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PREVALENCE AND RISK FACTORS OF POSTPRANDIAL HYPOTENSION AMONG ELDERLY PEOPLE ADMITTED IN A GERIATRIC EVALUATION AND MANAGEMENT UNIT : AN OBSERVATIONAL STUDY

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Abstract: *Objectives:* To explore the prevalence and potential risk factors of postprandial hypotension (PPH) among elderly patients in an acute geriatric ward. *Design:* A prospective observational study. *Setting:* Geriatric Unit in a Belgian tertiary-care University Hospital. *Participants:* Seventy-six hospitalized elderly patients after stabilization of their acute conditions. *Measurements:* PPH and orthostatic hypotension (OH) measured by a non-invasive automated blood pressure device, demographic data, Katz's Basic Activities of Daily Living (ADL) and Lawton's instrumental ADL, Short Physical Performance Battery, Charlson Comorbidity Index, Mini Nutritional Assessment-Short Form, Timed Up and Go test, Get-up Early test, grip strength and 7 classes of drugs. *Results:* Overall, the prevalence of PPH was 46% (n=35/76), and it was symptomatic in 31% of the patients (n=11/35). PPH is associated with OH in one-third of the cases (n=12/35). Two-thirds of the patients with HPP had a significant drop in systolic blood pressure within the first 75 minutes after a meal. In univariate analyses, risk factors of PPH were nursing home residence, alpha-blocker consumption, help needed for eating and a good level of global functional status. However, patients with a good functional status were at increased risk of alpha-blocker exposure. In multivariate analyses, only alpha-blocker consumption and help needed for eating remained statistically significant. *Conclusion:* PPH is frequent among hospitalized elderly people in a Geriatric Evaluation and Management Unit, affecting nearly one out of two people. The use of alpha-blockers is an important risk factor and may alert clinicians to the risk of PPH.

Key words: Postprandial hypotension, elderly, orthostatic hypotension, risk factors, epidemiology.

Introduction

Since its first description in 1935, postprandial hypotension (PPH) has been described as a frequent but under-diagnosed condition among elderly people (1, 2). Its physiopathology is complex and likely multifactorial, including a blunted baroreflex response leading to inadequate postprandial increases in cardiac output and peripheral vasoconstriction, reduced sympathetic nervous system compensation for meal-induced splanchnic blood pooling by activation of stomach stretch receptors, insulin-induced vasodilation and the potential release of vasodilator gastrointestinal peptides (3). Sympathetic dysfunction is particularly important in the presence of diabetes mellitus or Parkinson's disease. PPH has been linked with potential negative symptoms or outcomes, such as dizziness, syncope, falls, coronary events, stroke and an increased risk of mortality (4, 5). PPH may influence the rehabilitation of frail elderly people with cerebrovascular disease (6). The prevalence may vary in the literature according to diagnostic criteria or procedures and patients included in the study population. In a systematic review published in 2014, PPH was observed in 20% of a healthy population over 65 years of age, 30-40% of nursing home residents and 20-91% of hospitalized elderly people (7). However, data from acute geriatric wards are still rare. Although PPH may influence the rehabilitation process which should start as soon as possible. Furthermore, PPH may be asymptomatic, contributing to a lack of recognition in the clinical setting (8). The aim of the current study is to determine, after stabilization of their acute conditions, the prevalence of PPH in a frail elderly population admitted to a Geriatric Evaluation and Management Unit and to define potential risk factors to better target patients at risk of PPH and to implement specific preventive strategies with the goal of improving the rehabilitation process.

