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Original Article

Influence of Ageing on Cardiovascular-Physiology in Myocardial Infarction Patients

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Abstract

The present study was conducted to compare the classical risk factors and clinical features between young age and old age patients with acute myocardial infarction. This is a retrospective comparative study of 80 adult patients (aged above 35 yearsand below 70 years) with acute myocardial infarction in JSS Hospital, Mysuru.The patients with acute myocardial infarction as confirmed by universal definition (symptoms, cardiac enzymes and electrocardiographic changes) were divided into two groups (i) 40 patients (age <50 years) as young age group and (ii) 40 patients (age >51 years) as old age group.

The number of patients with history of smoking was significantly higher in young age group, when compared to old age group with odds ratio 6.2. The biochemical values LDL, Troponin T and CK-MB were statistically significantly higher in young age patients compared to old age patients, with p value of <0.05.The number of patient with atypical chest pain (56% vs 33%), hypertension (56% vs 40%), type 2 diabetes mellitus (63% vs 40%), left ventricular diastolic dysfunction (40% vs 23%), were significantly higher in old age group.Smoking and dyslipidemia are the most important modifiable risk factors of myocardial infarction among the young age patients. In the old age patients with myocardial infarction risk factors such as autonomic nervous system dysfunction presenting as atypical chest pain, hypertension, diabetes mellitus, and left ventricular diastolic dysfunction were more common.

Introduction

The most important determinant of cardiovascular health is person's age. The average lifespan of humans is increasing, and with it, the percentage of people entering the 65 and older age group is growing rapidly. Elderly healthy individuals have a reduced cardiac output, reduced exercise tolerance and a decreased left ventricle inotropic reserve. This is due to increased vascular after load, arterial ventricular load mismatching, physical deconditioning due to impaired autonomic regulation and "β-adrenergic desensitization". These changes in cardiovascular physiology must be differentiated from the effects of pathology, such as coronary artery disease (1, 2).

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Advanced age is the single strongest non-modifiable risk factor for coronary artery disease (CAD) and independent predictor for poor outcomes following an acute coronary syndrome (ACS). ACS refers to a spectrum of conditions compatible with acute myocardial ischemia and/or infarction due to various degrees of reduction in coronary blood flow due to plaque rupture/erosion and thrombosis formation or supply and demand mismatch (3). Acute myocardial infarction (AMI) occurs when there is prolonged ischemia, caused generally by coronary athero-thrombosis resulting in irreversible damage to the segment of the cardiac muscle supplied by the subtended artery.

The WHO has proposed 3 criteria for making the diagnosis of AMI namely: 1) Typical chest pain, 2) Increased cardiac enzymes, 3) Electrocardiographic changes. The major modifiable classical risk factors for myocardial infarction include smoking, hypertension, diabetes mellitus and obesity. In all these classical risk factors there is co-existence of autonomic nervous system dysfunction. Typical angina symptoms predictive of AMI are less helpful in diagnosing AMI in the elderly population (3). Autonomic symptoms such as dyspnoea, diaphoresis, nausea and vomiting, pre-syncope or syncope are more common accompaniments to chest discomfort in elderly AMI patients (3). The elderly with AMI have been reported to present with more atypical symptoms (4, 5). AMI is associated with significantly higher mortality in the elderly compared with the young (5). Hence, high index of suspicion for AMI, along with an appreciation of its context, must be maintained in assessing elderly patients to achieve timely diagnosis and appropriate management (3).

The younger age generation is characterized by a marked increase in the intake of energy-dense foods, a decrease in physical activity, and heightened level of psychosocial stress (6). An examination of patients with non ST-segment elevation myocardial infarction revealed that 9% were found to have insignificant coronary artery disease, suggesting a pathophysiological mechanism distinct from progressive plaque rupture that may drive acute coronary syndrome event (7). Hypercoagulable states (high fibrinogen, high D-dimer) also have been associated with premature acute coronary syndrome (8-10).

