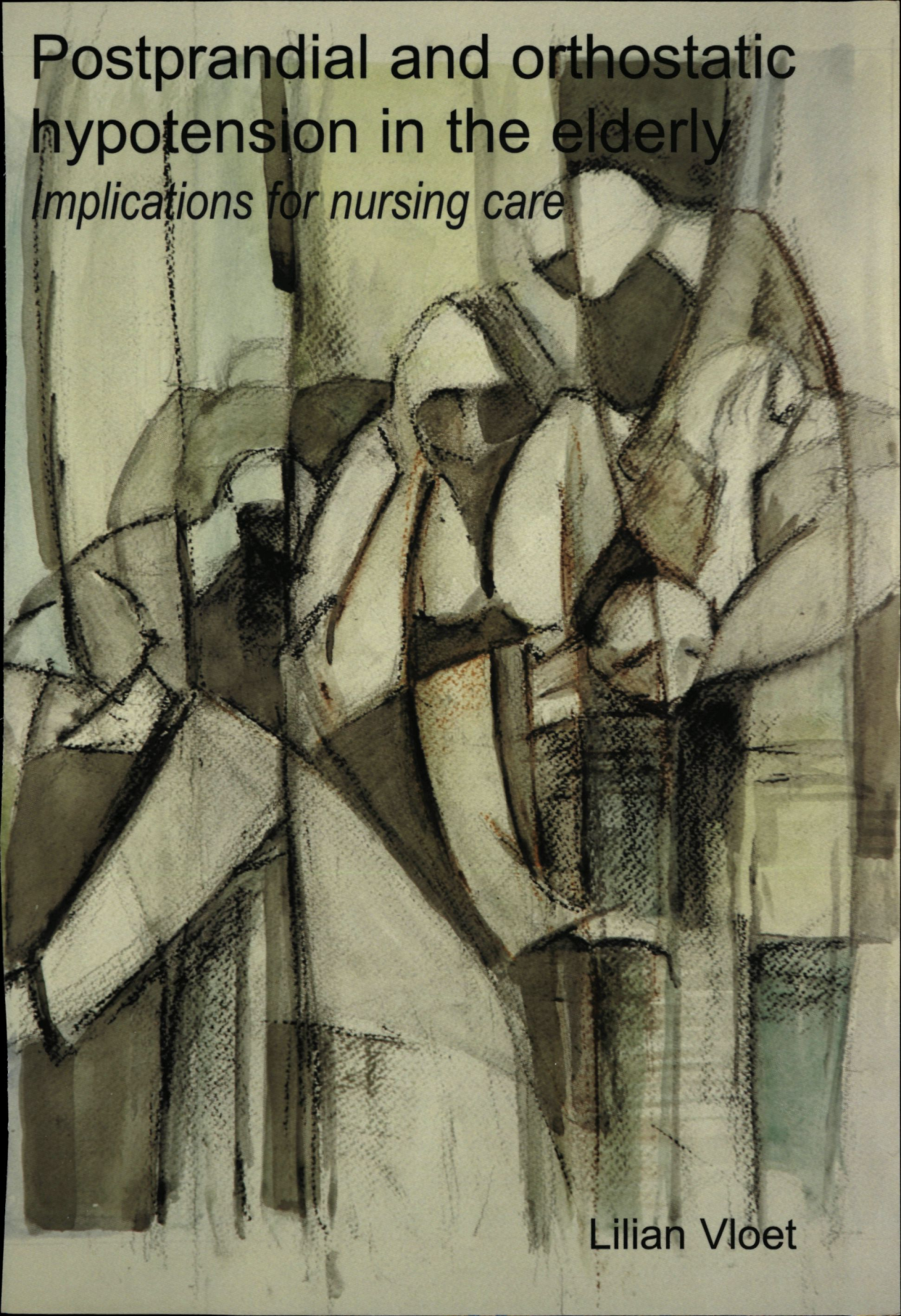
Postprandial and orthostatic hypotension in the elderly

Implications for nursing care



Lilian Vloet

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Postprandial and orthostatic hypotension in the elderly: Implications for nursing care

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"Technique and ability alone do not get you to the top, it is the willpower that is the most important This willpower you cannot buy with money or be given by others

it rises from your heart'

Junko Tabei in 1975 after becoming the first women to climb the mount Everest

Voor Pap

Table of Contents

Chapter 1

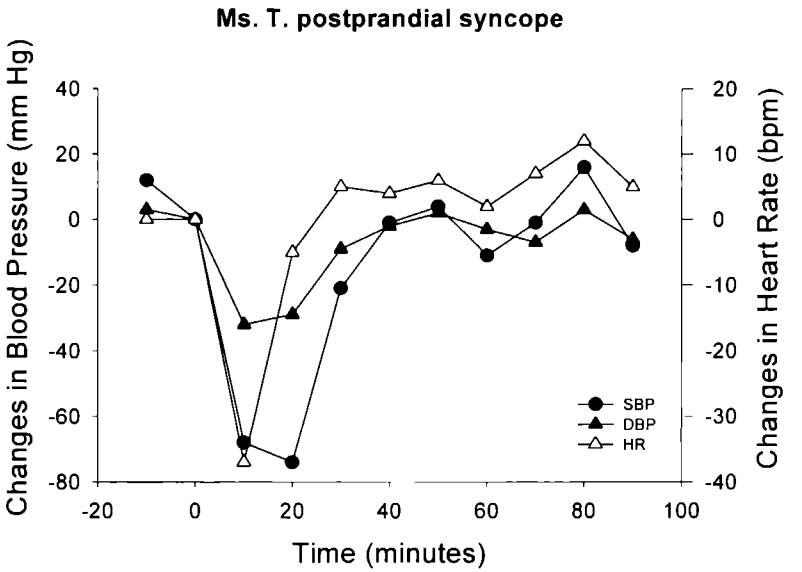
Introduction

Introduction

Mrs T is a woman of 83 years old She was admitted to the geriatric ward of the hospital for recurrent falls and two periods of syncope at home In the hospital, it was noticed that Mrs T was restless after each meal She walked around, waggled, and was unstable when standing up and during walking and was at risk for falling During post-meal conversation her concentration was reduced, and sometimes her speech was disturbed and she was mumbling She was yawning and complained of sleep Because of the tiredness and the dangerous walking we advised Mrs T to rest in bed for an hour after each meal It seemed like Mrs T was taking a nap To reduce the instability after standing up, we advised the use of a walking aid

Physical examination, a CT scan of the head, several electro-cardiograms and Holter monitoring gave no abnormalities that could explain the syncope and falls The physician asked the nurses to measure blood pressure every 15 minutes from 30 minutes before breakfast until 2 hours after eating and several mornings after awakening and standing up It appeared that the blood pressure decreased more than 70 mm Hg after meal ingestion After standing up, the blood pressure decreased with 30 mm Hg after 1 minute of standing and 35 mm Hg after 3 minutes of standing On the second and third morning blood pressure was measured after standing up and again it decreased with more than 20 mm Hg It was diagnosed that Mrs T had both postprandial and orthostatic hypotension

Because hypotensive syndromes like orthostatic and postprandial hypotension can predispose to dizziness, falls and syncope, Mrs T was informed about the dangers and consequences Several interventions were applied The physician considered all prescriptions, discontinued unnecessary medication and prescribed medication with hypotensive (side-) effects in the evening The dietician was asked for advice to prevent dehydration, to adjust the size of meals and to reduce the amount of carbohydrates in meals The nurses were focussed on symptoms of hypotension, took care of fall prevention after meals and standing up, and let the patient rest after meals They introduced the advice of the dietician and gave small frequent meals, with low carbohydrate Mrs T became familiar with the dizziness and followed the guidelines about food, medication, standing up, and safety She had no more syncopes and speech disturbances, and the lowering of consciousness after meals was diminished The number of falls was reduced, and transfers were safe Mrs T was successfully discharged from the hospital



Introduction

The difficulties for nurses in diagnosing the symptoms and in choosing interventions in patients with postprandial or orthostatic hypotension as described in the case study, were reasons to initiate nursing research on this subject This thesis on postprandial and orthostatic hypotension in the elderly, focussing on the implications for nursing care, describes the methods, results and conclusions of the studies on the prevalence of postprandial or orthostatic hypotension, the skills and knowledge of nurses regarding diagnosis and treatment, and two potential interventions for postprandial hypotension.

The research line of the department of Geriatric Medicine, UMC Nijmegen, is part of the research program Heart Function and Circulation, which resides under the UMC Nijmegen Main program 2, entitled, Kidney-, Heart-, and Vascular Diseases. During the last 15 years, the department of Geriatric Medicine has built a tradition of investigating abnormalities in blood pressure regulation in the elderly, especially in postprandial hypotension and orthostatic hypotension. In 1989, Dr. R.W.M.M. Jansen finished his thesis on 'Meals and blood pressure in the elderly'. Before starting research on postprandial and orthostatic hypotension, L. Vloet worked as a nurse on the department of

Geriatric medicine Out of her experiences with geriatric patients with postprandial and orthostatic hypotension, she was interested in conducting research on patients with these problems In 1997, she got the opportunity to start in a combined project of nursing and medical research The medical part of the study was performed by a physician and focussed on the cerebral oxygenation in geriatric patients with hypotensive syndromes In the medical part of the study four groups of patients were included patients with syncope, patients with heart failure, patients with Parkinsonism and patients with depression and resulted in a thesis by D J Mehagnoul-Schipper entitled 'Hypotensive syndromes and cerebral oxygenation in elderly patients' The entire study was supported by the Council for Medical and Health Research / NWO, funded by the Ministry of Health, Welfare and Sports, the Netherlands The nursing part was funded by the Netherlands Hearth foundation as well, and resulted in this thesis by L C M Vloet on 'Postprandial and orthostatic hypotension in the elderly implications for nursing care' Both studies were performed at the department of Geriatric Medicine of University Medical Center Nijmegen In this study we collaborated with multiple centers with a department of Geriatric Medicine, and several departments of UMC Nijmegen like Biostatistics, Cardiology, Internal medicine, Surgery and Nursing Science This project is included in the research theme of the department of Nursing Science, focussing on 'clarifying care needs' and 'interventions and implementation', and is part of the cross-section 'Evaluation and prevention in Health Service' of the main research programs of the UMC Nijmegen

Geriatric patient

The subject of this study, the geriatric patient, is a person of old age, with multiple disorders The geriatric patient is defined as a person who is prevalent with several chronic diseases, he/she often has multiple physical, psychological and social problems, with complex problems[1] The geriatric patient is frail, with a vulnerable balance of health and potential care deficits Often his or her social activities are decreased, and the social network has become smaller Furthermore, because of the co-morbidity, the geriatric patient often uses

multiple prescriptions[2]. Geriatric patients are at higher risk of falling for a number of reasons, including orthostatic and postprandial hypotension, balance or gait impairment and polypharmacy[1] All together this makes the geriatric patient at high risk for disturbances of homeostasis, and therefore for an impaired blood pressure regulation as in postprandial and orthostatic hypotension[2]. The consequences of these hypotensive syndromes, such as falls and syncope, can be enormous for the patient, and his/her environment Good care for postprandial and orthostatic hypotension by early diagnosis, and evidence-based interventions can reduce the consequences and therefore increase the comfort of the patient. In addition, considerable financial costs are involved in case of hospital admission because of for example fractures, or the need of extra special care at home Early recognition and treatment of postprandial and orthostatic hypotension could reduce these costs.