Methods

Study design, setting and participants

This prospective observational study took place at the 27-bed Acute Geriatric department, CHU UCL Namur, Godinne site, Catholic University of Louvain, which is a 370-bed tertiary care teaching hospital located in a rural area in the southern part of Belgium. During a 4-month inclusion period, all consecutively admitted patients were prospectively enrolled in the study with the following inclusion criteria: age over 70 years, cognitive status allowing to participate, ability to stay in a sitting position for at least 120 minutes, stabilization of the acute condition responsible for the hospital stay and written informed consent. The exclusion criteria were patients with an unstable acute condition according to the physician evaluation, a systolic

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blood pressure (systBP) at rest ≥ 180 mmHg, an acute digestive disorder such as gastro-enteritis, the use of parenteral nutrition or tube feeding at the time of evaluation, and an inability to eat a meal of ≥ 400 Kcal, as well as patients at the end of life, patients refusing to participate and those being discharged on the day of the measurements. For an alpha level of 0.05, to achieve an absolute precision estimate of ±10%, with a 95% confidence interval (95%CI) and an expected prevalence of 67%, as reported in a previous study, a sample size of 85 people was estimated (9).

Blood pressure measurement

Blood pressure (BP) was recorded using a non-invasive oscillometric automated BP device (Edan M3 Vital Signs Monitor- www. EDAN Instruments, Inc., San Diego, USA). After a rest period of 15 to 30 minutes, BP and heart rate (HR) were determined 18 minutes before starting the meal (t-1), at the time of starting the meal (t0) and every 15 minutes after the meal for a total period of 90 minutes (t1-6), allowing a total of 8 different measurements. Orthostatic hypotension (OH) was determined 18 minutes before starting the meal in a lying position and after 1 and 3 minutes in an upright position. A drop of systBP ≥ 20 mmHg or of diastolic BP (diastBP) ≥ 10 mmHg within the following 3 minutes in a standing position indicated OH. During the test, investigators checked for specific symptoms, such as vertigo, dizziness, nausea, general weakness, thoracic pain, visual complaints and altered level of conscientiousness. At the time of eating the meal and during the 90 following minutes, the patient was in a sitting position. PPH within 2 hours after a meal was defined as a drop of systBP of more than 20 mmHg or a systBP ≤ 90 mmHg if pre-prandial systBP was ≥ 100 mmHg (7). All tests were performed after a meal with a global caloric intake of more than 400 Kcal. In a subgroup of 25 patients, quantitative and qualitative data of meals, including glucide, lipid, protein amount (gr), meal temperature at the time of starting eating (°C) and duration of meal consumption (minutes), were recorded by a trained dietician.

Demographic and clinical data

Demographic data were collected from the electronic medical record of the patient and during a standardized interview. Clinical data were collected by the investigators through a standardized comprehensive functional assessment. A list of drugs was recorded in the electronic record of the patient and divided into 7 major groups, including antihypertensive drugs, alpha-blockers, diuretics, antiarrhythmics, analgesic drugs, proton pump inhibitors and psychoactive drugs. Comorbidity was assessed using the Charlson Comorbidity Index and a specific screening for hypertension, diabetes, atrial fibrillation and Parkinson's disease (10). The Charlson Comorbidity Index was divided into 3 severity categories according to the total score (mild for a total score ≤ 1; moderate for a total score >1 and ≤ 4 and severe for a total score ≥ 5). Cognitive impairments were scored in 2 groups (absent or mild and moderate or severe) according to the multidisciplinary team assessment. The level of functional status was evaluated on the day of the test using the Belgian version of Katz's Basic Activities of Daily Living (B-ADL), assessing a total of 6 activities of daily living ranked for a total of 24 points (a score of 6 indicating complete independence and a score of 24 indicating complete dependence) (11). Participants were categorized into two groups according to the scores (6-15/24 for the first group and >15-24/24 for the second group). The Lawton scale was used to assess functional status in 7 instrumental activities of daily living (i-ADL) before admission; each activity was rated dichotomously (0 for dependent and 1 for independent) (12). Participants were divided into two groups, with scores of 7/7 indicating a high level of autonomy and scores <7 indicating a low level of autonomy. Nutritional status was assessed using anthropometric data including body mass index (BMI), maximal calf circumference (MCC) and the MNA-Short Form questionnaire (MNA-SF) (13, 14). An MNA-SF score ≤ 7/14 was considered to indicate malnutrition.

