Syncope : an integrative physiological approach

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Water drinking as a potential treatment for idiopathic exercise-related syncope: a case report

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Clinical Autonomic Research 2003; 13(2):103-5

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Chapter 11

Abstract

We report a 20-year-old sportsman with frequent attacks of lightheadedness, chest pain, blurred vision and falls during and shortly after exercise. Cardiac and pulmonal evaluation and routine autonomic function tests were normal apart from a relatively high resting heart rate (70 bpm) compared to endurance-trained men. In view of the relation to exercise, the patient was asked to cycle with maximal effort on an ergometer with continuous blood pressure (BP), heart rate (HR) and electroencephalogram (EEG) registration. Immediately after cessation of exercise a brief hypotensive period (75/45 mmHg) occurred together with sinus tachycardia (180bpm) during which the patient experienced his typical complaints. We hypothesized that our patient's symptoms were primary related to sympathetic failure. As water drinking has been demonstrated to raise sympathetic activity rapidly, we undertook a second cycling test after ingestion of 1000 mL tap water. Symptoms nor hypotension re-curred. Because of the short lasting pressor effect and its minimal side effects, we suggest water drinking as simple and possible effective therapy for idiopathic exercise-related syncope.

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Case report

Exercise-related syncope without organic heart disease has frequently been reported in young athletes.[40,93,136,137,206,240] The exact incidence of idiopathic exercise-related syncope among young athletes is not known. Calkins *et al.* and Colivicchi *et al*. found that after a thorough cardiac evaluation athletes with an exertional-related syncope could safely continue to participate in athletics.[40,51] Tilt-table testing may be a useful diagnostic tool provoking syncope in 41% of 24 athletes and up to 79% after isoproterenol infusion.[93] Idiopathic exercise-related syncope has been reported to result from hypotension together with a normal HR, tachycardia, bradycardia or asystole.[40,136] The pathophysiology of this condition is poorly understood.[136,141] Atenolol, hydrofludrocortisone, disopyramide, transdermal scopolamine and increased salt intake have been recommended as treatment for exercise-related syncope.[40,93,137,206,232] To our knowledge this is the first report of a beneficial effect of water drinking for this condition.

A 20-year-old male pupil of a sporting school had had attacks of lightheadedness over several months. The first time he felt unsteady and fell to the ground when he dismounted his bicycle after 1-hour of moderate exercise. In addition, he had chest pain and was short of breath. He was not certain whether or not he had passed out. Nobody had witnessed the event. For two hours afterwards he complained of unclear vision as if "looking through salad oil". He had not been incontinent, had sustained no bruises and no tongue bite. Later, similar attacks occurred during light cycling, after competition skating, after skiing and during micturition after exercise. He has a medical history of asthma and migraine. Both a cardiologist and a pulmonologist had analyzed the presenting complaints previously but could not find an explanation. Previous examinations had consisted of an ECG, echocardiography, bicycle stress testing, laboratory screen, chest X-ray and a lung perfusion scintigraphy. His medications were formoterol inhalations 12 mcg bid, budesonide inhalations 200 mcg bid and pantazol 20 mg od. The patient did not use coffee, nicotine or drugs. On physical examination no abnormalities were noted. The patient's supine blood pressure (BP) was 110/65 mmHg with a resting heart rate (HR) of 70 beats per minute (bpm). Neurological examination showed slightly impaired fine motor skills and frequent eye blinks either left or right sided.

A magnetic resonance imaging study of the brain was normal. Test of HR and BP during rest (70bpm; 108/65mmHg), deep breathing, standing up (85 bpm; 121/91mmHg), a Valsalva manoeuvre and sustained hand grip were all normal. A tilt-table test (without medication) showed no abnormalities. Cathecholamine concentrations in plasma obtained by venipuncture

in both supine and after 30 minutes upright position (norepinephrine(NE):1.22 nmol/l vs. 3.67 nmol/l, epinephrine(E): 0.13 vs. 0.16 nmol/l, dopamine(DA): 0.04 vs. 0.07nmol/l resp.) and in 24-hour urine (NE: 0.43 umol, E: 0.06 umol, DA: 2.46 umol).

