Acute Myocardial Infarction in a Young Bodybuilder Fighter Pilot

Sasirajan Jeevarathinam; Saleh Al Sabei; Yousuf Al Wardi

BACKGROUND: Although advanced coronary artery disease in young, healthy fighter pilots is uncommon, an acute cardiac event in flight could be catastrophic.

CASE REPORT: After a gym workout, a 31-yr-old F-16 pilot reported severe central chest pain, one vomiting episode, and excessive sweating but no radiation of pain. Electrocardiograph showed ST elevation in V2-V6. Coronary arteriography showed a thrombotic lesion at the proximal left anterior descending (LAD) artery (90%) and one occluded LAD branch with thrombus; the rest of the arteries were normal and ejection fraction was 55%. Primary percutaneous coronary intervention to LAD with one drug-eluting stent was done. The pilot was discharged in stable hemodynamic condition with medication advice. Assessment revealed no significant cardiac risk factors. He did not seek medical care for two central chest pain episodes following a gym workout prior to this event because rest relieved the pain. He gave a history of using commercial protein supplements for bodybuilding in the past 6 yr.

DISCUSSION: In this case report, the impact of aggressive gym workouts and chronic use of commercially available bodybuilding protein supplements on cardiovascular health is discussed, as well as aeromedical dilemmas related to this pilot's career. This case sparks debate about whether a highly motivated young pilot with an unexpected cardiac event should be subjected to regular intensive cardiac evaluation throughout his remaining flying career, with permanent flying limitations, or be motivated to pursue a career shift to facilitate noncomplicated career rehabilitation.

KEYWORDS: myocardial infarction, fighter pilot, protein supplements, aggressive gym workouts.

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It is well-known fact that fighter pilots are selected from the elite of potential cadets possessing high cardiovascular and physical fitness, strong mental drive, and exceptional academic records. Hence the probability of presence of advanced coronary artery disease (CAD) in a young, healthy fighter pilot is remote. But, if it occurs, it may be catastrophic provided an acute cardiac event develops in-flight. CAD is known to account for approximately one third of all global deaths, and acute myocardial infarction (MI) is the most severe form of CAD. The most common etiologies for MI in young people are lifestyle modifications, including: sedentary lifestyle; change in dietary habits; stressful and long working hours; strong family history of heart disease; smoking; and development of other comorbid conditions such as diabetes and hypertension at an early age.[7] Recently, the younger generation is showing an increasing trend toward bodybuilding and the use of various protein supplements and anabolic steroids for faster results. Although an association between bodybuilding and MI has been reported in the literature, no exact mechanism has been identified. It has been stated that vigorous physical activity can also acutely and transiently increase the risk of acute MI and sudden cardiac death in susceptible individuals.[14] It is estimated that only 4–17% of MI incidents in men are linked to physical exertion, with much lower rates observed for women.[6] It is postulated that to increase protein synthesis and induce muscle growth, strenuous isotonic exercise or the use of performance enhancers

From the Royal Air Force of Oman, Muscat, Sultanate of Oman.

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Address correspondence to: Medical Center - RAFO Seeb, P.O. Box 732, Seeb, COP Seeb 111, Oman; drsasirajan@gmail.com.

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and protein supplements (or a combination of both) can cause MI.[8] This is an interesting case of a MI in a young fighter pilot who was taking protein supplements (whey protein and amino acids) for bodybuilding.

CASE REPORT

A 31-yr-old male fighter pilot with about 950 h of F-16 flying was brought to the base medical center with severe central chest pain following a gym workout and an episode of vomiting and excessive sweating. No radiation of pain was stated. Electrocardiograph showed ST elevation in V2-V6. After initiating primary cardiac care, he was transferred to a tertiary hospital for further management. Coronary arteriography revealed a 90% thrombotic lesion at proximal left anterior descending (LAD) artery, and one of the LAD branches was occluded with thrombus; the rest of the other arteries were normal and ejection fraction was 55%. Troponin T was raised and all other parameters (lipid profile, liver function test, renal function test, and coagulation profile) were within normal limits. Primary percutaneous coronary intervention to LAD artery with one drug-eluting stent was done. He was discharged in stable hemodynamic condition with medication advice. With regards to cardiac risk assessment, he is a nonsmoker, nonalcoholic, and physically active. There is no family history of young-age heart disease or sudden cardiac death. No red flag signs in the noted blood parameters were suggestive of undergoing atherosclerosis. Thrombophilia screening was negative. Homocysteine levels were within normal limits. He gave a history of central chest pain episodes following gym workouts: two times (once weekly) prior to this event, both of which were relieved by rest between 30 min and 3 h. He did not seek medical care nor report to the medical department. He gave a history of intake of commercial protein supplements for bodybuilding in the past 6 yr. He was taking a random proportion mixture of whey protein and amino acids 1–3 times per wk. His intake was unguided, unmonitored, and unregulated by a professional expert. As far as his workout history prior to the event, he was working out 3–4 times per wk, each session lasting about 120 min and involving a mix of cardio, isotonic, and isometric exercises. His intention was to build up his body musculature, and he categorized his workout as "moderate to severe". He was bearing weights in the range of 50–120 kgs, depending on the involved body region. He is presently stable and asymptomatic. He is on regular cardiology follow-up. He has now limited his exercise regimen to 60 min per session involving warm-ups, cycling, and bearing weights up to a maximum of 60 kgs. He is no longer consuming any commercial protein supplements.

