

You're the Flight Surgeon

This article was prepared by Winton P.D. Laslie.

You're the flight surgeon at a U.S. Naval hospital on a small island in the South Pacific 7000 mi from nowhere. While pondering the reason brown tree snakes cause so many power failures on-island, your cell phone rings and it's the fire chief, with whom you had lunch last week while preparing for the upcoming mass casualty exercise. One of his young firefighters was overdue for his annual firefighter surveillance occupational health exam and will be in this afternoon. You agree to see him at the end of clinic as a walk-in, reinforcing unit efforts to take action on their firefighter surveillance occupational health exam compliance rate.

The work history, firefighter questionnaire, vital signs, anthropometric measurements, immunizations, vision testing, electrocardiogram, audiogram, 10-yr Framingham risk calculation, bloodwork, chest radiograph, and head-to-toe physical examination are all normal (Hetrick SM, Fitts RF. Personal communication; 2018 Sep. 17).^{2,7} He is compliant with daily medications: prazosin, amlodipine, esomeprazole, montelukast, gabapentin, and as-needed clonazepam. He takes no vitamins or supplements and is allergic to ciprofloxacin, which gives him hives. However, spirometry appears newly abnormal today compared with last year's study. The report reflects forced vital capacity (FVC) trials were acceptable, reproducible, and showed good effort, but with FVC = 3.45 L and 73% of predicted [lower limit of normal (LLN) = 3.91 L],⁴ forced expiratory volume in 1 s (FEV₁) = 71% of predicted (normal ≥ 80%), FEV₁/FVC = 79% of predicted (normal ≥ 70%), and forced expiratory flow = 25–75% midflow 56% of predicted (normal ≥ 65%). You cross-check the National Health and Nutrition Examination Survey equation input by the medical technician into the machine to determine normal range pulmonary function values and note that patient age, gender, height, and ethnicity are correct. Your attention then returns to a focused review of systems, where the patient reports moderate nonprogressive sudden-onset dyspnea with exertion (only with inhalation).

1. What is the general interpretation of this patient's pulmonary function test (PFT) values?

- A. Normal PFT.
- B. Obstructive pattern.
- C. Restrictive pattern.
- D. Mixed obstructive-restrictive pattern.
- E. Invalid or unable to determine.

ANSWER/DISCUSSION

1. C. A normal FEV₁/FVC ratio in the setting of decreased FVC indicates a restrictive pattern. Severity of the restrictive defect may then be assigned based on FVC percentage of predicted (mild severity in this case since FVC ≥ 60% of predicted). An initial differential diagnosis includes disorders of the chest wall, drugs, interstitial lung disease, and neuromuscular disorders.⁵

Despite the patient's desire to obtain his annual return-to-duty clearance memorandum today, you elect to withhold full duty clearance pending further workup and notify the shop supervisor for internal shift-scheduling purposes.⁷ You order a chest radiograph, consult pulmonology online at a regional Army medical center for specialist review, and complete forms for routine aeromedical evacuation next week to the closest military pulmonology consultant off-island just in case.

The chest radiograph returns showing an elevated left hemidiaphragm with adjacent left lower lobe atelectasis, so you elect to repeat the imaging study next week hoping for spontaneous resolution. The repeat study shows unchanged findings, so you process the evacuation paperwork and the patient proceeds off-island for specialist consultation. The pulmonology report returns showing spirometry was repeated off-island with FVC = 3.82 L and 88% of predicted (LLN = 3.91 L).⁴ Normal expiratory flows were shown with reduced inspiratory flow consistent with variable extrathoracic obstruction and indicating upper airway obstruction. A third PFT was administered 2 mo later with FVC = 3.75 L and 87% of predicted (LLN = 3.91 L).⁴ When comparing chest radiographs, the pulmonologist noticed the elevated left hemidiaphragm was not present in a comparison film 2 yr earlier.

2. When the patient returns after off-island pulmonology consultation, which of the following therapies is likely to be of greatest benefit?

