

Aerospace Medicine Clinic

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You're the flight surgeon on call for two independent duty medical technician (IDMT) paramedics providing medical support for U.S. Air Force (USAF) training in an austere environment. Training involves hiking through forested areas carrying backpacks weighing between 40–60 lb while moving through areas of dense forest with thick underbrush in mountainous, uneven terrain. Your IDMTs notify you they are responding to a call of an otherwise healthy high-performance aviator trainee in his 20s complaining of worsening bilateral leg pain. In this environment, response times vary depending on the location and terrain, but the IDMTs reach the aviator within 20–30 min following a short drive and hike to his location.

Upon arrival, the IDMTs notice the aviator seated on the ground in mild to moderate distress secondary to leg pain. On initial evaluation, IDMTs note that the aviator appears uncomfortable and is rubbing his legs. He is alert and able to appropriately respond to their questions. The aviator denies any history of injury or falls while hiking. He reports a popping sensation in his throat/upper chest about 2 h prior to evaluation, but denies chest, abdominal, or back pain. He was not short of breath and was able to speak in full sentences. After the popping sensation, the aviator reports developing pain in the bilateral lower extremities that limited his ability to continue hiking. He advised his instructor and took a single dose of ibuprofen without relief. The aviator tried to continue hiking but reports his leg pain was progressing distal to proximal and right worse than left.

1. Which of the following should be considered in the differential diagnoses for this aviator with worsening bilateral leg pain?
 - A. Lumbar spinal stenosis.
 - B. Exertional compartment syndrome.
 - C. Rhabdomyolysis.
 - D. Acute aortic dissection.
 - E. All of the above.

ANSWER/DISCUSSION

1. E. Each of these conditions should be considered when developing the differential diagnosis, particularly given the

field conditions where the aviator is being evaluated. With a distinct lack of imaging or lab work, one must rely on history and physical exam to determine the most likely cause and plan of care. While more common in middle-aged and elderly patients, lumbar spinal stenosis can present in younger patients. Symptoms are typically bilateral; however, the pain usually progresses from proximal to distal.¹ Exertional compartment syndrome often presents more chronically but may be seen acutely. Compartment syndrome is thought to be due to an increase in the muscle's fluid volume pushing against an unyielding fascial layer. As pressure increases, vessels and nerves are compressed, leading to classic symptoms of "The Five P's": pain, pallor, pulselessness, paresthesia, and paralysis. These are late findings, however, and more commonly patients will have a tense "wood-like" feeling over the involved compartment and pain with exercise.¹³ Rhabdomyolysis is the breakdown of muscle tissue caused by overexertion, crush injury, or toxicities including alcohol and medications. Symptoms are often nonspecific and may include muscle pain, swelling, weakness, and tea-colored urine.¹² Aortic dissection, while uncommon and more commonly seen in older men, is a potentially life-threatening condition with a mortality rate as high as 1–2% per hour if not immediately identified and treated.^{3,9,11}

Initially, the aviator reports his past medical history as unremarkable and denies any medication use, allergies, or significant past medical/surgical history. On examination, vital signs reveal an elevated blood pressure in the 200s/100s, pulse of 102, respiratory rate of 16, and a pulse oximeter reading of 97%. Initial cardiac and pulmonary examination is unremarkable. Examination of his lower extremities reveals sensation is intact to light touch and symmetric, he has a negative straight leg raise bilaterally, capillary refill is intact, and distal pulses are symmetric and normal bilaterally. During the evaluation, the aviator complains of increasing pain in his legs and is unable to walk to the medics' vehicle.

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2. The IDMTs are considering their next steps in evaluation and treatment and ask for your recommendation. What would you advise?
 - A. Provide additional analgesia with acetaminophen 1000 mg by mouth and return the aviator to training.
 - B. Administer a single dose of ketorolac 60 mg intramuscularly and monitor for pain relief with a plan to return to training if pain is relieved.
 - C. Administer a single dose of ketorolac 60 mg intramuscularly, provide intravenous normal saline 1–2 L, and return to training if pain is relieved.
 - D. Immediate medical evacuation to the nearest emergency department for further workup and treatment options.

ANSWER/DISCUSSION

2. **D.** Each of the conditions in the differential diagnosis require emergent evaluation and treatment to avoid potential loss of life or limb. Providing analgesia, regardless of the medication used, with a plan to observe for a reduction in pain only delays diagnostic clarification and potential lifesaving and limb-sparing treatment. With rhabdomyolysis in the differential, any potentially nephrotoxic medications, including ketorolac, should be avoided until the diagnosis can be ruled out.¹² Without access to diagnostic imaging and lab work, this aviator must be medically evacuated to the closest emergency department.

The aviator is carried out on a litter and driven to the nearest emergency department 30 min away. During transport, the aviator recalls that he had a surgical repair of a patent ductus arteriosus as an infant, but no other significant past medical or surgical history. He is unaware of any significant family history of genetic connective tissue disorders or aneurysm. The aviator denies taking any medications or supplements, drinks only socially, and denies illicit drug use. Review of symptoms remains negative for chest, abdominal, or back pain other than the popping sensation he felt in his throat and upper chest prior to onset of his leg pain. Serial examination of his legs reveals decreasing distal pulses and pallor in his right leg greater than left.

In the small rural emergency department, the aviator has a computed tomography scan, which reveals a thoracic aortic dissection extending from the ascending aorta to the right femoral artery.

