Head-up Tilt Test for Recurrent Syncope in Pilots

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SYNCOPE IS DEFINED as a sudden temporary loss of consciousness and postural tone with spontaneous recovery. Although a single episode can occur in normal people, recurrent episodes of syncope are worrisome and require investigation. The commonest cause of syncope is vasovagal and occurs in up to 37% of the general population (6). Trigger factors for vasovagal syncope can be divided into central and peripheral. The most common central triggers are pain and anxiety. Retaining an upright position for a long period and dehydration are common peripheral triggers (4). Vasovagal syncope without a specific stimulus is defined as malignant vasovagal syncope, and is more common in older people (11).

Accepted physiological mechanisms of vasovagal syncope are cardioinhibitory and vasodepressor (12). The central nervous system mechanisms responsible for vasovagal syncope are poorly understood. Presumably, the cerebral stimuli act directly on the vasomotor center. Somatic causes, such as dehydration, indirectly affect the vasomotor center. Vigorous myocardial contraction of a relatively empty left ventricle activates myocardial mechanoreceptors and vagal afferent nerves that inhibit sympathetic activity and increase parasympathetic activity (Bezold-Jarisch reflex) (5). Bradycardia is mediated by parasympathetic outflow along the vagus nerve. Sympathetic withdrawal causes dilatation of arterioles and venules, resulting in peripheral blood pooling and hypotension. The overall effect is reduced cerebral blood flow, resulting in cerebral ischemia and loss of consciousness.

The prevalence of syncope in the United States Air Force (USAF) population has been reported to be between 12–48% (13). The assessment of syncope in aviators relies on history (patient and eyewitness) and physical examination, as well as cardiac, neurological, and psychological evaluation as dictated by the clinical scenario. Cardiac evaluation usually includes 12-lead ECG, echocardiography (to exclude structural heart disease), and a 24-h ECG recording (13). A recently published article describes an algorithm for assessing flying fitness in aviators having syncope (10).

The head-up tilt test (HUTT) is not usually part of the evaluation of simple syncope. It may be useful in recurrent or unexplained syncope, syncope in high-risk populations, and in cases where treatment may be influenced by the coexistence of vasovagal syncope (1,6).

The head-up tilt maneuver induces pooling of venous blood in the lower extremities. This decreases the venous return to the heart. Myocardial baroreceptors sense a relatively empty left ventricle. This activates the Bezold-Jarisch reflex, intensifying heart contractility and increasing afferent vagus nerve flow. The vasomotor center is stimulated and increased parasympathetic outflow ensues. Sensitivity of the HUTT can be increased by administering vasodilators such as isoproterenol, adenosine, or nitroglycerine (3,7).

The HUTT protocol usually calls for at least 2 h of fasting. The subject rests supine for 20 to 45 min. The angle and duration of the test are the most important determinants of its diagnostic ability. Tilting angles of 60 to 80° are optimal in creating sufficient orthostatic stress without increasing the number of false positive or negative results. The duration of the tests varies between centers, but prolonged tests that last 30–45 min are optimal (6). A positive response is syncope or presyncope, caused by rapid fall in BP, asystole, or a combination of the two (1). Syncope recurrence after a positive HUTT is estimated at 0.4% per year.

The HUTT has the following limitations: lack of standardization of tilt angles and duration, different positive
Syncope is an alarming situation in aviators. The danger of sudden incapacitation is obvious, even if the syncope is benign. Recovery may be prolonged, and accompanied by nausea and vomiting, which limits the aviator’s ability to perform his flying duties. It is critical to correctly diagnose the etiology of the syncope, since non-benign syncope has a more sinister prognosis.

The decision regarding flying fitness depends on several factors: absence of organic basis for the syncope, recognizable presyncope symptoms, known and avoidable triggers, and feasibility to stop the progression to syncope (14). Almost all aviation authorities grant waivers after a single episode of vasovagal syncope. Recurrent cases of syncope are usually disqualifying for all flying duties.

Our two cases represent the wide spectrum of vasovagal syncope. In the first case, all of the syncopal episodes were related to a definite trigger unrelated to flying. A HUTT was performed in order to confirm the diagnosis of vasovagal syncope. The long asystole demonstrated resulted in disqualification for high-performance flying duties. In the second case, because a definite trigger was not apparent regarding all his syncopal episodes, the pilot was disqualified for all flying duties. The HUTT was not relevant for his disqualification as an aviator. He underwent repeated HUTTs, initially to establish the diagnosis, and further to assess the efficacy of the prescribed medication. In both cases the HUTT ended in syncope caused by asystole or BP drop, considered a clearly positive endpoint.

Due to the low sensitivity of the HUTT, the reproducibility of a positive HUTT is as low as 35%. On the other hand, the specificity is high with the negative reproducibility approaching 100% when the standard protocol is used. Once a positive test is demonstrated, we disqualify high-performance aviation. Further HUTT is unnecessary for flight-fitness assessment and is performed for medical reasons alone.

The controversy regarding HUTT revolves around a negative test in the case of recurrent vasovagal syncope caused by established triggers not present in the flying environment. In our opinion, this benign syncope does not disqualify from any flight duties. Our opinion is supported by a recently published article (10). In these benign cases, we require at least two separate HUTTs. If the HUTTs are negative, we recommend waiver for all flying duties. But, if one or more of the HUTTs is positive, we disqualify high-performance flying duties and waiver low-performance multicrew aviation (Fig. 1).

**Algorithm for evaluation of flying fitness in recurrent syncope.**

- **Recurrent syncope**
  - Definite trigger*
    - Yes
    - HUTT x 2
      - Negative: Waiver all aircraft
      - Positive: Low-performance aircraft
    - No: Permanent disqualification
  - No: Permanent disqualification

* = definite trigger, not present in the aviation environment.
High-performance flying duties do not allow for reclining. Therefore, the presyncopal or syncopal aviator may not be able to terminate the syncope. Only low-performance multicrew flying duties may be considered, because in the event of syncope-caused sudden incapacitation of the aviator, the aircraft can be managed by other crewmembers while the aviator is pulled to the floor. Regarding single-seated aircraft, obviously no option of taking over the flight control by another crewmember is possible. In conclusion, although the HUTT has low sensitivity, its high specificity makes it nevertheless useful in the decision whether to allow the aviator with recurrent trigger-defined vasovagal syncope to return to high-performance aviation. By performing two separate HUTTs, and using the correct tilt angle and duration, the sensitivity is improved.

REFERENCES