- A. Inhaled short-acting beta-agonist.
- B. Immediate referral to general surgery for chemical or surgical pleurodesis.
- C. Immediate referral to general surgery for left lower lobectomy.
- D. Inhaled corticosteroid.
- E. Increased aerobic conditioning to "power through the dyspnea."

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ANSWER/DISCUSSION

2. E. Given the case history and recurrent PFT restrictive pattern, an isolated neuromuscular etiology is suspected. Pulmonology continues to follow along and cardiothoracic surgery is also consulted to assist with insight and treatment. The dyspnea symptoms progressed 6 mo later such that the patient can no longer walk up one flight of stairs without significant dyspnea, and he's now restricted to administrative duties at the firehouse. Repeat PFT shows FVC = 3.11 L and 66% of predicted (LLN = 3.91 L)⁴ with FEV₁/FVC = 71% of predicted (normal ≥ 70%). The patient is counseled to begin conservative care, watchful waiting, and maximum tolerated aerobic conditioning because the surgeon suspects possible recent injury to an anatomic structure.

3. Which anatomic structure, when injured, may explain the chest radiograph hemidiaphragm findings?

- A. Lingula.
- B. Tracheal cartilage.
- C. Sternum.
- D. A left posterior thoracic section of rib.
- E. Left phrenic nerve.

ANSWER/DISCUSSION

3. E. Each hemidiaphragm is innervated by the ipsilateral phrenic nerve, which terminates along the medial portion of the diaphragm muscle.⁹ Numerous causes of phrenic palsy exist.^{1,11} Likely culprits in this case include trauma, lateral hyperextension of the neck, chiropractic manipulation, idiopathic phrenic neuropathy, and postviral neuropathy.⁶

It's now been 11 mo since the previous firefighter surveillance exam and the patient returns to clinic for this year's surveillance exam seeking clearance for full firefighter duty. Interestingly, he reports 90% spontaneous improvement in symptoms, can climb two flights of stairs without dyspnea, runs a mile with ease, and has returned to vigorous exercises 5 d weekly. Objective measurement of this patient's capability would prove helpful in rendering your occupational disposition, so you call up your friend the fire chief and learn a fire exercise is scheduled for next week. The patient is motivated to demonstrate his recovery by participating in the exercise under unrestricted firefighter duty status and he invites you to come watch. Your patient dons full gear and helmet and then dispatches a fire hose while providing leadership to two fellow firefighters. He enters the building, fights the fire, accomplishes appropriate building searches, and negotiates challenging architectural barriers within. First-hand observation shows your patient performed his duties successfully without abnormal difficulty, experiencing rapid return of normal respiratory rate and speedy physical rebound from vigorous exercise. In the lower pocket of your flight suit you've brought along a blank fitness-for-duty letter, which you gladly sign and greet the patient with just as the exercise concludes.

AEROMEDICAL DISPOSITION

Annual firefighter surveillance occupational health exams are considered routine occupational medicine practice for military flight

surgeons. It is unknown whether this patient with diaphragmatic hemiparesis will regain complete functionality. Reassuring is his proof of required functional capacity during a rigorous firefighter exercise scenario. All classes of aeromedical certification from the Federal Aviation Administration (FAA) would require special issuance (a waiver) from the home office, as this condition falls outside the scope of what an Aviation Medical Examiner can issue during a routine FAA flight physical. Item 35 of the FAA medical examination is the lung and chest section, and the applicable disqualifying line item states: "Other diseases or defects of the lungs or chest wall that require use of medication or that could adversely affect flying or endanger the applicant's well-being if permitted to fly."³ All medical documentation regarding the patient's clinical course should be submitted for consideration. Additional testing may be required to determine whether significant hypoxia exists at altitude compared to peer pilots. A review of the U.S. Navy Aeromedical Reference and Waiver Guide pulmonology and neurology sections did not reference this diagnosis.⁸ A review of Army Regulation 40-501 reveals that diaphragmatic hemiparesis is incompatible with enlistment, appointment, and induction, but is not specifically mentioned in the section on retention unless the diaphragmatic hemiparesis is congenital.¹⁰

