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Testing for Orthostatic Hypotension and Recognizing Symptoms in Persons with Spinal Cord Injury

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Orthostatic Hypotension

One of the many physiological changes that individuals with spinal cord injury (SCI) experience includes dramatic changes in the functioning of the autonomic nervous system (ANS). That is, in addition to sensory and motor impairments following SCI, individuals must deal with unstable blood pressure control which may lead to frequent episodes of orthostatic hypotension (OH) as well as uncontrolled hypertension (Claydon et al., 2006, Krassioukov and Claydon, 2006, Mathias, 2006). Orthostatic hypotension is characterized by a reduction in blood pressure of 20mmHg or more, or a decrease in diastolic blood pressure of 10mmHg or more, upon a change in body position from a supine to upright posture, in the presence or absence of symptoms (e.g. dizziness, nausea, fatigue, etc.) (Krassioukov et al., 2006, Duschek et al., 2003, American Autonomic Society and American Academy of Neurology, 1996).

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In able-bodied individuals, heart rate and blood pressure control are coordinated by the two components of the ANS: the sympathetic and parasympathetic nervous systems (Claydon et al., 2006).

However, SCI may lead to autonomic dysfunction, affecting spinal pathways that modulate cardiovascular control (Claydon et al., 2006). Specifically related to blood pressure control, sympathetic hypoactivity and unopposed vagal parasympathetic control often result following injury (Furlan et al., 2003), ultimately leading to low resting blood pressure (Mathias and Frankel, 2002, Teasell et al., 2000). Furthermore, low levels of efferent sympathetic nervous activity and the loss of reflex vasoconstriction following SCI have been associated with OH (Krassioukov et al., 2006). Orthostatic hypotension occurs due to pooling of blood and subsequent increased plasma filtration in dependent regions of the body when in an upright position, leading to a decrease in venous return and blood pressure.

Measuring Orthostatic Intolerance in Persons with SCI

In addition to learning about autonomic function following SCI, there are several non-invasive tests that are

available to assess cardiovascular response to an orthostatic challenge help determine the presence of orthostatic hypotension. While there are several ways of eliciting an orthostatic challenge, a method that is easy to perform and can be done practically anywhere is the "sit up test" (Claydon and Krassioukov, 2006). Classically, orthostatic tolerance would be evaluated using tilt table testing (Claydon et al., 2006), but this requires extensive strapping to prevent buckling in the paralyzed legs and could lead to a condition of uncontrolled hypertension, known as autonomic dysreflexia (Elliott and Krassioukov, 2006), which is a life-threatening condition and would be expected to mask OH and invalidate the assessment. The sit-up test is a simple bedside test that requires minimal strapping and is sufficient to evaluate orthostatic cardiovascular control in individuals with SCI

While the orthostatic challenge is being performed, measures of heart rate and blood pressure are collected to determine changes in these cardiovascular variables during the manoeuvre; this will help determine whether or not the individual experiences orthostatic hypotension. Additionally, patients should be asked to report of any dizziness, nausea or light-headedness since OH may occur with our without symptoms.

How to Perform the Sit Up Test to Evaluated Orthostatic Tolerance in Persons with SCI

1. If possible, investigations should be performed in the morning in a temperature-controlled laboratory.
2. Participants should be asked to refrain from caffeine and alcohol the night before testing, and to only consume a light breakfast on the day of testing.
3. Just prior to testing, participants should be asked to empty their bladder to minimize the influence of reflex sympathetic activation on peripheral vascular tone (e.g., prevent occurrence of autonomic dysreflexia)
4. Initially, participants will lie in the supine position during which time they should be instrumented with an electrocardiogram to monitor heart rate and a machine that measures beat-to-beat blood pressure.
5. A Velcro strap may be placed around the participant's waist to prevent them from slipping during the sit up maneuver.
6. The sit up maneuver is a passive one, so from the supine position, participants are moved into the upright position without any effort from the participants themselves. The bed that is used for this orthostatic challenge should allow the upright position to be assumed by raising the head of the bed by 90^{o} and dropping the base of the bed by 90^{o} at the knee so that the feet are dangling freely from the knees.
7. Participants should be instructed not to help with the maneuver at all and informed about the importance of the sit up being performed as passively as possible.
8. The upright position should be maintained for 15 minutes, during which time recordings of heart rate and blood pressure should be continuously measured.
9. The test should be stopped early and participants should be returned to the supine position if they experience any symptoms associated with OH. Participants should be prompted to report any feeling of dizziness, nausea, fatigue, light-headedness, etc.

While it is beyond the scope of this brief article outlining how to perform a simple orthostatic challenge in persons with SCI, the data collected from this assessment may be used to analyze changes in autonomic function following SCI via analysis of heart rate variability, which looks at different spectral powers which help to delineate the sympathetic from the parasympathetic nervous system. While not discussed in this article, there are other ways to elicit an orthostatic challenge, such as by head-up tilt, and lower body negative pressure. The challenge described here is one that is simple and easy to perform and is well-tolerated by individuals with SCI.

Qualifications

The authors' qualifications are as follows: Shirley Wong M.Sc. CSEP-CEP.

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