than 29%	0(0.0)
30-39%	60(20)
40-49%	150(50)
50-60%	54(18)
>60%	36(12)
CXR-PA	
Normal	286(95.3)
Cardiomegaly	0(0.0)
Pulmonary edema	14(4.7)
Type of MI	
AWMI	181(60.33)
IMMI	113(37.67)
LWMI	6(2)
Killip's class at admission time	
Class I	278(92.7)
Class II	6(2)
Class III	7(2.3)
Class IV	9(3)
Mean STEMI risk score	1.94±0.918
‡ CXR-PA, Chest X-ray posteroanterior view; MI, Myocardial infarction; AW, Anterior wall; IW, Inferior wall; LW, Lateral wall; ECHO, Echocardiography; STEMI, ST-Elevation myocardial infarction	

Table-3: Clinical characteristics of the patients (n=300)

Treatments	n(%)
Primary PTCA	50(16.7)
Fibrinolysis	200(66.7)
Elective PTCA	130(43.3)
CABG	10(3.3)
Aspirin	300(100%)
Clopidogrel	300(100%)
Beta-Blocker	281(93.6%)
ACEI/ARB	281(93.6%)
Statin	300(100%)
Nitrates	172(57.3%)
UFH/LMWHs	298(99.3%)
Lignocaine	4(1.3%)
GPIIb/IIIa inhibitor	35(11.7%)
‡ ACEI/ARB, Angiotensin-converting enzyme/ angiotensin receptorblocker; UFH, Unfractionated heparin; LMWHs, Low-molecular-weight heparins; GP,Glycoprotein	

Table-4: Treatment received:

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

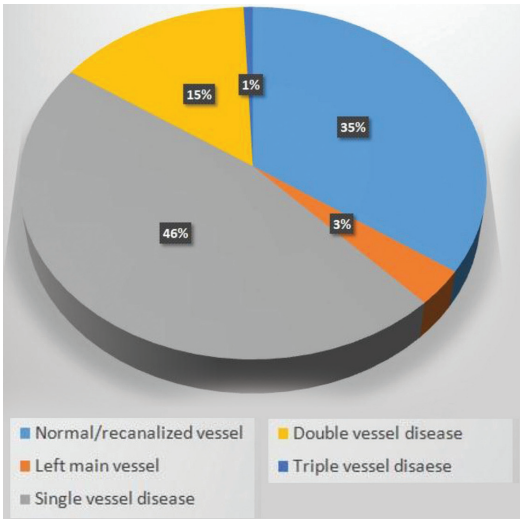

Figure-1: Chart displays the vessel involved in STEMI

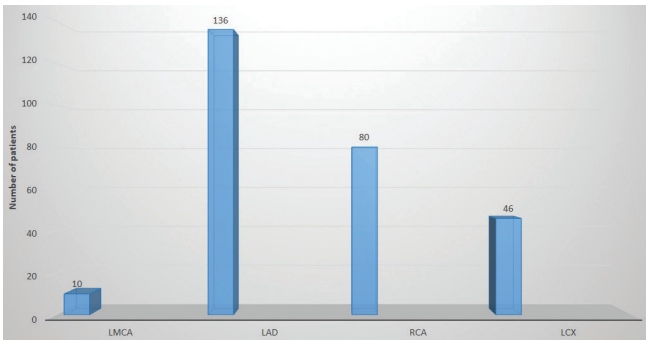

Figure-2: Graphical presentation of involved artery in young patients with STEMI

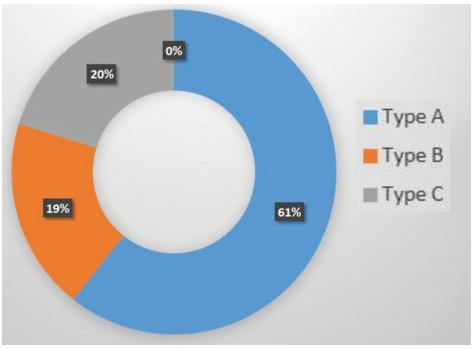

Figure-3: Type of lesion associated with STEMI

Complications No complications	n(%) 250(83.33)
Arrhythmia	17(5.67)
Ventricular tachycardia	8 (2.67)
Complete heart block	8 (2.67)
Atrial fibrillation	1(0.33)
Left ventricular (LV) failure	15(5)
LV clot	7(2.33)
Cardiogenic shock	5(1.66)
Mitral regurgitation	4(1.33)
Intracranial bleeding	1(0.33)
Death (In hospital)	1(0.33)

Table-5: List of complications (n=300)

standard procedure.

