ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 08 | August - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STUDY OF ST ELEVATION MYOCARDIAL INFARCTION IN YOUNG ADULTS: RISK FACTORS, CLINICAL PRESENTATION , ANGIOGRAPHIC PROFILE AND SHORT TERM PROGNOSIS

Cardiology

Mukesh Kumar Sharma — Senior professor & HOD, Department of Cardiology, RNT Medical College, Udaipur, Rajasthan.

Deepak Ameta — Assistant Professor, Department of Cardiology, RNT Medical College, Udaipur, Rajasthan.

Sushil Yadav — Senior Resident, Department of Cardiology, RNT Medical College, Udaipur, Rajasthan.

Shalinder Pal Singh* — Senior Resident, Department of Cardiology, RNT Medical College, Udaipur, Rajasthan. *Corresponding Author

ABSTRACT

Background: Acute myocardial infarction (AMI) is often present in old populations and rare in young people. Its incidence has significantly increased in recent years. The mechanism and disease course of AMI in young people are probably different from that in old population. The present study aimed to evaluate the risk factors, clinical presentation, angiographic profile, and short term prognosis in young patients (*≤40 years*) with ST elevation myocardial infarction (STEMI). **METHODS:** Total of 68 consecutive patients with ST-segment elevation acute myocardial infarction (STEMI) were studied between January 2019 and December 2020 in Cardiology department at RNT Medical College, Udaipur, Rajasthan, India. **RESULTS:** Mean age of the patients was 33 years. Risk factors were smoking (58.8%), hyperlipidemia (51.4%), family history of premature coronary artery disease (CAD) (22.1), obesity (10.2%), physical inactivity (48.5%) and stressful life events (32.3%). STEMI in young patients is more frequent in males, mainly due to smoking. The most common symptom and presentation was chest pain and anterior wall myocardial infarction (AWMI) in 91.1% and 67.6%, respectively. About 44.1% of patients had obstructive CAD with single vessel disease in 80.8%, 16.1% had double-vessel disease and 1.4% had significant left main involvement. Left anterior descending (LAD) was commonest culprit artery in 55.8% followed by right coronary artery in 19.1%. In-hospital mortality was 0%. **CONCLUSION:** STEMI in young patients is more frequent in males, mainly due to smoking. AWMI owing to LAD artery involvement was the most common presentation. Mean time of presentation after symptom onset was 14.7 hours in young patients, it is characterized by earlier onset, delayed presentation, severe and more co-morbidities but with least in-hospital 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]

India is going through an epidemiologic transition whereby burden of communicable diseases has been declining slowly, but that of non-communicable diseases (NCD) has been rising rapidly, thus facing a dual burden. 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. Recently, the age spectrum of acute MI is also encompassing younger individuals. However, individuals younger than 40 years of age represent only 3% of total cases with MI.[3] Moreover, it carries significant morbidity, psychological impact, and financial burden for the patient and their family when it occurs at a young age as the productive age group is being affected. The prevalence of CAD as well as AMI has progressively increased in India in the last three decades from 1.1% to 7.5% in the urban and 2.1% to 3.7% in the rural population.[4] By far the most commonly associated risk factors are conventional, which include age, sex, hypertension, smoking, diabetes mellitus, dyslipidemia and obesity.[5] 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 novel risk factors.[6] Besides, dietary habits as well as expanding 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.[7] 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.[8] In literature, there is a lack of evidence based study from India[9] as well as western countries that focus on the clinical data in young patients with STEMI. This study outlines the conventional risk factors, clinical presentation and angiographic profile in young patients with STEMI to characterize this medical condition.

