Physiology & Behavior 147 (2015) 227–232

Contents lists available at ScienceDirect

Physiology & Behavior

journal homepage: www.elsevier.com/locate/phb

A prospective 1-year study of postural tachycardia and the relationship to non-postural versus orthostatic symptoms

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HIGHLIGHTS

- Asymptomatic orthostatic tachycardia in young population
- Head-up tilt and symptom assessments for orthostatic tachycardia
- No non-postural or orthostatic symptoms present despite tachycardia on HUT
- Need for re-evaluation of heart rate criteria for POTS in young population

ARTICLE INFO

Article history:
Received 21 October 2014
Received in revised form 23 March 2015
Accepted 27 April 2015
Available online 1 May 2015

Keywords:
Orthostatic tachycardia
Postural Tachycardia Syndrome
Orthostasis
SF-36
Multidimensional Fatigue Inventory
Body Vigilance Questionnaire

ABSTRACT

Purpose: Healthy subjects with asymptomatic postural tachycardia at baseline were evaluated over a one year period to determine whether they developed non-postural versus orthostatic symptoms that could predispose them to develop Postural Tachycardia Syndrome (POTS).
Methods: Participants ($n = 30$) were recruited for a 1-year follow-up (FUP) study if at baseline they demonstrated a heart rate increment of ≥30 bpm on head-up tilt (HUT). At FUP, HUT was repeated and four self-report questionnaires were used to assess symptoms.
Results: Heart rate (HR) increment was reduced in 19 subjects (-11.8 ± 7.4 bpm) and increased in 11 subjects (8.3 ± 6.1 bpm) at FUP versus baseline. Heart rate increment at FUP demonstrated no correlation to general fatigue ($r = 0.006$), body vigilance ($r = 0.195$), or the component scores for physical ($r = -0.087$) and mental ($r = -0.137$) health of the SF-36. Similarly, there was no correlation between HR increment at FUP and orthostatic scores ($r = 0.04$). However, orthostatic scores did show a significant positive correlation with general fatigue and body vigilance scores ($r = 0.374$, $r = 0.392$, respectively; $p < 0.05$).
Conclusions: Despite meeting the heart rate criteria for POTS, these findings further support that the majority of young individuals express benign orthostatic tachycardia. In addition, after one year this patient population showed no predisposition to develop non-postural or postural symptoms that could lead to the full syndrome of POTS. These data further argue for the re-evaluation of the heart rate criteria for diagnosing POTS in young populations.

1. Introduction

Postural Tachycardia Syndrome (POTS) is characterized by symptoms of lightheadedness, dizziness and palpitations in the standing or upright position [11]. The physiological criteria for POTS is defined as a heart rate increment greater than 30 bpm on head-up tilt (HUT) [11]. In younger populations, orthostatic disorders, including POTS, have been shown to have significant morbidity and impaired social development [1,11,19].

The degree of postural tachycardia that is considered abnormal or likely to be associated with orthostatic symptoms has come into question in younger individuals [8,23]. There are a large proportion of asymptomatic adolescents and young adults who naturally express excessive heart rate increments on HUT [8,9,23]. These selected populations could be considered as having an orthostatic tachycardia without symptoms. These issues have raised questions regarding the diagnostic criteria for POTS and whether revision is needed in younger patient populations. Some have proposed increasing the HR criteria for POTS to 40 bpm, but little study has primarily focused on this crucial question [5]. Furthermore, our lab previously undertook a prospective one year study of persons with asymptomatic orthostatic tachycardia that showed that individuals were not predisposed to developing orthostasis

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http://dx.doi.org/10.1016/j.physbeh.2015.04.049
0031-9384/

[4]. These findings argue that orthostatic tachycardia is a benign finding in the young and not associated with a significant predisposition to develop orthostasis or POTS.

There is evidence to support the lack of significant mental illness in POTS including the argument that anxiety is not a significant contributor to the postural tachycardia [20]. However, it is very likely that poor adaptation strategies to psychosocial/environmental stressors may contribute to the disability experienced by POTS patients [2,3]. Therefore, we questioned whether those individuals with asymptomatic orthostatic tachycardia may become symptomatic with respect to their potential orthostatic disorder based on poor coping strategies to psychosocial stressors.

We undertook a follow-up study of persons with asymptomatic postural tachycardia (≥30 bpm) at baseline to determine whether these individuals were predisposed to the development of constitutional symptoms including hyper-vigilance, fatigue, and changes in their physical/mental health that in turn, could result in the full syndrome of POTS. We evaluated participants at one year using the Body Vigilance Questionnaire (BVQ), Multidimensional Fatigue Inventory (MFI) and the 36-item Short-Form health survey (SF-36). Our objectives were to determine whether these symptoms correlated to changes in postural heart rate and/or orthostatic symptoms (as defined by the Orthostatic Hypotension Questionnaire).

