

Teaching Round

Coronary risk profile: a tale of two teachers

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Abstract

The 10-year younger mean age for the first presentation of coronary artery disease (CAD) in Africa, the Middle East, and South Asia compared with other regions of the world is contributing to the large increase in cardiovascular diseases witnessed in these regions over the years. Implementing preventive strategies based on current knowledge would avert the majority of coronary heart disease worldwide. Two clinical scenarios of male teachers of similar ethnicity, socioeconomic background, and emotional stress in their early years, developing acute coronary syndrome are being reported. However, the age at which they developed acute vascular events is distinctly different. The role of various risk factors, especially smoking, implicated in the genesis of premature atherosclerosis and CAD has been discussed and the importance of healthy lifestyle and regular exercise in imparting protection against the development of CAD is highlighted. It is aimed to sensitise the readers to stress on smoking cessation and adoption of appropriate lifestyle measures while advising their patients.

Key words: Atherosclerosis; coronary artery disease; risk factors; smoking; yoga.

Introduction

Two clinical scenarios of male teachers sharing the same ethnicity, socioeconomic background and emotional stress in their early childhood developing acute coronary syndrome are being presented. Strikingly, the age at which they developed acute vascular events were distinctly different; one developed acute myocardial infarction early at the age of 44 yrs while the other had acute onset syncope and trifascicular block at age of 70 years. Besides, there are certain other discriminating factors which contributed to the varying time of onset of acute coronary event. It is intended to discuss these important issues with the help of these two illustrative cases since they have immense therapeutic and preventive implications.

Clinical details

Two male teachers, one of middle age and another old, present to the cardiology unit on the same day with complaints of severe chest pain and syncope, respectively, which turned out to be due to acute coronary syndrome (table 1).

What are the common risk factors for coronary artery disease?

Health researchers have recently discovered that 90% of first heart attacks (myocardial infarction) suffered by people can be attributed to nine risk factors [1]. These risk factors include: cigarette smoking, an abnormal ratio of blood lipids, high blood pressure, diabetes mellitus, abdominal obesity, stress, alcohol consumption, a lack of daily consumption of fruits and vegetables, as well as a lack of daily exercise. INTERHEART study [1] showed that the effect of these nine risk factors is consistent in men and women, across different geographic regions, and by ethnic group. The interplay of these factors decides how early the coronary insufficiency appears in a particular patient. Family history of cardiovascular disease and other novel risk factors viz. plasma levels of homocysteine, high sensitive C- reactive protein (hs-CRP), lipoprotein (a), Lp(a) and fibrinogen are also known risk factors.

What are the risk factors observed in the two cases? What contributes to the early development

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Table 1 - Short history and clinical features of the two teachers

Clinical features	Teacher 1 (Active)	Teacher 2 (Retired)
Age, Sex, Religion	44 years, male, Hindu	70years, male, Hindu
Presentation	Acute chest pain	Syncope
Socioeconomic status (Kuppuswamy scale)	Lower middle income	Lower middle income
Parents	Mother died after his birth. Father remarried.	Father missed/killed in war Mother remarried; died of carcinoma at 50 years age.
Sibling	Three unmarried step-sisters; financial crisis in marriage.	Step-sister with chronic kidney disease.
Progeny	One son and one daughter	Younger son mentally retarded.
Smoking-Type	Bidi	nil
Number x years	20 x 22yrs	
Smoking index	440	
Present status	Continuing	
Blood pressure (mmHg)	120/70	120/70 (Hypertension for 2 years; on treatment)
Waist Hip Ratio	96: 98 (0.98)	81: 90 (0.9)
FBS/PPBS (mg/dl)	FBS- 150, PPBS-228	Known diabetes for 2 years
Lipids: HDL (mg/dL)	30	35
Triglycerides (mg/dL)	68	44
Cholesterol (mg/dL)	188	137
C-Reactive Protein	>6	<6
Lipoprotein (a)	10.30	8
Plasma Homocysteine	26.30	18
Electrocardiography	Acute anteroseptal myocardial infarction	Trifascicular block
Echocardiography	Anterior wall hypokinesia, Ejection Fraction 32%, Diastolic Dysfunction present	Global hypokinesia, Ejection Fraction 33%, Diastolic Dysfunction present
Carotid Intima Media Thickness		
Right CCA	0.055	0.073
Left CCA	0.062	0.084
Plaque	No	Present

of acute coronary syndrome in Teacher 1?

Apart from the irreversible risk factors of age, sex and ethnicity, the risk factors observed in Teacher 1 are- stress, smoking, central obesity, diabetes mellitus, sedentary lifestyle and low HDL-cholesterol while in Teacher 2 are- stress, hypertension (though controlled), central obesity, diabetes mellitus, sedentary lifestyle and low HDL-cholesterol. Teacher 2 also has a carotid plaque which is an atherosclerotic marker. The risk factor profile in the two cases is by and large similar. A long history of smoking and presence of central obesity in Teacher 1 along with co-existent diabetes mellitus seem to contribute to accelerated atherosclerosis in

Teacher 1, whereby he has developed an acute coronary syndrome so early in life.

