Study details

The effect of water drinking on orthostatic tolerance

The primary purpose of this investigation is to determine whether drinking water can improve orthostatic tolerance in healthy control volunteers. Orthostatic tolerance refers to the ability to maintain an adequate blood pressure when standing[1]. In some individuals blood pressure can fall when standing, predisposing to dizzy spells or fainting episodes[1]. Drinking water can boost blood pressure and making fainting episodes less likely[2–8]. However, it is not clear whether the temperature of the water has an impact on the blood pressure response[9,10]. This is important because it may be that cold water constricts the blood vessels in the abdominal circulation more than room temperature water, and if so this would boost blood pressure. Warmer water might have the opposite effect. Resolving this question would have important implications for patients with syncope. We will test whether warm water and cold water have the same effect on blood pressure responses.

Prior Approval

The tests proposed in this study were previously approved by SFU DORE (#2009s0191 "The effect of compression stockings on orthostatic tolerance"; #2011s0095 "Cardiovascular autonomic function in adults: #2009s0632 "Cardiovascular autonomic control in adolescents"; 2017s0405 "Cerebrovascular responses to a seated Valsalva manoeuvre as an indicator of susceptibility to fainting spells"). These studies were deemed to be minimal risk.

Procedure

Volunteers will be asked to undergo a "tilt test" to assess cardiovascular reflex control and orthostatic tolerance (measured as time to presyncope, or near fainting, in minutes). We and others have previously shown this technique to be reproducible, reliable, and to have high sensitivity and specificity for differentiating persons with differing orthostatic tolerance, or for examining the effects of interventions aimed at improving orthostatic tolerance[4,6,11–18].

Volunteers will undergo this test on three separate days. On each day participants will be asked to drink a glass of water: either a 500ml drink of room temperature water (20°C), a 500ml drink of ice cold water (0-3°C), or a 500ml drink of warm water (45°C). The study will be conducted in a randomised, single-blind fashion.

Tests will usually be conducted in the mornings. On the day of the test volunteers will be asked to have only a light breakfast avoiding caffeine, and should avoid strenuous exercise for at least 12 hours prior to testing. Women will be asked to make a note of the date of their last period (we would prefer to schedule testing on a day when they do not have, or expect, their period because this may influence orthostatic tolerance).

Prior to testing volunteers will be asked a brief medical history including questions as to whether they have any known cardiovascular or neurological disease, are taking any medications, and questions about general cardiovascular risk factors such as smoking, and alcohol consumption. A copy of the prompt sheet used by the investigators is included with the submission. Note that this is a generic data collection form for all studies in the laboratory as is standard for all our submissions; so not all components apply to all studies. However, it does outline the medical history data collected in general terms. Participants will be asked to empty their bladder in the nearby washroom, and to retain a sample of their urine for testing for sodium levels (a marker of salt intake and hydration). Participants will be asked to remove any clothing on their upper body so we can make measurements

of heart function. They can choose to complete the testing bare chested, or to change, in privacy, into a hospital gown. Participants will then be asked to lie down on the tilt table. We will then attach the following CSA approved cardiovascular monitoring (all monitors are non-invasive and painless):