There is disparity in the literature on the definition of young with respect to premature AMI. The term young age with respect to AMI varies from 40 years to 55 years of age (11-14). Till date not much data available on myocardial infarction patients in Mysuru city. There is a need for research on cardiovascular ageing, which can lead to better understanding of cardiovascular diseases. Hence, we hypothesise that, in old age patients there is risk of autonomic nervous system dysfunction causing a typical clinical presentation of AMI patients. Thus, in this study we have compared the differences in classical risk factors and clinical features between young and older AMI patients.

Objective of the study:

The aim of this study is to compare the classical risk factors and clinical features between young age and old age patients with acute myocardial infarction.

Materials and Methods

This study is a retrospective comparative study. This study was conducted with prior approval from the Institutional Ethical Committee of JSS Medical College and Hospital. The patients data recorded in the acute coronary syndrome (ACS) register of JSS hospital, Mysuru from December 2015 to December 2016 was analysed.

Inclusion criteria

1. The patient aged more than 35 years, but less 70 years old.

2. Patients with first or consequent acute myocardial infarction. The Myocardial infarction as confirmed by standard definition (symptoms, cardiac enzymes and electrocardiographic changes) (15).

Detection of rise/fall of cardiac biomarker values (such as CPK, CK-MB, troponin I, high sensitive cardiac troponin (hs-Tn)) with at least one value above the 99th percentile upper reference limit (URL) and

with atleast one of the following:

1. Symptoms of ischemia
2. New or presumed new significant ST-segment-T wave (ST-T) changes or new left bundle branch clock (LBBB)
3. Development of pathological q-waves
4. Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality
5. Identification of an intracoronary thrombus by angiography.

Exclusion criteria:

1. The patients ageless than 35 years and more than 70 years.
2. The patients who do not meet the universal definition of Myocardial infarction.
3. The patients with diseases such as severe valvular diseases, recurrent ventricular arrhythmias, heart failure (NYHA class 4), cancers, severe aortic incompetence, severe atrial fibrillation, end stage renal diseases and end stage liver diseases.

Group: (I) A set of 40 patients with acute myocardial infarction (age <50 years) was taken as young age group.

Group: (II) A set of 40 patients with acute myocardial infarction (age >51 years) was taken as old age group.

Statistical analysis:

Statistical analysis was carried out using SPSS software. The percentage of patients with classical risk factors was calculated. This includes percentage of patients with diabetes mellitus, hypertension, dyslipidaemia, obesity and smoking. The odds ratio was calculated for number of smokers in the two groups. Similarly, the percentage of patients with typical chest pain, increased cardiac enzymes, electrocardiographic changes (15), were calculated in the two groups. The mean values and standard deviation of LDL, HDL, Troponin T, and CK-MB levels were calculated in both the groups. Both groups were compared by unpaired t-test. A p value <0.05 was considered to be statistically significant.

Results

The present study comprised of total of 80 patients of AMI of which, 40 patients (34 male and 6 female) belonged to young age group with mean and S.D. of age 47.90±5.70 years. Another 40 patients of AMI (31 male and 9 female) belonged to old age group with mean and S.D. of age 62.6±6.31 years, as shown in the below Table I. The number male patients was more than the number of female patients in both the groups. However there was no significant difference in the mean and S.D. of body mass index (BMI) in both the groups. Only 4 patients had BMI less than 23 kg/m^2. The remaining patients were overweight and obese.

The number of patient with atypical chest pain (58% vs 20%), hypertension (60% vs 38%), type 2 diabetes mellitus (68% vs 45%), left ventricular (LV) diastolic dysfunction (60% vs 20%), were significantly higher in old age group. The number of patients with history of smoking was significantly higher in young age group when compared to old age group with odds ratio 6.2. The number of patients with typical chest pain (80% vs 43%) and electrocardiographically ST elevation MI (STEMI) (45% vs 30%) were more in young age group when compared to old age group as shown in the below Table II and Fig. 1.

TABLE I: Characteristics of the patients in both the groups.

	Young age group	*Old age group*
Total number of patients	40	40
Age (Years)	45.90±5.70	62.60±6.31
Male	34	31
Females	6	9
BMI (Kg/m^2)	27.5±3.80 kg/m^2	27.6±2.87 kg/m^2

TABLE II: The risk factors and clinical features of the patients in both the groups.

