What is the optimal duration of tilt testing for the assessment of patients with suspected postural tachycardia syndrome?

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Aims
The aim of this study is to define the optimal duration of tilt testing for the assessment of patients with suspected postural tachycardia syndrome (POTS).

Methods and results
This was a case–control study. Cases were identified retrospectively from a database of patients referred with orthostatic intolerance (OI). All met the diagnostic criteria for POTS. Controls were enrolled prospectively. All subjects underwent tilting to 70° for 40 min if tolerated. Continuous monitoring was provided by a Finometer. Analysis of responses to tilting was performed on 28 cases and 28 controls. The mean age in the case group was 23.6 and in the control group was 26.2. The majority was female in both groups (cases ¼ 4F:3M, controls ¼ 2F:1M). All cases met the criteria for POTS within 7 min of orthostasis. No controls demonstrated a sustained tachycardia. The prevalence of vasovagal syncope (VVS) was 36% in cases vs. 7% in controls (P = 0.02) and 25% in the remaining patients (n = 233) on the OI database (P = 0.259).

Conclusion
A 10 min tilt will diagnose POTS in the majority of patients. It will not, however, be sufficient to identify the overlap that exists between POTS and VVS. The optimal duration of tilt testing in patients suspected of POTS is 40 min.

Keywords
Postural orthostatic tachycardia syndrome • Tilt testing • Syncope • Orthostatic intolerance • Vasovagal syncope

Introduction
Postural tachycardia syndrome (POTS) is a form of chronic orthostatic intolerance (OI) with associated tachycardia. It is more common among adolescents and is generally characterized by symptoms of lightheadedness, fatigue, headache, and blurred vision during prolonged standing.1

There is much disagreement surrounding the definition of POTS. Most state that monitoring should continue for a minimum of 10 min following orthostatic stress,2–4 but there remains no consensus regarding the optimal duration of tilt required for the diagnosis.

Anecdotally, it is recognized that there is a higher prevalence of vasovagal syncope (VVS) among patients with POTS. We hypothesize, therefore, that tilt-test durations in excess of 10 min may be required to fully evaluate the exact causes of OI in patients with suspected POTS. Our aim therefore is to define the optimal duration of tilt testing required for the assessment of patients with suspected POTS.

Methods
The following definitions were used for the purposes of this study.

(i) Postural tachycardia syndrome. POTS is defined by a sustained heart rate (HR) increase of ≥30 bpm or an increase of HR to ≥120 bpm during the first 10 min of orthostasis with associated symptoms of OI. This should happen in the absence of a significant orthostatic drop in blood pressure (i.e. ≥30 mmHg systolic).2

(ii) Vasovagal syncope. A diagnosis of VVS was made if there was reproduction of presenting symptoms with associated...
haemodynamic changes. There are a number of subtypes identified, but we did not subclassify patients for the purposes of this study.

(iii) Orthostatic hypotension. Orthostatic hypotension (OH) is defined as a drop in systolic blood pressure (SysBP) of ≥20 mmHg or a drop in diastolic blood pressure (DiasBP) of ≥10 mmHg within 3 min of orthostatic stress.

This was a case–control study. Case identification was performed retrospectively from a database maintained by the Syncope Unit at the Mid-Western Regional Hospital, Ireland. All cases met the haemodynamic criteria laid out above for the definition of POTS and were referred for the assessment of OI (i.e. symptomatic). Controls were identified prospectively using a snowball sampling method and were matched to cases on the basis of age and sex. None of the controls had previous symptoms of OI. Both case and control groups were felt to be representative of the population affected by POTS. All subjects were otherwise healthy young adults.

All consecutive prolonged HUT tests performed between May 1998 and February 2005 were analysed for the identification of POTS cases. Controls were recruited between February 2006 and July 2006.

The following protocol for prolonged HUT testing was used. Patients were initially assessed by a physician with a special interest in syncope. The indication for testing in all cases was unexplained OI and syncope. Subjects were initially asked to lie supine for a period of 5 min. Thereafter, they were tilted to an angle of +70° using an automated tilt table with footplate (CNSystems). This was then sustained for a period of 40 min if tolerated. Monitoring was provided by Finometer with external Siemens electrocardiograph tracing. All tests were performed without pharmacological provocation. Subjects provided informed consent prior to HUT testing.

For each subject, we measured average (over 1 min) HR, SysBP, and DiasBP for 10 min following orthostatic stress. We also recorded symptoms and haemodynamic changes consistent with a diagnosis of VVS and recorded time of onset in each subject.

Demographic and haemodynamic data were entered into a Filemaker Pro database at the time of testing for both cases and controls. These were subsequently exported to SPSS16.0 for statistical analysis.