1. A standard 3 lead electrocardiogram (ECG) will be recorded to assess heart rate and rhythm.
2. Beat-to-beat blood pressure will be determined using the Finometer blood pressure monitoring device. This consists of a small Velcro cuff placed around the middle finger that pulses gently against the digital arteries and records and displays blood pressure with every heart beat.
3. End tidal gases will be sampled using a nasal cannula. This is to enable us to evaluate any influence of possible hyperventilation and the associated decreases in carbon dioxide on cerebral blood flow.
4. Cerebral blood flow will be determined in the middle cerebral artery using Doppler ultrasound. An ultrasound probe will positioned on the skin overlying the temple and held in place with a head band. Participants can move their head freely when wearing the ultrasound probe.
5. We will measure blood flow in the brachial artery, also with ultrasound. The arm will be placed on a support on a probe positioned over a little ultrasound gel near the elbow.
6. We will measure the cardiac stroke volume – the amount of blood the heart pumps with each heart beat. To do this we will hold an ultrasound probe on top of some ultrasound gel on the left side of the chest, over the heart. These measures will be taken intermittently at various times during the test. Participants will feel the ultrasound probe touching their skin, but will not be able to feel the ultrasound. The ultrasound probe needs to be placed on bare skin, so it will not be possible for participants to wear a bra during the measurement. They can choose whether to be bare chested, or whether to wear a hospital gown to cover their chest. During these measurements the person holding the ultrasound probe will need to adjust the position of the gown and to palpate or visualise the participant's chest in order to put the probe in the correct position. The person making these measurements will be a male cardiologist.
7. We will place a strap over the participants' knees and a box over their legs that seals against their waist (a bit like a canoe skirt). The strap is to help them stand in a relaxed position without minimal muscle activity in the legs. If participants contract their leg muscles it may increase blood pressure and so improve orthostatic tolerance. For the same reason, we will ask participants to try not to move their legs too much during testing (some movement is inevitable). The box is placed over their legs so that we can apply lower body negative pressure to the legs later on in the test without disturbing the monitoring.

Once the monitors are in place, we will make recordings from them for 15 minutes of supine rest. We will then ask them to drink the water at the temperature that has been allocated for that day. Participants will be asked to drink the entire volume of water within 2 minutes. We will tilt the table to 15° to facilitate their drinking the water without spilling or choking. Once the water has been drunk, they will return to the supine position for another 15 minutes. We will then tilt the table into an upright position (at 60 degrees). We will make recordings from the monitors throughout the upright portion of the test. After 20 minutes of standing, while still upright, we will apply lower body negative pressure to the box over their legs. This typically feels a little draughty on the legs, and some participants are conscious of the sound of the motor that generates the negative pressures. However, it is not painful or unpleasant. The effect mimics prolonged standing by inducing further hydrostatic/gravitational stress on the lower limbs and enables the precise determination of orthostatic tolerance. Without the addition of lower body negative pressure, most healthy volunteers can tolerate orthostatic stress for extremely protracted time periods that become barriers to testing. The addition of the lower body negative pressure permits the precise determination of orthostatic

tolerance within a maximum of 50 minutes. We will apply the lower body negative pressure at three different levels for 10 minutes each (-20mmHg, -40mmHg and -60mmHg).

The test will be stopped and the participant returned to the supine position immediately if:

- They complete the whole procedure (30 minutes lying down, 20 minutes standing, and 30 minutes of lower body negative pressure).
- They experience symptoms of dizziness or light-headedness (presyncope) and/or blood pressure or heart rate begin to decrease. If the blood pressure declines to a systolic pressure of 80mmHg or less, sometimes associated with symptoms of presyncope such as light-headedness, the test will be immediately terminated. The beat-to-beat determination of blood pressure ensures prompt termination of the test as the blood pressure begins to decline and avoids undue hypotension. This ensures that volunteers typically experience only modest hypotension for a few seconds and are only mildly symptomatic (if at all). In some individuals presyncope is associated with slowing of the heart rate. For this reason, new onset bradycardia of less than 50bpm while upright will be taken as criteria to terminate the test. The tilt table is returned to supine using a manual system that permits a full transition from upright to supine in ~1 second. This enables prompt resolution of orthostatic hypotension or bradycardia, and so minimises the discomfort to the participant, and ensures actual fainting is very unlikely.
- The participant requests for the test to stop.

If the volunteer experienced symptoms or signs of presyncope at the end of the test, lying down will quickly resolve them. The monitors will be removed and any residue from the ultrasound gel will be removed.

