Aerospace Medicine Clinic

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Vou are a military flight surgeon assigned to a small aviation medicine clinic. Today you have a number of flight physicals to perform and a handful of return-to-duty determinations. Before you dive into the scheduled work, the front desk of the clinic calls and asks if you can see a pilot who has walked into the clinic with a complaint of "chest pain." Not wanting to ignore a possible emergency, you ask that the patient be immediately escorted into an examination room.

Walking into the examination room, you are quietly relieved to see a young, fit-appearing patient sitting upright, relaxed, and in no apparent distress. The patient is a 29-yr-old male rotary wing student pilot. He is currently in Survival, Evasion, Resistance, and Escape (SERE) training and reports that he has progressive dull/aching pain in his chest. The pain began an indolent course weeks before coming to this training. He explains that the SERE cadre directed him to the clinic as his chest pain is worsening and distracting from his ability to train. He describes the peak pain as an 8/10 and "stabbing" in nature, with difficulty taking in a full breath during exertion. He denies having a cough, fatigue, other symptoms, or contact with other students with similar concerns. He is a never-smoker and his medical record supports his assertions of having no previous history of notable disease, injury, or significant occupational exposures. He denies any chest trauma preceding the symptoms. However, he does report episodes of forceful physical exchanges as part of his training.

Knowing that SERE training can be extremely demanding and not for the faint-of-heart, you are initially skeptical of the veracity of his story. Considering the physical and mental stress that realistic survival training can place on a student, you wonder if he is seeking relief from the course. However, you see that the pulse oximeter displays an oxygen saturation (S_po_2) of 82% with a heart rate of 105 bpm as the patient sits calmly on the examination table.

The patient is appropriately warm to the touch and does not have an elevated temperature. He is not tender to palpation along the chest wall, there is no discernible anatomic defect, and there is no sign of chest trauma. However, there are signs of mild bruising and minor abrasions on other parts of his body. Auscultation reveals decreased breath sounds on the right with no adventitial sounds detected in any lung fields. The right pulmonary fields are also dull to percussion. His neck veins appear to be distended, but he is a very vascular individual with prominent veins of the upper body.

- 1. What is the most likely immediate concern to address?
 - A. Tension pneumothorax.
 - B. Pneumonia.
 - C. Asthma.
 - D. Costochondritis.

ANSWER/DISCUSSION

1. A. Considering the rough physical treatment that is inherent in the service member's current training, unilateral diminished breath sounds, distended neck veins, and worrisome S_pO_2 levels, you need to address a possible tension pneumothorax.³ The other choices are less acutely life threatening. Diminished breath sounds and a worrisome S_pO_2 level could be the result of a lower respiratory infection such as pneumonia, considering the training environment he is in.⁴ However, the lack of elevated body temperature and other constitutional symptoms makes this less likely. Lack of history of asthma, as well as no irregular lung sounds on auscultation, makes this diagnosis less likely.⁵ Physical examination with lack of pain to palpation does not make costochondritis a likely cause of his pain and would not explain his vital signs.¹¹

As you think through your treatment plan for this patient, you review your resources: ample supply of sick call medications, a trauma bag with sufficient supplies for combat casualty care, and a base emergency department that is only 5 min away by your clinic's ambulance. Your medic places the patient on

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high flow oxygen. You see that his S_pO_2 is rising quickly and now is above 90% and his heart rate is slowing to 80 bpm.

- 2. Which of the following is the next best step?
 - A. Dispense a metered dose inhaler of albuterol and refer to a pulmonologist.
 - B. Send to the emergency department for further acute workup.
 - C. Perform a needle decompression.
 - D. Dispense a nonsteroidal anti-inflammatory drug for the pain, offer reassurance, and schedule a follow-up for 2 wk.