To give an indication of the number of geriatric patients in the Netherlands, we used the calculations of the Central Bureau of Statistics Netherlands (CBS)[3]. According to the CBS, in 2002 13,7% of the Dutch population was 65 years or older (n=6947315), and the number of elderly is still growing Of these elderly, 69,7% have chronic diseases, 31,6% have functional impairments, and 12,2% have psychosocial disorders. On average, elderly people visit a medical specialist 5 times a year.

Background of the study

Diseases and aging of the heart and vessels and alterations in blood pressure regulation play an important role in the complex mechanism of aging in the elderly[4]. These age-associated changes include an increased systolic blood pressure and an impaired blood pressure regulation, and therefore can be a hazard for the adaptation to changes in activity or the ability to regulate hypotensive stresses in the elderly[4 5]. Decreases in blood pressure after standing up (orthostatic hypotension) and after eating a meal (postprandial hypotension) are two clinically relevant examples of this hypotensive stress[5-7].

The underlying mechanisms and causes of postprandial and orthostatic hypotension are schematically presented in chapter 8 (figure 8.1 and 8.2).

The mechanism of postprandial hypotension is not fully understood[5] Postprandial hypotension can be considered as a physiologic process associated with age-related changes in the regulation of blood pressure and with additive disease-related pathologic processes that impair the autonomic control of blood pressure[5] Some of the hypothesis and underlying mechanisms are described below

Meal ingestion induces splanchnic blood pooling, with an increase of the bowel blood volume with 20%, and a reduced systematic vascular resistance[5 8] Standing up induces pooling of blood in the legs (500-700 ml), leading to a decrease in the venous blood return to the heart and stroke volume[9]

A normal cardiovascular response after a meal involves splanchnic blood pooling, a rise in cardiac output of about 25 %, and activation of the sympathetic nervous system Possible factors in postprandial hypotension are impaired cardiovascular compensation, reduced baroreflex sensitivity, impaired activation of the sympathetic nervous system and also humoral factors might play a role Furthermore, oral carbohydrate- or glucose-mediated factors are involved

The activity of the sympathetic nervous system increases after eating a meal and also after standing up, which induces increases of heart rate, plasma norepinephrine, sympathetic nerve activity of muscles and cardiac output, which can compensate for splanchnic blood pooling or pooling of the blood to the legs, and result in a stable blood pressure after food or standing up[5 7 9 13] Postprandial hypotension appears to develop in case of an inadequate cardiovascular compensation for the blood volume into the mesenteric artery, by a reduction of the baroreflex sensitivity to increase heart rate and vasoconstriction, or by an impaired sympathetic nervous system activation[5] The shift of fluid into the gut after a meal, reducing the intravascular volume, may influence postprandial hypotension[5] Changes in the intravascular volume may further reduce diastolic filling of the heart With the absence of compensatory mechanisms, cardiac output may decrease further resulting in hypotension[5] Postprandial hypotension is related to carbohydrates, oral glucose in particular, since oral glucose does affect postprandial BP responses[14] An effect of intravenous glucose, oral fructose and oral xylose has

not been found In addition, one study reported no effect of water, fat or protein intake on BP responses[14]

The etiology of orthostatic hypotension is as in postprandial hypotension not fully known[7] Failure of the autonomic system, inadequate cardiovascular response to blood pooling to the legs in changing posture, and volume depletion are the major causes of orthostatic hypotension[7] Finally, certain diseases associated with an impaired autonomous nervous system such as Parkinson's disease, or an impaired cardiovascular compensation such as hypertension, increase the risk for both postprandial and orthostatic hypotension Furthermore, medication with hypotensive (side effects) and circumstances inducing hypotensive stress such as heat straining, can provoke the risk for hypotension[5 7 9]

Postprandial and orthostatic hypotension are very common in the elderly[5 7] These hypotensive syndromes can be a-symptomatic, but can also be accompanied by serious, invalidating symptoms such as dizziness, falls, syncope, angina pectoris, stroke or even death[5 7 15 17]

Definition of postprandial and orthostatic hypotension.

Postprandial and orthostatic hypotension are common conditions in elderly patients[4 5 7 15 17 19] In the literature, no standardized definition is found for postprandial hypotension, but it is usually defined as a meal-induced decrease in systolic blood pressure of 20 mm Hg or more within 90 minutes after the start of the meal[5] Orthostatic hypotension is commonly defined in the medical literature as a decline of 20 mm Hg or more in systolic blood pressure within 3 minutes after changing from a supine to an upright posture[5 7 15 17 20] Some authors also use a decline of 10 mm Hg or more in the diastolic blood pressure after standing up to define orthostatic hypotension[20] The considerable day-to-day and within-day variability in blood pressure responses to changes of position or food, the possible absence of symptoms, the lack of a standardized definition, make it hard to diagnose hypotensive syndromes and to compare studies on the prevalence[5 16 20 22]

In this thesis we define postprandial and orthostatic hypotension analogue to earlier definitions, as a decrease in systolic blood pressure of 20 mm Hg or more within 90 minutes after a meal[5], and as a decrease in systolic blood pressure of 20 mm Hg or more within 3 minutes of standing, respectively[16 20 21]

Prevalence of postprandial and orthostatic hypotension

When elderly people eat a meal, they may have a decline in blood pressure[5 23] The prevalence of postprandial hypotension is dependent of the group studied Research in elderly nursing home residents has shown that almost all patients experience a decline in blood pressure after meals[19 24] In 24-36% of these patients, systolic blood pressure decreases more than 20 mm Hg within 90 minutes after the meal[19] Postprandial hypotension occurs more commonly in certain groups of patients[5] because the presence of some illnesses can impair the blood pressure regulatory mechanisms and the ability to adapt to hypotensive stress[4] These groups at higher risk include patients with autonomic dysfunction[8], as in Parkinson's disease[25 26] or diabetes[27], with hypertension[28-30], with heart failure[31 32], or patients with falls or syncope[22] Furthermore, the use of certain medication, such as furosemide[31] or antiparkinsonian drugs like levodopa, can provoke or aggravate postprandial hypotension One-fourth of the patients with a history of falls had postprandial hypotension[22], and in patients with Parkinson's disease recently a prevalence of 82% was found[25]

The prevalence of orthostatic hypotension described in the current literature is also highly variable, varying from 5 to 30 % in studies in various elderly populations[7 21 33] The occurrence of orthostatic hypotension increases with age[34 7], predicts mortality in elderly men[35], and indicates an increased risk for stroke[36 37] The use of certain medication that causes vasodilatation, such as drugs with cardiovascular effects, or levodopa, can cause orthostatic hypotension[7]

Due to the orthostatic effect of prolonged sitting or standing up, this can have an additional effect to postprandial hypotension, and eating a meal can have an additive impact on blood pressure after standing up[5 7] In other words,

orthostatic and postprandial hypotension can affect each other However, because they do not always occur together in the same patient, it has been suggested these phenomena do have different etiologic backgrounds[5]

Symptoms

The symptoms of postprandial and orthostatic hypotension are very common and general In the literature, the symptoms mentioned of postprandial and orthostatic hypotension are very similar[5 7 9] Therefore, the circumstances under which the patient has symptoms are very important for diagnosing the problems Both postprandial and orthostatic hypotension can occur without experiencing symptoms of the blood pressure declines[5 7] When symptoms do occur, they are often due to a cerebral hypoperfusion[5 7 38] The severity of the symptoms probably depends on the extent to which the cerebral perfusion is diminished[5 39] In chapter 2, symptoms occurring in postprandial or orthostatic hypotension are studied extensively

The symptoms of orthostatic and postprandial hypotension can be very serious Patients can experience complaints such as dizziness, weakness, visual disturbances such as blurred vision or color defects or blacking out, light-headedness, or loss of consciousness[5 7], that seriously influence their activities of daily living such as difficulties in walking[34], increased risk for falls and their consequences[15 22 40] Furthermore, patients with postprandial or orthostatic hypotension have an increased risk for syncope[16 41], for coronary events and stroke[15 36 37 42] Therefore, it is important to diagnose postprandial and orthostatic hypotension without delay, to start early with interventions

Diagnosis of postprandial and orthostatic hypotension.

Because the symptoms are a-specific, elderly patients can consult a variety of health care professionals with their problems of for example dizziness or syncope, including the cardiologist, the neurologist, the general practitioner, the internist or the geriatrician and nurses working at these specialisms Because orthostatic and postprandial hypotension are very prevalent in the elderly, with severe and disabling symptoms, every health care professional working with

elderly should consider these problems during the assessments in case of symptoms as described above.

The diagnosis of both postprandial and orthostatic hypotension can be made by performing blood pressure measurements before, during and after a meal, or in supine and upright position after standing up, respectively. Furthermore, the history of the patient is important In addition, observation of symptoms can give indications for the presence of postprandial- or orthostatic hypotension[5,7]. For orthostatic hypotension, the symptoms are associated with change in posture[7]. In postprandial hypotension, symptoms are related to taking a meal[5]

Blood pressure measurement

Accurate blood pressure measurements are very important because they can determine diseases such as high blood pressure or hypotension Many staff members regard this task as simple and straightforward; however, it is very complex[43] A lot of problems can occur that influences the validity of the measurement. A potential source of error in blood pressure management can be attributed to the observer because of knowledge deficits, sight or hearing problems or not knowing or following the correct procedure[44-46]. The equipment can also lead to errors in the measurement of blood pressure, for example in the case of defects in the tubes, the mercury column, the calibration of the clock, in the stethoscope, or in choosing the wrong size of the cuff[44-46] Furthermore, patient related factors can influence the blood pressure readings such as in 'white coat hypertension', heat or cold, tight clothing, variation in blood pressure during the day, or emotions such as anxiety or excitement[44-46]. The importance of updating knowledge and skills in blood pressure measurements is often not recognized[44] With information on potential sources of errors that interfere with valid blood pressure measurements, and taking this into account in blood pressure measurements, blood pressure can be determined more accurately, which allows a more accurate diagnosis and valid monitoring of a therapy[46].