After the cardiac event, the pilot's flying duties were downgraded. During his observation period of 1 yr, he was subjected to periodical and comprehensive cardiological follow-up at a cardiology center, with all relevant investigations (echocardiography, cardiac magnetic resonance imaging, treadmill test, Holter test) complemented by successful modification of cardiac risk factors using appropriate medications and no other comorbidities. Subsequently, his case was discussed in an aviation medicine waiver panel for clinical review and aeromedical disposition. He was documented to be asymptomatic with good-effort tolerance, normal cardiac functional status, and controlled cardiac risk factors. This young pilot was strongly motivated to pursue his piloting career despite being aware of a few permanent career limitations and the need for periodical, detailed cardiological evaluation throughout his career. He was deemed to be permanently unfit for fighter flying duties and instructor duties. He was considered fit to resume flying duties in fixed-wing aircrafts as or with an experienced copilot. He was also advised to continue periodical cardiologist follow-up and aviation-compatible medications as per standard clinical recommendations. He will be reviewed in a waiver panel at periodical intervals with updated cardiologist reports and appropriate investigations, such as angiography, echocardiography, Holter, and treadmill test reports. Presently, the pilot is keen and highly enthusiastic to pursue a career in military drone-flying duties.

DISCUSSION

A young fighter pilot with no known significant cardiac risk factors in the post ST segment elevation MI – percutaneous coronary intervention done status, with a history of chronic commercial protein supplement intake and aggressive gym workout for bodybuilding, poses the following aeromedical dilemmas and challenges.

It is widely accepted fact that physical activity and exercise training delay the development of atherosclerosis and reduce the incidence of coronary heart disease events. Despite this fact, we could find few case reports[7,8,12] in recent literature and media news involving professionals in different fields indicating the occurrence of young-age MI in those exposed to aggressive gym workouts. In one of the published scientific statements of the American Heart Association,[14] it is stated that chronic extreme exercise training and competing in endurance events may lead to heart damage and rhythm disorders. It is also stated that vigorous physical activity, particularly when performed suddenly by unaccustomed individuals or involving high levels of anaerobic metabolism, may transiently increase the risk of acute MI and sudden cardiac death.

The mechanism by which vigorous exercise provokes such events is not defined, but suggested triggering mechanisms include: increased wall stress from increases in heart rate and blood pressure; exercise-induced coronary artery spasm in diseased artery segments; and increased flexing of atherosclerotic epicardia coronary arteries, leading to plaque disruption and thrombotic occlusion.[14] It is also stated that vigorous exercise could provoke acute coronary thrombosis by deepening existing coronary fissures, augmenting catecholamine-induced platelet aggregation, or both.[14]

In one of the research studies,[4] it is stated that spontaneous coronary plaque fissures are common and have been reported in 17% of people dying of noncoronary atherosclerosis.

This observation suggests that mildly fissured coronary plaques require some exacerbating event, such as vigorous physical activity, to induce coronary thrombosis. Increased platelet activation has been reported in sedentary individuals who engage in unaccustomed high-intensity exercise, but not in physically conditioned individuals.[9,11] The predominant pathological cause of exercise-related events in adults is occult CAD.[14] Compelling evidence indicates that vigorous physical activity acutely increases the risk of cardiovascular events among young individuals and adults with occult heart disease.[3,14,15]

In a published scientific statement by the American Heart Association,[5] the conceptual overview of dose-response association between physical activity volume and cardiovascular health outcomes is highlighted. The prevailing dogma, which is also strongly supported by epidemiological evidence,[1,16] suggests a curvilinear relationship between exercise volume and cardiovascular health risks. This indicates that individuals performing none to very low volumes of exercise training have the highest risk for adverse outcomes, whereas the individuals who exercise the most have the lowest risk.[5] The observation that very high volumes of physical activity may yield lower risk reductions than moderate to high activity volumes resulted in the extreme exercise hypothesis, which postulates a U-shaped relationship between physical activity volumes and health outcomes and is characterized by partial loss of exercise-induced health benefits among the most active individuals.[5] However, only limited data are available to support this hypothesis.[6,10,13] Despite all these, there is currently no compelling evidence to reject the curvilinear association between exercise volumes and cardiovascular health outcomes.