Inclusion/exclusion criteria

We are looking for healthy English-speaking men and women aged 19-50 years to take part in this study. Women will be excluded if they are pregnant or think they might be. Participants who self-identify as having cardiovascular or neurological disease, or who are taking any cardiovascular acting medications will be excluded from the study. These exclusion criteria are because these factors may influence the outcome of the study, not because it is thought that tilt testing carries any particular risks for those with cardiovascular or neurological disease. The cardiovascular end points are generally unaffected, but the time taken to reach them (the orthostatic tolerance) may be greatly different in disease states. Volunteers will be recruited using poster advertisements (a sample of the wording to be used for advertising is attached). Volunteers will include members of the community at large, as well as staff and students at Simon Fraser University. Individuals who suffer from recurrent fainting episodes (≥2 episodes of syncope in the prior 6 months) will be excluded.

What are the potential advantages to taking part?

There are no direct benefits to participants from taking part in the study. It is hoped that the results of this study will ultimately aid in the treatment and management of fainting spells in patients who are prone to these episodes, and so improve quality of life for those affected by recurrent fainting episodes. Participants will receive up to $75 to compensate them for their participant in the study ($25 per test). Free parking is available on request.

What are the potential disadvantages to taking part?

The study will take place in a controlled laboratory environment and most participants do not find the assessments unpleasant. Every effort will be made to ensure their safety, privacy and comfort. The following are discomforts or risks that may be associated with the procedures.

1. During the tilt table test they may experience some dizziness or lightheadedness associated with reduced blood pressure and/or heart rates. Rarely, participants have been known to faint briefly. Actual fainting is unusual and is always very short in duration with rapid return to consciousness.
2. These assessments will take time to perform and participants will be asked to keep still during the assessments. They may find that they become uncomfortable or bored during these investigations. Every effort will be made to maintain their comfort throughout the study. They will be provided with pillows, blankets etc as appropriate to ensure their comfort. We recognise that this study involves an extensive time commitment. Therefore, we wish to provide some reimbursement for our participants, for their time and travel costs. We have budgeted $75 for their participation ($25 per test), which we feel is a reasonable reflection of some of the cost implications, without providing an undue financial incentive to participate.
3. Preparing the skin for electrode placement may cause minor irritation or redness. It is possible that volunteers will experience an allergic reaction to the electrode gel or adhesive.
4. Some participants may feel embarrassed about having cardiac ultrasound measurements because they must be made on a bare chest. If they prefer, they can wear a gown to help maintain their modesty. The person making these measures is a cardiologist and makes these measurements all the time.

How will confidentiality and anonymity be assured?

All data and test results will be identified only by a random code number from which participants cannot readily be identified. The code details will be kept in a locked cabinet in the principal investigator's office. Records will be maintained for a period of 20 years, after which time they will be destroyed.

Material Incident Findings

Material incident findings are a possibility in studies such as these. For some parameters there are well-established normative data, e.g. resting blood pressure. If we record data on a study participant that are outside of these usual physiological parameters, Dr. Claydon or Dr Parsons will inform the participant that following their recent participation in the study, it was noted that there was an apparent deviation from the "physiological norms" that may have been expected. They will be advised that this is not to be considered a diagnosis. Any deviation observed may or may not be significant, and only their physician can provide them with medical advice as to whether further investigation is required.

Sample wording for poster/online advertising

Does it make sense to have a drink of water if you feel faint? We are conducting a research study to find the answer. We are looking for men and women aged 19-50 years to take part in a study examining the effect of water drinking on blood pressure control and fainting. Your participation will help improve the treatment and management of fainting spells. As a thank you for your participation, all participants will receive $75 in compensation. Your participation in this study will involve three tests, on three separate days, of your blood pressure control and susceptibility to fainting. On each

day you will be asked to drink a glass of water. The temperature of the water will change on the different test days.

Recruitment posters will be displayed at various locations on the SFU campus, included in the BPK Departmental e-newsletter, posted on institutional websites associated with the investigators, and disseminated through the SFU graduate student research participant recruitment initiative.

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