2. Methods and materials

2.1. Subjects

Participants between the ages of 13 and 80 were recruited as part of a normative database being compiled by our lab. Participants with a heart rate increment of ≥30 bpm on head-up tilt were asked to return 1-year later at a similar time of day for a follow-up (FUP) visit. The following steps were taken to rule out other possible explanations for the excessive tachycardia, in addition to determining the general health of our studied population: 1) Participants were examined by a neurologist (KK) prior to testing to exclude any neurological conditions, including chronic pain disorders, and to verify that they did not have a history of orthostatic and/or autonomic dysfunction. 2) A list of medications was provided from each participant from which, there were no medications that would indicate the presence of chronic pain or anxiety disorders. 3) Following testing the results of the Body Vigilance Questionnaire, which has been significantly correlated to both panic and generalized anxiety disorders [7,12], revealed values within the normal range for a control population [22]. 4) Despite no reported findings of anxiety disorders, anxiety was not found to be a significant contributing factor to postural tachycardia [20].Therefore, we would argue that the presence of excessive tachycardia was not a result of co-existing/alternative morbidities, including chronic pain, anxiety and panic disorders. Additional exclusion criteria to verify that our studied population was of good general health included at least one of the following: i) pregnant or lactating females, ii) the presence of another cause of autonomic failure, iii) clinically significant coronary artery disease, iv) concomitant therapy with anticholinergic, alpha- and beta-adrenergic antagonists or other medication which could interfere with testing of autonomic function, and v) failure of other organ systems or systemic illness that could affect autonomic function or the subject's ability to cooperate. This included: dementia, pheochromocytoma, heart failure, hypertension, renal or hepatic disease, severe anemia, alcoholism, malignant neoplasms, hypothyroidism, sympathectomy, diabetes, amyloidosis or cerebrovascular accidents. A total of 30 participants were included in this study. Ethical approval was obtained from the Health Science Research Ethics Board at Western University and written consent was obtained from each participant prior to study commencement.

2.2. Head-up tilt

Subjects were placed in the supine position for a minimum of 15 min prior to testing. The subject's beat-to-beat blood pressure and heart rate were measured using a BMEYE Nexfin device (Amsterdam, The Netherlands) and an electrocardiography (ECG) device (Model 3000 Cardiac Trigger Monitor, IVY Biomedical Systems, Inc., Branford, CT) with ECG electrodes (Ambu® Blue Sensor SP, Glen Burnie, MD), respectively. All recordings were made using WR TestWorks™ software (WR Medical Electronics Co., Stillwater, MN). Baseline recordings were obtained for 1 min. The subject was then passively tilted to 70° upward from horizontal for a period of 5 min followed by an additional 5 min recovery period in the supine position. A change in HR (ΔHR) was calculated by obtaining the average HR during the 1-minute baseline and subtracting it from the maximal HR achieved between the second and fifth minutes of tilt (maximal HR-average baseline HR).

2.3. Questionnaires

2.3.1. The 36-item Short-Form health survey (SF36)

The SF36 is a self-report questionnaire used to assess quality of life in clinical and non-clinical populations [2,18,27]. The questionnaire contains 36 items to yield scores in 8 domains: physical functioning, role limitations caused by physical problems, bodily pain, general health, vitality, role limitations caused by emotional problems, social functioning, and mental health. The 8 domains can be further aggregated into physical and mental summary scores. Each domain was scored using a norm-based approach which can be compared to general populations with a mean of 50 and standard deviation of 10, with higher scores indicating better health.

2.3.2. Multidimensional Fatigue Inventory (MFI)

The MFI is a self-report instrument used to assess fatigue as experienced by patients [24]. The MFI-20 contains 20 items organized into 5 sub-scales: general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue. Each item was scored between 1 and 5, with higher scores indicating more fatigue. Summation of each item per scale yielded a total score ranging from 4 to 20.

2.3.3. Body Vigilance Questionnaire (BVQ)

The BVQ is a 4 item self-report questionnaire used to assess the degree to which a subject focuses on internal bodily sensations [22]. Items 1–3 assess the degree of focus to bodily sensations, perceived sensitivity to bodily changes, and the average amount of time spent attending to bodily sensations. The fourth item gathers ratings for attention to 15 sensations that include all of the physical symptoms described for panic attacks in accordance with the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). Ratings for the 15 sensations were averaged to yield one overall score for item 4. A total score was calculated by finding the sum of items 1–4, with higher scores indicating greater focus on bodily sensations, which has been correlated to anxiety and panic disorders.

2.3.4. Orthostatic Hypotension Questionnaire (OHQ)

The OHQ is divided into two parts. Part I: the orthostatic hypotension symptoms assessment (OHSA), consists of six questions to measure the presence and severity of orthostatic symptoms, and Part II: the orthostatic hypotension daily activity scale (OHDAS), consists of four questions to assess the impact of orthostatic symptoms on daily activities [14]. Each item was scored on an 11-point scale from 0–10, with 0 indicating no symptoms/no interference and 10 indicating the worst symptoms/complete interference. Included was the option of selecting "cannot do for other reasons". The total OHQ score was calculated by averaging the OHSA and OHDAS scores.