MATERIAL AND METHODS

This was a prospective, observational study conducted between January, 2019 and December, 2020 . Written informed consent obtained from all the patients before enrollment. The study was conducted in accordance with the Declaration of *Helsinki.*

Inclusion criteria were based on diagnosis of STEMI defined by the European Society of Cardiology (ESC)/American College of Cardiology Foundation (ACCF) as (a) new ST elevation at the J point in ≥ 2 contiguous lead of ≥ 2 mm in men or ≥ 1.5 mm in women in leads V2–V3 and/or of 1 mm in other contiguous chest or the limb leads, and (b) new or presumably new left bundle branch block (LBBB) was considered STEMI equivalent. Exclusion criteria were: (a) patients with prior history of MI, coronary artery bypass graft (CABG) surgery or percutaneous coronary intervention (PCI), (b) electrocardiogram (ECG) suggesting bundle branch block or left ventricular hypertrophy, (c) electrolyte abnormality, (d) certain conditions influencing ST-segment on ECG (e.g. suspected myocarditis, pericarditis, hypothermia, receiving amiodarone treatment etc.). Patients subsequently underwent coronary angiography and revascularization by either primary PCI or pharmaco-invasive PCI or CABG surgery if required.

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. Smokers were defined as those who were either currently smoking (> 4 weeks) including bidi, cigarette and cigar or who had quit their smoking (< 1 year). Anthropometric and clinical examinations including blood pressure estimation were performed for each patient. Body mass index (BMI) was also calculated using Quetelet index formula, and overweight was

considered as BMI > 30 kg/ m^2. Blood pressure was recorded in left arm in supine position with an appropriately sized cuff using a sphygmomanometer. Hypertension was defined as systolic blood pressure ≥ 140 and/or diastolic ≥ 90 mmHg and/or on anti-hypertensive treatment. Diabetes mellitus (DM) was defined as patients having fasting plasma glucose (FPG) ≥ 126 mg/dl and/or post-prandial plasma glucose (PPPG) ≥ 200 mg/dl or a past history of DM and/or taking medication for diabetes. Hyperlipidemia was defined as serum cholesterol of ≥ 200 mg/dl, triglyceride (TG) >150 mg/dl, low-density lipoprotein > 130 mg/dl, HDL-C < 50 mg/dl for female and < 40 mg/dl for male, a total cholesterol/HDL-C value of ≥ 4.5, known cases of dyslipidemia and/or those on medication for dyslipidemia.

The risk factors which were studied were hypertension, diabetes mellitus, smoking habits, overweight, hyperlipidemia, physical inactivity (using the International physical activity questionnaire-IPAQ), stressful life events (using Presumptive Stressful Life Events Scale i.e. PSLES) and a family history of premature CAD (in first degree relatives < 55 years in men and < 65 years in women). Prasad's Socio-economic status(SES) scale which is based on monthly per capita income is used to divide into lower, lower middle, middle, upper middle and upper class. Obstructive CAD was defined by QCA analysis as ≥ 70% lesion in 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.[11] Culprit artery was diagnosed on the angiographic finding.

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 percentage

RESULTS

***Baseline Characteristics*:** Total patients enrolled in study were 68 . The mean age of the patients was 33 ± 3.9 years, with maximum number of patients (47.1%) being within the age of 36–40 years. The youngest patient was 22 years old. Men comprised 88.2% (n = 60) of the patients (Table 1). AMI in very young patients was more prevalent in urban population (55.8%). Considering the socioeconomic status most of the patients were from lower middle class 35.2% (n=24) while 32.3% (n=22) were from middle class. Smoking was the most common risk factor (58.8%), hyperlipidemia being the second common risk factor (51.4%), whereas 22.1% of the patients had a family history of premature CAD. Hypertension was seen in 16 patients (23.5%) while 13 patients had diabetes (19.1%). History of tobacco intake was present in 17.6%.Sedentary lifestyle was present in 48.5% while moderate activity was seen in 32.3% of patients. Substance abuse was rare, 2 patients reported using cannabis (2.9%). Oral contraceptive drugs were used by 1 woman (1.4%). One woman had 6 weeks pregnancy.

