

Original Article

## Clinical and angiographic profile of aircrew with coronary heart disease undergoing cardiac evaluation before being reflighted

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### ABSTRACT

In recent years, cardiovascular disease has emerged as a leading cause of death and morbidity in India. As per recent World Health Organization (WHO) data it is projected to be the primary cause of mortality, being responsible for 30% of all deaths. This study analyzes various clinical presentations, conventional risk factors, pattern and severity of Coronary Heart Disease (CHD) on angiography among 52 aircrew with CHI) who underwent cardiac evaluation at AFCME, New Delhi, between June 1999 to July 2001, prior to being reflighted. Of these 29 were fresh cases and 23 on follow up. Follow up period ranged from 10 to 156 months, mean being 39.2 months. All the patients were males. 27 were in the age group of 30 to 50 years and 25 in that of 51 to 60 years. 27 aircrew (53%) had presented with stable angina or acute coronary syndrome and 25 (48%) were asymptomatic. 4 (8%) had diabetes mellitus, 11 (21%) had hypertension and 20 (58%) were smokers and 32 (62%) had dyslipidemia. 27 (52%) had two or more risk factors. 4 (8%) had insignificant disease, 22 (42%) had multi vessel disease and 26 (50%) had single vessel disease. 8 (15%) subjects had left ventricular (LV) dysfunction while 44 (85%) had normal LV function. 12 (23%) underwent percutaneous transluminal coronary angioplasty (PTCA). Of the 33 patients who underwent revascularization procedures 7 had major adverse cardiac events; 4 developed instant restenosis after PTCA, 2 developed blockages of grafted vessels and 1 developed myocardial infarction (MI). Of the 52 aircrew, 33 (63%) were reflighted as they met the laid down criteria. Analysis of the 19 (37%) aircrew revealed that 1 refused to undergo revascularization, 3 had instant restenosis after PTCA. 2 had blocked grafts after coronary artery bypass graft surgery (CABGS), and 13 had not been advised revascularization because of extensive disease or lack of viable myocardium. This study revealed that coronary artery disease presents as a multifactorial systemic disease.

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**KEYWORDS:** Coronary heart disease, PTCA, CABGS

Recent studies from India and abroad show that Coronary Heart Disease (CHD) rates in India have doubled in both rural and urban India. As a result, the prevalence of CHD is now fourfold higher in urban India than in United States. When compared with Americans, Europeans and other Asians, CHD rates among Indians are five to ten folds higher under the age of forty [1-11]. This is in sharp contrast to 50% fall of cardiovascular disease related mortality shown by 'established market economies' in recent time. CHD has been found to be the most

common cause of temporary and permanent grounding among aircrew in India [12].

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## Objective

The objectives of the study were :

To study the clinical presentation and various conventional coronary risk factors among aircrew having CHD.

To study the severity and pattern of the disease on coronary angiography and assess recurrence after revascularization procedures and any major adverse cardiac events during follow up of those reflighted.

To assess adoption of various life style modifications by aircrew

To carry out analysis of various factors most likely responsible for grounding among those found unsuitable for flying.

## Materials and Method

This study covers the cardiac evaluation of 52 aircrew patients with CHD, confirmed by angiography at this centre between June 1999 to July 2001. 29 were fresh cases and 23 were on follow up. This aircrew had been either revascularised (PTCA or CABGS) or was on medical management. They had presented for cardiac evaluation at this centre between 6 to 12 months of the onset. Details of clinical presentation, biochemical investigations, coronary angiograms and revascularization procedures were available for all the patients from the onset of CHD.