3. What is the most common presenting symptom of an acute aortic dissection?
 - A. Absent or decreased distal pulses that may be unilateral or bilateral.
 - B. Sudden onset of severe, sharp, or stabbing pain in the chest, back, or abdomen.
 - C. Dyspnea at rest and with exertion.
 - D. Syncope.

ANSWER/DISCUSSION

3. **B.** The classic clinical triad in acute aortic dissections includes an abrupt onset of chest or abdominal pain, a difference in pulse and/or blood pressure between the two upper extremities, and a chest X-ray demonstrating mediastinal and/or aortic widening.⁵ The classic pain description from aortic dissection is a “tearing” or “ripping” pain in the chest or abdomen. Most patients, however, describe a sudden onset of a severe “sharp” or “stabbing” pain in their chest or back, occasionally the abdomen, that is worse at onset and may radiate. Depending on the degree and location of the dissection, the other symptoms listed could be present, but not as commonly as pain. With decrease in perfusion of the ileac artery, a patient could experience lower extremity ischemia presenting as absent or decreased distal pulses. Patients with an aortic dissection pushing on the trachea or bronchus, affecting the aortic valve and causing aortic regurgitation with resulting congestive heart failure or cardiac tamponade, may experience dyspnea. Lastly, syncope could occur in cases of carotid artery involvement or cardiac tamponade.^{5,9}

The aviator is flown to a level II trauma center with surgical capabilities and undergoes surgical repair of his aortic dissection.

4. What is the most common predisposing factor for the development of an acute aortic dissection?
 - A. Genetically mediated connective tissue disorders such as Marfan syndrome and vascular Ehlers-Danlos syndrome.
 - B. Preexisting aortic aneurysm.
 - C. Systemic hypertension.
 - D. Prior aortic instrumentation.

ANSWER/DISCUSSION

4. **C.** While each of the conditions listed is considered a high-risk condition, systemic hypertension is, in fact, the most common predisposing factor for the development of an acute aortic dissection. Multiple genetically mediated conditions, including Marfan syndrome, vascular Ehlers-Danlos syndrome, bicuspid aortic valve aortopathy, and familial thoracic aortic aneurysm and dissection syndrome, among others, place individuals at higher risk for dissection. However, increased blood pressure and aortic stress, as seen during heavy exertion, places these individuals at highest risk of dissection and/or rupture. Similarly, while having a known aortic aneurysm is a risk factor for aortic dissection, the mechanism for dissection is increased blood pressure.^{3,9} Hypertension remains the most important risk factor for aortic dissection and is present in around 80% of patients who develop an aortic dissection. Hypertension accounts for around 54% of the population-attributable risk of aortic dissection in the general population. Comparing those with hypertension to those without,

the incidence rate for aortic dissection is 21 vs. 5 per 100,000 person-years, respectively.⁸

Following his postoperative observation and recovery, he is discharged to an inpatient rehabilitation facility for ongoing care, recovery, and strengthening postoperatively. As a trained high-performance Air Force aviator, he is placed on duties not to include flying status.

5. Which of the following describes the aeromedical considerations for an aviator who experiences an acute aortic dissection status post-repair?
 - A. Literature describing management of aeromedical disposition in aviators with a history of aortic dissection is limited.
 - B. The Federal Aviation Administration (FAA) requires Aviation Medical Examiners to defer the decision to return to fly to the FAA.
 - C. The U.S. Air Force Aerospace Medicine Waiver Guide advises aortic dissection is disqualifying for all flying classes.
 - D. All of the above.

ANSWER/DISCUSSION

5. D. Aortic dissection is an uncommon condition in the general public. As such, it makes sense this is not commonly diagnosed in aviators either. Given the higher prevalence in patients 60–80 yr old,⁵ this is an even more unlikely diagnosis in military aviators who tend to be younger. Upon review of available literature, the first case of an acceleration-induced aortic dissection was presented in 2020, 10 yr after a 49-yr-old fighter pilot instructor with over 6000 flight hours experienced an aortic dissection during a high +G_z maneuver. He reported severe chest pain during a spiral down maneuver from 6562 ft (2000 m), noting that at 755 ft (230 m) he developed sudden onset of severe chest/back pain. Upon landing emergently, he was transported to the emergency department, where computed tomography angiography showed his dissection. He underwent emergency surgical repair and had no evidence of recurrence 10 yr later. The authors did not comment on the aeromedical disposition, however.²

The FAA provides guidance for aortic aneurysm, including post-repair, requiring Aviation Medical Examiners to defer aeromedical disposition to the FAA for review/decision, but does not specifically list aortic dissection.⁷ Instead, the FAA provides a generic statement that “any other cardiac condition not otherwise covered in this section” must be deferred to the FAA for review/decision.⁶ Similarly, neither Navy nor Army aeromedical waiver guides mention aortic dissection specifically.^{10,15} The Air Force Medical Standards Directory states that “disease and disorders of the aorta, including surgical or percutaneous therapeutic intervention, including but not limited to aneurysm, dissection, arteriosclerosis, collagen vascular disease, inflammatory conditions, and infectious diseases” are disqualifying for retention and all flight duty

categories.¹⁴ This is also reflected in the U.S. Air Force Aerospace Medicine Waiver Guide.⁴

The aviator continues to recover postoperatively from his aortic dissection, and both his military retention status and aeromedical disposition are yet to be determined. Should his condition post-recovery allow him to remain in the military, his case will require evaluation at the U.S. Air Force Aeromedical Consult Service given the rare nature of his condition, especially in aviators.

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