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Orthostatic hypotension does not predict recurrent falling in a nursing home population

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ABSTRACT

Objective: Most studies regard orthostatic hypotension (OH) as a causal factor for falls. However, the evidence is lacking for this assumption. We aimed to investigate the relationship between orthostatic hypotension and fall incidents in nursing home residents.
Methods: A total of 249 patients was included in a prospective observational cohort study of nursing home residents. Falls were prospectively registered. Cox proportional hazard modelling and the conditional frailty model were used to analyse the relationship between OH and (recurrent) falling.
Results: Among the 249 patients, 450 falls were recorded during follow-up and OH was present in 93 out of 249 patients. No significant associations were found between OH and the first fall incident (Hazard Ratio (HR) 1.01 (95% Confidence Interval (CI) 0.60–1.69) and recurrent falling (HR 1.21 (95%CI 0.65–2.24)).
Conclusions: Although falling and OH were both highly prevalent in nursing home residents, no relationship between OH and falling was found.

1. Introduction

Orthostatic hypotension (OH) is frequently seen in the elderly population, and its prevalence increases with advancing age (Lahrmann et al., 2006). OH is regarded as a risk factor for falling and could potentially lead to severe morbidity (Scheffer et al., 2013; Shaw & Claydon, 2014; Angelousi et al., 2014; Graafmans et al., 1996a; Gangavati et al., 2011; Heitterachi, Lord, Meyerkort, McCloskey, & Fitzpatrick, 2002). Many studies reporting a positive association between falls and OH, were performed in nursing homes (Graafmans et al., 1996a; Ooi, Hossain, & Lipsitz, 2000). However, the lack of prospective fall data (Blumenthal & Davie, 1980; Romero-Ortuno, Cogan, Foran, Kenny, & Fan, 2011; van der Velde, van den Meiracker, Stricker, & van der Cammen, 2007), adjusting for important confounders (Heitterachi et al., 2002), or using the international consensus definition of OH (Graafmans et al., 1996a), limit the generalizability of these studies.

Besides, various studies only described the relation between OH and falling in subgroups instead of within the total study population (Ooi et al., 2000; Maurer, Cohen, & Cheng, 2004; Luukinen, Koski, Laippala, & Kivela, 1995).

Two recent systematic reviews described the relationship between OH and falling in elderly. However, the absolute attributive risk was not established due to the lack of a meta-analysis (Shaw & Claydon, 2014;; Angelousi et al., 2014).

Although OH is widely accepted as an important risk factor for falls, it remains to be established whether and to what extent OH contributes to falling (Angelousi et al., 2014; Maurer et al., 2004). Despite the lack of evidence for a causal relationship between OH and fall risk, a variety of interventions are currently being investigated and already deployed that target OH, such as discontinuation of antihypertensive medication (Moonen et al., 2016).

Because in particular nursing home residents are frail elderly, who are most likely to have serious injuries after falling, we aimed

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to prospectively investigate the relationship between orthostatic hypotension and fall incidents in nursing home residents.

2. Materials and methods

2.1. Study population

For this prospective observational cohort study, patients were recruited from a nursing home facility in the north-eastern region of the Netherlands (TriviumMeulenbeltZorg, Hengelo). The design and details of the study population have been presented elsewhere (Hartog, Cizmar-Sweelssen, & Knipscheer, 2015). For this study, all patients had to be at risk for falling; therefore bedridden patients were excluded.

2.2. Data collection

Baseline data included demographic characteristics, a full medical history including a history of cardiovascular disease, diabetes mellitus, hypertension, fall history, and medication use. During admission, every individual fall was registered with date and type of injury caused by falling. A fall was defined as an unintentionally coming to the ground. In case of a recurrent faller, only information about the first 5 fall incidents was collected.

Patients were considered to have cardiovascular disease when they had a history of angina pectoris, myocardial infarction, percutaneous transluminal coronary angioplasty, coronary artery bypass grafting, stroke or transient ischaemic attack. The activities of daily living were measured with the Barthel-Index (Sainsbury, Seebass, Bansal, & Young, 2005); the score ranges from 0 to 20. Blood pressure was measured following a standardized protocol, using an automated sphygmomanometer (Omron M6) (Altunkan, Iliman, & Altunkan, 2008). If the automated sphygmomanometer displayed an error message, blood pressure was manually measured with a sphygmomanometer Heine Gamma XXL-T (Dorigatti, Bonso, Zanier, & Palatini, 2007).