Table 1. Baseline characteristics of the patients (n = 68)

Variables	N(%)
Mean Age (year)	33 ± 3.9
Sex (male/female)	60/8 (88.2/11.8)
Background (urban/rural)	38/30 (55.8/44.1)
Smoking	40 (58.8)
Hypertension	16 (23.5)
Diabetes	13(19.1)
Family history of premature CAD	15 (22.1)
Obesity	7 (10.2)
Physical inactivity	33 (48.5)
Substance abuse (cannabis)	2 (2.9)
Stressful life events	22 (32.3)
Dyslipidemia	35(51.4)
Total cholesterol (mg/dl)	190.7 ± 32.4
LDL-C (mg/dl)	113.2 ± 28.1
TG (mg/dl)	162.1 ± 47.4
HDL-C (mg/dl)	37.2 ± 5.3
Non-HDL-C (mg/dl)	148.0 ± 12.9

CAD: Coronary artery disease; LDL-C: Low-density lipoprotein cholesterol; TG: Triglyceride; HDL-C: High-density lipoprotein cholesterol

***Mode of clinical presentation*(table-2):** The most common symptom was chest pain in 62 (91.17%) patients with radiation of pain (44.7%), followed by sweating 58 (80.8%), nausea/vomiting 12 (17.6%), palpitation 8 (11.7%), and breathlessness 6 (8.8%). Two patients (2.9%) had atypical symptoms. Eleven patients (16.1%) experienced prodromal symptoms (Table 2). The mean time of presentation after the onset of the symptoms was 14.7 hours. Of these 73.5 % (n=50) patients presented within window period and these were thrombolysed.

Anterior wall myocardial infarction (AWMI) was found in 67.6% of the patients, 20.5% had inferior wall MI (IWMI) without right ventricular MI (RVMI), 4.4% had IWMI with RVMI, 5.8% had posteroinferior MI while 1.4% had lateral wall MI (Table 2). About 18 patients (26.4%) presented late (> 12 hour) and they were managed medically as per guideline. Remaining 50 patients (73.5%) received thrombolysis with uroinase ,streptokinase, reteplase or tenecteplase.

Table 2. Clinical characteristics of the patients (n = 68)

Variables	n (%)
Clinical presentation	
Chest pain	62 (91.1)
Breathlessness	6 (8.8)
Nausea/vomiting	12 (17.6)
Sweating	58(80.8)
Palpitation	8 (11.7)
Syncope	2 (2.9)
Atypical presentation	2 (2..9)
Prodromal symptoms	11 (16.1)
Pattern of AMI	
AWMI	46 (67.6)
IWMI	14 (20.5)
IWMI with RVMI	3 (4.4)
LWMI	1(1.4)
IWMI with PWMI	4(5.8)

AMI: Acute myocardial infarction; AWMI: Anterior wall myocardial infarction; IWMI: Inferior wall myocardial infarction; RVMI: Right ventricular myocardial infarction; LWMI: Lateral wall myocardial infarction;PWMI:Posterio wall myocardial infarction.

Coronary angiographic characteristic: Angiography was done by either radial or femoral route after Allen's test. About 30 (44.1%) patients had obstructive CAD, 4 (5.8%) had normal angiogram while 5 (7.3%) had spontaneous dissection. Single vessel disease (SVD) was observed in 55 (80.8%), double vessel disease (DVD) in 11 (16.1%), triple vessel disease (TVD) in 2 (2.94%), left main in 1 (1.4) and anomalous coronaries in 1 (1.4%) patients. Left anterior descending (LAD) artery was infarct related artery (IRA) in 55.8%, right coronary artery (RCA) in 19.1% and the left circumflex coronary artery (LCX) in 5.8% patients (Table 4). In DVD, LAD and RCA involvement in 6 (8.8%) were the most affected arteries followed by LAD and LCX involvement in 4 (5.8%), and the least common was LCX and RCA involvement in 1 (1.4%) patients. TVD was seen in 2 (2.94%) patients and left main coronary artery (LMCA) disease was seen only in one patient(1.4%).Patients with diabetes had trend toward double vessel, multi-vessel and left main involvement in comparison to non diabetic patients. DVD was seen in 8 (11.7%) of patients with diabetes and in 3 (4.4%) of patients without diabetes.Only patient which had TVD was diabetic. In the present study, type A lesion was most common (52%), followed by type C (28%) and type B (20%).one patient had fistula from LAD and RCA to pulmonary artery. From patients who had obstructive CAD 29 (42.6%) underwent PTCA and 2 (2.9%) patients underwent CABG surgery.