A strong association has been observed across all age, gender and ethnic groups between smoking and CAD. A graded relationship between the number of cigarettes and death from CAD has been observed in the multiple risk factor screening study [2] (risk ratio of smoking 1-25 cigarettes/day is 2.1, rises to 2.9 for >25 cigarettes/day) Acute MI in younger individuals (< 50 years) is strongly associated with smoking. Smoking has an additive as well as multiplicative effect on other risk factors. Smoking promotes atherothrombosis [3] by several mechanisms- enhancing oxidation of LDL, reducing

HDL, promoting coronary vasoconstriction, increasing hs-CRP, fibrinogen, spontaneous platelet aggregation. Smoking acts synergistically with oral contraceptives, placing younger women at even higher relative risk. Smoking cessation among adults significantly reduces the risk of CAD.

What are the important risk factors for stroke?

In a multivariate risk factor evaluation for stroke in Framingham Heart Study [4,5] with subjects aged 55 to 84 years. In men, systolic blood pressure was given the maximum risk rate of 1.91, only after left ventricular hypertrophy (LVH) 2.32, compared to 1.4 to diabetes mellitus (DM), smoking 1.67, CAD 1.68 and atrial fibrillation (AF) 1.83. In women, however, AF was the most important risk factor with RR of 3.16, LVH 2.34, DM 1.72, smoking 1.70.

Is central obesity an important risk factor for type 2 diabetes mellitus?

Central obesity is an important risk factor for the development of type 2 diabetes mellitus [6]. Central obesity is associated with insulin resistance and hyperinsulinemia. The pathophysiologic basis for the importance of central obesity relates to higher rates of lipolysis in visceral adipocytes, which are relatively resistant to insulin-induced suppression of lipolysis following meals; thus, portal-vein free fatty acid (FFA) concentrations are increased in central obesity. Exposing hepatocytes to higher rates of FFA delivery increases gluconeogenesis. Increased FFA in peripheral circulation causes decreased rates of insulin-mediated glucose uptake in skeletal muscles. In addition, visceral adipocytes are rich source of diabetogenic hormones like plasminogen activator inhibitor -1 (PAI-1). A potential additional link between obesity and diabetes is obstructive sleep apnea, causing insulin resistance through catecholamine excess. The combination of insulin resistance and increased gluconeogenesis leads to development of diabetes.

How diabetes produces coronary atherosclerosis?

Many factors contribute to the increased incidence of CAD among diabetics [7,8,9]. Microalbuminuria defined as albumin excretion rate of 0.03-0.3 g/dL, may be the result of generalised endothelial dysfunction that enhances the penetration of atherogenic lipoprotein in the arterial wall. It has

been associated with several cardiovascular risk factors like insulin resistance, hyperinsulinemia, central obesity and dyslipidemia.

Lipoprotein abnormalities: oxidation of lipoprotein is enhanced in presence of hyperglycemia and hypertriglyceridemia, which are cytotoxic to endothelium and contribute to atherosclerosis. Triglycerides are elevated in diabetes secondary to decrease in lipoprotein lipase activity with increase in plasma low density lipoprotein (LDL), Lp(a) and decrease in plasma high density lipoprotein (HDL).
Coagulation abnormalities: Diabetics have higher levels of plasminogen activator inhibitor than non-diabetics, which inhibits fibrinolysis. Decreased level of antithrombin-III, protein C, protein S associated with cell injury, micro and macro vascular damage and poor diabetic control, platelet adhesion and aggregation are enhanced. In diabetics, there is decrease production and increased destruction of nitric oxide (NO), resulting in increased platelet aggregation.

Insulin resistance: Traditionally considered as an important risk factor for CAD by promoting hypertension, as a result of chronic enhancement of sympathetic nervous system activity, increasing renal tubular sodium resorption, and inducing smooth muscle hypertrophy.

Endothelial dysfunction: Hyperglycemia alters endothelial matrix production, leading to basement membrane thickening. There is impaired degradation of glycosylated fibrin increased concentration of glycated end products and elevated expression of endothelin-1. Other alterations include decreased release of nitric oxide and decreased response to nitric oxide, increased superoxide amino generation, and increased expression of adhesion molecules.

DM and CAD form a continuum of vascular disease characterised by endothelial dysfunction. In a recent study [10], the temporal development of CAD, diabetes and hypertension was studied in cases suffering from all the three diseases and the existence of phenomenon of cardiovascular continuum was observed in the majority. Concept of cardiovascular continuum is important for holistic approach to their early recognition, prevention and treatment. It was also hypothesised that the endothelial dysfunction might be the fulcrum of this cardiovascular continuum.

What is the relation of smoking to diabetes?