Muscle strength was measured by the handgrip test with Martin's dynamometer, and scores were divided into three groups (≤18 kPa, 19-35 kPa and ≥35 kPa) (15). Fall risk assessment was assessed using the Timed Up and Go test (TUG) (using 20 seconds (sec) as a cut-off value) (16). Global physical activity performance was determined by the Short Performance Physical Battery test (SPPB), and scores were divided into 2 groups (0-6/12 indicating low performance or >6-12/12 indicating intermediate and higher performance) (17). The Get-up Early test was used as a screening test for psychomotor disadaptation syndrome (PMDS), in which a score of >1/4 indicates a risk of PMDS (18).

Statistical analysis

Numerical data are expressed as the mean ± standard deviation (SD). Categorical data are expressed as the absolute value and percentage. Categorical data from independent samples were compared with chi-square or Fischer's exact tests, when appropriate. Numerical data from independent samples were compared with the Wilcoxon Rank-Sum test or Student's t-test when appropriate. All tests were two-tailed and performed with Stata IC 12.1 Software, StataCorp LLC, Texas. In univariate analyses, all P-values under 0.05 were considered statistically significant. Variables with a P-value <0.05 were included in the multivariate model based on multivariate logistic regression.

Results

Characteristics of the study population

During the 4-month period of recruitment, 178 patients were admitted to the geriatric ward. A total of 102 patients were excluded from the study according to our exclusion criteria. A total of 76 patients were included in the protocol.

The characteristics of the included population are listed in table 1. The main characteristics were as follows: a mean age of 85±5 years, female (58%) , nursing home residents (11%), a high proportion of patients with moderate to severe comorbidities (72%), a high proportion of patients with hypertension (67%), patients taking more than 8 drugs (72%), patients suffering from moderate to severe cognitive disorders (45%) and patients with malnutrition (45%). The mean number of drugs in the global population was high (9±3 drugs). A comparison of the 76 included and 102 excluded patients did not reveal any significant differences for age, sex or living location.

Table 1
Clinical characteristics of enrolled patients in the observational study (n=76)

	n (%) or mean±SD
Age, years	84.9±4.9
Sex	
Female	44 (58)
Male	32 (42)
Living location	
Community	68 (89)
Nursing home	8 (11)
Charlson Comorbidity Index	
Mild (0-1)	21 (28)
Moderate (2-4)	44 (58)
Severe (≥5)	11 (14)
Hypertension	
No	25 (34)
Yes	50 (66)
Diabetes	
No	62 (82)
Yes	14 (18)
Atrial fibrillation	
No	49 (64)
Yes	27 (36)
Cognitive disorders	
Absent or mild	42 (55)
Moderate or severe	34 (45)
Number of drugs	
3-7	21 (28)
8-10	26 (36)
11-18	26 (36)
Antihypertensive drugs	
No	24 (32)
Yes	52 (68)
Antiarrhythmics	
No	44 (58)
Yes	32 (42)
Alpha-blockers	
No	58 (76)
Yes	18 (24)
Diuretics	
No	44 (58)
Yes	32 (42)
Analgesic drugs	
No	21 (29)
Yes	54 (71)
Proton pump inhibitors	
No	45 (61)
Yes	30 (39)
Psychoactive drugs	
No	19 (25)
Yes	57 (75)
Functional status	
Katz score in B-ADL	
6-15/24	42 (57)
16-24/24	32 (43)
Lawton score in i-ADL	
7/7	4 (6)
1-6/7	64 (94)
Nutritional status	
BMI	
< 23 kg/m^2	13 (17)
≥ 23 kg/m^2	62 (83)
MCC	
> 31 cm	19 (25)
≥ 31 cm	57 (75)
MNA-SF	
8-14/14	36 (55)
0-7/14	29 (45)
Help needed for eating	
No	45 (59)
Yes	31 (41)
Physical parameters	
Timed Up and Go test	
<20 sec	18 (25)
≥ 20 sec	55 (75)
Get-up Early test	
0/4	25 (34)
≥ 1/4	48 (66)
SPPB	
7-12/12	5 (20)
0-6/12	20 (80)
Handgrip	
36-86 kPa	33 (43)
19-35 kPa	26 (34)
2-18 kPa	17 (23)