	Young age group	*Old age group*
Typical chest pain	32 (80%)	17 (43%)
Atypical chest pain	08 (20%)	23 (58%)
Hypertension	15 (38%)	24 (60%)
Type 2 diabetes mellitus	18 (45%)	27 (68%)
Smokers	27 (68%)	10 (25%)
STEMI	18 (45%)	12 (30%)

LDL was statistically and significantly higher in young age group (127.1±33) when compared to old age group (98.2±29). However there was no significant difference in HDL in both the groups. The biochemical markers for AMI, Trop T and CKMB were significantly higher in young age group (0.75±0.84 and 44.66±42), when compared to old age group (0.36±0.39 and 12.8±10.8) as shown in the below table 3. In Coronary angiography, the number patients with single vessel disease were more in young age group (70%) when compared to old age group (28%). However, double vessel disease and triple vessel disease were more in old age group (73%) when compared to young age group (30%) as shown in the below Table III.

Discussion

In the young age group patients, single vessel disease was most prevalent, with the lesion most commonly located in the left anterior descending artery. In most studies, smoking was the major risk factor for AMI in young men and women (16-18). In both the groups evaluated, the most common risk factors, identified were dyslipidaemia, and BMI ≥ 25 kg/m^2.

In the old age patients the adaptations of cardiovascular system to stress are impaired as a consequence of physiological and metabolic changes

TABLE III: The Biochemical, Echocardiographic and Coronary angiographic features in both the groups.

	Young age group	*Old age group*	*Normal value*	*p' value*
LDL (mg/dl)	127.1±33	98.2±29.2	Upto 100	0.007*
HDL (mg/dl)	37.32±6.9	35.28±5.20	40-60	0.5
Trop T (ng/ml)	0.75±0.84	0.36±0.39	0.0001-0.02	0.04*
CKMB (ng/ml)	44.66±42	12.8±10.8	1-7	0.009*
LVDiastolic dysfunction	08 (20%)	24 (60%)		
Single Vessel Disease	28 (70%)	11 (28%)		
Doubleand Triple Vessel Disease	12 (30%)	29 (73%)		

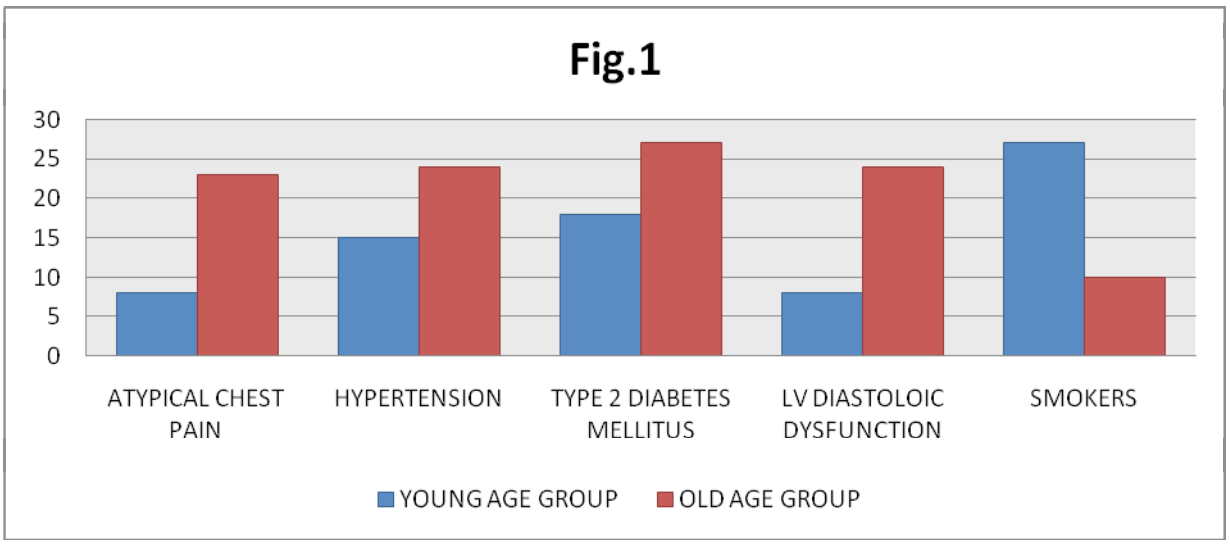

Fig. 1: The clinical features of the patients in both the groups.

