

Aerospace Medicine Clinic

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You're the flight surgeon at an F-16 base when a 37-yr-old male experienced command pilot presents with palpitations and chest discomfort, on and off for the last week. He reports this has been a problem since he was a child. He denies any history of syncope, shortness of breath, or exercise intolerance and has never had any problems performing as an F-16 pilot. He also reports excellent $+G_z$ tolerance in the past and his resting heart rate in clinic is 55 bpm. He has an electrocardiogram done in the clinic that is normal; however, a 7-d Holter monitor shows paroxysmal atrial fibrillation (A-fib). He is referred to Cardiology and an echocardiogram is done that shows normal structure and function; he then undergoes pulmonary vein isolation A-fib cardiac ablation.

1. What is the long-term recurrence rate of paroxysmal A-fib following this pilot's first pulmonary vein isolation ablation?
 - A. 0–20%.
 - B. 20–40%.
 - C. 40–60%.
 - D. 60–80%.

ANSWER/DISCUSSION

1. B. This pilot has nonvalvular paroxysmal A-fib. Recurrence of A-fib after a single ablation is relatively high. In a 2013 meta-analysis, the success rate of a single cardiac ablation for paroxysmal A-fib was 67% at 1 yr and 54% at 3–5 yr.³ This success rate has traditionally resulted in permanent disqualification of pilots to fly high-performance aircraft after a diagnosis of A-fib with or without cardiac ablation. Indications for cardiac ablation are the presence of symptoms associated with A-fib, typically after ineffectiveness or intolerance of medication.⁷ The pilot in this case was a candidate for ablation therapy since he was symptomatic and unable to tolerate rate control medications like beta blockers due to his low resting heart rate. There is no recommendation to pursue cardiac ablation just to get a pilot back in the air, and appropriate treatment of the medical condition is critical. Some identified risk factors for recurrence of A-fib post ablation include older age, hypertension,

structural heart disease, male sex, persistent A-fib, and presence of coronary artery disease. Early recurrence in the first 1–3 mo post ablation of A-fib can occur in 30–70% of individuals who undergo cardiac ablation; however, this is thought to be due to remodeling and inflammation and may be transient in some cases. That being said, early recurrence is a strong independent predictor of long-term recurrence.⁹ After the early recurrence period, most recurrences are reported in the first 3–6 mo; thus, it is recommended to wait at least 4–6 mo before a return to flying.^{4,12}

After the ablation, the pilot is treated with metoprolol succinate 25 mg daily as well as apixaban 5 mg twice a day for 1 wk. He denied any additional palpitations or chest discomfort and had a normal 7-d Holter monitor. He has no history of hypertension, chronic heart failure, vascular disease, diabetes mellitus, stroke, bleeding tendencies, or alcohol use. He has normal kidney and liver function and takes no medications.

2. What recommendations would you make to the pilot regarding long-term oral anticoagulation and/or antiplatelet therapy to prevent ischemic stroke?
 - A. No anticoagulation or antiplatelet medication needed.
 - B. Aspirin 81–325 mg daily.
 - C. Warfarin with an international normalized ratio goal of 2.0 to 3.0.
 - D. Direct oral anticoagulants (e.g., apixaban).

ANSWER/DISCUSSION

2. A. Thromboembolism is a common complication of A-fib, and the American Heart Association recommends a risk-based anticoagulant therapy approach. This can be done with the $CHA_2DS_2-VAS_c$ score. The risk factors worth 1 point are congestive heart failure, hypertension, diabetes mellitus, vascular disease, age 65–74 yr, and sex (female), and those worth 2 points are age > 75 yr and history of stroke, transient ischemic attack,

or systemic embolism. People who have a score of 0 have a 0.2% annual risk of ischemic stroke. Risk increases with a higher score, e.g., 2 points is 2.2% risk while 9 points is 12.2%. Oral anticoagulation is currently recommended for a score of 2 or greater in men and 3 or greater in women. Treatment options include nonvitamin K oral anticoagulants like apixaban or more traditional medication like warfarin.⁸ Therapy, however, needs to be balanced with the risk of bleeding, and the HAS-BLED score can be used for this. Since our pilot's CHA₂DS₂-VAS_c score is 0, he is not at a significant risk for thromboembolic stroke due to his A-fib; therefore, anticoagulation therapy is not indicated.

The pilot remained symptom free and was evaluated at the Aeromedical Consult Service for waiver consideration to return to flying duties. He underwent a maximal treadmill stress test that showed rare ventricular ectopy but no other arrhythmia or evidence of ischemia. He had a normal electrocardiogram, 24-h Holter monitor, and echocardiogram. He underwent cardiac monitoring during an F-16 protocol centrifuge ride that showed a normal cardiac response to +G_z, with only three ectopic atrial beats, and no A-fib or other arrhythmias in the +3 G_z to +9 G_z profile.

3. What physiological stressors may increase the risk for hemodynamically unstable A-fib?
 - A. Vibration.
 - B. Spatial disorientation.
 - C. +G_z.
 - D. Thermal stress.

ANSWER/DISCUSSION

3. C. A-fib results in a decrease in cardiac output due to loss of the atrial contribution, atrioventricular synchrony, and, if developed, rapid ventricular response.⁵ This may not be enough to be clinically significant at +1 G_z; however, in high-performance aircraft like our pilot's F-16, this could be enough to decrease +G_z tolerance and increase the risk of G-induced loss of consciousness.¹¹ The normal effect of a high +G_z environment is a decrease in cardiac output by 20% when subjected to +4 G_z. In a 2004 study of 195 male Japan Air Self-Defense Force fighter pilots, 85.6% had arrhythmias during centrifuge training; 14.4% of these pilots had clinically significant arrhythmias and one pilot had an episode of paroxysmal atrial fibrillation.⁶ Finally, if a pilot requires medications such as beta blockers to control his or her A-fib, the medications could also reduce +G_z tolerance to an unacceptable level. The ability of the heart to adequately supply oxygenated blood to the brain is critical when operating in the high +G_z environment; therefore, A-fib has historically been a permanently disqualifying condition in high-performance pilots in all branches of the U.S. military. Traditionally waivers are granted for episodes with a precipitating factor like holiday heart.^{1,10,13} The Federal Aviation Administration requires all cases of A-fib to be deferred, so the airman will require a special issuance.²

Based on the pilot demonstrating no recurrence of A-fib after a 6-mo waiting period, minimal risk factors for recurrence, a normal heart structure, a low risk for thromboembolic event without anticoagulation, and his ability to perform a +9 G_z centrifuge profile without pathological arrhythmias, it was felt that he was at low risk for sudden incapacitation in the F-16. This pilot is the first U.S. Air Force high-performance pilot with paroxysmal A-fib recommended for return to unrestricted flight duties.

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