ANSWER/DISCUSSION

2. B. Considering the improvement in vital signs on high flow oxygen, the lack of patient distress, the ready availability of transport, and the proximity of the emergency department, transfer to a higher level of care is advised over performing the invasive temporizing condition of C in your small clinic. Answer A may be appropriate for a mild asthma exacerbation and D may be fine for costochondritis. However, neither A nor D address the possible immediacy of the situation, not to mention his return to an austere training environment where his condition may worsen.

The patient agrees with your decision to be transported to the emergency room. You direct your staff to begin packaging the patient for transport and you alert the emergency department of the patient's pending arrival. When the patient is well on his way, you inform the patient's training cadre of his status and you mentally review your decisions.

Although your working tension pneumothorax diagnosis was made out of an abundance of caution, you are not completely convinced that it is the cause of his condition. Considering his pleuritic pain, you return to your office and do a deeper dive on his signs and symptoms. You refresh your memory that pulmonary embolism is the most common cause of pleuritic pain as part of a broad differential diagnosis that also includes, but is not limited to, myocardial infarction, pericarditis, aortic dissection, pneumonia, and pneumothorax.¹⁰ As you second guess yourself, you are consoled by the thought that getting him to the emergency room was a good move and you get back to your scheduled patients.

At the end of the workday, you check in with the emergency department. The student aviator's physician allays your fears of a pneumothorax but expresses grave concerns for a possible malignancy. She discusses with you that the chest X-ray reveals a 3×4 -in (7.62×10.16-cm) mass on the lateral view and a 1×2 -in (2.54×5.08-cm) measurement of the mass on the anterior posterior view, located primarily in the mediastinum. The mass is compressing the fields of his right lung.

You immediately start working to get an oncology referral placed and the service member has his first appointment with an oncologist the next day. You also inform the SERE cadre that the service member needs to be removed from the course and that he is temporarily restricted from any flight duties. After the oncologist performs a workup on the patient, you receive a courtesy call outlining the findings. The patient has been diagnosed with a primary mediastinal seminoma.

Somewhat surprised by the diagnosis, you decide to review the literature on seminomas. Seminomas are germ cell tumors (GCTs) that are most commonly found in men between the ages of 15 and 40. The most common presenting symptom of a seminoma is a painless, palpable, testicular mass. Only 20% of GCTs are malignant, with seminomas making up approximately 50% of the malignancies. The mediastinum is the most common location for extragonadal GCTs to reside, although such tumors represent a rare 3–10% of all mediastinal tumors.¹²

- 3. Which one of the following syndromes sees the development of mediastinal GCTs approximately 10 yr earlier than those without this condition?
 - A. Barlow.
 - B. Gitelman.
 - C. Klein Levine.
 - D. Klinefelter.

ANSWER/DISCUSSION

3. D. Klinefelter patients are males born with an extra X chromosome. Hormone abnormalities in this syndrome, i.e., low testosterone with elevated estradiol and luteinizing hormone levels, indicate the presence of a problem with the germ cell line. These germ line irregularities can cause dysregulation of spermatogenesis and predispose the patient to extragonadal malignancies, including earlier onset mediastinal seminomas.¹ Barlow syndrome is a condition that involves the prolapsing of leaflets of the mitral valve. Gitelman syndrome is an autosomal recessive kidney disease that features low potassium, magnesium, and calcium levels. Klein Levine is a rare sleep disorder with excessive daytime somnolence and cognitive/mood changes. These three syndromes are not correlated with the premature development of mediastinal tumors.

The patient underwent surgery for removal of the primary mediastinal seminoma. Following successful removal of the tumor, he completed four rounds of chemotherapy consisting of bleomycin sulfate-etoposide phosphate-cisplatin (also known as BEP therapy). Follow-up with the patient and his oncologist after recovery from surgery and chemotherapy revealed no complications or permanent sequelae.

- 4. Classically, which one of the following chemotherapy agents was considered a permanent contraindication to diving and possible aviation?
 - A. Bleomycin sulfate.
 - B. Etoposide phosphate.
 - C. Paclitaxel.
 - D. Cisplatin.