in the cardiovascular system itself. This leads to increase in impedance to ventricular ejection due to atherosclerotic changes in the arteries and insufficient vasodilatory capacity of the peripheral blood vessels. Age-related changes occur throughout the arterial wall. The arterial tree is a visco-elastic tube. In younger individuals, the central arteries are more elastic and less stiff than the peripheral arteries. Compared to vessels from healthy younger individuals, arteries from older individuals are characterized by increased reactive oxygen species (ROS) content, inflammatory changes, decreased NO availability, and endothelial dysfunction. Increased arterial stiffness secondary to atherosclerosis causes decreased elasticity of the aorta and great arteries (19). Ageing is associated with a decline in aortic distensibility and with increased aortic stiffness as measured by pulse wave velocity (PWV). This strongly suggests that arterial stiffness is mainly driven by ageing process (19, 20). These ageing associated cardiovascular-physiologic changes cause left ventricular dysfunction.

There are significant age-related changes in autonomic nervous system function that are responsible for an impaired ability to adapt to environmental or intrinsic visceral stimuli in the elderly. The influence of physiological ageing also causes attenuated baroreflex and autonomic reflexes due to the decreased responsiveness to â-adrenergic receptor stimulation (1, 21). The chronic diseases such as diabetes mellitus or hypertension are associated with autonomic nervous system dysfunction. The coexistence of these chronic diseases in old age patients causes the clinical features of myocardial infarction to be uncharacteristic. In the present study more cases among the old age patients had atypical chest pain with other nonspecific autonomic symptoms like nausea, vomiting, giddiness, syncope and palpitation on admission to hospital as compared to young age patients. This is because the old age patients appear to have reduced pain perception. This phenomenon may result from the increase of pain threshold of permanently ischemic sensory nerves, ischemic dysfunction of the cerebral cortex, and dysfunction of the autonomic nervous system (16).

The patients of AMI are treated by either by thrombolysis or coronary angioplasty should undergo cardiac rehabilitation (CR). It is the process of restoring desirable levels of physical, social, and psychological functioning after the AMI. These CR programs provide patient education, identify and monitor risk factors. It also helps in lifestyle modification such as cessation of smoking, and enhances exercise training for patients with AMI. These programs are tested and proven to be beneficial to both young age and old age group of AMI patients (22, 24). The research on cardiovascular ageing can lead to new view and better understanding of cardiovascular diseases (23).

Conclusion:

Smoking and dyslipidaemia are the most important modifiable risk factors and can be the targeted to reduce the rate of myocardial infarction in the young age patients (22). In the old age patients with AMI, the influence of physiological ageing causes autonomic nervous system dysfunction and presents more commonly with a typical chest pain, hypertension, diabetes mellitus, and left ventricular diastolic dysfunction (3, 24).

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References

1. Melvin DC. Cardiovascular Physiology-Changes with Aging. *Am J Geriatr Cardiol* 2003; 12(1): 9–13.
2. Nicola F, ClaraK, Graziamaria C, et.al. Review: β-adrenergic receptor responsiveness in aging heart and clinical implications. *Frontiers in Physiol* 2014; 4: 1–10.
3. Xuming DA, Jan Busby-Whitehead, Karen PA. Acute coronary syndrome in the older adults. *J Geriatr Cardiol* 2016; 13: 101–108.
4. Bayer AJ, Chadha JS, Farag RR, Pathy MS. Changing presentation of myocardial infarction with increasing old

age. *J Am Geriatr Soc* 1986; 34(4): 263–266.