In view of the relation to exercise, the patient was asked to mimic a typical bicycle tour on an ergometer, while EEG, ECG and BP (Finapres, finger photoplethysmography) were continuously monitored. Cycling at maximal effort increased HR up to 185 bpm (mean +/- standard deviation: 176 +/- 7 bpm) without significant BP changes (systolic BP (SBP) 119 +/- 14mmHg; diastolic BP (DBP) 72 +/-9mmHg). Immediately after cessation of exercise BP fell to 75/45 mmHg, during which the patient felt unsteady and complained of blurred vision; there was no loss of consciousness. During the BP drop, electrocardiography revealed sinus tachycardia of 180 bpm. The patient recognized the sensations as similar to those of spontaneous attacks. A second exercise test was performed two weeks later, 15 minutes after rapid consumption of 1000 mL water. Symptoms did not recur at the second test. Compared to the first cycling test the maximal rise of HR during exercise was reduced to 155 bpm and the BP raised during exercise (SBP 149+/-21 mmHg; DBP 94+/-14mmHg). No significant BP drop occurred after cycling. Figure 1 displays the changes of heart rate and blood pressure during both tests. Further exercise-related symptoms were successfully prevented by water ingestion. However, after 2 months our patient complained of attacks during ordinary daily activity. As these attacks could not be anticipated and occurred frequently, we advised to stop the extra water ingestion and prescribed sodium tablets (7,2 g/day) instead. After 2 months he had had no complaints.

Discussion

Our patient had symptoms and signs of exercise-related (pre)-syncope. Despite extensive investigations we could not identify a certain cause for this disorder of cardiovascular regulation.

Our patient had compared to healthy men a low exertional BP[273] and compared to healthy endurance trained men a relatively high resting HR.[16] The cardiovascular changes of our patient seem similar to those seen in patients with postural orthostatic tachycardia syndrome (POTS) while standing.[120] Supposing that exercise poses a larger workload to the cardiovascular system compared to standing, one could argue that our patient has a mild variant of POTS.

We hypothesized that our patient's symptoms were primarily related to failure of sympathetic vasoconstriction. Therefore, we examined the effect of water drinking, as water drinking has been demonstrated to rapidly raise sympathetic activity.[124]

Water drinking has been described previously by Shannon *et al.* as a treatment for orthostatic and postprandial hypotension in patients with autonomic failure and orthostatic tachycardia in patients with orthostatic intolerance.[216] Water drinking (480 mL) raises plasma nor-epinephrine levels as much as classic sympathetic stimuli as caffeine and nicotine.[124] The pressor effect of water in patients and older controls reached a maximum after 30 minutes and lasted over 60 minutes. In our case we chose to use 1000 mL tap water in stead of 480 mL, as the pressor effect of 480mL tap water was not present in healthy young subjects compared to older controls. Moreover, as exercise induces a decrease of plasma volume[110] a larger volume is needed.

As the symptoms of post-exercise hypotension result from an only brief failure of cardio-vascular regulation, a short lasting therapy is preferable. Besides this, symptom relief should outweigh any possible side effect. In contrast to previously recommended medications, water drinking has both a short lasting effect and little side effects. Therefore we suggest water drinking as a simple and possible effective therapy for idiopathic exercise-related syncope.

Figure 1 Changes of heart rate (HR) and systolic (SBP) and diastolic blood pressure (DBP) during maximum cycling exercise, as measured on 2 separate occasions, without water drinking (a) and after rapid ingestion of 1000mL tap water (b). BP was continuously recorded with finger photoplethysmography (Finapres). An algorithm was developed to exclude frequent calibrations of the Finapres device from analysis