Subject demographics, coronary risk factors and clinical variables such as age, sex, history of diabetes mellitus, hypertension, smoking and family history of premature CHD, clinical interventions and left ventricle ejection fraction (LVEF) were evaluated. Diabetes mellitus was defined as a fasting and postprandial blood sugar greater than 120 mg/dl and 180 mg/dl respectively, use of antidiabetic medication or glycosylated hemoglobin greater than 8.0%. Hypertension was defined as a systolic blood pressure greater than 160mm Hg or a diastolic blood pressure greater than 90mm Hg or use of antihypertensive medication. Family history of premature CHD was considered positive if a first

order relative had suffered cardiovascular death, myocardial infarction or coronary revascularization before the age of 45 years. Tobacco use was considered present in subjects who were active smokers or had a smoking history of greater than 10 pack-years. Baseline fasting lipid profile had been determined during first hospitalization. Only conventional risk factors parameters were assessed in this study. The clinical presentation at hospitalization was categorized as stable angina (stable exertional symptoms only), unstable angina (progressive symptoms, or symptoms at rest), or myocardial infarction (diagnosed by WHO criteria, when any 2 of the 3 conditions were present viz, classical history, raised enzyme levels or classical ECG changes). Clinical treatment at hospitalization was categorized as medical therapy only, percutaneous transluminal angioplasty (including plain old balloon angioplasty, atherectomy and/or stenting), and coronary artery bypass surgery.

An assessment of adoption of lifestyle modification by aircrew was carried out by personal interviews. Life style modifications consisted of maintenance of desirable body weight, cessation of tobacco use, regular aerobic exercises at least five times a week, and avoidance of saturated fat rich food.

During the first cardiac evaluation of aircrew, who reported between 6 to 12 months after treatment of CHD, non-invasive investigations were carried out after a detailed history and physical examination for assessment of atherosclerotic occlusive disease in other vascular beds? Resting 12 lead ECG and a 24-hour ambulatory ECG monitoring for assessment of any cardiac arrhythmia, conduction defect and silent ischaemia, was carried out. Echocardiography and doppler study to assess regional wall motion abnormality, status of the valves, presence of cardiomyopathy and to determine LVEF, was carried out. Maximal symptom limited treadmill test by Bruce protocol (usually stage 3 or more), stress thallium myocardial perfusion study and stress MUGA study was also carried out.

Coronary angiography (CART) was evaluated by severity and extension of CHD. All patients were

classified to be having significant CHD if any of the coronary artery or its major branch showed 50% luminal diameter stenosis, while less than 50% stenosis was termed as insignificant CHD. The number of such occluded vessels (1 to 3 vessel disease) was also recorded. LVEF on LV angiography, if 50% or more, was considered normal, and less than 50% was termed LV dysfunction. Any mitral regurgitation was also recorded. Coronary angiography was done at the time of first cardiac evaluation, and repeated during follow up of reflighted aircrew, if warranted. CART was repeated for assessment of revascularization treatment and any progression of the disease in native vessels was recorded.

Those who were reflighted after initial cardiac evaluation were subjected to follow up every six months, which consisted of detailed history, physical examination, resting ECG, biochemical parameters and stress thallium myocardial perfusion studies once in every two years. Any other investigations including CART were asked for, if warranted.

Reflighting was on case to case basis. Aircrew who were asymptomatic, were not on any cardioactive drugs, had good effort tolerance, and did not have any arrhythmias on resting and ambulatory ECG and coronary risk factors if present were under control were reflighted. All these patients had undergone detailed echocardiography and doppler studies. There was no evidence of LV dysfunction, gross regional wall abnormalities, cardiomyopathy and any valvular heart disease. There was no evidence of reversible myocardial ischaemia on treadmill test (TMT) and on stress thallium myocardial perfusion / MUGA studies. Repeat coronary angiography in them did not show any progression of the disease in the native coronary vessels and angioplasted vessels did not have any re-stenosis. The aircrew who had undergone CABGS did not show any blockage of grafted vessels. The LV function in all these patients was normal.

## Results

All aircrew in the present study were males. 6 patients were in age group 30 to 40 years, 21 in 41 to 50 years and 25 in 51 to 60 years. 52% were less than 51 years when they developed the disease. Observation period ranged from 10 to 156 months, mean being 39.2 months. 11 (21%) had stable or unstable angina while 16 (31%) had acute myocardial infarction (AMI) as the first presentation and 25 (48%) were asymptomatic. These 25 aircrew were found to have evidence of reversible myocardial ischaemia in either treadmill test or on stress thallium myocardial perfusion studies.