Table 3. Coronary angiographic characteristics of the patients (n = 68)

Variables	n (%)
Obstructive CAD	30 (44.1)
Single vessel disease	55 (80.8)
a. LAD	38(55.8)
b. RCA	13 (19.1)
c. LCX	4 (5.8)
Double Vessel Disease	11(16.1)
a. LAD and RCA	6 (8.8)
b. LAD and LCX	4(5.8)
c. RCA and LCX	1 (1.4)

Triple vessel disease	2 (2.9)
Left Main disease	1 (1.44)
Anomalous coronaries	1 (1.4)
Spontaneous dissection	5 (7.3)
Normal coronaries	4 (5.8)
Lesion characteristics (length wise)	
a. Type A	52%
b. Type B	20%
c. Type C	28%

CAD: Coronary artery disease; DVD: Double vessel disease; LAD: Left anterior descending artery; LCX: Left circumflex artery; RCA: Right coronary artery; SVD: Single vessel disease; TVD: Triple vessel disease

As shown in Table 4, out of 68, 54(79.4%) patients had no complications, whereas 13(19.1%) patients had complications. 5 patients (7.3%) had arrhythmia out of that 3 had VT, 1 patient had CHB and 1 patient had Atrial Fibrillation. 3 patients had left ventricular failure, 1patient had LV Clot, 2 patients had Cardiogenic shock, 2 patients developed Mitral Regurgitation.No mortality occurred in 68 patients during hospital stay.

Prognosis: In Hospital short term prognosis was very good in young patients with STEMI. Out of 68 patients no patient died during hospital stay. Those who had cardiogenic shock following extensive AWMI and late presentation to the hospital recovered well during hospital stay. Average hospital stay was around 5 days .At one month follow up, no mortality was noted in 60 patients, as 8 patients were lost in follow up.

Table-4: List of complications (n=68)

Complications	N (%) 13(19.1)
Arrhythmia a. Ventricular tachycardia b. Complete heart block c. Atrial fibrillation	5(7.3) 3 (4.4) 1 (1.4) 1(1.4)
Left ventricular (LV) failure	3(4.4)
LV clot	1(1.4)
Cardiogenic shock	2(2.9)
Mitral regurgitation	2(2.9)
Death (In hospital)	0

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 age10, 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. 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.[11] 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 (47.1 %) fall within 36-40 years age group, which was comparable to study by Sricharanet al.,[12] Swain et al.,[13] Sinha et al.,[14] INTERHEART study and its South Asian cohort.[15] Controversially, other studies reported a higher prevalence in 31-35 years age group. Overall, we can say that age after 30 years has been predominately affected with CAD.

One of the most consistently demonstrated risk factors for CAD is male sex. The skewed gender distribution among males (88.2%) vs females (11.8%) of the study population is attributed to the protective effects of estrogens in preventing atherosclerosis and prevalence of smoking which was much more common amongst male that has been clearly demonstrated in various epidemiological studies.[16] It manifests decades earlier than western population as in GUSTO trial in which mean age was 62 ± 5 years as conducted by Hochman et al.[17]

MI without prodromal symptoms is more common in younger patients with CAD as seen in our study. Histopathological studies have shown that these plaques contain more lipid with relative lack of cellular scar tissue and are present for a shorter period of time or develop more quickly than plaques seen in older patients. These vulnerable plaques are prone to rupture that attributes for more STEMI at younger age than chronic stable angina.[18] High prevalence of stressful life events (32.3%) may have accounted for the instability of the plaque leading to its rupture culminating into STEMI. The relatively high prevalence of DVD (11.7%) and TVD (1.4%) in patients with diabetes when compared with those free of diabetes (4.4% and 0%, respectively) confirms the role of diabetes as a risk factor in CAD.[18]

Hypertension is another conventional risk factor for CAD. In our study, 23.5% of the patients had hypertension which was lower than South Asian cohort of INTERHEART study (31.1%) as population subgroup were different.[15]

Diabetes mellitus has been well described as a cardiovascular risk factor in developed and developing countries. In INTERHEART study the odds ratio of diabetes as risk factor for cardiovascular disease was 2.37 and PAR of 9.9%.In this study among those having myocardial infarction 18% had diabetes mellitus . In our study 19.1% patients had diabetes mellitus.