Interventions in postprandial or orthostatic hypotension

Once the diagnosis of postprandial and/or orthostatic hypotension is made, treatment of the underlying causes and interventions to minimize symptoms are necessary Although patients with postprandial or orthostatic hypotension can be a-symptomatic, they are at risk for major decreases in blood pressure after eating or standing up respectively, and consequently for impaired hypoperfusion of various organs including the brain[5 7] This condition should be considered as potentially dangerous, and therefore be treated well

For both hypotensive syndromes pharmacological and non-pharmacological treatment is applicable However, for postprandial hypotension, the numbers of effective medications as well as the evidence-based non-pharmacological treatment are limited[5] Pharmacological treatment intends merely to reduce the risk of hypotension[5 30 47] or to reduce the combined effect of meals and cardiovascular medication Therefore, unnecessary medication that lowers blood pressure should be discontinued[5] The effect of caffeine has been suggested and often recommended as a simple and effective method to treat patients with postprandial hypotension because the preprandial pressor effect of caffeine should prevent declines in blood pressure below the baseline value of the patient However, recent studies showed that both coffee and tea did not prevent postprandial hypotension, but did reduce the postprandial fall in systolic BP and could therefore be potentially beneficial in the treatment of postprandial hypotension[11 48] A pharmacological therapy that can be useful for postprandial hypotension, because of systemic vasoconstriction, is 3,4-DL-threo-dihydroxyphensylserine[49] The somastostatin analogue octeotride, can be effective in reducing postprandial hypotension, but is not a very suitable solution[50 51] Treatment with octeotride is expensive, needs frequent subcutaneous injections and is painful because of the low pH of the solution Moreover, diarrhea has been described as a side-effect[51]

Non-pharmacological interventions for postprandial hypotension include informing and educating the patient about the dangers and conditions that provide an increased risk for blood pressure decreases[5] Considerations have to be made on discontinuing unnecessary medication[31], and avoiding

hypotensive (side-) effects of medication in the treatment of postprandial hypotension[5] Other effective measures in the care for patients with postprandial hypotension are to let the patient rest after a meal to reduce the risk for falls, or walking around, although the effect on blood pressure immediately disappears if the patient stops walking[52] Furthermore suggestions are made that changing the size of meals into taking smaller and more frequent meals[53], or adjusting the composition of the meal[10 14 54 56] may reduce the postprandial decrease in blood pressure Splanchnic blood pooling after meal ingestion reduces the systemic vascular resistance[5] and in young patients, a larger meal induced larger decreases in vascular resistance, mean arterial pressure and gave a greater increase in cardiac output than small meals did[57] Carbohydrates in the diet have been demonstrated to be involved in postprandial hypotension[14] Therefore, limiting the amount of carbohydrate might be effective in the treatment of postprandial hypotension

In managing orthostatic hypotension, the first priority is optimizing the circulating blood volume[9] Because of the dysfunction of the autonomic nervous system, the blood pressure regulation is disturbed Maintaining or increasing the central blood volume can be achieved by advising to avoid dehydration, and to discontinue unnecessary diuretics or other hypotensive medication[7 9] Practical manners proved to be effective to increase the central blood volume are liberalizing the salt intake, and elevating the head of the bed (by placing blocks or raising the headrest) during the night, to reduce the nocturnal diuresis and an exacerbation of symptoms in the morning[7 9] Furthermore, sudden head-up changes, especially after waking up should be avoided as well as prolonged bed rest, standing motionless, lifting heavy objects, working with arms above shoulder level, straining during micturation or defecation, and circumstances such as hot environment, hot baths, large meals, alcohol or medication with hypotensive effects[7 9] The use of elastic stockings is disputable because only waist-high, custom-fitted elastic support garments provide graded pressure on the legs and increase the interstitial hydrostatic pressure[9] If the patient takes the upright position with waist-high stockings on, this pressure will tend to keep blood from pooling to the legs Therefore, although theoretically useful,

stockings are not of much use unless they go at least to the waist, which is less acceptable in practice[7] An abdominal binder in association with elastic stockings is even more useful[58]. However, this is also not a very handy measure. Antigravity suits, are expensive and difficult to fit, and not practical in use and therefore not suitable for clinical practice[7] If non-pharmacological interventions are ineffective, and the patient is still symptomatic, drug therapy has to be prescribed to reduce symptoms.

The pharmacological treatment options of orthostatic hypotension include fludrocortisone, a mineralcorticoid that reduces salt and water loss and increases blood volume[59]. Furthermore, sympathomimetics including ephedrine are valuable, especially in central autonomic disorders, where the peripheral sympathetic nerves are relatively unaffected[7] Midodrine, an alpha-1-adrenoreceptor antagonist, is a well-studied drug that has been beneficial in some patients resistant to other drugs or interventions[60-62]

For many non-pharmacological measures to prevent or reduce postprandial and orthostatic hypotension, the cooperation of the patient is essential. Therefore, patient education is very important. The reasons for some measures seem quite obvious, such as avoiding sudden head-up postural changes in orthostatic hypotension, or to avoid large meals in postprandial hypotension. For patients however, it does not have to be so obvious for example to avoid hot baths or a hot environment. Therefore, it is important for the patient to know a reason behind an intervention and to explain for example that the temperature of the water or of the environment causes vasodilatation and therefore can decrease blood pressure. If the patient understands the intervention, this can increase the compliance with the treatment.

Implications for nursing care

Whatever the cause of postprandial and orthostatic hypotension might be, nurses play an important role in the early recognition of hypotensive syndromes in elderly patients All nurses working with elderly patients will come across patients at high risk for postprandial or orthostatic hypotension. These nurses should be able to identify the patients at high risk. They should be alert for signs

and symptoms of hypotension, and be capable to observe of symptoms and circumstances under which the patient is at high risk for hypotension[63,64]. If the patient experiences symptoms, the nurse should explain what is happening, and assisting the patient in understanding the situation. Furthermore, the nurse is important for measuring blood pressure around meals and standing up, to diagnose postprandial or orthostatic hypotension, respectively Blood measurements are easy applicable in all health care facilities Usually, nurses perform these measurements. However, for good measurements and reliable blood pressure values, guidelines on when and how to measure blood pressure for diagnosing postprandial and orthostatic hypotension are necessary.

It is important that nurses know the problems of postprandial and orthostatic hypotension, the high prevalence in the elderly and the severity of the consequences for the patient. If nurses are aware of the importance of these problems and play an active role in performing blood pressure measurements, postprandial and orthostatic hypotension can be diagnosed and treated in an early stage. Nurses should discuss their observations and blood pressure measurements with the physician treating the patient For good care for patients diagnosed with postprandial or orthostatic hypotension, nurses should also have knowledge of the management of these hypotensive syndromes. Because pharmaceutical treatments are limited, non-pharmacological interventions become more important. These could be perfectly carried out by nurses, and should be basic nursing skills Nurses can play an important role in observing the patient, and giving education about postprandial and orthostatic hypotension. Furthermore, prevention and guidance of the patient and teaching how to cope with hypotensive syndromes can be part of the nursing activities in the care for patients with postprandial or orthostatic hypotension. By performing a comprehensive assessment in close collaboration with the physician, including screening for postprandial and orthostatic hypotension, nurses can provide appropriate interventions and improve the quality of life for their geriatric patients.

Research Questions

In this thesis the following research questions are formulated.

1. What is the prevalence of orthostatic and postprandial hypotension in geriatric patients admitted to the hospital?
2. To recognize the symptoms and problems of geriatric patients with postprandial and orthostatic hypotension, nurses need certain skills and knowledge. The following questions are posed:
    a. What is the knowledge of nurses about postprandial and orthostatic hypotension?
    b. What are the skills and knowledge of nurses to measure blood pressure for the diagnosis of orthostatic hypotension in clinical practice compared to recommendations in literature, using the guideline of the American Heart Association for recommendations on general blood pressure determination?[65]
    c. How to measure blood pressure in order to diagnose orthostatic hypotension?
3. The options for evidence-based non-pharmacological treatment of postprandial hypotension are limited. Most interventions are based on empirical data or common sense[5]. We intended to provide evidence for interventions to manage postprandial hypotension with applicability to nurses in clinical practice Suggestions have been made about the influence of the size and composition of the meal, especially about limiting the amount of carbohydrate and about a variability of postprandial hypotension during the day[5]. To study the effect of two potential non-evidence based interventions for the treatment of postprandial hypotension, implying composition of meals and timing of intake manageable by nurses, the following questions are formulated.
    a. What is the effect of reducing the amount of carbohydrates in meals on blood pressure and symptoms in geriatric patients with postprandial hypotension?

b. Is there a variation in time of day and the effect of meals on blood pressure and symptoms in geriatric patients with postprandial hypotension?

4. What are the implications of the results of the study for nursing care for elderly patients with postprandial and/or orthostatic hypotension?

Clinical relevance of the study

Orthostatic hypotension and postprandial hypotension, are common, very serious, but often underestimated and unrecognized conditions in the elderly The aim of this study is to get more insight in the prevalence of both postprandial and orthostatic hypotension in elderly patients and the knowledge of nurses to recognize, diagnose and manage these problems. When we get more insight into the importance and impact of these problems, we have arguments to justify the attention we believe is necessary for postprandial and orthostatic hypotension in the elderly Only a few evidence-based interventions for postprandial hypotension are applicable, and information on standardized observations and measurements for diagnosing hypotensive syndromes and on nursing care for these patients is scarce. Some general reviews on postprandial hypotension describe interventions based on common sense. In this study we intend to provide evidence for these intervention. Nurses can use the outcomes of this study in their daily practice working with elderly patients at risk for hypotensive syndromes.

The overall goal in the management of postprandial and orthostatic hypotension is not to cure patients, but to help patients to prevent periods at risk, and to maintain their independence and level of functioning The characteristic multidisciplinary approach for geriatric patients brings a special expertise to improve the health and wellbeing of patients with chronic conditions, such as orthostatic and postprandial hypotension[66].

Outline of the thesis.

This thesis comprises nine chapters, including this introduction (Chapter 1) Chapter 2 to 7 describe several issues concerning the problems of patients with postprandial or orthostatic hypotension and their implications for the management and nursing care

Chapter 2 gives an overview of the prevalence and combined occurrence of postprandial and / or orthostatic hypotension in patients admitted to the geriatric ward of the hospital.

In chapters 3 to 5 the recognition of the problems postprandial and orthostatic hypotension in elderly patients by nurses and their diagnostic skills and guidelines are presented. In chapter 3 nurses' knowledge of postprandial hypotension and the availability and accessibility of information on postprandial hypotension in nursing literature is compared to the familiarity of nurses with the presumed to be well-known diagnosis orthostatic hypotension Chapter 4 reports the evaluation of skills of nurses on orthostatic blood pressure measurements in elderly patients compared to a preliminary guideline. In chapter 5 recommendations on measuring blood pressure for the detection of orthostatic hypotension are presented

In the next two chapters an effort is made to provide evidence for non-pharmacological interventions in the treatment of postprandial hypotension. Chapter 6 shows the results of a study on the influence of low-, normal-, and high amount of carbohydrates in meals on blood pressure and symptoms in geriatric patients with postprandial hypotension. In chapter 7 the effect of time of day of a meal on the variation of postprandial hypotension during the day is discussed In chapter 8, the results of all studies in this project are discussed in the light of previous studies on postprandial and orthostatic hypotension, and describes the implications for patients with postprandial and/or orthostatic hypotension, for nursing care, clinical practice and future research. The final chapter, chapter 9, gives a summary of the findings of all studies in this dissertation.

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Chapter 2

High prevalence of postprandial- or orthostatic hypotension among geriatric patients admitted to acute care hospitals.

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Submitted

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Abstract

Background A previous study indicated that postprandial hypotension (PPH) and orthostatic hypotension (OH) occur infrequently together Because data about geriatric patients in Dutch acute care hospitals are scarce, we investigated the prevalence of PPH, in comparison with OH and the combined occurrence of PPH and OH

Methods During 9 months, in all patients admitted at two geriatric departments in academic hospitals, hemodynamic changes were measured with Spacelab 90207 after standing up and after a standardized liquid test-meal

Results 85 patients (44 men) aged 60-98, were included PPH was present in 57 subjects (67%) Postprandial mean systolic blood pressure (BP) declined significantly with 34 ± 4 mm Hg OH was present in 44 subjects (52%) with a mean decline in systolic BP of 44 ± 4 mm Hg after standing up Thirty-two patients (37%) had both OH and PPH Only sixteen patients (19%) had neither OH nor PPH Symptoms of PPH were present in 37 patients (65%), with syncope in 5 patients, symptoms of OH in 27 patients (61%)

Conclusions PPH and OH occur together in one-third of the geriatric patients admitted to acute care hospitals PPH is prevalent in two-third and OH in half of these geriatric patients Only one-fifth of these geriatric patients has no hypotensive syndrome Both PPH and OH are symptomatic in over 60% of the patients, with postprandial syncope in 5 patients Because of the high prevalence of symptomatic PPH and OH, BP measurements for diagnosis of PPH and OH should be part of the comprehensive geriatric assessment at admission

Introduction

Postprandial hypotension (PPH) and orthostatic hypotension (OH) are common problems in elderly subjects[1-5]. PPH and OH are both associated with disabling symptoms such as dizziness, instability, falls, loss of consciousness, stroke and mortality and can lead to serious complications for patients and influence the use and costs of healthcare facilities because of hospitalization with fractures or stroke[5-13].