10 (18%) aircrew were obese with BMI more than 30. 4 (8%) had diabetes mellitus (DM), 3 detected for the first time during the investigations, while 1 had impaired glucose tolerance which had progressed. 4 (8%) had family history of premature CHD and 11 (21%) had hypertension. 30 (58%) were active smokers and 70% of these had been smoking for last 20 years. 27 (52%) had two or more than two coronary risk factors, of which smoking and dyslipidemia were the commonest combination.

32 (62%) aircrew had dyslipidemia. High LDL, high triglycerides and low HDL was the commonest combination in the lipid profile. During the follow up of aircrew with dyslipidemia only 11 (21%) had lipid lowering drugs, that too, irregularly. The reasons for this were not always known. It may have been because of poor communication between cardiovascular specialists and referring physicians, lack of symptoms in patient and variation in the lipid profile reported by different laboratories.

4 (8%) aircrew had insignificant CHD with less than 50% narrowing of the lumen diameter. 22 (42%) had multi-vessel disease with 13 having double vessel disease and 9 having triple vessel disease (TVD). Single vessel disease (SVD) was present in 26 (50%) aircrew. None of these aircrew had left main artery disease.

8 (15%) aircrew had left ventricular dysfunction on left ventricular angiography. 44 aircrew (85%) LV function was preserved.

12 (23%) aircrew underwent CABGS. All had undergone CABGS by conventional method on cardiopulmonary bypass, except one who underwent CABGS by mid-CAB method. One patient had all saphenous venous grafts for TVD. 3 other aircrew had mixed arterial and venous grafts, while 8 aircrew had only arterial grafts.

21 (39%) aircrew underwent revascularization by PTCA. 2 aircrew underwent plain old balloon angioplasty while all others had PTCA by stent implantation. 1 patient had congenital a cyanotic heart disease in the form of coronary arterio-venous fistula along with CHD. He was managed with PTCA with stent implantation for single vessel disease and coil embolizations in two fistula (left anterior descending (LAD) and pulmonary artery) with adequate results. 1 patient had two stents implanted along with PTCA, while all others had single stent implantation. 4 aircrew had instant restenosis 8 to 10 months following PTCA. 1 patient out of these 4 cases of instant restenosis was managed successfully with rotablation, PTCA and stent implantation, while 3 others did not undergo any repeat revascularization procedures and were not reflighted.

Out of 33 (62%) aircrew who underwent revascularization procedures, 7 aircrew developed major adverse cardiac events, 2 had blocked grafts after having undergone CABGS, the blocked grafts being saphenous venous grafts. 4 aircrew had instant restenosis after PTCA, 1 had acute myocardial infarction (AMI) after CABGS.

In this study 6 aircrew were under the age of 41 years. 2 had single vessel disease and 4 aircrew had triple vessel disease. 1 patient of single vessel disease presented with AMI and was managed with PTCA with stent implantation in LAD. This resulted in instant restenosis and he was not reflighted. Another patient of SVD underwent PTCA with stent implantation in right coronary artery and also developed instant restenosis which was managed with rotablation. 2 aircrew with TVD underwent CABGS and both developed blockage of the grafts subsequently. In the remaining two aircrew with

TVD, LV function was normal and both these aircrew were asymptomatic, hence medical management was recommended. Young aircrews with CHD have accelerated progress of the disease and usually undergo repeated revascularization procedures.

