YOU'RE THE FLIGHT SURGEON

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You are the flight surgeon at a base that routinely conducts hypobaric chamber flights. A 23-yr-old white female student navigator who underwent a Type II hypobaric chamber flight at 1000 h with a maximum attained altitude of 35,000 feet presents to flight medicine clinic at 1645 h that day complaining of a rash and itching on her chest and neck that began at about 1300 h and progressively worsened until the time of presentation. She also complains of significant fatigue. She reports no other complaints to the technician on check-in. Her vital signs are: Height: 5'5" (165 cm); Weight: 175 lbs (79.4 kg); BP: 110/66 mmHg; HR: 52 bpm; Respiratory Rate: 12 breaths per min; Temperature: 98.6°F (37°C)

1. You have not yet seen the patient. From the introduction, which criteria have been met for the diagnosis of DCS?
   A. Symptoms.
   B. Onset time.
   C. Exposure.
   D. Response to treatment.
   E. A and C.
   F. A, B, and C.
   G. All of the Above.

ANSWER/DISCUSSION

1. E. The patient had a credible exposure during the Type II hypobaric chamber flight with a maximum attained altitude of 35,000 feet (FL350). The patient's skin symptoms, rash and itching over her chest and neck, could be consistent with skin bends, which are typically characterized by the presence of any or all of the following: pruritis, formication, and scarlatiniform rash. A scarlatiniform rash is a nonserious skin decompression sickness (DCS) finding and is generally not treated with hyperbaric oxygen (HBO). Cutis marmorata is a separate DCS skin manifestation generally treated with HBO. It is characterized by skin marbling and at times is a harbinger of more serious DCS, especially in diving. The onset time is not characteristic of skin bends, which generally resolves within 20 to 30 min of chamber flight completion.

Hypobaric chamber flights are a routine part of aviation training. The Type II hypobaric chamber flight profile is designed to acquaint original trainees with the over-all effects of barometric pressure change including experience in positive pressure breathing at altitude, hypoxia recognition and treatment, hypoxia effects on night vision, and proper use and in-flight checks of oxygen equipment (1). The Type II chamber flight profile duration is approximately 68 min and includes 30 min of ground level oxygen breathing (denitrogenation) before beginning ascent to peak altitude (FL350). After attaining FL350, a rapid descent is made to FL250 where the hypoxia exercise is accomplished, followed by descent to FL180 where the visual acuity exercise is accomplished, followed by descent to ground level, which concludes the flight. It is generally agreed that the lowest altitude a sea-level acclimatized person is likely to develop symptoms of decompression sickness (DCS) is 18,000 ft (5), making the Type II chamber flight a credible exposure. In addition to altitude attained, some factors contributing to DCS risk include duration of exposure, previous exposures to altitude, flying following diving, advancing age, dehydration, and exercise at altitude (5).

The diagnosis of DCS is entertained on the basis of a credible exposure placing the patient at risk for DCS, symptoms attributable to DCS, temporal relationship between exposure and onset of symptoms, and response to treatment. DCS risk results when blood and tissue nitrogen reach critical supersaturation as a result of decreased partial pressure of nitrogen in the environment (increasing altitude, surfacing from a dive) compared with the partial pressure of nitrogen in the body. Once critical supersaturation is reached bubble formation can occur. These bubbles have both mechanical and biochemical effects on surrounding tissues, leading to various symptoms depending on their location (5). In altitude DCS, altitudes at or above 18,000 ft and are considered credible exposures. Serial flying and flying after diving lower this "at risk" altitude. DCS can manifest in a variety of clinical forms and is generally classified as Type I (mild DCS) and Type II (serious DCS). Type I DCS includes joint pain ("bends") and cutaneous and lymphatic manifestations ("skin bends"). Type II DCS can have cardiovascular, pulmonary ("chokes"), or neurologic effects, including cerebrum, cranial nerves, cerebellum, spinal cord, and vestibular system (4,5). The symptoms on presentation would be best categorized as Type I DCS, pruritis affecting the chest and neck.

While most texts state that DCS symptom presentation is extremely rare after 36 h (3), it has been the staff's experience at the U.S. Air Force Davis Hyperbaric Laboratory that altitude DCS symptoms may present later and that DCS should remain in the differential diagnosis if there has been a valid exposure, even past 36 h. As noted previously, skin DCS is the notable exception with symptom resolution generally within 30 min.