Several studies investigated either the prevalence of PPH or OH in elderly subjects, or in specific categories of patients[2,10,14-18]. After a meal, nearly all elderly subjects experience a decline in systolic BP (SBP), in 24-36% of the patients this decrease is more than 20 mm Hg (PPH)[6 13,14]. The symptoms experienced during postprandial BP declines are not described, only an association between the postprandial decline in BP and falls, syncope and coronary events in the patients history and during follow-up[6,14]. PPH occurs more commonly in specific groups of patients such as in patients with a history of falls or syncope, patients with hypertension, patients with Parkinson's disease, and in patients with heart failure[10,15,17-19]. The prevalence of PPH is variable over the day, with larger declines in SBP after breakfast and lunch, and absence of PPH in more than half of the patients in the evening[20] The prevalence of OH depends on the group of patients studied, and on the timing of measurement because of the large within-day and between-day variability of OH, and ranges from 10% to 30%[1 2,7], is greater in institutionalized populations[3], and increases with age[4]. Furthermore, circumstances at the time of measurement such as activity, smoking, medication or taking a meal can influence the established prevalence of OH[1 21,22]. Elderly subjects with highly variable orthostatic BP measurements have an increased risk of stroke[5,8].

Because the prevalence of both PPH and OH is high, increases with age, and with the number or the type of drugs used[23], we hypothesized that PPH and OH occur even more often in geriatric patients with old age, high level of co-morbidity and use of multiple drugs, than described so far in elderly populations. Nevertheless, detailed information about the prevalence of PPH and presentation of symptoms in a large group of frail geriatric patients, admitted to

acute care hospitals, is very limited. Furthermore, because PPH and OH are both very common in the elderly, it might be expected that these syndromes occur frequently together in the same patient. However, in a small study in nursing home residents, it appeared that PPH occurred more frequently than OH in these subjects, and PPH and OH were infrequently found together in the same patient[24].

The present study was designed to establish the prevalence of PPH and symptoms of hypotension in patients admitted to the geriatric ward of academic acute care hospitals, in comparison with OH and to determine to what extent PPH and OH occur together in the same geriatric patient. Analysis of the prevalence of both PPH and OH and the overlap in their presence in geriatric patients, and the occurrence of invalidating symptoms may possibly identify a population at higher risk and account for approaches to include screenings for OH and PPH in the geriatric assessments.

Methods

Subjects

All patients admitted to the departments of Geriatric Medicine of the University Medical Centers Nijmegen and Utrecht, the Netherlands during a period of 9 months were recruited for participation in the first week of admission. Preset exclusion criteria were. acute diseases, infectious diseases with fever, delirium, insulin dependent diabetes mellitus, fixed pacemaker, problems with oral food ingestion, and severe cognitive impairments such that they could not cooperate with the study protocol. Before participation in this study, all patients gave their informed consent.

Instrumentation and procedure

BP measurements were performed with an ambulatory automatic BP device (Spacelab 90207, Spacelabs Medical Inc, Redmond, WA, U S A)[15]. All tests took place in the morning in a quiet room at an ambient room temperature of 21-24°C. For all measurements, the participants had an overnight fast and refrained from medication from midnight the night before Before the start of the

test, the subjects voided, were familiarized with the study protocol, and the BP equipment was applied to the upper arm BP was measured at the arm with the highest BP, in case there was no difference between arms, the non-dominant arm was used To diagnose OH, baseline supine BP was measured in the morning after at least five minutes of supine rest BP measurements in standing position were performed exactly one and three minutes after the patients had taken the upright position OH was defined as a decline in SBP ≥ 20 mm Hg within 3 minutes after standing up[25] Because OH is highly variable over time, the BP measurements were repeated the next morning[14]

Subsequently, patients were seated for 20 minutes of rest, ingested a standardized liquid test-meal consisting of a mixture of 100 ml of liquid glucose-syrup (Nutrical®, Nutricia, Zoetermeer, the Netherlands) and 100 ml lactose-free whole milk, containing a total amount of 65 g carbohydrate, 2 g fat, and 4 g protein within 10 minutes, and rested for 90 minutes after the start of the meal, all in the sitting position to simulate a common eating situation as best as possible To avoid potential influence of temperature on BP, the test-meals were served at room temperature[16] Movements were limited as far as possible during the test During the meal-test SBP, Diastolic BP (DBP) and Heart Rate (HR) were measured every 10 minutes, from 20 minutes before until 90 minutes after the start of the meal PPH was defined as a meal-induced decline in SBP ≥ 20 mm Hg within 90 minutes after eating[13] Symptoms after standing up an after meal ingestion and changes in the patients' baseline condition in relation to BP changes were observed by the researcher continuously, unaware of the hemodynamic changes during the measurement, because the display of the BP device was covered Furthermore, the patient was asked for symptoms every 15 minutes, or when the researcher noticed changes Symptoms were classified and coded in a four-point scale of severity, score 0 stands for absence of symptoms, score 1 for mild, score 2 for moderate and score 3 for severe

Statistical analysis

Statistical analysis was performed with SPSS for Windows 10.0 (SPSS Inc., 2000, Chicago USA). A p-value < .05 was taken as the level of significance The results are expressed as mean ± standard error of the mean (SEM).

Subject characteristics were compared by means of one-way analysis of variance (ANOVA). Baseline values for BP and HR, for OH were defined as the BP measurement just before standing up after 5 minutes of supine rest, and for PPH as the BP value just before the start of the meal ingestion after 20 minutes of rest respectively. Every decline in SBP ≥ 20 mm Hg after mealingestion or after standing up compared to baseline BP was defined as PPH or OH, respectively. Two-way repeated measures ANOVA was applied to examine the effect of time on the orthostatic and postprandial changes in BP versus baseline. The correlation between BP responses and patient characteristics were determined by Pearson's correlation test, and for dichotomous variables with the Chi-square test In addition, paired t-tests were used to examine the similarity of the individual maximum variable changes during the two orthostatic tests, and unpaired t-tests to compare the means of selected variables in the subgroups with or without OH and PPH The Fisher's exact test was used to calculate the relative risk for patients with certain characteristics such as heart failure and the occurrence of OH or PPH. The relations between patient characteristics, such as age, gender, BP-outcomes, diseases, medication, GDS, MMSE, ADL, mobility, falls, syncope, and postprandial changes in BP were calculated using multiple regression analysis.

Results

Subjects

During the study period, hundred-nine patients were admitted to the geriatric wards. Eighty-five patients, aged 60-98, were included in this study (44 male / 41 female) Twenty-four patients were excluded because of problems with oral intake (n=7); insulin dependent diabetes mellitus (n=2), refusal to participate (n=3), delirium (n=3), infectious diseases with high fever (n=5), and four persons were terminally ill. The characteristics of the 85 patients who finished

the protocol are shown in Table 1, their medical history and medication use are presented in Table 2. There were no significant initial differences in DBP, HR, Mini Mental State Exam (MMSE) (21 ± 1), Activities of Daily Living (ADL) (Barthel, 13 ± 1), or Geriatric Depression Scale (10 ± 1) or residence between the subgroups of patients with or without PPH or OH, or both.

Table 1. *Patient characteristics (mean ± SEM)*

	Total group	With PPH	Without PPH	With OH	Without OH
	n = 85	*n* = 57	*n* = 28	*n* = 44	*n* = 41
Age (years)	80 ± 1	81 ± 1	79 ± 1	79 ± 1	82 ± 1
Gender (M/F)	44 / 41	28 / 29	16 / 12	23 / 21	21 / 20
Height (meters)	1 66 ± 0 01	1 66 ± 0 01	1 68 ± 0.02	1 66 ± 0 01	1 66 ± 0 01
Weight (kg)	68 8 ± 1.4	67 6 ± 1 7	71 5 ± 2 6	70 0 ± 1 0	67.2 ± 2 2
Body Mass Index (kg/meters^2)	24 5 ± 0 4	24 3 ± 0 5	24 9 ± 0 8	25 1 ± 0 5	24 0 ± 0 7
SBP (mm Hg)	147 ± 3	155 ± 3	132 ± 4	150 ± 5	145 ± 4
DBP (mm Hg)	82 ± 2	84 ± 2	78 ± 3	82 ± 2	83 ± 3
Heart Rate (bpm)	76 ± 2	75 ± 2	77 ± 3	75 ± 2	77 ± 3
Number of diseases	4 ± 0	5 ± 0	4 ± 0	5 ± 0	4 ± 0
Number of medications	6 ± 0	6 ± 0	7 ± 1	6 ± 0	7 ± 1

SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure

Prevalence of PPH in geriatric patients

PPH was present in 57 subjects (67%) In the PPH group, the mean maximal individual SBP decline was -34 ± 4 mm Hg occurring at variables times between 20 and 80 minutes after the meal Mean maximal DBP decrease versus baseline was -15 ± 1 mm Hg at 50 minutes after the meal (P<.001). The maximum individual increase in HR was 12 ± 2 bpm, occurring between 20 to 70 minutes after the meal, whereas mean maximal HR rose 4 ± 2 bpm at 70 minutes (p<.050). Figure 1 shows the group-averaged postprandial hemodynamic changes in geriatric patients with and without PPH The only

Table 2. *Summary of the medical history in number of patients (and percentages)*

	Total group *n* = 85	With PPH *n* = 57	Without PPH *n* = 28	With OH *n* = 44	Without OH *n* = 41
Cardiovascular disorders	49 (58)	35 (61)	14 (50)	27 (61)	22 (54)
- Hypertension	25 (29)	19 (33)	6 (21)	12 (27)	13 (32)
- Heart failure	15 (18)	10 (18)	5 (18)	7 (16)	8 (20)
- Atrial fibrillation	10 (12)	10 (18)	0 (0)	6 (14)	4 (10)
- Ischemic heart diseases	20 (24)	12 (21)	8 (29)	12 (27)	8 (20)
Respiratory disorders	17 (20)	12 (21)	5 (18)	7 (16)	10 (24)
Neurological disorders	41 (48)	24 (42)	17 (61)	25 (57)	16 (39)
Cerebrovascular accidents	21 (25)	12 (21)	9 (32)	12 (27)	9 (22)
Gastrointestinal disorders	43 (51)	27 (47)	16 (57)	24 (55)	19 (46)
Memory disturbances/ dementia	13 (15)	8 (14)	5 (18)	8 (18)	5 (12)
Pscychiatric disorders	37 (44)	27 (47)	10 (36)	21 (48)	16 (39)
Mobility problems	54 (63)	36 (63)	18 (64)	28 (64)	26 (63)
Syncope in history	4 (5)	2 (4)	2 (7)	2 (5)	2 (5)
Cardiovascular medication	44 (52)	31 (54)	13 (46)	25 (57)	19 (46)
- ACE-inhibitors	13 (15)	11 (19)	2 (7)	6 (14)	7 (17)
- Beta-blockers	15 (18)	12 (21)	3 (11)	8 (18)	7 (17)
- Diuretics	22 (26)	15 (26)	7 (25)	14 (32)	8 (20)
Corticosteroids	13 (15)	8 (14)	5 (18)	3 (7)	10 (24)
Levodopa / benseraside	11 (13)	8 (14)	3 (11)	8 (19)	3 (7)
Psychiatric medication	45 (53)	32 (56)	13 (46)	24 (55)	21 (51)
- Sedatives	35 (41)	26 (46)	9 (32)	18 (41)	17 (41)
- Hypnotics	16 (19)	9 (16)	7 (25)	9 (20)	7 (17)
- SSRI	12 (14)	8 (14)	4 (14)	8 (18)	4 (10)
- Tricyclic antidepressants	7 (8)	4 (7)	3 (11)	4 (9)	3 (7)
- Anxiolytics	12 (14)	8 (14)	4 (14)	4 (9)	8 (20)
- Antipsychotics	13 (15)	9 (16)	4 (14)	9 (20)	4 (10)
Analgesics	37 (44)	23 (40)	14 (50)	16 (36)	21 (51)
- Nonopioid drugs	34 (40)	22 (39)	12 (43)	15 (34)	19 (46)
- Opioid drugs	6 (7)	4 (7)	2 (7)	12 (27)	4 (10)
- NSAID	7 (8)	5 (9)	2 (7)	0 (0)	7 (17)