Legend : SD= Standard Deviation ; B-ADL=Basic–Activities of Daily living ; i-ADL= instrumental Activities of Daily Living : BMI= Body Mass Index ; MCC= Maximal Calf Circumference ; MNA-SF= Mini-Nutritional Assessment-Short form ; SPPB= Short Physical Performance Battery

Table 2
Risk factors of PPH according to univariate or multivariate analysis (n=76)

			Univariate analysis		Multivariate analysis	
Predictors	**PPH- group n=41**	**PPH+ group n=35**	**OR (95% CI)**	**P-value**	**OR (95% CI)**	**P-value**
Age, years	84.5±4.5	85.4±5.1	1.04 (0.95-1.15)	0.411		
Sex						
Female	26 (59)	18 (41)	Ref.			
Male	15 (47)	17 (53)	1.64 (0.65-4.17)	0.291		
Living location						
Community	40 (59)	28 (41)	Ref.		Ref.	
Nursing home	1 (12)	7 (88)	10.00 (1.16-85.87)	0.002	1.52 (0.25-9.18)	0.645
Charlson Comorbidity Index						
Mild (0-1)	15 (71)	6 (29)	Ref.			
Moderate (2-4)	20 (45)	24 (55)	3.00 (0.98-9.17)	0.054		
Severe (≥5)	6 (55)	5 (45)	2.08 (0.46-9.51)	0.343		
Hypertension						
No	13 (52)	12 (48)	Ref.			
Yes	28 (56)	22 (44)	0.85 (0.32-2.23)	0.743		
Diabetes						
No	32 (52)	30 (48)	Ref.			
Yes	9 (63)	5 (37)	0.59 (0.18-1.97)	0.390		
Atrial fibrillation						
No	27 (55)	22 (45)	Ref.			
Yes	14 (52)	13 (48)	1.14 (0.44-2.92)	0.786		
Cognitive disorders						
Absent or mild	21 (62)	13 (38)	Ref.	0.219		
Moderate or severe	20 (48)	22 (52)	0.56 (0.22-1.41)			
Number of drugs						
3-7	12 (57)	9 (43)	Ref.			
8-10	16 (58)	11 (42)	0.98 (0.31-3.13)	0.970		
11-18	13 (50)	13 (50)	1.33 (0.42-4.24)	0.626		
Antihypertensive drugs						
No	12 (57)	9 (43)	Ref.			
Yes	28 (54)	24 (46)	1.14 (0.41-3.18)	0.798		
Antiarrhythmic drugs						
No	25 (61)	16 (39)	Ref.			
Yes	15 (31)	33 (69)	1.77 (0.69-4.51)	0.230		
Alpha-blockers						
No	35 (64)	20 (36)	Ref.		Ref.	
Yes	5 (28)	13 (72)	4.55 (1.41-14.64)	0.008	6.65 (1.51-29-36)	0.012
Diuretics						
No	26 (63)	15 (37)	Ref.			
Yes	40 (55)	33 (45)	2.23 (0.87-5.73)	0.094		
Analgesic drugs						
No	10 (53)	9 (47)	Ref.			
Yes	30 (56)	24 (44)	1.12 (0.39-3.22)	0.826		

Table 2 (continued)
Risk factors of PPH according to univariate or multivariate analysis (n=76)