33 (62%) of the 52 aircrew included in this study were reflighted as they met the criteria laid down in the Indian Air Publication (IAP) / DGCA guidelines. The reflighted aircrews were asymptomatic, had good effort tolerance, were not on cardioactive drugs and did not have either arrhythmias or silent ischaemia on both resting and ambulatory ECG. They had no evidence of LV dysfunction, gross regional wall abnormalities, cardiomyopathy or valvular heart disease on echocardiography and doppler studies. They also had no evidence of reversible myocardial ischaemia on treadmill test and stress thallium myocardial perfusion / MUGA studies. They also did not show any progression of the disease either in the native coronary vessels or restenosis in the angioplasted vessels on repeat CART. No blockage of grafted vessels was seen in the aircrew that had undergone CABGS. The LV function in all these aircrew was normal on LV angiography.

19 (37%) aircrew could not meet the above mentioned criteria and were not reflighted. Analysis revealed that 1 had refused to undergo revascularization for SVD, 5 had progression of the disease after revascularization procedures with 3 having instant restenosis after PTCA and 2 having blocked grafts after CABGS, while 13 were not advised revascularization procedures. In these 13 aircrew, 4 had gross LV dysfunction as there was no viable myocardium on non-invasive assessment, while 9 had extensive disease so that revascularization procedures such as PTCA or CABGS were not recommended.

### **Discussion**

It is widely realized that at present, developing countries contribute a greater share to the global burden of cardiovascular disease than the developed

countries [1]. During last 30 years CHD rates in India have doubled in both rural and urban India, more alarming is the much higher rates among young Indians [3, 6, 8, 11]. In this study 27 (53%) aircrew were in the age group of 30 to 50 years while 6(11%) aircrew were less than 41 years old. Clinical presentation of CHD ranges widely from asymptomatic, stable or unstable angina, acute MI and sudden death. In this study 25 (48%) aircrew had no symptoms but CHD was detected among them by TMT or stress thallium test. 6(11%) aircrew had extensive disease by the time CHD was detected among them. Stringent evaluation to detect various coronary risk factors and the disease should be applied, so that appropriate risk reduction strategy can be undertaken. Smoking increases the risk of CHD by three to five times. 58% of our aircrew were active smokers. While the trend for smoking in western countries is on the decline, it is increasing in our country.

A combination of high cholesterol, high LDL and high triglycerides and low HDL has been described in Indians and the same is reflected in this study. Multiple risk factors were present in 52% of the aircrew.

There is a graded and continuous relationship between total cholesterol and risk of CHD. Total cholesterol levels may underestimate the risk of CHD in aircrew with low HDL (common in Indians). In the last five years several randomized clinical trials have clearly demonstrated that adequate lipid lowering therapy with HMG - CoA reductase inhibitors (statins) can dramatically alter the natural history of the disease [13-17]. The statins reduce LDL, triglycerides and total cholesterol as well as increase the HDL levels, thereby slowing, arresting or even reversing the progress of atherosclerosis. The higher than anticipated benefit from statins is best explained by stabilization of vulnerable plaque, antithrombotic, antiplatelet properties and reversal of endothelium dysfunction. Statins reduce major adverse cardiac events including coronary deaths and the need for coronary revascularization procedures by 30 to 45%. In this study majority of aircrew with dyslipidemia were not on any lipid lowering drugs.

Effective steps need to be taken in this regard. 4 (8%) aircrew had insignificant disease but they require regular periodical review since disease progresses steadily and these may cause major adverse cardiac events if risk factors remain uncontrolled. There is no simple relation between size of a plaque and its vulnerability to rupture. Plaque composition rather than size is the important factor in plaque rupture [13, 18-22]. PTCA is more successful in relieving angina than medical therapy but the major limitation is restenosis that occurs at a rate of 12-53% [23-27]. Improvements in stents have reduced the rate of restenosis. The new entity of instant restenosis after PTCA has serious consequences as was evident in 3 of the aircrew. CABGS is also highly effective in relieving angina and improves survival in a select subset of aircrew with left main disease and multivessel disease with LV dysfunction. Although early patency is excellent, a redo CABG in 50% aircrew is needed within 10 years in those with saphenous venous grafts [28-29]. Younger aircrews, in general, tend to have more revascularization procedures performed. There have been several trials of PTCA vs CABGS such as RITA, CABRI, EAST and BARI with no difference in death and AMI at the end of 5 years [30-33]. Relief of angina and requirements for repeat revascularization procedure is better among CABG patients than those who have undergone PTCA. Since coronary revascularization procedures have no impact on the natural history of CHD, these are only palliative procedures.