The rate of diabetes increases for both men and women, as smoking prevalence rises. Among those who smoked 2 packs per day at baseline, men had a 45% higher diabetes rate than men who had never smoked. The comparable increase for women was 74%. Quitting smoking reduced the rate of diabetes to that of non-smokers after 5 years in women and after 10 years in men [11].

What role does lifestyle play in early development of CAD?

An unhealthy lifestyle is responsible for the deposition of cholesterol in the coronary arteries. An unhealthy or faulty lifestyle involves:

- (a) Faulty dietary habits (a combination of bad carbohydrates and bad fats), high saturated fat, low in fibre, low in vegetables and fruits and very high in salt.
- (b) Lack of exercise because of rapid urbanisation.
- (c) The increasing stress of civilization, especially the negative competitive stress, which further adds to the misery.
- (d) Regular and continuing tobacco consumption either via tobacco chewing or cigarette or bidi smoking worsens the process.

Cholesterol is not present in foods of plant origin. In foods of animal origin cholesterol is very high in red meat, yolk of egg and animal milk. People who are non-vegetarians can take fish, which contains omega-3 fatty acids, which may be beneficial to the heart. Vegetarians have four times less chance of getting a heart attack than non-vegetarians. The cholesterol levels of vegetarians are 15 per cent lower than the cholesterol levels of non-vegetarians. Junk foods (a combination of bad carbohydrate and bad fats) are one of the causes of obesity, diabetes and heart disease all over the world. Thirty minutes of exercise done daily (7 days a week) is not only good for the heart but also for the lungs, bones, joints and overall health. It is anti-ageing, reduces obesity, reduces cholesterol and controls diabetes. The results of INTERHEART study [1] indicate that psychosocial factors (stress at work or home, financial stress, stressful life events, depression) may contribute to a substantial proportion of risk for acute CAD. The global effect was less than that for smoking, but comparable with hypertension and abdominal obesity.

Life style heart trial (D'Ornish study) [12] used zero fat diet, physical exercise and stress management through yoga and demonstrated regression of blockages from 40 to 37% over a period of time and demonstrated that a strict life style may lead to regression of coronary atherosclerosis after 1 year. More regression of coronary atherosclerosis occurred after 5 years than after 1 year in the experimental group.

What is the role of yoga in retardation, reversal and prevention of atherosclerosis?

The Yoga Life-Style trial [13] was conducted at All India Institute of Medical Sciences, New Delhi. It involved a very low fat and high fibre diet with no tobacco or non-vegetarian diet and regular, moderate daily exercise. Angina was reduced by 73%. Treadmill duration was increased by 33%. Yoga is "emotion control". Anger, ego, hostility, greed and attachments need to be controlled. *Shavasan* can reduce metabolic rates by 15%. In *Pranayama*, one can do alternate nose breathing and abdominal breathing.

There are two types of preventions available if a person has established heart disease. Firstly, identification of risk factors and preventing first heart attack. This is called primary prevention. On the other hand primordial prevention includes prevention of risk factors like smoking, diabetes, high blood pressure, obesity, not walking, stress, etc. Most of the risk factors are related to the present-day stress. The basic mantra therefore for primordial prevention is management and prevention of stress which is only possible by understanding the 8 principals of our (India's) traditional ancient yoga. Yoga means union of body with mind. Eight limbs include dos and don'ts (yamas & niyamas), asanas (mind body physical postures), pranayama, pratihara (spiritual atmosphere), dharma (intention), dhyana (concentration and transident), samadhi (absorbing with oneself). These 8 processes collectively are called meditation. During meditation one acquires para-sympathetic mode which reduces blood pressure, respiratory rate, increases the immunity and prepares the body to heal.

How will you manage Teacher 1?

Teacher 1 deserves to be counselled for smoking abstinence and diet control (high fibre diabetic

diet, fruits, vegetables, nuts). Psychological counseling for de-stressing along with a graded exercise schedule, meditation and yoga can be beneficial. Medical therapy includes streptokinase (thrombolysis, if the patient has presented within the window period), aspirin, clopidogrel, beta-blockers, ACE inhibitors, statins, control of blood pressure and differentiating stress hyperglycemia from actual diabetes mellitus undetected previously and its appropriate management. Coronary angiography followed by intervention, as required should be planned. Weight maintenance/reduction and reducing the waist circumference is also bound to be helpful.

What advice would you give to Teacher 2?

Teacher 2 also needs to be managed on the same lines as Teacher 1 but the need to control all the risk factors may not be so vigorously applied. Thrombolysis is definitely not indicated. Teacher 2 is not habituated to tobacco and has his hypertension under control on drug therapy. Coronary angiography in a specialised centre is an important step to delineate the extent of coronary atherosclerosis. Presence of a tri-fascicular block and presenting as syncope may warrant need for pacing and a permanent pacemaker installation may be required. In view of global hypokinesia and poor ejection fraction, a 24-hour Holter monitoring will need to be performed to assess for ventricular tachyarrhythmias; which will indicate need for implantable cardioverter defibrillators (ICD).

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