Coronary Artery Disease in a Young USAF Pilot: Screening for Premature Artherosclerosis

Lt Col Richard E. Blair, USAF MC FS

ABSTRACT

Introduction: Clinically significant coronary artery disease (CAD) in military and civilian pilots may result in disastrous consequences. Pilots with undiagnosed CAD occasionally suffer acute coronary syndrome (ACS) in flight. In single-pilot operations, ACS often ends in crew and passenger fatality. Current standards for assessing the presence of CAD are inadequate. In other nations, additional modalities are used to assess pilots for CAD. Case: A 38-year-old F-16 pilot with no cardiac risk factors presents with chest pain following an 8-hour flight. Angiogram reveals significant single lesion stenosis. The pilot undergoes coronary artery bypass graft. Discussion: Significant CAD is present in a very small minority of young pilots and more so in older pilots and those with cardiac risk factors. Exercise treadmill test (ETT) followed by multislice computed tomography (MSCT), in lieu of coronary angiography, is highly sensitive and specific in the diagnosis of CAD. MSCT has been implemented by the German Air Force with good results.

INTRODUCTION

Unrecognized coronary artery disease (CAD) in aviators can be deadly. Severe CAD can suddenly manifest as acute coronary syndrome (ACS). Fortunately, ACS in pilots during mid-flight is a rare event. When ACS does strike in flight, the pilot in command (PIC) may become incapacitated and unable to perform flight operations. In the airline industry, the copilot is available to assume flight duties and land the aircraft uneventfully. Recent events regarding a transatlantic Boeing 777 point to the unpredictability and lethality of inflight ACS. The Boeing 777, bound from Brussels to Newark, was captained by a 60-year-old male with 32 years of airline experience. Halfway through the flight, the captain suffered ACS followed by sudden cardiac death (SCD). Fortunately, the copilot assumed PIC duties and a reserve pilot served as the copilot. A passenger who also happened to be a cardiologist was summoned to assist in reviving the captain. An onboard AED was used in attempt to revive the captain. Unfortunately, efforts to resuscitate the captain were unsuccessful. The flight continued on uneventfully and landed in Newark without incident. The captain was reported to be in “excellent health.” He underwent the standard Federal Aviation Administration (FAA) class I flight physical every 6 months. Fatal aircraft accidents involving pilot incapacitation due to ACS are more common in general aviation. Given the fact that most private pilot operations are performed by a single pilot, a sudden incapacity of the sole aviator may result in a fatal accident.

Although no exact statistics exist on the probability of inflight ACS in military, commercial, or general aviation pilots, the FAA estimates the probability to be 4 per 100 million flights. In an ongoing study, the FAA examined 44 inflight incapacitations that occurred between 1982 and 1991. The events were broken down further into 33 accidents and 11 incidents. Nine of the 44 pilots identified in the study had one or more antecedent conditions: myocardial infarction, angioplasty, coronary artery bypass graft, CAD, atrial fibrillation, hypertension, and diabetes. In addition to the above risk factors, hyperlipidemia and smoking are significant contributors to CAD. Therefore the older aviator with multiple risk factors may be identified during the flight physical. Further testing, notably the exercise treadmill test, may be used to facilitate the diagnosis of CAD in at-risk aviators. However, exercise treadmill test (ETT) sensitivity for identifying those with CAD ranges from 10 to 70%. Significant CAD may be present but asymptomatic until a coronary plaque ruptures. Thrombosis at the plaque rupture site occurs followed by ACS. Most often, ACS in pilots during flight operations occur in the older pilot (>40) population. Consequently, age and cardiac risk factors are the most common reasons for which a pilot is referred for assessment of cardiac issues. Also, age plays a major role in the career of an airline pilot. FAA regulations prescribe the mandatory retirement age at 65 years, the chief concern being health reasons associated with the aging process.

At the other spectrum, very little is known regarding the presence of CAD in the young aviator population. Significant CAD in those under 40 years of age is rare. The incidence of angiographically proven CAD in the young aviator group is 0.678 to 2.44%, respectively. Whether the presence of CAD in the young pilot population is clearly associated with ACS is unknown. One may assume as much, most notably in the young aviator with the associated risk factors of smoking, hyperlipidemia, sedentary lifestyle, and genetic predisposition for the development of CAD. However, the gold standard for the definitive diagnosis of clinically significant CAD in all age groups remains coronary angiography (CA). CA is not without risk and thus is not used in the standard flight physical for the otherwise healthy civilian or military aviator. The question remains: how may young aviators be noninvasively screened for clinically significant CAD?

This article reviews the epidemiology, screening, and impact of CAD in the young pilot population. A case study is presented describing a young male fighter pilot with clinically...
significant CAD. Finally, noninvasive CAD screening methods are reviewed.

CASE REPORT
John Q. Public is a 38-year-old United States Air Force F-16 pilot. He departs his home station on an 8-hour transoceanic flight en route to a deployed location. The flight is long and physically demanding. Multiple in-flight refuelings are necessary to complete the mission. Cruise altitude is 32,000 feet. All pilots of the six-ship flight are required to wear the anti-exposure suit. Consequently, cockpit operations are awkward and cumbersome. The six-ship flight arrives at its destination uneventfully. Ten hours later the KC-10 lands at the primary destination, the medical hospital with full cardio-thoracic capabilities. In the meantime, Major Public is treated with 325 mg aspirin and H2 blockers. Sublingual nitroglycerin is available. He sleeps for 4–6 hours uneventfully. The next morning he feels well. While walking out on the apron to board the KC-10, Major Public experiences another episode of pressure to the chest and dyspnea. Symptoms resolve with rest. The flight departs and continues uneventfully. Ten hours later the KC-10 lands at the prescribed destination and Major Public disembarks. He is then admitted to the hospital and a cardiologist is consulted to assess the major for presence of CAD. Chest X-ray and EKG are normal. Cardiac studies, including troponin and CPK-MB levels, are normal. Workup for pulmonary embolus is negative. Complete blood count, complete metabolic panel, and urinalysis demonstrate no abnormalities. In spite of a negative cardiac work up, the cardiologist’s index of suspicion remains high. Coronary angiography is scheduled.