SSRI= Selective Serotonin Reuptake Inhibitor, NSAID = Non-Steroidal Anti-inflammatory Drugs

difference in patient characteristics in the groups with or without PPH was a significantly higher baseline SBP, 155 mm Hg versus 132 mm Hg, respectively (p< 000) The presence of PPH was also significantly correlated with maximal individual declines in DBP (*r*= - 470, p< 000), and all patients with atrial fibrillation turned out to have PPH In multiple regression analysis, baseline SBP and maximal individual declines in DBP were the only factors significantly related to large postprandial declines in SBP (p< 000) Between the patient groups with and without PPH, there were no other significant differences in patient variables, such as baseline DBP and HR, age, ADL, MMSE, GDS, falls, syncope or stroke in medical history

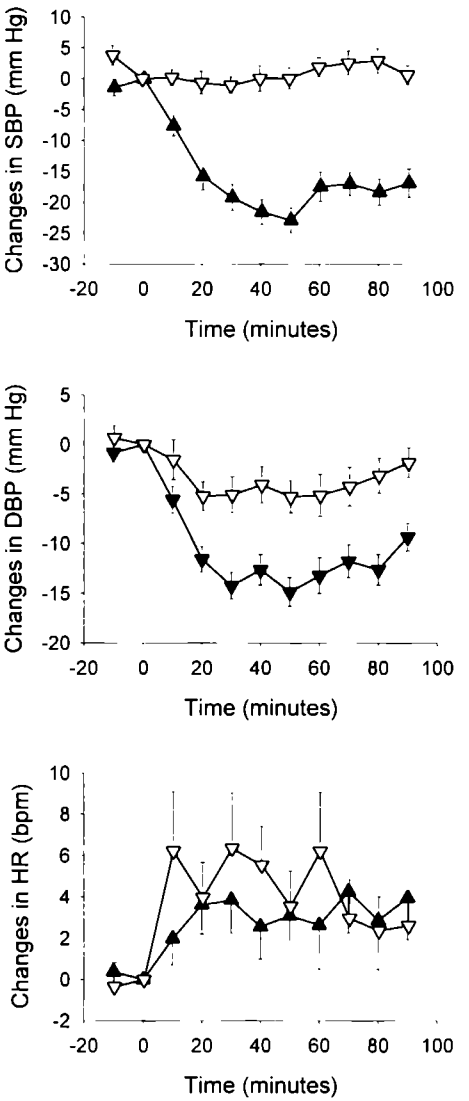
Prevalence of OH in geriatric patients

Fifty-two percent (n=44) of the geriatric patients showed OH on at least one measurement (95% CI 51%-53%), 37 patients had a decline in SBP ≥ 20 mm Hg after standing up at the first test, 33 at the second test Seventeen patients had OH in one measurement, and 27 patients on both measurements Because of the variability of OH during and between days, multiple BP measurements have to be taken in order not to miss the diagnosis of OH[1]

In all 85 geriatric patients, mean BP decreased at the first test from 153/82 mm Hg to 137/80 mm Hg after both 1 and 3 minutes of standing, and from 154/84 mm Hg to 140/80 mm Hg after both 1 and 3 minutes of standing at the second test In patients diagnosed with OH (n=37, 44%) BP decreased from 161/84 mm Hg to 131/77 mm Hg after both 1 and 3 minutes of standing at the first test HR increased from 78 bpm to 80 bpm and 83 bpm after 1 and 3 minutes of standing, respectively The mean maximum decrease in SBP in the OH-group was 36 ± 4 mm Hg In 7 patients, OH was established only after 1 minute of standing Twenty-three patients had OH at both 1 and 3 minutes after standing up In seven patients OH was determined only after 3 minutes of standing

At the second measurement, in the patients with OH (n=33, 39%) BP declined from 162/86 mm Hg to 132/77 mm Hg and 134/77 after 1 and 3 minutes of standing, respectively The mean maximum decrease in SBP was 33 ± 4 mm Hg

Fig 1. *Changes in Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart Rate (HR) after a meal in elderly subjects with PPH (black triangles, ▲) or without PPH white triangles ▽). Values are expressed as mean ± SEM.*



HR increased from 71 bpm to 84 bpm after 1 minute standing, and to 74 bpm after 3 minutes standing. In 6 patients OH was determined only after 1 minute of standing, in 4 patients just after 3 minutes of standing and in 23 patients at both time points. The maximum SBP decrease after standing up at 1 and 3 minutes was significantly correlated with the number of prescriptions (p= 027), and with baseline SBP (p=.006). Because OH was variably present after either 1 or 3 minutes of standing, multiple BP measurements have to be taken after changing position. With taking only one BP measurement, the diagnosis of OH can be overlooked[1].

Combined occurrence of PPH and OH in geriatric patients

The combined occurrence of PPH and OH is shown in Table 3 Thirty-eight percent (n=32) of the geriatric patients were diagnosed with both OH and PPH. In only 16 patients (19%), neither OH nor PPH were present. Baseline SBP in the patients without PPH and OH (SBP = 135 ± 5 mm Hg), and in patients with OH (SBP = 128 ± 7 mm Hg) was significantly lower compared to patients with PPH (SBP = 151 ± 5 mm Hg) or in patients with both PPH and OH (SBP = 158 ± 5 mm Hg)(p< 05). The other outcome measures were not significantly different between the four groups.

Table 3. *Combined occurrence of PPH and OH in percentages (and numbers of patients)*

	PPH present	PPH absent	Total
OH present	38 (*n* = 32)	14 (*n* = 12)	52 (*n* = 44)
OH first test	31 (*n* = 26)	13 (*n* = 11)	44 (*n* = 37)
OH second test	29 (*n* = 25)	9 (*n* = 8)	39 (*n* = 33)
OH both tests	21 (*n* = 18)	11 (*n* = 9)	32 (*n* = 27)
OH absent	29 (*n* = 25)	19 (*n* = 16)	48 (*n* = 41)
Total	67 (*n* = 57)	33 (*n* = 28)	100 (*n* = 85)

Presentation of symptoms of hypotensive syndromes

The presence of symptoms in patients with PPH and OH are shown in Table 4 Of the 57 patients with PPH, 65% (n=37) showed mild to severe symptoms, all concurrent with postprandial declines in SBP of 20 mm Hg or more Five patients (14%, 4 male) had a postprandial syncope. In these five patients postprandial SBP decreased by -44 ± 10 mm Hg. This meal-related decline in SBP in the syncope group was significantly larger compared to the decline of 24 ± 2 mm Hg in other patients (p< 010) The fainted patients, who had no history of syncope, were lied down and a physical examination was performed All patients with postprandial syncope regained consciousness within 10 minutes, when BP regained to normal. Four of these syncope patients had a history of hypertension defined as a SBP > 140 mm Hg, and had SBP >140 mm Hg at baseline[26] However, the baseline SBP in the syncope patients was not significantly higher than in the total group (p=.175) Three of the patients with syncope also had OH. All syncope patients had > 3 diseases and used more than two medications. Three patients used diuretics[19]. Four of the patients used medication with cardiovascular effects[16]. There were no other common characteristics in medication or diseases for these five patients with postprandial syncope, or significant differences with the total group.

Of the 44 patients with OH, 27 patients (61%) showed symptoms simultaneous with declines in SBP after standing up; 17 patients (39%) did not have symptoms in the first 3 minutes after standing up All symptomatic patients but one, who was unstable, complained about dizziness. Tendency to fall, and instability were also common complaints, whereas syncope and looking pale were not present in this study.

Table 4. *Presentation of symptoms in percentages*

Symptom	PPH (n = 57)	OH (n = 44)
A-symptomatic	35	39
Symptomatic	65	61
Dizziness	0	96
Tendency to fall	0	15
Instability	0	11
Vision changes	11	7
Loss of strength	0	7
Tendency to faint	0	7
Speech disturbances	19	4
Nausea	38	4
Syncope	14	0
Sleepiness	78	0
Very tired	35	0
Yawning	24	0
Headache	19	0
Looking pale	16	0
Restlessness	14	0
Loss of concentration	5	0
Chest pain	3	0

Discussion

The main findings of the present study are threefold. First, the prevalence of postprandial and orthostatic hypotension in frail geriatric patients is high, much higher than previously described in other groups of elderly[1 2 7 10 14,27]. Eighty-one percent of the geriatric patients admitted to a geriatric department of acute care hospitals had either PPH or OH. Two-third of these elderly had PPH and more than half of the patients had OH. Only one-fifth of the geriatric patients had no hypotensive syndrome. Second, in contrast to earlier findings, we demonstrated that PPH and OH occur frequently together in the same geriatric patient in more than one-third of the cases[24]. Finally, we found that PPH was symptomatic in two-third of the geriatric patients, with postprandial syncope as the most serious disorder in 5 patients and sleepiness as the most common complaint.

Symptoms of OH were present in 60% of the patients, with dizziness in all but one patient

Previous studies demonstrated that old age, co-morbidity, polypharmacy, age-related alterations in BP regulation and certain diseases such as systolic hypertension, autonomic failure and heart failure, can increase the risk for developing hypotensive syndromes such OH and PPH[4 11 13 18 19 25 28 29] In this study no specific disease or medication, except for high baseline SBP gave significant outcomes to be indicative for developing PPH or OH This can be explained by the relatively small number of patients in the subgroups, and the characteristics such as high co-morbidity and use of medication in all geriatric participants

The second important finding of this study was, in contrast to previous studies, that PPH and OH occur frequently together in over one-third of the geriatric patients[10 24] Jansen et al found OH and PPH together in only 2 of 22 nursing home residents (9%), and a prevalence of 3 patients with OH (14%) and 10 with PPH (45%)[24] Puiseux et al found a slightly higher frequency of OH in elderly patients with PPH compared to patients without PPH[10] Masuo et al found in hypertensive patients of middle age, that patients with OH were more at risk to develop PPH[10 30 31] In our patients we observed a slight but not significantly higher prevalence of OH in patients with PPH (56%, p= 3558), than in patients without PPH (43%)

It has been suggested that the effect of OH and PPH can be cumulative[13] There could be an orthostatic effect on postprandial BP due to prolonged sitting after a meal, or standing up after a meal could provoke hypotension In patients with autonomic disorders it has been suspected that PPH and OH had similar mechanisms[31] However, we concluded that OH and PPH occur frequently but not necessarily together in geriatric patients[10 30 31] In our total population, 52% of the patients had OH, so the presence of OH in slightly more than half of the patients with PPH, could also be expected by a distribution of probability, and argues for independent underlying mechanisms for OH and PPH Our results are in agreement with other authors suggesting that the underlying mechanisms are at least partly different[10 24] The high frequency of the simultaneous

occurrence of OH and PPH in 37% of the geriatric patients could be explained by the large analogy of causes and circumstances influencing OH and PPH such as autonomic failure, hypertension, age, (cardiovascular) medication, and co-morbidity[13 24 30-32].