5. Tresch DT, Brady WJ, Aufderheide TP, Lawrence SW, Williams KJ. Comparison of elderly and younger patients with out-of-hospital chest pain. *Arch Intern Med* 1996; 156(10): 1089–1093.
6. Salim Y, Srinath R, Stephanie O, Sonia A. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. *Circulation* 2001; 104: 2746–2753.
7. Patel MR, Chen AY, Peterson ED, et al. Prevalence, predictors, and outcomes of patients with non-ST-segment elevation myocardial infarction and insignificant coronary artery disease: results from the Can Rapid risk stratification of unstable angina patients Suppress Adverse outcomes with early implementation of the ACC/ AHA Guidelines (CRUSADE) initiative. *Am Heart J* 2006; 152(4): 641–647.
8. Pineda J, Marin F, Marco P, et al. Premature coronary artery disease in young (age<45) subjects: interactions of lipid profile, thrombophilic and haemostatic markers. *Int J Cardiol* 2009; 136(2): 222–225.
9. Arzamendi D, Benito B, Tizon-Marcos H, et al. Increase in sudden death from coronary artery disease in young adults. *Am Heart J* 2011; 161(3): 574–580.
10. Egred M, Viswanathan G, Davis GK. Myocardial infarction in young adults. *Postgrad Med J* 2005; 81: 741–745.
11. Aggarwal A, Aggarwal S, Goel A, Sharma V, Dwivedi S.A retrospective case-control study of modifiable risk factors and cutaneous markers in Indian patients with young coronary artery disease. *JR Soc Med Cardiovasc Dis* 2012; 1–8.
12. Ghosh K, Khare A, Shetty S. Fasting plasma homocysteine levels are increased in young patients with acute myocardial infarction from western India. *Indian Heart J* 2007; 59(3): 242–245.
13. Wiesbauer F, Blessberger H, Azar D,et al. Familial-combined hyperlipidaemia in very young myocardial infarction survivors (< or =40 years of age). *Eur Heart J* 2009; 30 (9): 1073–1079.
14. Awad-Elkarim AA, Bagger JP, Albers CJ, Skinner JS, Adams PC, Hall RJ. A prospective study of long term prognosis in young myocardial infarction survivors: The prognostic value of angiography and exercise testing. *Heart* 2003; 89: 843–847.
15. Kristian T, Joseph SA, Allan SJ, Maarten LS, Bernard RC, Harvey DW. Third universal definition of myocardial infarction. *Circulation* 2012; 126: 2020–2035.
16. Lovleen CB, Ruchi HN. Clinical profile of acute myocardial infarction in elderly patients. *J Cardiovasc Dis Research* 2013; 4: 107–111.
17. Sozzi FB, Danzi GB, Foco L, et al. Myocardial infarction in the young: a sex-based comparison. *Coron Artery Dis* 2007; 18(6): 429–431.
18. Constantini M, Oreto G, Albanese, et al. Presumptive myo-carditis with ST-elevation myocardial infarction presentation in young males as a newsyndrome. Clinical significance and long term follow up. *Cardiovasc Ultrasound* 2011; 9: 1–6.
19. Xuming Dai, Scott LH, Jorge BS, George ET, Susan Z, Janice BS. Cardiovascular physiology in the older adults. *J Geriatr Cardiol* 2015; 12: 196–201.
20. Chia-Ying Liu, Shenghan Lai, Nadine Kawel-Boehm, et.al. Healthy aging of the left ventricle in relationship to cardiovascular risk factors: The Multi-Ethnic Study of Atherosclerosis (MESA). *Plos one* 2017; 12(6); 1–13.
21. Davies CH, Ferrara N, Harding SE. Beta-adrenoreceptor function changes with age of subject in myocytes from non-failing human ventricle. *Cardiovasc Research* 1996; 31(1): 152–156.
22. Nadim S, Anne-Maree K, Nicholas C, Chiew W, Kean S. Myocardial infarction in the young: Risk Factors, Presentation, Management and Prognosis. *Heart Lung Circulation* 2016; 25: 955–960.
23. Brian JN, David AS. Review: The Intersection between aging and cardiovascular disease. *Circ Res* 2012; 110(8): 1097–1108.
24. Alexander DS, Philip DB, John Kurian, Nigel Durham, Christopher PG. Review: Acute coronary syndromes: an old age problem. *J Geriatr Cardiol* 2012; 9: 192–196.