Literature review revealed around 8–10 case reports[7,8,12] of cardiac events in bodybuilders who were under some commercial supplements. A mouse study conducted at the Washington University School of Medicine[17] claims that high-protein diets boost artery-clogging plaque, which dangerously increases the risk of heart disease. The most commonly abused supplements among bodybuilders are whey protein, amino acids, and anabolic androgenic steroid tablets. These are mostly prescribed by peer groups or untrained gym professionals without judging their adverse effects.

Literature review of case reports of bodybuilders who experienced MI revealed that the most commonly abused supplement was anabolic androgenic steroid, followed by a whey protein and amino acid combination. Their usage duration ranged from 5–10 yr, with one case reporting MI within 21 d of usage. The clinical presentation is documented to be from sudden cardiac death to ST segment elevated MI. No exact mechanism of action has been identified. Some postulate that strenuous isotonic exercise alone can produce plaque rupture and lead to acute MI, while others blame the coexistence of high-risk attitudes toward over-the-counter medications and supplements.[8] Documented adverse effect of anabolic androgenic steroids on the myocardium[2] may include: decreased left ventricular (LV) ejection fraction; decreased LV diastolic function; significantly more LV hypertrophy, suggesting an anabolic effect on cardiac muscle mass; and increased coronary atherosclerosis. Most of the effects get reversed upon discontinuation. Use of whey protein powder is speculated to be the associated risk factor for coronary thrombus formation in a similar pathophysiologic mechanism in case reports involving whey protein intake.[7,8,12]

To summarize, it is very difficult to pinpoint the exact mechanism of coronary artery occlusion, provided that there are no known risk factors for atherosclerosis in our case and also we do not have data concerning whether there was any plaque burden below the thrombi area. However, on corroborating the evidence from similar case reports to the details of our case, we postulate that there is a strong possibility of chronic unregulated and unmonitored intake of whey protein and amino acids playing a significant role in plaque formation and/or transformation from stable to vulnerable plaque. The precipitating factor might have been aggressive gym workouts exacerbating mildly fissured plaques to induce coronary thrombosis.

The most prominent aeromedical disposition dilemma is: what will the future flying career of a young, motivated, and experienced fighter pilot with an unexpected cardiac event be? In most air forces around the world, there is no hope of him returning to fighter flying duties. So, what is the next best possible career option? Restreaming to transport or helicopter is possible, but he may be flying with some permanent limitations on his flying privileges (e.g., being allowed to fly only as a copilot). The chance of him becoming an instructor is very remote. In addition, he will be subjected to periodic detailed cardiac evaluation throughout his remaining flying career. There is a high chance that permanent limitation of flying privileges and intensive periodic cardiac follow-up evaluation might add to the peer pressure impact on pilot motivation toward his flying duties, as his colleagues and juniors might bypass him administratively. This sparks a debate about whether it is wise to motivate such a young person for an early career shift to facilitate satisfactory career rehabilitation. So, what are the options ahead to balance both career and passion? Some options include becoming a drone pilot or simulator instructor, or accepting non-flying administrative duties. In our case, the pilot is presently motivated to pursue his career in military drone-flying duties and wishes to seek an upgrade in flying privileges in due course of time, depending upon his cardiac stability in the coming years.

To conclude, chronic supra-physiological protein supplements and isotonic strenuous exercises might be the cause of MI in bodybuilders like in our case. More case reports and prospective studies among bodybuilders might clarify the cause-effect relationship of commercial protein supplements and MI. We recommend some squadron-level strategies to prevent such cardiac events in aircrew. It is ideal to do preparticipation screening and recommend prudent exercise programs to aircrew who intend to involve bodybuilding in their exercise regimen. It is important to educate the aircrew about the health implications of chronic, unregulated intake of the commercial protein supplements whose use has become quite frequent these days. Aircrew should have awareness to maintain physical fitness through regular physical activity rather than sporadic unaccustomed high intensity exercises.

And lastly, the most important is to encourage timely reporting of prodromal symptoms to prevent serious effects.

This case report highlights the rarely described risk factors which might contribute to the development of CAD and contributes to better understanding of the aeromedical disposition dilemmas in young aircrew for suitable long-term career rehabilitation.

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Authors and Affiliations: Sasirajan Jeevarathinam, M.B.B.S., M.D., DAvMed, Saleh Al Sabei, M.D., DavMed, and Yousuf Al Wardi, M.D., DAvMed, Royal Air Force of Oman, Muscat, Sultanate of Oman.

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