ANSWER/DISCUSSION

4. A. Historically, bleomycin was considered to be a permanent contraindication to diving and aviation due to the concern for pulmonary toxicity. According to Lauritsen et al., rates of pulmonary toxicity range from 5 to 16%.⁸ However, with careful monitoring of pulmonary function during use, this rate can be decreased. Answers B–D are not typically associated with pulmonary toxicity. Common adverse effects of etoposide include bone marrow suppression and dermatological effects (among other concerns). Paclitaxel is more associated with bone marrow suppression and neuropathy, while cisplatin is historically associated with nephrotoxicity.

With regard to the U.S. Army, the primary documents that pertain to returning to flight duties are the Aeromedical Policy Letters and Aeromedical Technical Bulletins. Within these documents, the main subsection that pertains to the case is the malignancy section that states: "In general terms, waiver authorities will often recommend a return to restricted flying status as long as there is a minimal risk of incapacitation as a result of recurrence, treatment is complete, no residual effects from surgery/treatment are present, and the risk of relapse/ CNS relapse is minimal (< 1% per year)."¹³ The section on testicular tumors specifically discusses the use of bleomycin: "If the aircrew member does develop bleomycin pneumonitis during therapy, then those aircrew are prohibited from ever being exposed to high (over 40% F_1O_2) concentrations of oxygen. This precludes chamber rides or operations in aircraft with oxygen use as a part of the mission, thus possibly necessitating permanent aeromedical suspension depending on the aviation MOS and airframe in question."14

According to the U.S. Navy Aeromedical Reference and Waiver Guide's section on testicular tumors and seminomas, "Stage IIB or III treated with [surgery] plus chemotherapy must complete a 2 year [Limited Duty] LIMDU board, during which time no waiver will be considered. After completion of LIMDU, waiver may be considered provided patient is free from recurrence (normal physical exam, tumor markers negative) and pulmonary function tests show no evidence for oxygen toxicity/hypersensitivity."⁹

In the U.S. Air Force, waiver for trained assets may be considered after 6 mo of stable, asymptomatic surveillance following completion of definitive treatment (2 yr for untrained assets). Additionally, "short-duration waivers for individuals with a history [of] bleomycin pneumonitis requiring return to manned aviation are considered on a case-by-case basis after 1 year of post-treatment asymptomatic stability."⁷

The Federal Aviation Administration (FAA) would address return to flight related to this patient's condition with a special issuance. The aeromedical examiner should defer the certification decision to the FAA. The FAA would require that the examiner submit a current status report, including oncologist's status report, list of medications, treatment records, imaging, tumor markers, laboratory results, operative notes, and pathology reports. If the patient is currently on radiation or chemotherapy, the treatment course must be completed.² The medical standards and recommended practices of the International Civil Aviation Organization (ICAO) are found in Annex 1: Personnel Licensing of the ICAO Manual of Civil Aviation Medicine. The guidelines for malignant disease in the ICAO Manual of Civil Aviation Medicine notes that "current curative or adjuvant chemotherapy is incompatible with certification, and recovery from the effects of such treatments will demand a period of unfit assessment after they have finished. If the pilot has recovered from the primary treatment and, as far as can be assessed with available techniques, there is no residual tumor, then the level of certification will depend on the likelihood of recurrent disease."⁶ However, ICAO does not make medical fitness decisions in individual cases.

- 5. Based on the course of his treatment, what is the next best course of action related to his flying career?
 - A. Medical separation from service.
 - B. Permanent removal from flight duties; retain in service.
 - C. Apply for waiver.
 - D. Continue temporary duties not including flying until 5 yr cancer free and then reengage for possible waiver.

ANSWER/DISCUSSION

5. C. As this patient did not ever develop bleomycin pneumonitis during therapy, there are no restrictions from altitude chamber or other sporadic oxygen exposure. It was determined that the patient was free from disease and had recovered from surgery and chemotherapy with no aeromedically significant sequelae. He adequately demonstrated his ability to perform his basic military and aviation duties. As such, his branch of service granted him a waiver and returned him to full flight duties. Answers A and B are not correct, as a trained and able individual who has fully recovered and can safely perform his duties does not need to be separated from the military or from flight duties permanently. Answer D is not correct as none of the services require a 5-yr stability period prior to waiver consideration.