			Univariate analysis		Multivariate analysis	
Predictors	**PPH- group n=41**	**PPH+ group n=35**	**OR (95% CI)**	**P-value**	**OR (95% CI)**	**P-value**
Proton pump inhibitor						
Psychoactive drugs						
No	9 (56)	7 (44)	Ref.		Ref.	
Yes	31 (54)	26 (46)	1.08 (0.35-3.29)	0.895	0.31 (0.92-1.04)	0.057
Functional status						
Katz score in B-ADL						
6-15/24	17 (40)	25 (60)	Ref.		Ref.	
16-24/24	22 (69)	10 (31)	0.31 (0.12-0.81)	0.018	4.35 (1.21-15.59)	0.024
Lawton score in i-ADL						
7/7	2 (50)	2 (50)	Ref.			
1-6/7	34 (53)	30 (47)	1.13 (0.15-8.55)	0.903		
Nutritional status						
BMI						
< 23 kg/m^2	10 (77)	3 (23)	Ref.			
≥ 23 kg/m^2	31 (50)	31 (50)	3.33 (0.84-13.29)	0.076		
MCC						
< 31 cm	10 (53)	9 (47)	Ref.			
≥ 31 cm	31 (54)	35 (46)	0.93 (0.33-2.64)	0.894		
MNA-SF						
8-14/14	24 (51)	18 (50)	Ref.	0.488		
0-7/14	17 (59)	12 (41)				
Help needed for eating						
No	29 (64)	16 (36)	Ref.			
Yes	12 (39)	19 (61)	2.87 (1.11-7.40)	0.027		
Physical parameters						
Timed Up and Go Test						
<20 sec	7 (39)	11 (61)	Ref.			
≥ 20 sec	33 (60)	22 (40)	0.42 (0.14-1.26)	0.123		
Get-up Early test						
0/4	12 (48)	13 (52)	Ref.			
≥ 1/4	28 (58)	20 (42)	0.66 (0.25-1.74)	0.401		
SPPB						
7-12/12	3 (60)	2 (40)	Ref.			
0-6/12	14 (70)	6 (30)	0.65 (0.08-5.26)	0.669		
Handgrip						
36-86 kPa	18 (55)	15 (45)	Ref.			
19-35 kPa	18 (75)	8 (25)	0.53 (0.18-1.57)	0.253		
2-18 kPa	5 (29)	12 (71)	2.88 (0.83-10.03)	0.097		

Legend :HPP-/+ = Group without/with postprandial hypotension; OR= Odds Ratio ; 95% CI= 95% Confidence Interval ; Ref.= reference group. B-ADL=Basic–Activities of Daily living ; i-ADL= instrumental Activities of Daily Living : BMI= Body Mass Index ; MCC= Maximal Calf Circumference ; MNA-SF= Mini-Nutritional Assessment-Short form ; SPPB= Short Physical Performance Battery

Prevalence of PPH

BP measurements were collected, on average, 10 days after admission to the hospital. Globally, in the entire group, the maximal drop in systBP (mean of 11.6±14.9 mmHg) and diastBP (mean of 6.9±9.6 mmHg) was observed after 75 minutes. The prevalence of PPH was 46% (n=35/76; 95% CI: 35-58%). Symptomatic PPH was present in 31% of the cases (n=11/35; 95% CI: 17-49%). Among patients experiencing PPH, the proportion of patients with PPH at t1-6 was 11%, 37%, 43%, 60%, 69% and 63%, showing that most patients suffered PPH at 75 minutes. In patients with PPH, a mean drop of 17.9±12.2 mmHg of systBP was observed, while the drop in the PPH-free group was 1.3±10.5 mmHg. The maximal drop of systBP in the PPH group was 48 mmHg. The proportion of patients with concomitant OH was 34% (n=12/35; 95% CI: 19-52%).

Risk factors of PPH

The results from the univariate analyses are summarized in table 2. Age and sex ratio were similar in both groups. Nursing home residents, patients with a B-ADL score ≤15/24 indicating good functional status, patients needing help for eating, patients using alpha-blockers, and patients with moderate comorbidities were all at increased risk for PPH (P-value ≤0.05). Patients with a BMI ≥ 23 kg/m2 or using diuretics tended to be more at risk but did not reach statistical significance (P-value ≤0.10). Surprisingly, hypertension, diabetes or anti-arrhythmic drug use were not associated with an increased risk of PPH in our study. The risk was also not increased in patients with a high fall risk as assessed by the Timed Up and Go test, low physical performance score and low muscle strength. Based on the logistic regression analysis, the use of alpha-blockers and help needed for eating remained independent predictors of PPH in the multivariate model and increased the risk by factors of 7 and 4, respectively. In the subgroup of patients with a good functional status (with a B-ADL score ≤15/24), the proportion of patients using alpha-blockers was significantly more important compared to patients with a lower level of autonomy (76% versus 24%, respectively; P-value=0.038).