A number of studies have demonstrated the beneficial effects of comprehensive life style changes (low fat diet, stress management training, and moderate aerobic exercises, maintenance of desirable body weight and cessation of smoking) on regression of atherosclerosis and correction of dyslipidemia [34-37].

### Conclusion

It is concluded that CHD started early and progresses at an accelerated rate among the aircrew. Multiple risk factors were present in most aircrew with CHD. Aircrews with dyslipidemia were not on adequate lipid lowering drugs. There is a high rejection rate among aircrew with CHD.

## References

1. Reddy KS, Salim Yusuf. Emerging epidemic of cardiovascular disease in developing countries. *Circulation* 1998; 97:596-601.
2. Enas A Enas, Salim Yusuf, Satyavan Sharma. Coronary artery disease in south Asians. *Indian Heart Journal* 1998; 30:105-113.
3. Reddy KS. Cardiovascular disease in India. *World Health State Q.*1993; 46:101-107.
4. Anand SS, Salim Yusuf et al. differences in risk factors, atherosclerosis and cardiovascular disease between ethnic groups in Canada : study of health assessment and risk in ethnic groups (SHAPE). *Indian Heart Journal* 2000; Nov-Dec (Suppl) 536-43.
5. Enas A Enas, Salim Yusuf. Third meeting of the international group on coronary artery disease in South Asians. *Indian Heart Journal* 1999; 51:99-103.
6. Gupta R. Epidemiological evolution and risk of coronary heart disease in India. *South Asian Journal of Preventive Cardiology* 1997; 1:14-20.
7. Destefano F, Metrit RK, Amla RF. Trends in coronary heart diseases in the US. 1980 through 1989. *Arch Intern Med* 1993; 153:2489-2494.
8. Bhatia ML. Prevalence of CAD in India : a contemporary view. *Indian Heart Journal* 1995; 47:339-342.
9. Enas A Enas. Why is there an epidemic of malignant CAD in - young Indians? *AJCC* 1998; 1:43-59.
10. Gupta R and Gupta V. Meta analysis of coronary heart disease prevalence in India. *Indian Heart Journal* 1996; 48:241-245.
11. Chadha SL, Radhakrishnan S, Ramachandra K, et al. Epidemiological study of coronary heart disease in urban population of New Delhi. *Ind. J Med Res.* 1990; 92 (B):424-430.
12. Ghosh PC and Gupta JK. Morbidity pattern in Civil Aircrew and the medical assessment system for Civil Aviators in India. *J Aerospace* 1999; 43:24-28.
13. Applegate RJ, Herrington DM and Little WC. Coronary angiography, More than meets the eye. *Circulation* 1993; 87:1392-1401.
14. Scandinavian Simvastatin Survival study group. Randomized trial of cholesterol lowering in 4444 patients with coronary heart disease. The Scandinavian Simvastatin Survival Study. (4S). *Lancet* 1994;
15. The Post Coronary Artery Bypass Graft Trial Investigators. The effect of aggressive lowering of low-density lipoprotein cholesterol levels and low-dose anticoagulation on obstructive changes in saphenous - vein coronary - artery bypass grafts. *N. Eng. J. Med.* 1997; 336:153-162.
16. Pitt B, Waters D, Brown WV et al. for the Atrovastain versus Revascularization treatment Investigators. Aggressive lipid - lowering therapy compared with angioplasty in stable coronary artery disease. *New Eng J Med* 1993; 341:70-76.
17. Shepherd J, Cobb SM, Ford 1, Isles CG Prevention of coronary heart disease with pravastain in men with hypercholesterolemia. *New Eng 1 Med* 1995; 333:1301-1307.
18. Falk E, Shah PK and Fuster V. Coronary plaque disruption. *Circulation* 1995; 92:657-671.
19. Ambrose J A and Fuster V. The risk of coronary occlusions nor proportional to the prior severity of coronary stenosis. *Heart.* 1998; 79:3-4.
20. Enas EA. Testing the efficacy of lipid lowering therapy versus revascularization. The time has come or it is past due? *Circulation* 1998; 97:2548-2596.
21. V Ambrose JA, Tannenbaum MA, Alexopoulos D, et al. Angiographic progression of coronary artery disease and the development of myocardial infarction. *J.Am. Coll. Cardiol.* 1988; 12:56-62.
22. Bilt JA. Advances in coronary angioplasty. *N Engl J Med* 1996; 335:1290-132.
23. Fishbein MC and Sugar. How big are coronary atherosclerotic plaques that rupture? *Circulation* 1996; 94:2662-2666.
24. Maynard C, Chapko MK, Every NR, Martin DC and Ritchie JL. Coronary angioplasty outcomes in the healthcare cost and utilization projects, 1993-94. *Am. J. Cardiol.* 1998; 81:848-852.
25. King S. The development of interventional cardiology. *J Am. Coll. Cardiol.* 1998; 31(S):64B-88B.
26. Deshpande NV and Serruys PW. Current status of plain old balloon angioplasty. *Indian Heart Journal* 1998;50 (suppl) : 5-13.
27. Carrozza JP, Kuntz RE, Leno MB, et al. Demographic, angiographic and procedural factors associated with late angiographic outcome in the STRESS trial : A multivariable analysis. *Circulation* 90:18A, 1994.
28. The post CABGS group investigators. The effect of aggressive lowering of low-density lipo-protein cholesterol levels and low dose anti-coagulation on obstructive changes in saphenous vein aorto-coronary artery bypass grafts. *NEng J Med* 1997;336:153-162.
29. Peduzzi P, Kaminar A and Detre K. Twenty two - year follow - up in the VA cooperative study of coronary artery bypass surgery for stable angina. *Am. J. Cardiol.* 1998; 81:1393-1399.