After completing his treatments and meeting all the requirements of his branch, the service member was granted a waiver and returned to SERE training. He continued his flight curriculum and graduated with no further concerns. The patient is currently in remission and is periodically screened for reoccurrence as is required by his branch and the oncologist's recommendations. With your ongoing direction and care, he is enjoying a successful career in military aviation.

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REFERENCES

- 1. Doll DC, Weiss RB, Evans H. Klinefelter's syndrome and extragenital seminoma. J Urol. 1976; 116(5):675–676.
- Federal Aviation Administration. Decision considerations—aerospace medical dispositions. Item 41. G-U system—neoplastic disorders. In: Guide for aviation medical examiners. Washington (DC): Federal Aviation Administration; 2023. [Accessed September 27, 2023]. Available from https://www.faa.gov/ame_guide/app_process/exam_tech/item41/ amd/nd/testicular.
- Gottlieb M, Long B. Managing spontaneous pneumothorax. Ann Emerg Med. 2023; 81(5):568–576.
- Heckerling PS, Tape TG, Wigton RS, Hissong KK, Leikin JB, et al. Clinical prediction rule for pulmonary infiltrates. Ann Intern Med. 1990; 113(9): 664–670.
- 5. Hirano T, Matsunaga K. Late-onset asthma: current perspectives. J Asthma Allergy. 2018; 11:19–27.
- International Civil Aviation Organization. Chapter 15. Malignant disease. In: Manual of civil aviation medicine. 3rd ed. Quebec (Canada): International Civil Aviation Organization; 2012. Doc 8984. [Accessed September 19, 2023]. Available from https://www.icao.int/publications/pages/ publication.aspx?docnum=8984.

- Keirns C, Menner L, Bridge L, Hedrick C, Allam C, Lee M. Testicular cancer. In: Aerospace Medicine Waiver Guide; 2023. [Accessed September 27, 2023]. Available from https://www.afrl.af.mil/711HPW/USAFSAM/.
- Lauritsen J, Kier MG, Bandak M, Mortensen MS, Thomsen FB, et al. Pulmonary function in patients with germ cell cancer treated with bleomycin, etoposide, and cisplatin. J Clin Oncol. 2016; 34(13):1492–1499.
- Naval Aerospace Medical Institute. 9.21. Testicular tumors. In: U.S. Navy aeromedical reference and waiver guide. Pensacola (FL): Naval Aerospace Medical Institute; 2023. [Accessed September 19, 2023]. Available from https://www.med.navy.mil/Navy-Medicine-Operational-Training-Command/Naval-Aerospace-Medical-Institute/Aeromedical-Referenceand-Waiver-Guide/.
- Reamy BV, Williams PM, Odom MR. Pleuritic chest pain: sorting through the differential diagnosis. Am Fam Physician. 2017; 96(5): 306–312.
- 11. Schumann JA, Sood T, Parente JJ. Costochondritis. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2023.
- Takahashi K, Al-Janabi NJ. Computed tomography and magnetic resonance imaging of mediastinal tumors. J Magn Reson Imaging. 2010; 32(6):1325–1339.
- U.S. Army Aeromedical Activity. Malignancy introduction. In: Flight surgeon's aeromedical checklists. Aeromedical policy letters [Mobile app]. 2021:91. [Accessed September 19, 2023]. Available from https://play. google.com/store/search?q=med%20standards&c=apps.
- U.S. Army Aeromedical Activity. Testicular tumors. In: Flight surgeon's aeromedical checklists. Aeromedical policy letters [Mobile app]. 2021: 112. [Accessed September 19, 2023]. Available from https://play.google. com/store/search?q=med%20standards&c=apps.