Dietetics parameters

The proportion of patients with malnutrition was similar between patients with or without PPH, like MCC. In the subgroup of 25 patients in which dietary data were collected, the duration of meal consumption and meal temperature were similar in patients with PPH compared to patients without (29 minutes (95% CI : 26-33) versus 30 minutes (95% CI : 20-40) and 54 °C (95% CI : 45-64) versus 52 °C (95% CI : 47-57), respectively). Total energy intake was slightly lower in the group with PPH than in the group without PPH (477 Kcal (95% CI : 416-538) versus 574 Kcal (95% CI : 500-648), respectively; P-value= 0.087). The total protein, lipid and glucide amounts were similar in both groups (31 g (95% CI: 23-39) versus 33 g (95% CI: 28-38), 15 g (95% CI: 11-19) versus 23 g (95% CI: 16-30) and 59 g (95% CI: 29-90) versus 62 g (95% CI: 52-71)).

Discussion

Prevalence of PPH

We found that PPH was a frequent condition among elderly people admitted in an acute geriatric ward, affecting almost half of the patients in our sample. A comparison with previous data showing a wide range of prevalence rates (between 20-91%) remains difficult because of differences in the enrolled participants, clinical settings and definitions of PPH that have been used (3). While a significant drop in BP was observed in 24% of elderly residents of long-term care facilities, rates as high as 59% were in contrast with those found among elderly Chinese people living in the community (19). The cut-off value of systBP decrease may have influenced the prevalence results. Using a drop of ≥ 30 mmHg of systBP as a cut-off value, Van Orschoven et al. found a risk as high as 30% of missing cases of PPH (8). In a study in Dutch hospitals, in a similar setting including octogenarians, a prevalence of PPH as high as 67% was found, with two-thirds of the patients being symptomatic. In that study, similar to our results, PPH was concomitant with OH in 37% of the cases (9). They showed a small overlap of symptoms between those two conditions. In our study, one-third of the patients with PPH experienced symptoms at the time of testing, while two-thirds were free of symptoms. However, PPH has been associated with negative outcomes, such as falls and mortality (5). This means that a clinical screening strategy, based only on the presence of symptoms, would miss a high number of « at risk » patients and that rapid screening tests are useful. A recent French study has shown that a simplified screening method using different cut-offs of systBP drop (10 mmHg compared to the 20 mmHg gold standard) combined with two BP measurements (before a meal and 75 minutes after a meal) would yield a sufficient diagnostic accuracy (20). Interestingly, similar to our study results, the proportion of patients experiencing PPH was highest at 75 minutes. This finding was, however, different in a Korean survey among nursing home residents, where the maximal drop in BP was achieved at 45 minutes (21).

Risk factor analysis

Our risk factor analysis identified alpha-blocker use and help needed for eating as the two best predictors of PPH in our survey. The observed potential link in univariate analyses between global functional status and PPH may be related to confounding factors. Indeed, we found that the proportion of patients with good functional status was more frequently exposed to alpha-blocker use.

Needing help for eating was a surprising finding. We did not find any significant differences in food macronutrient composition analysis, time for meal consumption and meal temperature. The glucide load, a well-known factor influencing

PPH, was slightly higher in the «need help for eating » group (66 g versus 49 g) but was not statistically significant (22). The sample size of the dietetic part of our study was notably small to support this conclusion, and no evaluation of drink volume, a potential contributing factor, was included in the dietary data.