Coronary angiographic characteristics

Out of 300 patients, the normal or recanalized vessel was observed in 104 (34.7%) patients on angiography, and remaining 196(65.3%) had an obstruction in the vessel. Of these 196 patients, obstructive CAD was seen in 138(46%) patients, and 58(19.3%) patients had total occlusion.

As shown in Figure 1, a maximum number of patients (46%) had single vessel disease (SVD), and only 1% had triple vessel disease (TVD). Left anterior descending artery (LAD) 136 (45.3%) has been the most frequently involved vessels in young patients, followed by right coronary artery (RCA) 80 (26.7%) and left circumflex artery 46 (LCX) (15.3%) [Figure 2]. In the present study, type A lesion was most common (61%), followed by type C (20%) and type B (19%) [Figure 3].

Of the 300 patients with STEMI, 50 (16.7%) received primary percutaneous transluminal coronary angioplasty (PTCA), while 200 (66.7%) patients received fibrinolysis and 50 (16.67%) patients received the medication as per standard acute coronary syndrome (ACS) protocol [Table 4]. Elective PTCA was done in 130 (43.3%) patients and CABG was done in 10 (3.3%) patients. Almost all patients were prescribed aspirin, clopidogrel, statin and heparin, and only 4 patients received injection lignocaine.

As shown in Table 5, out of 300 patients, 250 (83.33%) patients had no complications, whereas 50 (16.67%) patients had complications. 17 patients (5.67%) had Arrythmia out of that 8 had VT, 8 patients had CHB and 1 patient had Atrial

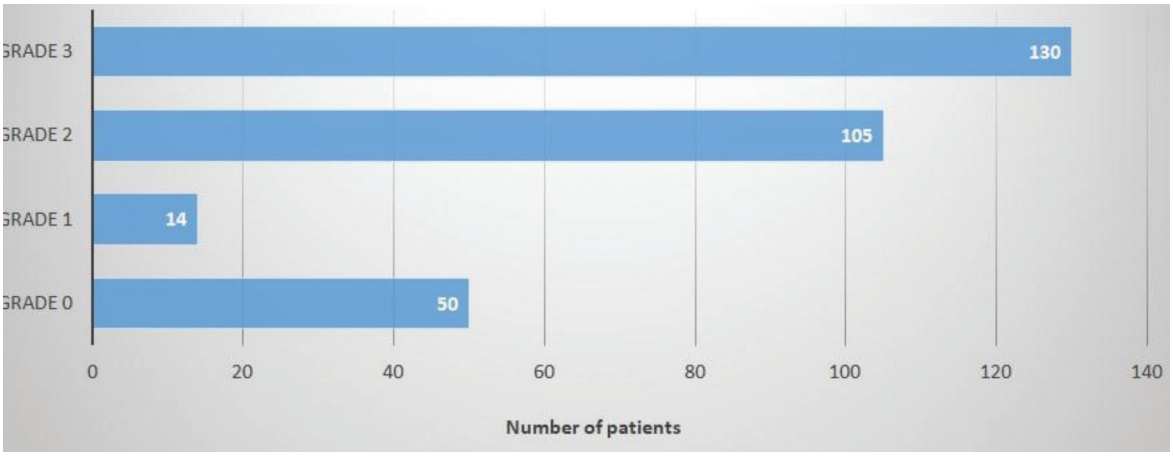

Figure-4: Distribution of patients according to TIMI flow grade after treatment

Fibrillation. 15 patients had left ventricular failure, 7 patients had LV Clot, 5 patients had Cardiogenic shock, 4 patients developed Mitral Regurgitation. 1 patient had intracranial bleed after fibrinolysis.Death occurred in one patient during hospital stay.

Prognosis: In Hospital short term Prognosis was very good in young patients with STEMI. Out of 300 patients only 1 Patient died during hospital stay, who had cardiogenic shock following extensive AWMI and late presentation to the hospital. Average hospital stay was around 4 days.