30. RITA-2 Trial Participants. Coronary angioplasty versus medical therapy for angina. The second Randomized Intervention Treatment of Angina (RITA-2) trial. *Lancet* 1997;350:461-468.
31. CABRI trial participants. First year results of CABR1 (Coronary Angioplasty vs. Bypass Revascularization Investigation). *Lancet* 1995; 346:1179-1184.
32. King SB, 3rd, Lembo NJ, Weintraub, WS, et al. A randomized trial comparing coronary angioplasty with coronary bypass surgery. Emory Angioplasty versus Surgery Trial (EAST). *N Eng J Med* 1994; 331:1044-1050.
3. Comparison of coronary bypass surgery with angioplasty in patients with multi-vessel disease. The Bypass Angioplasty Revascularization Investigation (BARI) Investigators. *N.Eng. M. Med* 1996; 335:217-225
34. Ornish D, Brown SE, Scherwitz LW, Billing JH, et al. Can lifestyle changes reverse coronary heart disease? The Life Style Heart Trial. *Lancet* 1990; 336:129-133.
35. Gould KL, Ornish D, Kirjeride R, Brown SE, Stuart Y, et al. Improved Stenosis geometry by quantitative coronary arteriography after vigorous risk factor modification. *Am J Cardiol* 1992; 69:845-853.
36. Gould KL, Ornish D, Scherwitz LW, Brown SE, et al. Changes in myocardial perfusion abnormalities by position emission tomography after long terms intense risk factor modification. *JAMA* 1995; 274:894-901.
37. Manchanda SC, Narang R, Reddy KS, Sachdev U, Prabhakaran D, Dharmand S, Rajani M, Rijlani R. Coronary Atherosclerotic reversal potential of yoga lifestyle intervention. *Indian Heart Journal* 1998; 50:227-2228.