The third finding was that both PPH and OH were often symptomatic in the geriatric patient. Although the symptoms of PPH and OH are diverse and nonspecific, all symptoms presented by the patients in our study were associated with PPH or OH according to the literature, and were concurrent with decreases in BP[13,32] The number of geriatric patients with symptomatic OH was unexpectedly high[3,29], with dizziness, instability and tendency to fall as most pronounced symptoms. In PPH, other and more severe symptoms, such as sleepiness, nausea, headache, chest-pain and syncope were present (Table 4). Remarkably, the presentation of symptoms of OH was distinct of the symptoms in PPH. Dizziness was absent in PPH, whereas this was the most important symptom in OH. Tiredness, which was the most common symptom in PPH is absent in OH The cerebral symptoms of PPH and OH probably depend on the extent to which cerebral perfusion is compromised, leading to postprandial syncope in five cases[13 33]. However, the large differences in presentation of symptoms between OH and PPH could not be explained by the BP declines alone, although the postprandial drop in SBP was significantly larger in the patients who showed syncope compared to the other patients Probably the duration of the BP decline in PPH, and the duration of the test also play a role in the more severe and different presentation and experience of symptoms in geriatric patients. The variance in symptoms of PPH and OH suggest that these phenomena have different patho-physiological backgrounds, and a distinct presentation[13,24]. These striking differences can be important in the patient's history in diagnosing OH or PPH.

Surprisingly, in the recently published clinical guidelines on syncope, PPH is only mentioned as a possible cause or circumstance in syncope, as part of OH[34,35] Although several authors indicated the association of PPH, falls and syncope, no advice on BP measurement around meals to diagnose PPH or on treatment to prevent hypotension is given in the guidelines[6,10,34,35] Because of

the high prevalence of symptomatic PPH and OH in geriatric patients and the seriousness of consequences, it is of clinical importance to follow people's BP after meals or standing up to diagnose PPH and OH, in all geriatric patients, especially in case of symptoms like dizziness, falls and syncope

We performed all BP measurements to diagnose OH and PPH in the morning OH is highly variable during the day and within days, but most prevalent in the morning after an overnight rest, before breakfast and use of medication[1 2 7 10 14 27] Recently, we found also a variability of PPH during the day, with frequent absence of PPH in the evening even in patients with PPH after breakfast and lunch[20] Furthermore, previous intake of food, or medication, or activity can influence the BP outcomes[1 21 22] Because of the high prevalence of OH in the morning, and the fact that postprandial BP responses have shown to be reproducible in the morning, we recommend performing BP measurements for diagnosing both OH and PPH in the morning, before taking a meal or medication[1 2 7 10 14 20 24 27] Because of the high within day variability of OH, OH can be missed taking only one BP measurement, therefore the measurements were repeated the next morning[1 2 7 10 14 27]

This study has a few limitations First, our study group was, as can be expected in geriatric patients, very heterogeneous Because of the diversity of the characteristics of the patients, the numbers of patients in the subgroups were too small to demonstrate significant relations between patient characteristics and the presence of PPH or OH Second, we measured PPH in the sitting position Although orthostatic changes in BP during prolonged sitting might contribute to the postprandial decreases in BP, we found it more comparable to the usual eating posture, to give patients their meal in a sitting position Third, some of the symptoms of PPH were very general (e g tiredness could also be due to the duration of the test), but all symptoms were related to declines in SBP

In conclusion, we identified geriatric patients as an important group of risk for serious and symptomatic PPH and OH In contrast to previous findings, we found that PPH and OH occur frequently together, but not more than by chance, in one-third of the patients admitted to geriatric ward of acute care hospitals,

that PPH and OH are both highly prevalent, and often symptomatic These findings emphasize the importance of early screenings for OH and PPH in frail geriatric patients at risk, to reduce serious complications due to hypotensive syndromes.

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Chapter 3

Unfamiliarity of nurses with postprandial hypotension

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Submitted

Abstract

Postprandial hypotension (PPH) or meal-induced decline in blood pressure (BP), and orthostatic hypotension (OH) are common abnormalities of BP-regulation in the elderly. Nurses are important for diagnosing these disorders.

To determine the accessibility of information on PPH, nursing literature was reviewed. By inquiries the actual knowledge of nurses at geriatric wards (n=126) about PPH was studied. We compared the available information on PPH with OH.

PPH was hardly traceable in nursing literature; OH was regularly described. PPH was unknown to 63% of the nurses, OH to 6% These knowledge deficits create a risk for good care for patients with PPH.

Introduction

Age- and disease-related changes in blood pressure (BP) regulation in elderly people increase the risk of hypotensive responses to daily activities such as standing up or eating a meal (postprandial hypotension (PPH))[1] PPH, as well as orthostatic hypotension (OH), are common disorders of BP regulation in older persons, especially in frail geriatric patients Both PPH and OH are associated with serious complications such as falls, syncope, coronary events and stroke[1-6]

OH has been known for decades, but PPH was first recognized as a clinical problem in 1977 in a patient with Parkinson's disease[7] Since then the hypotensive effect of meals has been appreciated and PPH has become recognized as a quite common disorder of BP regulation in the elderly[2]. The current knowledge on PPH has been well described in a review published in 1995 by Jansen et al[5]. This article reviewed every study on PPH in the elderly until 1994 on methodological criteria, limitations and outcomes for clinical practice and provides a complete overview of the actual available knowledge of PPH[5]. Research of more recent date on PPH has updated prevalence and added evidence about the influence of certain medication and treatment[4 6 8-13]

The prevalence of PPH in elderly > 65 years of age in small groups of patients ranges from 40% to more than 80%, increases with age, and is more prevalent in patients with certain diseases, such as autonomic dysfunction, Parkinson's disease, heart failure or hypertension[3,9 12,14]. In comparison, the occurrence of OH in elderly, aged 65 years or older has been reported to range from 5% to 30%[15-17]. In hospital- and institutionalized populations, the prevalence of both PPH and OH in elderly subjects is higher than in the community because of the higher frequency of co-morbid conditions and diseases and the increased number of medications, which all may have important effects on BP regulation[18,19]. In yet unpublished data, we recently found a prevalence of 67% PPH and 52% OH, in 85 consecutive frail geriatric patients admitted to the hospital over a 9-month period.

Since PPH and OH are common problems in elderly patients, associated with serious morbidity and complications, diagnosing these hypotensive syndromes

at an early stage is important to initiate interventions and prevent associated problems such as falls[1 10]

The diagnosis of PPH can easily be made from the patients' history e g in case of dizziness, falls or syncope, asking for a possible relation of symptoms with food, by observing the patient and by performing BP measurements before and after meals In all health-care-facilities and in the community, nurses working with elderly people are the most appropriate group to screen for the occurrence of PPH in daily practice Because of their intensive contact with the elderly patient they should be able to recognize the symptoms and problems of PPH and OH However, data on the actual knowledge on PPH in the elderly among nurses are not available It is also unknown which information on PPH is provided in nurses' professional education or in the nursing literature Therefore, we aimed at studying the availability and accessibility of information on PPH in the nursing literature and the familiarity of Dutch nurses working at a department of Geriatric Medicine with PPH in elderly patients and to compare it with the existing knowledge of nurses of the supposed to be well-known diagnosis OH

Methods

Subjects and design

In the medical literature, PPH is generally defined as a decrease in systolic BP ≥ 20 mm Hg within 75 minutes of the start of a meal[5] OH is usually defined as a decline ≥ 20 mm Hg in the systolic BP or ≥ 10 mm Hg in the diastolic BP within 3 minutes after changing from a supine to an upright position[20]

To investigate which information on PPH was available for nurses in professional nursing literature, we searched for nursing journals and handbooks, interdisciplinary classifications used by nurses and for articles published by a nurse with regard to nursing diagnosis or interventions concerning PPH in Medline, CINAHL, and OCLC PICA (PiCarta, an European online Library Co-operative and shared cataloguing system to help libraries and individuals by providing access to knowledge through collaboration) In addition, we compared this information with the knowledge available for nurses on OH A

recently published review on OH provides a complete overview of the state of the art on OH[16] For the state of the art on PPH we used a review published by Jansen et al in a medical journal[5]

We used the following MeSH keywords to search for publications in the years 1980-2000 hypotension, postprandial, orthostatic, nursing and nurse Other related keywords or subheadings combined with nursing, nursing care or nursing diagnosis such as food, blood pressure, low blood pressure, blood pressure determination, blood pressure monitoring, intervention, treatment, management, elderly, aged, protocols and guidelines gave no relevant records All original research and reviews were included Criteria for selection were that the first author was a nurse or that the article was published in a nursing journal The actual knowledge of PPH and OH was investigated in nurses working at 17 departments of Geriatric Medicine in hospitals, throughout the Netherlands (Table 1) The head-nurse of each of these 17 wards was asked to give permission for participation, and to randomly select a representative sample of nurses conceivable to the formation and workload of the department On every participating ward a contact person was asked to monitor the response of the survey A total of one-hundred-and-fifty nurses were selected for the study

By means of a questionnaire the knowledge of the definition, diagnosis, circumstances, consequences and treatment of PPH and OH, clinical practice, and task perceptions about the role of nurses in the care of elderly people with PPH and OH were explored This combined qualitative and quantitative method was used to gain better insight into the acquaintance of nurses with PPH in comparison with OH and their role in diagnosis and treatment[21]

The questionnaire

In the construction of the questionnaire, a decision had to be made about the way of data-collection[22] We used a written questionnaire, because a large group of nurses participated in this study The diagnostic reasoning pattern according to Gordon, using Problem-, Etiology- and Signs and Symptoms was used to formulate the questions[23] As a result of this process, a questionnaire with 32 open ended, semi-structured questions (16 questions about PPH, and

16 about OH) together with information about the age, sex, level of education and working experience of the nurses, was used to explore the nurses' knowledge of the diagnosis and treatment of PPH and OH in elderly patients The open-ended questions gave respondents the opportunity to reply to questions in their own words Some examples of the questions are 'According to you what is the definition of PPH?' 'Describe all symptoms of PPH you know ' or 'Name all interventions to treat PPH you know ' The questionnaire was discussed and pre-tested on clarity, unambiguousness, completeness, ability to respondents to reply and to give information, bias, readability, content, the handling of sensitive information and question relevance by four experts in geriatric nursing and hypotensive syndromes The finalized version of the questionnaire was mailed with a cover letter explaining the procedure and the aim of the survey One month after the first mailing, the contact persons of each ward were asked to mail a second questionnaire to the non-respondents

Analysis

Through literature review an overview of the information on PPH and OH in the nursing literature was made The first author screened the literature for articles and handbooks Studies were selected based on the content of the abstract, a nurse as first author or publication in a nursing magazine The answers of the nurses in the inquiries were compared to the state of the art on PPH and OH in the current literature The first author identified, clustered and coded the answers Codes were compared with the original text in the questionnaire Data were analyzed with SPSS for Windows 10 0 (SPSS Inc , 2000, Chicago, USA) using descriptive statistics