DISCUSSION

With great emergence of CAD in India, World Health Organization (WHO) proposes that India will become cardio-diabetic hub globally. Cardiovascular disease appears to be more aggressive, and begins to manifest at a very young age[13], which was also observed in our study. Various probable mechanisms that lead to coronary atherosclerosis early in life have been extensively studied in the last few years; such as rupture of a vulnerable plaque or erosion of the endothelial layer, hypercoagulable states, coronary artery spasm, and inflammation with atherosclerosis.[5] Generally, atherosclerotic course starts from birth, but significant lesions in the coronary arteries may be visible as early as the age of 25 or 30 years.[14] The reason behind such rapid development of atherosclerosis that lead to MI at an early stage has been a mysterious matter.

In the present study, the majority of patients (39.3%) fall within 36-40 years age group, which was comparable to study by Sricharanet al.[15], Swain et al.[16], Sinha et al.[17], INTERHEART study and its South Asian cohort.[18] Controversially, other studies reported a higher prevalence in 31-35 years age group.[19-21] Overall, we can say that age after 30 years has been predominately affected with CAD.

One of the best reported and the most compatible risk factor for coronary atherosclerosis appears to be the male sex. Several epidemiological studies reported that the preponderance of smokers were more common amongst male, this poses to be the main reason for the higher incidence of STEMI in male. On the other hand, the prevalence is much lower in female that mainly attributed to the beneficial role of estrogens in the prevention of atherosclerosis.[22] In western studies, male: female ratio was found to be 12.3:1[23], and 11.5:1.[24] Although, these values were more inconsistent in Indian studies[17-19], the trend has remained the same towards males.

Epidemiological research has established smoking, hyperlipidemia, family history of IHD, HT, DM as independent risks of STEMI among the multiple factors worldwide in both sexes and at all ages. These all factors have been related with increased fibrousplaques and their sequelae. In agreement with previous studies, our study reported that smoking is one of the leading causes of STEMI and other chronic cardiovascular diseases as well.[11,25,26] Following smoking, dyslipidemia is another vital risk factor for STEMI. In literature, the plasma lipoprotein profile, the cholesterol levels as well as morbidity and mortality have been directly correlated with coronary atherosclerosis. In young Asian adults, hyperlipidemia is a major risk factor for MI consistent with earlier studies.[27-29] DM and HT are the most frequently encountered risk factors among the older MI patients, while those are less common in young patients in our study as well as previously reported studies.[12,26,30] In the present study, triglyceride (TG) was directly, and high-density lipoprotein (HDL) was inversely associated with the relative risk of MI, these verdicts were in favour of findings obtained in Asian Indians. Controversially, increased low-density lipoprotein (LDL) has been blamed for the cause of CAD in the western world.[31] BMI>30kg/m^2 has been the most common risk factor in western studies[12,32], but in Indian studies[33] it was less pronounced, this similar finding was noted in our study.

The chest pain was the most common presentation in our study, which was comparable with earlier studies also.[19,20] As in previous studies[15,17,19-21], in present study too, AWMI was the most common type of STEMI among young patients. In contrast, other studies[16] demonstrated inferior wall MI (52% vs. 45% and 40% vs. 33.3%) as common location. So far, there was a paucity of angiographic data in patients less than 45 years since only a small proportion of young patients were suggested for angiography. With respect to the extent of coronary lesions, our subjects demonstrated a less evolved disease. The probable reason behind this may be premature coronary artery disease is correlated with rapid progression of disease rather than with a gradually evolving process in young patients.[34] In the present study, the SVD was more obvious among young patients, which was in favor of the findings reported earlier.[12,15,17,19-21,26,30] In addition, the incidence of TVD was much higher (35%) in our study than other reported studies.[15,16,19-21] Regarding the extent of disease, 19% patients had type B lesion, and 20% patients had type C lesion. On the other hand, AMIYA study[17] reported 18.4% and 47.5% involvement of type B and type C lesion, respectively. In present study, involvement of left main vessel was observed in 44% of total cases. This was similar to values reported by Baduiet al.35 (41%), but lower than the values reported by Zimmerman et al. (85%)[12] and Colkesenetet al. (60%).[26] This discrepancy in findings may be explained by the difference in atherosclerotic behavior among the individuals. There were some major limitations associated with this study. Only conventional risk factors that cause STEMI in young patients had been studied. Other newer risk factors like homocysteinaemia, hereditary thrombophilia, anti-phospholipid antibody syndrome and genetic factors were not included. The lack of long-term follow-up was another restriction. Further large randomized study needs to be addressed emerging risk factors, and their association in STEMI in young patients.