Age was not a significant risk factor in our survey, as was also reported in a previous study (23). In our sample, we did not find any association between physical frailty markers such as grip strength or SPPB results and the occurrence of PPH. There are many other examples in the geriatric field showing that age « per se » is not an independent strong risk factor of geriatric syndromes and that other factors, such as functional status, comorbidities or drug use, may be better predictors. A link between OH and frailty indicators has been demonstrated among nursing home residents and is associated with an increased subsequent risk of falls and mortality (24). To our knowledge, no published studies have found a direct relationship between frailty markers and PPH. In contrast, residents living in long-term care facilities that are frequently very frail were pointed out as « at risk persons » in previous works (25, 26).

We also highlight an important increase in risk, a PPH factor of 7 among patients using alpha-blockers. OH-related syncopal falls have been reported recently in patients with dementia using alpha-blockers (27). Tamsulosin, widely used in Belgium, has also been an important risk factor for worsening OH among hypertensive patients (28). The risk was also confirmed more recently among women (29). To our knowledge, few studies have specifically examined the risk of PPH and alpha-blocker use. We inform clinicians to pay special attention to patients with other risk factors of PPH and who will start taking alpha-blockers, especially as benign prostate hypertrophy is highly prevalent among frail elderly people (30).

Contrasting with our results, PPH has been reported to be more frequent among older hypertensive people with a history of cerebro-vascular disease (31). A complementary issue is the potential risk of PPH and antihypertensive drug use that has been reported in previous studies, where angiotensin-converting enzyme inhibitors, calcium channel blockers, diuretics, nitrates and psychotropic drugs all increased risk (19). In contrast, in a multicentre case-control study in elderly people living in residential care facilities with a high prevalence of PPH (57%), no association was found between antihypertensive drug consumption and PPH, as in our study (32). While a link between small lacunar infarction and PPH was described, we did not find any association between PPH and cognitive status (33). However, we did not assess cognitive function or vascular cerebral damage with a standardized protocol of measurements, leading to a potential risk of underdiagnosis.

Limits

The first limit is related to the small sample size that may have led to a type II error risk. However, we provided 95% confidence intervals of estimates. A large proportion of admitted patients during the inclusion period were excluded from the study, which may have led to sampling bias. Even though we used a standardized protocol of measurements, BP tests were performed by different physiotherapists in the geriatric multidisciplinary team, which may have led to a lack of reproducibility. As mentioned before, the subgroup including food composition analysis was small, and we did not collect water consumption data before and during meal consumption, which is a potential influencing factor as it was reported in patients suffering from multiple system atrophy (34). Factors influencing gastric emptying have not been reported, but they may influence this phenomenon (35). As our survey included a heterogeneous elderly population admitted for acute unstable conditions, the generalizability of our results may be cautiously applied. However, our study adds important epidemiological and clinical data regarding the prevalence and risk factors of PPH among elderly people hospitalized in an acute geriatric ward and using geriatric assessment tools to better define risk factors. Based on our clinical experience, this condition may influence the rehabilitation process, which should be demonstrated in the future (6). Earlier recognition and screening of patients at risk of PPH, not only based on symptoms or the presence of OH, may influence appropriate care of this frail elderly population.

Conclusion

We conclude that PPH is frequent among elderly people admitted in an acute geriatric ward, affecting almost half of them, and is concomitant with OH in one-third of the cases. The more at-risk period is observed after 75 minutes. The two major predictors in our observational study were alpha-blocker use and patients needing help for eating. No correlation between PPH and age or frailty indicators was found after multivariate adjustment. A systematic screening that is not based only on the presence of symptoms that are present in only one-third of the cases should help in earlier recognition of this condition that has been reported to have negative outcomes in the literature.

Ethical standards: All participants or their legal representatives were required to sign written informed consent forms. The study protocol was approved by the Local Ethics Committee of the CHU UCL Namur (NUB: B039201628238). The experiment complies with the current Belgian Law of Human Experiments of the seventh of May 2004.

Conflict of interest: The authors declare that they have no conflict of interest. No specific funding was used for the study.

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