Angiography reveals a single coronary lesion proximal to the left anterior descending artery (LAD). The area in question exhibits 80% stenosis. The area is not amenable to percutaneous transluminal coronary angioplasty (PTCA). Cardiothoracic Surgery is consulted. Major Public undergoes a coronary artery bypass graft (CABG) using the left internal mammary artery (LIMA). Recovery is speedy and free of complication. A year later, Major Public receives an aero-medical waiver for flight duties in aircraft requiring two or more pilots.

DISCUSSION
The aforementioned case clearly describes premature CAD in a young pilot with no cardiac risk factors. Fortuitously, the outcome was favorable. But, the presence of advanced CAD in a young and healthy pilot may well be disastrous if not catastrophic. A review of the prevalence and screening modalities for CAD in young patients is therefore in order. Also, the case points out the need for more definitive CAD screening in both young and old aviators.

The incidence of symptomatic CAD in young adults is roughly 3%. It is highly atypical. Premature CAD is usually seen in the presence of hypertension, smoking, diabetes, sedentary lifestyle, hyperlipidemia, or genetic predisposition as determined by family history. Patients with early CAD are usually male, given the cardioprotective effects of estrogen. In a cohort study of transplanted hearts (mean donor age 34) the prevalence of coronary disease was 50% with one in six teenagers manifesting coronary lesions.

There appears to be two distinct groups that manifest CAD at an early age. One group presents with single vessel stenotic plaque disease. Plaque rupture precipitates ACS. The plaque rupture seems to be related to acute physical or acute emotional stress with resultant coronary shear forces. The group tends to exhibit significant vasospasm superimposed on a genetic predisposition for the development of dangerous plaque formation. The group exhibits long-term benefit from coronary revascularization.

The second group of young patients suffering from premature CAD tends to present with a pattern of diffuse coronary disease. Diabetes, hypertension, and hyperlipidemia along with other CAD risk factors are present in the second group. This group of patients derives short-term benefit from revascularization. Rapid progression of diffuse CAD predominates. Long-term outcomes are not as favorable when compared to the first group.
Coronary Artery Disease in Pilots

CAD is an inflammatory phenomenon. C-reactive protein (CRP) is a common inflammatory marker. Also, Chlamydia, mycoplasma, and Helicobacter pylori are believed to have a role in the development of premature CAD. In young patients with CAD, studies should be conducted for evidence of recent infection.

Screening for CAD in the pilot population is an inexact science. The EKG performed on airline pilots and military aviators is used as a screening process for identifying those with undiagnosed CAD. In a Korean study conducted between June 1993 and December 1998, the medical records of all pilots of Asiana Airlines were reviewed. Further, those pilots underwent exercise treadmill testing based on risk factors identified. Pilots with abnormal EKG or ETT were evaluated further with more definitive modalities. Cardiac CT and angiography were performed on those with abnormal findings. No CAD was diagnosed in the study group.

Additional noninvasive methods to screen for CAD include magnetic resonance imaging (MRI) and multislice computed tomography (MSCT). In a meta-analysis of 28 studies involving 903 patients, MSCT was demonstrated to be superior in the noninvasive diagnosis of CAD. The sensitivity and specificity of MSCT and MRI were 85% and 95% versus 72% and 87%, respectively. Additionally, the odds ratio (OR) was 17-fold greater using MSCT versus MRI in the identification of abnormal results \( p < 0.001 \). MSCT is clearly the method of choice when considering noninvasive means to definitively diagnose CAD.

The German Air Force has implemented the use of MSCT in identifying asymptomatic CAD in pilots. Pilots undergo an annual ETT. Those that demonstrated EKG changes from the previous year were referred for MSCT. In a study involving 3,409 flight crew members, 1.73% (59) pilots were suspicious for CAD. Significant CAD was definitively diagnosed in nine persons. Consequently the German Air Force implemented MSCT, if necessary, into the annual physical exam, owing to its high negative predictive value of almost 100%.

At present the FAA class I physical exam requires one EKG after the age of 35 and annually after 40. Likewise the United States Armed Forces requires an EKG with further studies if abnormalities are noted. ETT is not a mandatory provision during the screening process or annual physical required of both military and civilian pilots. In the past, ETT has been proposed by the FAA. In protest, the American Airline Pilots Association (ALPA) threatened industrial action. Consequently, the proposal was dropped.

The above case study and discussion serves to reinforce that however rare it may be, significant CAD exists in the young aviator. Disastrous consequences may ensue. Also, CAD is more prevalent in the older population groups as well in those with CAD risk factors. The current screening tools for CAD are inadequate for diagnosis in those pilots with significant disease. Other nations have implemented tighter screening methods to identify those with clinically significant CAD before ACS. The FAA and Department of Defense (DOD) may be well served in the future to adapt more accurate CAD screening tools as used elsewhere.

REFERENCES