CONCLUSION

Incidence of critical CAD has been continuously rising in young patients, especially in males. Smoking was the most common risk factor of STEMI followed by dyslipidemia in young patients. A higher number of patients had SVD. AWMI due to LAD occlusion was the most typical presentation of STEMI in Indian populations. Prevention of the disease is presumably good alternative to improve outcomes by cessation of smoking, modifying life style, adopting healthy dietary habits, public awareness programs

ISSN (Online): 2565-4810; (Print): 2565-4802 | ICV 2019: 98.48 |

and regular exercise. All young patients who presented with STEMI with or without LV dysfunction should be screened by coronary angiogram as soon as possible, and required interventions should be done, so they can gain a better quality of life in their prime age.

REFERENCES

1. Horton R. Offline: Chronic diseases—the social justice issue of our time. The Lancet. 2015;386(10011):2378.
2. Danaei G, Singh GM, Paciorek CJ, Lin JK, Cowan MJ, Finucane MM, et al. The global cardiovascular risk transition: associations of four metabolic risk factors with national income, urbanization, and Western diet in 1980 and 2008. Circulation. 2013;127(14):1493-502.
3. Mohan V, Deepa R, Shanthi Rani S, Premalatha G. Prevalence of coronary artery disease and its relationship to lipids in a selected population in South India. The Chennai Urban Population Study (CUPS No 5). 2001;38(3):682-7.
4. Gupta A, Bharadwaj A, Ashotra S, Gupta B. Feasibility and training of multipurpose workers in detection, prevention and control of coronary artery disease in apple-belt of Shimla hills. South Asian J Prev Cardiol. 2002;6(4):17-22.
5. Fournier JA, Cabezón S, Cayuela A, Ballesteros SM, Cortacero JA, Díaz De La Llera LS. Long-term prognosis of patients having acute myocardial infarction when </=40 years of age. Am J Cardiol. 2004;94(8):989-92.
6. Chadha SL, Radhakrishnan S, Ramachandran K, Kaul U, Gopinath N. Epidemiological study of coronary heart disease in urban population of Delhi. Indian J Med Res. 1990;92(1):424-30.
7. Bhardwaj R, Kandoria A, Sharma R. Myocardial infarction in young adults-risk factors and pattern of coronary artery involvement. Niger Med J. 2014;55(1):44-7.
8. Kouichi Ozaki. Genetic background of acute coronary syndrome. Nihon Rinsho. 2010;68(4):615-20.
9. Jneid H, Fonarow GC, Cannon CP, Hernandez AF, Palacios IF, Maree AO, et al. Sex differences in medical care and early death after acute myocardial infarction. Circulation. 2008;118(25):2803-10.
10. Shah N, Wang C, Lee V, Cox N, Wong C, Kelly A-M, et al. Myocardial Infarction in Young versus Older Adults: An Analysis of Differences in Proportion, Risk Factors, Clinical Demographics, Angio- graphic Findings and in-Hospital Outcome. International Journal of Clinical Cardiology. 2016;3(2):34-39.
11. Sharma M, Ganguly NK. Premature coronary artery disease in Indians and its associated risk factors. Vasc Health Risk Manag. 2005;1(3):217-25.
12. Zimmerman FH, Cameron A, Fisher LD, Ng G. Myocardial infarction in young adults: angiographic characterization, risk factors and prognosis (Coronary Artery Surgery Study Registry). J Am Coll Cardiol. 1995;26(3):654-61.
13. Enas EA, Yusuf S, Mehta J. Meeting of the International Working Group on Coronary Artery Disease in South Asians. 24 March 1996, Orlando, Florida, USA: Indian Heart J. 1996;48(6):727-32.
14. Tuzcu EM, Kapadia SR, Tutar E, Ziada KM, Hobbs RE, McCarthy PM, et al. High prevalence of coronary atherosclerosis in asymptomatic teenagers and young adults: evidence from intravascular ultrasound. Circulation. 2001;103(22):2705-10.
15. Sricharan K.N. RR, Rashmi, Meghana H.C., Sanjeev Badiger, Soumya Mathew. Study of Acute Myocardial Infarction in Young Adults: Risk Factors, Presentation and Angiographic Findings. Journal of Clinical and Diagnostic Research. 2012;6(2):257-60.
16. Swain L, Routray P. Demographic and clinic-angiographic profile of coronary artery disease in young adults: a retrospective observational study. International Journal of Research in Medical Sciences. 2018;9(5):12-19.
17. Sinha SK, Krishna V, Thakur R, Kumar A, Mishra V, Jha MJ, et al. Acute myocardial infarction in very young adults: A clinical presentation, risk factors, hospital outcome index, and their angiographic characteristics in North India-AMIYA Study. ARYA Atheroscler. 2017;13(2):79-87.
18. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364(9438):937-52.
19. Malik F-T-N, Kalimuddin M, Ahmed N, Badiuzzzaman M, Ahmed MN, Dutta A, et al. AMI in very young (aged ≤35years) Bangladeshi patients: Risk factors & coronary angiographic profile. Clinical Trials and Regulatory Science in Cardiology. 2016;13(3):1-5.
20. Baiju Rajan KP. Risk factors and coronary angiographic profile of very young patients with acute Myocardial Infarction –a tertiary center experience. Stanley Medical Journal. 2017;4(1):92-00.
21. Kumbhalkar S, Bisne V. Clinical and angiographic profile of young patients with ischemic heart disease: A central India study. Journal of Clinical and Preventive Cardiology. 2019;8(1):6-12.
22. Weinberger I RZ, Fuchs J. Cardiology heart disease morbidity and mortality in the sexes; a 26 year follow-up of the Framingham population. Am Heart J. 1986;113:383-90
23. Gallet B, Leroy G, Saudemont JP, Baragan J, Desnos M, Juillard A, et al. [Myocardial infarction in the young subject: a medium-term clinical and coronary angiographic study in 40 patients under 36 years of age. Comparison with coronary angiographic data of myocardial infarction in patients after 50 years of age. Arch Mal Coeur Vaiss. 1984;77(1):27-36.
24. Glover MU, Kuber MT, Warren SE, Vieweg WV. Myocardial infarction before age 36: risk factor and arteriographic analysis. Am J Cardiol. 1982;49(7):1600-3.
25. Jamil G, Jamil M, Alkhazraji H, Haque A, Chedid F, Balasubramanian M, et al. Risk factor assessment of young patients with acute myocardial infarction. Am J Cardiovasc Dis. 2013;3(3):170-4.
26. Colkesen AY, Acil T, Demircan S, Sezgin AT, Muderrisoglu H. Coronary lesion type, location, and characteristics of acute ST elevation myocardial