Proper U.S. Air Force occupational disposition regarding diaphragmatic hemiparesis requires consideration at multiple levels. Members on active duty with the U.S. Air Force must first be evaluated for retention, as this condition is disqualifying for retention and also introduces deployment limitations per the Medical Standards Directory.* Physical fitness must also be assessed to determine whether the patient meets general Airman fitness requirements along with the more strenuous duties of firefighting. For those on aviation duty status, diaphragmatic hemiparesis is disqualifying for all classes of flying duty, controller duty, missile operations, and operational support duty. If a retention determination is first reached, the next step is aeromedical waiver consideration for personnel on flying status. Documented stability, satisfactory performance of duties in all environments, and in-depth review by the Air Force Aeromedical Consultation Service prior to disposition from a waiver authority is highly recommended.[†]

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† U.S. Air Force. Section G: chest wall and pulmonology. USAF medical standards, G2. In: Medical standards directory (MSD). 2018:19. [Accessed 6 Dec. 2018]. Available from <https://kx2.afms.mil/kj/kx4/FlightMedicine/Documents/Forms/ShowFolders.aspx?RootFolder=%2Fkj%2Fkx4%2FFlightMedicine%2FDocuments%2FMedical%20Standards%20Directory%20%28MSD%29&FolderCTID=0x0120004DEB19A0C597EF4794DF99094B5AD8FC&View=%2FBE6B00DAE%2DE012%2D41B4%2DB351%2DDE160D7DA68D%7D> to those with access.

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You're the flight surgeon attached to a red air F-16 squadron. You are tasked to deploy for 7 wk to Guam followed by Australia for separate training exercises. Secondary to manning concerns, you will be the only medical member for the 130-member deployment made up of both flyers and nonflyers.

During your mission medical brief, an F-16 pilot approaches you about a new wound on the dorsal surface of his hand. On exam you notice an open wound with some minor erythema around the border and serosanguinous drainage. His range of motion, strength, and sensation are intact and he has little to no pain. The rest of his exam is unremarkable. He states the injury occurred 2 d ago at the gym when a light weight was dropped on the area. The member does not report any other concerns or symptoms. You are able to get the patient in for an X-ray of the affected area, which was reported as normal. The deployment is tasked to depart in 48 h, and it is unlikely that you will be able to follow up with the patient before that time.

1. What would be the most appropriate treatment in this given scenario?

- A. Wound care education and supplies.
- B. Antibiotic therapy.
- C. Activity restriction for affected limb.
- D. All the above.
- E. A & C.

ANSWER/DISCUSSION

1. D. Although a full workup was not accomplished due to time constraints, the initial presentation indicates a local soft tissue infection

that would benefit from antibiotic therapy.⁸ Close follow-up and appropriate wound care could eliminate the need for antibiotics, but these options are likely not available in this situation.

If this pilot drops out of the exercise it could potentially affect the success of training as a whole. A specific number of sorties are planned for each day's training, so it is important to treat in a way that would limit complications. The pilot will likely have little to no negative side effects to the antibiotics, but the treatment could make a significant difference in recovery time.

2. This pilot is tasked with flying a jet on the first leg to Guam. What is the best course of action regarding his flight status?

- A. Duties not to include flying.
- B. Remain on flight status for the upcoming movement.
- C. More information is needed for the decision.

ANSWER/DISCUSSION

2. C. Many factors will come into play that would not be as important in a standard medical appointment at home station. A decision will need to be made regarding the likelihood and timing of recovery. This

^{*} U.S. Air Force. Official Air Force aerospace medicine approved medications. 2018 Sep. 25. [Accessed 1 Oct. 2018]. Available from <https://kx2.afms.mil/kj/kx4/FlightMedicine/Documents/Forms/ShowFolders.aspx?RootFolder=%2Fkj%2Fkx4%2FFlightMedicine%2FDocuments%2FStandards%2FAircrew%20Medication%20Lists&FolderCTID=0x0120004DEB19A0C597EF4794DF99094B5AD8FC&View=%7BE6B00DAE%2DE012%2D41B4%2DB351%2DDDE160D7DA68D%7D> to those with access.

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