Following age, cigarette smoking is the most important and consistent risk factor for CAD with contribution ranging from 62% to 90% in various studies.[19] Like previous studies, smokers comprised 58.8% of the patients in our study. It adversely affects all phases of atherosclerosis by hastening thrombotic process, endothelial dysfunction, and coronary vasoconstriction, induces proinflammatory effects and ultimately creates a thrombotic milieu. Smoking cessation should be started as primordial prevention. There should be a strong legislation as well to prevent its uptake as it will cut down the major risk.

Family history of premature CAD was present in in 22.1%, which is higher as compare to study by Sekhri et al, which has prevalence of 4.6%.

Obesity was the infrequent cause in all the earlier studies with incidence of 3.3%–20%.[19] Physical inactivity was present in 48.5% patients. The prevalence of obesity was 10.2% in our study which was less as compare to South Asian cohort of INTERHEART study (44.2%).15. 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. Increased low-density lipoprotein (LDL) has been blamed for the cause of CAD in the western world.[20]

As in previous studies[12,14] in present study too, AWMI was the most common type of STEMI among young patients. In contrast, other studies[13] 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. In the present study, the SVD was more obvious among young patients, which was in favor of the findings reported earlier.[12,14]. The incidence of TVD was lower (2.94%) in our study than other reported studies.[12,14]. Regarding the extent of disease, 20% patients had type B lesion, and 28% patients had type C lesion. On the other hand, AMIYA study[14] 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 1.4% of total cases, this was less as compare to values reported by Badui et al.[21]

CONCLUSION

Among young patients presenting with STEMI, AWMI owing to LAD occlusion is the most common presentation, which manifests decades earlier as compared to Western population. Smoking, hypertension, hyperlipidemia, family history of premature CAD, stressful life, lack of physical activity and obesity were the most common risk factors. Multi vessel disease and complication were more in diabetic population. Young patients had favorable in-hospital outcome overall. Primordial prevention about smoking cessation and life style modification in cutting down obesity will be important epidemiological tool.

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. 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
4. 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: 424-30
5. 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.
6. Kouichi Ozaki. Genetic background of acute coronary syndrome. Nihon Rinsho. 2010;68 (4):615-20.
7. 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.
8. 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.
9. Sharma M, Ganguly NK. Premature coronary artery disease in Indians and its associated risk factors. Vasc Health Risk Manag. 2005; 1 (3): 217-25.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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.
15. 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.
16. Wenger NK, Speroff L, Panhard B. Cardiology heart disease morbidity and mortality in the sexes; a 26 year follow-up of the Framingham population. Am Heart J 1989; 113: 383-90.
17. Hochman JS, Tamis JE, Thompson TD, Weaver WD, White HD, Van de Werf F, et al. Sex, clinical presentation, and outcome in patients with acute coronary syndromes. Global Use of Strategies to Open Occluded Coronary Arteries in Acute Coronary Syndromes IIb Investigators. N Engl J Med 1999; 341(4): 226-32.
18. Tewari S, Kumar S, Kapoor A, Singh U, Agarwal A, Bharti BB, et al. Premature coronary artery disease in North India: an angiography study of 1971 patients. Indian Heart J 2005; 57(4): 311-8.
19. 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.
20. Hughes LO, Wojciechowski AP, Raftery EB. Relationship between plasma cholesterol and coronary artery disease in Asians. Atherosclerosis. 1990;83(1):15- 20
21. 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.