Confounders were controlled for as follows. All subjects were at least 2 h post-prandial at the time of testing. They were also asked to abstain from caffeine on the day of tilt testing. All subjects were pre-assessed to ensure adequate hydration prior to HUT. Anxiety was minimized through provision of a calm climate-controlled environment. Pregnancy was an indication for exclusion from the study.

Results

We analysed a total of 298 tilt tests (Figure 1). From these, we identified 65 (21.8%) potentially eligible cases of POTS. When we analysed the data directly and applied strict diagnostic criteria, there remained 28 (9.4%) cases of POTS that were confirmed eligible for inclusion. The remaining patients were excluded because, although there was a trend towards an orthostatic increase in HR accompanied by symptoms, they did not meet the strict sustained ≥30/≥120 bpm criteria.

The case group was composed of 16 females and 12 males (4:3, F:M) and the control group was composed of 18 females and 10 males (2:1, F:M). This difference was not statistically significant (P = 0.785). The mean age for cases was 23.6 years (range 14–60) and for controls was 26.2 years (range 11–59) (P = 0.414). The HR data for both groups are summarized in Figure 2.

Within the initial 3 min of head-up tilt, 75% (21/28) of cases had developed a sustained tachycardia and fulfilled the HR criteria for POTS. Within 7 min of HUT, 100% (28/28) of the cases had met the diagnostic criteria for POTS. None of the controls had a sustained tachycardia.

Orthostatic hypotension occurred in 7/28 (25%) cases had developed a sustained tachycardia and fulfilled the HR criteria for POTS. Within 7 min of HUT, 100% (28/28) of the cases had met the diagnostic criteria for POTS. None of the controls had a sustained tachycardia.

Orthostatic hypotension occurred in 7/28 (25%) patients diagnosed with POTS. The average drop in SysBP in this group was 26 mmHg (range 22–29 mmHg). Orthostatic hypotension occurred in 6/28 (21%) controls, with an average drop in SysBP of 23 mmHg in this group (range 20–26 mmHg). There was no significant difference in the prevalence of OH in cases compared with controls (P = 0.752).
Ten of 28 (36%) cases developed VVS on prolonged tilt testing. This occurred at an average time of 15.7 min (range 7.4–31.6). Two of 28 (7%) controls developed VVS, at 19.9 and 28 min, respectively. The prevalence of VVS was significantly higher in cases than controls (P = 0.02). This compared with a prevalence of VVS of 59 of 233 (25%) in the remainder of patients undergoing prolonged tilt testing (P = 0.259) (i.e. those not included in the study).

All tilt tests lasted 40 min unless terminated early due to VVS. The mean duration of testing in the case group was 32.65 vs. 38.85 min in the control group (P = 0.011).

Discussion

Our results indicate that within 7 min of the onset of orthostatic stress, all cases subsequently diagnosed with POTS had developed a sustained tachycardia. No sustained increase in HR was observed in the control group. This suggests that a tilt duration of 10 min is adequate to diagnose POTS. However, we observed a significant overlap between POTS and VVS.

There was a higher prevalence of VVS among patients with POTS when compared both with controls and with all other patients referred for the assessment of OI. Cessation of tilt testing at 10 min would lead to the under-diagnosis of VVS in the group who are seemingly at the highest risk of having it. There is disagreement in the literature regarding co-existing OH.\textsuperscript{7} Some authors exclude a diagnosis of POTS if significant OH is present\textsuperscript{6} with various levels of hypotension described, e.g. a decrease in SysBP \( \geq 10 \text{ mmHg}\),\textsuperscript{9} \( \geq 20 \text{ mmHg}\),\textsuperscript{10,11} or \( \geq 30 \text{ mmHg}\).\textsuperscript{1,12} Some authors suggest that OH can co-exist with POTS,\textsuperscript{13} whereas others do not refer to OH in their definition.\textsuperscript{3,14} For the purposes of our study, we felt it reasonable to exclude significant OH (based on SBP reduction \( \geq 30 \text{ mmHg}\)) particularly when it is prolonged. None of the patients in the POTS group surpassed this threshold.

The primary limitation of our study lies in the retrospective identification of POTS cases. This was controlled via direct examination of all these traces and stringent application of diagnostic criteria. We are therefore confident that all patients included in the case group met the strictest definition of POTS. A second limitation to this study was the balance between males and females in the case group. Previous epidemiological studies have quoted a ratio of 4:F:1 for POTS patients.\textsuperscript{3} Our group had a ratio of 4:3. The age profile in our groups was however consistent with that previously described for POTS.\textsuperscript{15} In spite of these limitations, we feel that both our case and control groups are representative of the population normally affected by POTS. For this reason, we are confident that the work is externally valid.

Conclusion

There is a large overlap between POTS and VVS. This overlap is such that the prevalence of VVS among POTS patients exceeds that in all groups analysed here. We suggest therefore that all patients with a history suggestive of POTS should undergo prolonged tilt testing for a minimum duration of 40 min.

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References