Trained medical staff performed all tests. Blood pressure was measured twice in supine position after 5 min of rest, and twice each at 1 and 3 min after postural change. The forearm of the patient was supported at heart level during the measurements in upright position (Mariotti et al., 1987). The postural change was from supine to standing position, with the exception of patients who were unable to stand during the orthostatic blood pressure measurement. For these patients the postural change was from lying to sitting position. All patients were asked whether they had consumed a meal or drink within two and one hours, respectively, prior to the measurements. Besides, the time of the day of the blood pressure measurement was registered.

Mean supine blood pressure was compared to the four individual sitting or standing blood pressure measurements to diagnose OH. OH was defined as a drop in SBP of ≥ 20 mmHg or diastolic blood pressure (DBP) of ≥ 10 mmHg after postural change compared to the mean value of the baseline measurements in supine position within 3 min (Lahrmann et al., 2006).

The presence or absence of characteristic symptoms of OH like light-headedness, syncope, or dizziness after postural change was scored, and the combination of OH and orthostatic complaints was described as symptomatic OH.

2.3. Statistical analyses

Continuous variables are presented as mean and standard deviation for normally distributed variables, or as median and interquartile range for non-normally distributed variables. Cox proportional hazard modelling was used to investigate the relationship between OH and first fall incidents. In the multivariate Cox regression models we adjusted for age, gender, body mass index (BMI), history of hypertension, previous fall (within last 12 months), the score on the Barthel questionnaire, type of department, and number of medications. The Schoenfeld residual plots were inspected for each predictor variable to check the assumption of proportional hazards. P values less than 0.05 were considered statistically significant. To analyse the relationship between OH and recurrent fall incidents, the conditional frailty model was used (Box-Steffensmeier & De Boef, 2006; Cui et al., 2009). The conditional frailty model was based on the Cox proportional hazards model. By using the conditional frailty model for analysing recurrent events, an individual was considered to be at risk for the n-th event only if the patient has experienced the (n-1)th event.

Since the results of a previous study suggested that not OH but orthostatic complaints or symptomatic OH are a risk factor for falling (van Hateren et al., 2012), post-hoc analyses to investigate the relationship between orthostatic complaints or symptomatic OH and (recurrent) falling were performed. The post-hoc analyses were comparable to primary analyses.

Since timing of the OH measurement and consumption of a meal or drink could have influenced the results a second post-hoc analyses was performed in which we additionally adjusted for timing of the OH measurement and consumption of a meal or drink (Ooi et al., 2000; Weiss, Grossman, Beloosesky, & Grinblat, 2002; Ooi, Barrett, Hossain, Kelley-Gagnon, & Lipsitz, 1997).

When necessary, interaction was tested between different variables. Interaction was considered to be significant, with a p-value less than 0.05.

All statistical analyses were performed using SPSS version 22 software and with SAS 9.3 software. The 'Strengthening the Reporting of Observational studies in Epidemiology' (STROBE) statement was used to describe this observational cohort study (von Elm et al., 2014).

3. Results

A total of 249 patients were included in this cohort, 80 patients at the psychogeriatric department, 42 patients at the somatic department, and 127 patients at the rehabilitation department. During a median follow-up period of 1.3 years, 450 falls were recorded during the follow-up; 181 (73%) patients reported no falls and 68 (27%) patients reported one or more falls. Fifty-three of the fallers (78%) were recurrent fallers. When stratified according to department; 9 (21%) of the somatic, 38 (48%) of the psychogeriatric, and 6 (5%) of the rehabilitation patients recorded ≥ 1 falls.

The baseline characteristics are presented in Table 1. Median age of the total study population was 82 (IQR (interquartile range 76–87)) years. OH was present in 93 out of 249 patients, resulting in a prevalence of 37% (95%CI (confidence interval) 31–43%). The intended postural change could be performed from lying to standing in 186 (75%) of the patients. The remaining patients performed the postural change from lying to sitting.

3.1. OH and falling

Tables 2 and 3 present the hazard ratios of OH with regard to the first fall incident and recurrent falls. No significant associations were found between OH and the first fall incident and recurrent falling, in both the unadjusted and adjusted models.

In the fully adjusted models, the Barthel index and type of department were significantly related to first fall incident and recurrent falls. A 1-point higher score on the Barthel index, increased the risk of a first fall incident with 7% (95%CI 2–11%) and the risk of recurrent falling with 6% (95%CI 1–12%). Interaction was