infarction in young adults under 35 years of age. Coron Artery Dis. 2008;19(5):345-7.
27. Kanitz MG, Giovannucci SJ, Jones JS, Mott M. Myocardial infarction in young adults: risk factors and clinical features. J Emerg Med. 1996;14(2):139-45.
28. The Lipid Research Clinics Coronary Primary Prevention Trial results. I. Reduction in incidence of coronary heart disease. JAMA. 1984;251(3):351-64.
29. Randomized trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). Lancet. 1994;344(8934):1383-9.
30. Wolfe MW, Vacek JL. Myocardial infarction in the young. Angiographic features and risk factor analysis of patients with myocardial infarction at or before the age of 35 years. Chest. 1988;94(5):926-30.
31. Hughes LO, Wojciechowski AP, Raftery EB. Relationship between plasma cholesterol and coronary artery disease in Asians. Atherosclerosis. 1990;83(1):15-20.
32. Ciruzzi M, Schargrodsky H, Rozlosnik J, Pramparo P, Delmonte H, Rudich V, et al. Frequency of family history of acute myocardial infarction in patients with acute myocardial infarction. Argentine FRICAS (Factores de Riesgo Coronario en America del Sur) Investigators. Am J Cardiol. 1997;80(2):122-7.
33. Pais P, Pogue J, Gerstein H, Zachariah E, Savitha D, Jayprakash S, et al. Risk factors for acute myocardial infarction in Indians: a case-control study. Lancet. 1996;348(9024):358-63.
34. Chen L, Chester M, Kaski JC. Clinical factors and angiographic features associated with premature coronary artery disease. Chest. 1995;108(2):364-9.
35. Badui E, Rangel A, Valdespino A, Graef A, Plaza A, Chávez E, et al. [Acute myocardial infarct in young adults. A report of 142 cases]. Arch Inst Cardiol Mex. 1993;63(6):529-37.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 30-08-2020; **Accepted:** 15-10-2020; **Published online**: 27-10-2020