Results

PPH and OH in nursing literature

In our literature search the major subheading 'PPH' resulted in 216 records, and 'OH' gave 5350 records In an advanced search 'PPH' combined with 'nursing' the number of articles reduced to 25 of which 24 were about PPH in patients in 'nursing homes' and not about 'nursing' but describing a category of patients Furthermore, these articles were not written by a nurse or published in a nursing magazine That leaves one article about 'PPH and nursing'[24] For OH, 51 records remained after a combination with 'nursing' Because OH is expected to be well known by nurses and not the primary focus of our research these articles are not described in detail The information on PPH and OH that we found in nursing articles and manuals is generally correct but neither extensive nor complete in comparison to the state of the art in medical reviews on PPH or OH[5 16] The 51 nursing records on OH together provide a complete overview of the current knowledge on OH[16] The correct data on etiology, symptoms and treatment of PPH and OH are marked in Table 2-4

Carpenito is the only author of a nursing manual who mentions PPH in her nursing diagnosis[25] She categorizes PPH in the nursing diagnosis as part of postural hypotension[25] She also describes interventions to reduce PPH, such as taking small, frequent meals, or remain seated or lie down after meals We found one research article about PPH in elderly patients written by a nurse in a gerontological nursing journal[24] Lilley underscored the strategic position of nurses to educate elderly about the risks of PPH and applying and evaluating interventions[24] Her article also gives insight in the prevalence, pathophysiology, symptoms and treatment of elderly with PPH[24] Apart from those two, PPH has not been described in nursing literature, neither as a diagnosis, nor as an etiologic factor or in interventions to our knowledge Campbell defines hypotension (but not the type induced by food) and postural hypotension as a nursing diagnosis[26] Carpenito uses 'high risk for injury related to vertigo secondary to orthostatic hypotension' to describe nursing diagnosis related to OH[25] Gordon does not define hypotension as a diagnosis or an etiologic factor[27] Gordon's diagnosis 'risk for injury' and 'potential for activity intolerance'

could be related to PPH and OH according to the authors of this article The North American Nursing Diagnosis Association (NANDA) describes OH in their approved diagnosis 'Altered tissue perfusion, cerebral' The NANDA diagnosis 'potential for injury' could also be related to PPH or OH[28] In the International Classification of Functioning, Disability and Health (ICF), hypotension is described under body functions Code b4201 decreased blood pressure, could be related to PPH or OH[29] In the International Classification of diseases, the 10th revision (ICD-10) hypotension is classified under unspecified disorders of the circulatory system (code 195)[30] OH is coded separately (195 1) PPH is not described but could be placed under 'hypotension unspecified' (195 6)[30] If OH is described in geriatric or gerontological nursing literature, it is often related to symptoms such as dizziness and fatigue or as a side effect of medication[31 33] Maas et al classify hypotension as a characteristic in fluid volume deficit and as a potential for injury related to OH[34] Although PPH is not mentioned in the Nursing Interventions Classifications[35], interventions for both PPH and OH can be classified in the field of fall prevention and safety measures, in domain safety, related to the class of risk identification

Familiarity of nurses with PPH and OH

One-hundred-and-twenty-six nurses (84%) of the 150 invited nurses completed the questionnaire (Table 1) The results will be presented for the 126 nurses who completed the forms Seventy-three percent (n=110 nurses) responded immediately, 16 nurses after a reminder Fifty-six nurses (44%) completed a continuing-education-course on care for elderly or geriatric patients PPH is a subject of education on one continuing professional geriatric nursing course in the Netherlands No significant differences in the answers were found between nurses with or without continuing education courses, neither between nurses with little (0-1 year) and extensive experience (>5 years) with elderly patients

The definition

PPH is known to 46 (37%) of the nurses as a decrease in BP after a meal Two respondents specifically mentioned a decline in systolic BP of > 20 mm Hg after

a meal, and the period of time after a meal in which the BP decline can be present, for diagnosing PPH. OH is known to 118 nurses (94%), as a decline in BP after standing up from a lying position. Four respondents made no difference in definition between OH and hypotension due to other causes such as voiding, defecation or eating a meal (PPH).

Table 1. *Characteristics of participating nurses in different hospital settings (n=17)*

		Nurses working at the departments of		
	Total group	Academic teaching hospitals	Non-academic teaching hospitals	Non-academic non-teaching hospitals
Number of departments	*n* = 17	*n* = 2	*n* = 5	*n* = 10
Number of nurses	126	21	33	72
Age (yrs)				
Mean ± SD	35 4 ± 8 5	37 8 ± 7.5	36.8 ± 9.1	34 7 ± 8 6
Range	20 - 56	23 - 50	23 – 56	20 – 52
Experience (yrs)				
Mean ± SD	13 2 ± 8 6	14.6 ± 7 0	14.7 ± 9 0	12 9 ± 8 7
Range	0 - 35	3 - 28	0 - 35	0 - 30
Experience with elderly (yrs)				
Mean ± SD	6.4 ± 5.7	6 1 ± 2 9	6 6 ± 5 5	6 5 ± 6 6
Range	0 - 28	0 5 – 12 5	0 - 21	0 - 28

The diagnosis PPH and / or OH

Thirty-seven nurses (29%) knew that BP measurements before and after a meal were necessary to diagnose PPH. Under which circumstances, and when BP measurements had to be taken was known to 4%. Four nurses mentioned observation of the patient, without specifying symptoms or complementary BP measurements, as diagnostic instrument for PPH.

Eighty percent of the nurses describe their activities in diagnosing PPH as observing the patient, documenting symptoms and performing BP measurements, all after a physician's assignment. Sixteen percent of the nurses found they had no interference with the care for patients with PPH.

The fact that the BP has to be measured in lying and in standing position to diagnose OH, was known by 92% (n=116) of the nurses. To their opinion, the decline in systolic BP after standing up to diagnose OH varied from 15 to 40 mm Hg. According to the definition of OH, the BP decrease had to be > 20 mm Hg after standing up[20]. Four nurses had no idea how to diagnose OH. Two nurses believed that examination of a urine sample and an electro-cardiogram was needed to diagnose OH. Twenty nurses (16%) specified time points for measuring the upright BP, varying from measuring BP immediately after standing up, after a while, till after five minutes of standing.

Nurses perceived their task in the diagnostic process of OH as varying from observing the patient and an assisting role in performing BP measurements only after assignment of a physician to an independent autonomous role to make observations and measure BP and give treatment and instructions to patients and their relatives about how to cope with OH.

Table 2. *Etiologic factors described in the literature[5,16] known to nurses (n = 126) to influence postprandial hypotension (PPH)* or orthostatic hypotension (OH)#*

Etiologic factor	PPH	OH
(Side-) effects of medication * #	5%	46%
Rising too quickly #	-	34%
Prolonged rest #	-	15%
Dehydration * #	1%	13%
Cardiovascular disorders * #	1%	23%
Neurological disorders * #	1%	7%
Inadequate fluid- and food intake * #	-	7%
Age * #	-	6%
High temperature #	-	2%
Large meals *	11%	-
Eating fast *	3%	-
Gastrointestinal problems *	1%	-
Body position during meals *	1%	-
Walking exercise after a meal *	4%	-

Knowledge of etiologic factors of PPH and/or OH

Thirty nurses (24%) mentioned etiologic factors influencing the occurrence of PPH (Table 2). One hundred and thirteen nurses (89%) knew some circumstances that affected the prevalence of OH Cold, stress, eating, a full bladder and smoking are known from the literature to influence the prevalence of OH. Nurses mentioned none of these important etiologic factors.

Familiarity with symptoms and consequences of PPH and/or OH for the patient

Symptoms that the nurses related to PPH and OH are shown in Table 3a and consequences in Table 3b. Dizziness was the best-known symptom, associated with PPH by 30% and with OH by 89% of the nurses Less than one-third of the nurses were familiar with other important symptoms of PPH or OH such as syncope, instability, and insecurity in walking or visual changes.

Table 3a. *Symptoms of postprandial hypotension (PPH)* or orthostatic hypotension (OH)# from the literature[5 16] known to nurses (n = 126)*

Symptoms mentioned by nurses	PPH	OH	Symptoms mentioned by nurses	PPH	OH
Dizziness * #	30%	89 %	Headache	-	6 %
Loss of balance *	-	26 %	Declines in BP *	4%	5 %
Fall risk/ tendency to fall * #	6%	26 %	Shaking	1%	5 %
Fainting/syncope/ collapse* #	4%	20 %	Changes in consciousness * #	9%	4 %
Falls *	6%	19 %	Clammy	2%	4 %
Looking pale	5%	19 %	Insecurity	-	2 %
Perspiration *	6%	14 %	Singing ears	1%	2 %
Unstable mobility *	5%	13 %	Feeling tired / sleepy * #	2%	2 %
Tachycardia *	-	11 %	Loss of concentration	1%	1 %
Lightheadedness * #	-	10 %	Disturbed speech	-	1 %
Nausea *	5%	9 %	Yawning	1%	-
Visual disturbances * #			Apathy	1%	-
- Black spots * #	3%	8%	Angina pectoris * #	-	-
- Blurred vision * #	-	5%	Weakness * #	-	-
- Double vision * #	-	1%			

Table 3b *Consequences of postprandial hypotension (PPH)* or orthostatic hypotension (OH)# from the literature[5 16] known to nurses (n = 126)*

Consequences of OH or PPH mentioned by nurses	PPH	OH
Falls and risk for falls * #	25%	94%
Injury, breaking bones *	4%	31%
Reduced consciousness * #	7%	19%
Loss of mobility	2%	16%
Insecurity / fear *	4%	12%
Isolation / reduced activities	2%	6%
Loss of independence	-	5%
Impaired cognition #	-	-
Transient ischemic attacks *	-	-

Nursing interventions and management of PPH and/or OH

In the management of PPH, making the patient rest in bed after a meal (7%) was the most applied intervention (Table 4) Rising slowly and avoiding sudden head-up postural changes, is the advice 73% of the nurses give to patients with OH Alternative interventions for the management of PPH or OH are known to less than one-fourth of the respondents (Table 4)

To describe PPH in the patient's record, 20% of the nurses used patient problems such as dizziness, and risk for injury Eight nurses (6%) described the diagnosis PPH, 12% the performed observation of PPH-related symptoms and 9% interventions such as small meals Twenty-six nurses (20%) did not document anything about OH in the patient's chart because they found OH was a medical diagnosis and not a nursing diagnosis These nurses stated that observing symptoms of OH was common practice, the management of OH was standard, simple and known to every nursing professional, therefore writing down was not necessary

Table 4. *Interventions described in the literatureliterature[5 16] performed by nurses in postprandial hypotension (PPH)* or orthostatic hypotension (OH)#.*

Interventions performed by nurses	PPH	OH
Rising slowly from a lying to a standing #	-	73%
Discuss prescribed medication with the physician * #	3%	28%
Transfers and walking under supervision * #	4%	17%
Giving advise in body positions and maneuvers * #	-	16%
Preventing falls * #	4%	13%
Giving information about the problems * #	6%	13%
Wearing elastic stockings #	-	13%
Advising a walking aid #	2%	8%
Elevating the head of the bed during sleep #	-	7%
Dangling with the legs before standing up #	-	7%
Taking care for good food- and fluid intake # *	-	6%
Observing patient after a meal *	4%	-
Advising frequent small meals * #	6%	-
Let patients rest in bed after a meal *	7%	-
Advising patient to eat in a quiet speed	3%	-
Avoid prolonged recumbency * #	-	-
Avoid high environmental temperature (hot bath) #	-	-
Avoid physical activity #	-	-
Avoid alcohol *#	-	-
Discontinue medication with BP lowering effect * #	-	-
Maintain patient's intravascular volume * #	-	-

Discussion

The main finding of this study is that PPH is a barely known disorder among nurses working with geriatric patients. Two-third of the nurses have never heard of PPH. One-third of the nurses know that PPH is a BP decline after eating, but their knowledge about symptoms, etiologic factors, diagnosing and feasible nursing interventions is very limited. Although almost all nurses know a definition of OH, knowledge deficits exist about the way of diagnosing OH

Recently, we demonstrated that the skills of nurses to measure BP to diagnose OH were poor and inaccurate[36]. This present study indicates that despite of the availability of information on OH, the knowledge of OH is limited. Because of the lack of knowledge of nurses, PPH and OH can be under-diagnosed. As a consequence, there will be a treatment delay, and known evidence or best practice based interventions will not be applied. Therefore, hypotension will remain in these frail patients at risk for injury, falls and syncope.