2. Based on the information presented, what should your next step be?
   A. Evaluate the patient.
   B. Place the patient O_2 2L via nasal cannula and evaluate.
   C. Place the patient on surface level O_2 by tight fitting aviators mask and evaluate.
   D. Call the service specific resource for dive medicine for instruction.

ANSWER/DISCUSSION

2. A. Based on the information presented the best course of action is to accomplish a thorough exam. The rash/pruritis is not characteristic of DCS due to timing and does not typically require treatment. Fatigue can be a normal post-hypobaric chamber flight finding while extreme fatigue may be a symptom of neurologic DCS (or, in some texts, a constitutional symptom of DCS) (5).

You see the patient and in addition to the information your technician gathered on check-in, the healthy appearing 23-yr-old female patient describes the rash as itchy and progressing from her chest to her upper back and neck over the last 4 h. She states she feels significantly fatigued despite adequate rest and nutrition and states she feels it's analogous to being up for 36 h. She has no other complaints. She denies shortness of breath, cough, chest pain, paresthesias, decreased sensation, or weakness. She denies fecal or urinary incontinence. On exam an area of pruritis over the upper chest and neck is identified by the patient. No erythema, induration, macules, or papules are appreciated. On extremity exam right knee pain is noted over the lateral anterior joint-line on palpation and with flexion against resistance. No other knee abnormalities are noted. The neurologic exam reveals intact cranial nerves I-XII, normal gait, normal rapid alternating movements, normal finger to nose with no past pointing, Romberg is positive, and the patient is unable to complete heel to toe walking without difficulty. Strength and reflex testing is normal. Sensory exam reveals no deficits to pin prick, light touch, or vibration.

3. Based on the history and clinical exam, what is the most appropriate course of action?
   A. Reassurance and release.
   B. Consult Hyperbarics.
   C. Place the patient on 100% oxygen by tight fitting aviators mask and begin IV hydration with normal saline. Then consult Hyperbarics and arrange for transport to the nearest hyperbaric chamber.
   D. Arrange local hyperbaric oxygen therapy at the nearest chamber facility based on your diagnosis and inform Hyperbarics after the treatment is complete.

ANSWER/DISCUSSION

3. C. Neurologic DCS is the primary concern in this case. Placing the patient on 100% oxygen by tight fitting aviator's mask and hydration with normal saline are standard practice and should be accomplished immediately. 100% oxygen therapy creates a nitrogen gradient favoring net nitrogen loss, reducing the body's overall nitrogen load, which may

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aid in reducing the bubble burden. After initiating the therapy noted, the Davis Hyperbaric Laboratory is consulted in accordance with AFI 48-123 Volume 3 paragraph A4.31.1.1.2 which states that the base Chief of Aeromedical Services and USAFSAM Hyperbaric Medicine will be consulted on all cases of DCS or arterial gas embolus (AGE) (2). Given the reported history and exam findings, the decision is made to transport the patient to the Davis Hyperbaric Laboratory at Brooks Air Force Base, TX, where the diagnosis is confirmed and the patient is treated by a USAF Treatment Table 6 (TT6) dive. The patient has near complete resolution of neurologic and skin symptoms and a follow-up the next morning by Hyperbarics is arranged. Repeat evaluation reveals minimal residual neurologic symptoms which completely resolve after a second TT6 dive. The patient follows up 72 h later (after second TT6 dive) in the flight surgeon's office and exhibits a normal physical exam. Normal exam findings are confirmed a day later by neurology and the patient is returned to flying status, no waiver necessary.

The rationale for treating DCS with HBO includes: 1) increased pressure reducing bubble size by mechanical compression; and 2) hyperoxygenation in a nitrogen poor environment creating a gradient favoring nitrogen off loading from the body resulting in reduction in nitrogen bubble size and number.

A high index of suspicion should be maintained and a complete physical exam conducted on all patients presenting with complaints after a credible hypobaric exposure. In this case, the exam revealed neurologic symptoms suggestive of neurologic DCS in a patient presenting with minimal skin symptoms. It would have been very easy to miss this potential neurologic DCS case without a thorough exam including a full neurologic exam.

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