Earlier studies showed that elderly are at increased risk for BP reductions after standing up or eating a meal[5,16]. Because of the high prevalence of PPH and OH and the growing elderly population, nurses will be faced with more and more elderly patients with these serious problems. They should consider evaluating PPH and OH in their nursing assessment, especially in those elderly with an increased risk for PPH and OH e.g. having Parkinsons' disease or heart failure, or in patients with symptoms associated with PPH of OH such as dizziness, falls or syncope[4,9 10 12 24]. The discovery of PPH or OH offers an opportunity to provide appropriate interventions to reduce symptoms or prevent potentially dangerous hypotensive situations However, accurate management is only possible with sufficient knowledge of nurses regarding PPH and OH, diagnostic principles and (evidence-based) treatment of PPH and OH.

There is a paucity of published nursing literature about PPH. In fact, only one research conducted by a nurse was published in a nursing magazine, and PPH was described once in a nursing manual but only within the framework of OH[24,25]. In the Netherlands, PPH is not a topic in nursing education, except for one course of continuing professional geriatric nursing education The absences of nursing literature about PPH, and of education on PPH in professional nursing training, make it difficult for nurses to acquire knowledge about PPH, symptoms, diagnosis and interventions. However, there are excellent reviews and articles on PPH and OH available in the medical literature[5,16]. For example, two reviews on diagnosis and management of PPH and OH, respectively, are very well readable for nurses and the information is well applicable in nursing practice[5 16] It is important that nurses know at least the problem of PPH and recognize important clinical symptoms associated with PPH like dizziness,

weakness, lightheadedness, syncope and falls Furthermore, nurses' knowledge about the management of PPH and the association of PPH with the size or composition of meals has to be enlarged[5 8]

Another important issue that could account for the lack of knowledge about PPH, and partly for OH, is that nurses feel that both OH and PPH are medical diagnoses. Therefore, they do not consider these diagnoses as belonging to the nursing domain In the case of OH, one-fifth of the nurses does not record the diagnosis and interventions in the patients' chart, because of this reason. Furthermore, they find its treatment should be well-known and common practice for nurses and therefore unnecessary to describe extensively in the patients chart.

The role of nurses in the Dutch health care system and in other countries has changed over the years and is determined to involve further[37]. The function of nurses in the care for geriatric patients has expanded into a professional trained to carry out specific independent roles in the assessment and management of elderly patients. The increasing complexity of care has encouraged the growth of multidisciplinary clinical teams[38]. New nursing opportunities and education, such as for nurse practitioners and professionals, the specialization of nurses, and home-care nurses performing a variety of interventions without direct medical supervision, has resulted in greater decision-making and independence for nurses. At the same time, nurses are attempting to liberate themselves from their old role in care or as 'executive in physician assignment', and in many cases are incorporating more 'cure' and independent diagnostic functions[39] The allocation of tasks between doctors and nurses and the important role of nurses in the diagnosis and interventions for PPH and OH in elderly patients could be considered in this perspective of changing roles. Therefore, the accessibility and availability of information for nurses should be improved by paying more attention to PPH in nursing literature and to focus on PPH and OH in (continuing) nursing education, to enhance the knowledge of nurses.

A limitation of a study by means of mailed questionnaires can be that many people fail to respond to them, leading to the risk of a biased sample. With the use of follow-up reminders and a key-contact person on each department the

response of this mailed questionnaire increased to 84% The questionnaires offered the respondents the possibility of complete anonymity, which resulted in a high proportion of socially unacceptable responses (e g admitting large knowledge deficits about PPH) With the use of open-ended questions, we tested the active knowledge of nurses Possibly, if we used multiple-choice questions, the outcomes on the (passive) knowledge of nurses on PPH would have been better However, to recognize symptoms of PPH and to apply interventions in daily practice, nurses need to know the problem, which requires active knowledge A limitation of the literature study is that the first author reviewed the literature on her own Although the education and skills of Dutch nurses working at Geriatric departments cannot be fully compared with nurses in other countries, it can be expected that the knowledge of nurses on PPH in other states is not very different We reviewed international literature, and only 2 nursing authors wrote about PPH

We conclude that the current knowledge deficits of nurses interfere with accurate diagnosis and management of PPH and OH in older persons The results of this study underscore the importance that more information, especially on PPH, should be available for nurses by providing educational programs, continuous nursing training and publications in nursing professional literature Furthermore, guidelines should be developed and implemented, to improve the clinical practice of diagnosing and management of PPH and OH by nurses

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Chapter 4

Evaluation of skills and knowledge on orthostatic blood pressure measurements in elderly patients

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Abstract

Objectives: Orthostatic hypotension is a common and potentially dangerous condition in elderly patients, often accompanied by dizziness and falls. To diagnose orthostatic hypotension (OH), many physicians rely on proper blood pressure (BP) measurements performed by nurses.

Design: Observational and descriptive study

Setting. Departments of Internal Medicine, Geriatric Medicine, and Surgery in eight hospitals throughout the Netherlands.

Subjects: 170 nurses working with elderly people in a general hospital. We selected a sample of 10 nurses on 17 participating wards

Methods: To evaluate nurses' skills and knowledge on blood pressure measurements to diagnose orthostatic hypotension, we performed standardized observations, based on published guidelines, of supine and standing BP determination in patients over 65 years

Results: The most important deviations in technique of orthostatic BP measurement from the published guidelines were: time between measuring supine and standing BP varied from 0-30 minutes; in 28% the arm position was not at heart level during standing BP measurements; in 46% the cuff was placed incorrectly.

Conclusions: The skills and knowledge of nurses to measure supine and standing BP are inaccurate for diagnosing orthostatic hypotension in elderly patients. Large differences in measurement technique and timing of standing BP could influence the individual detection and treatment of OH and the reported prevalence of OH. The BP measurement procedure to diagnose OH needs more standardization and implementation of guidelines in daily practice.

Introduction

Orthostatic hypotension (OH) is commonly observed among frail elderly people and may contribute to dangerous and serious morbidity such as dizziness, syncope and falls[1 5] The prevalence of OH in unselected elderly people ranges from 5% to 30%[1 6] It is greater in institutionalized populations[7], and increases with age[2] OH is a predictor of mortality in elderly men[8] and for stroke[9] Elderly people with highly variable orthostatic blood pressure (BP) measurements have an increased risk of stroke[10]

OH is commonly defined as a decline of 20 mm Hg or more in systolic BP or 10 mm Hg or more in diastolic BP after standing[4 11] Although there is no gold standard method for the detection of OH[4], several authors suggest optimal position and timing for BP measurement that should be followed in the evaluation of OH[1 3 11 13]

Accurate measurement of blood pressure in the clinic is of paramount importance in the assessment and modification of cardiovascular risk[14] To diagnose OH, physicians in many countries rely on proper BP measurements performed by nurses Therefore, it is critical to know how accurately these measurements are performed However, detailed information on the skills and knowledge of nurses for the performance of orthostatic BP measurements is scarce Since OH is such a common, potentially dangerous condition in elderly patients and accurate BP measurement is important, we investigated skills and knowledge of orthostatic BP measurements in elderly patients by registered nurses in general hospitals in the Netherlands

Methods

Subjects

The subjects of this study were 170 registered nurses working at 17 different departments in eight hospitals throughout the Netherlands (Table 1) The departments of Geriatric Medicine, Internal Medicine, and Surgery were chosen because of the high percentage of elderly patients admitted to these wards We invited all nurses of the 17 departments to participate We selected a sample of

10 nurses of the participating wards by the working schedule, taking all nurses working on the specific day that this study was performed

Instrumentation and procedure

The nurses technique in recording orthostatic BP measurements was evaluated in a two-part test The first part evaluated the practical performance We asked the participating nurses to measure supine and standing BP with a sphygmomanometer in a patient over 65 years, in their usual way One of the investigators (RS) made observations according to a standardized protocol based on the American Heart Association (AHA) recommendations for BP measurement[15] and the pertinent research literature[1 3 4 11 13 16 18] The American Academy of Neurology's consensus statement definition of OH was used in our study-protocol for the BP measurement part on OH[11] The investigator who had previously been trained to follow the standardized protocol, made all observations at the time of the day when the orthostatic BP measurements were usually taken at the different departments[3 11 13 15]

The participating nurses were informed about the procedure shortly before the observation in order to prevent preparation and minimize consulting with or influencing nursing colleagues

In the second theoretical part of the test, a standardized set of questions was asked about details of the BP measurement procedure and information about the age, sex, education and experience of the nurses

Data analysis

All dichotomous variables in the questionnaire were analyzed in SPSS for Windows 8 0 (SPSS Inc 1998, Chicago Illinois, USA), using simple descriptive statistics A total score of all parts of the BP measurement procedure was used to give a final analysis on the nurses' BP skills The Kruskal-Wallis was used to compare the means of the three departments The Chi-square-test were used to compare the scores of individual nurses We compared nurses working in Geriatric-, Internal Medicine, and Surgical departments and in general and university hospitals, to establish if specialty or working in a university hospital

influenced the outcomes of BP measurement skills. A p-value of less than 0.05 was considered as statistically significant. Data are presented as group means ± standard deviation (SD), unless indicated otherwise

Results

Subject characteristics

The subject characteristics are presented in Table 1. There was no significant difference in experience, education, or age between the participating departments

Table 1. *Subject characteristics of participating nurses (n=170)*

		Nurses working at the departments of		
	Total group	Geriatric Medicine	Internal Medicine	Surgery
Number of nurses	*n* = 170	*n* = 80	*n* = 50	*n* = 40
Nurses per setting				
University hospitals	80	20	40	20
General hospitals	90	60	10	20
Age (yrs)				
Mean ± SD	33 8 ± 8 7	34 1 ± 8.6	34 9 ± 8 0	32 3 ± 9 4
Range	21 - 56	21 - 51	24 – 56	21 - 53
Experience (yrs)				
Mean ± SD	10.0 ± 8.2	9.2 ± 7 7	11 3 ± 8 5	9 8 ± 8.7
Range	0 – 33	0 – 30	0 – 28	0- 33

Overall results of the BP measurements

The most important results of the nurses' performance on BP measurements are presented in Table 2 as mean of all nurses and split by department. The departments of Internal Medicine had the best overall results of BP measurements ($p < 0.001$). Three Geriatric, three Surgical and all five Internal Medicine departments used a protocol for general manual BP recordings. Only one department of a general hospital used a protocol for measuring orthostatic

BP but their results were not significantly different from the other departments for any of the observed items. In university hospitals, the BP measurements followed guidelines to a significantly greater extent than in general hospitals ($p < 0.001$). The skills and knowledge of nurses with short experience 0-1 year) and nurses with longer experience (>5 years) were not significantly different

Preparation of blood pressure measurement

In 16% of the BP measurements, the supine rest was less than the recommended five minutes[15]. Eighty-nine percent of the nurses used the proper cuff-size[15,19]. In 46% of all BP measurements, the cuff was not placed with the bladder centred over brachial artery[15].

The equipment

In 22% of all BP equipment and significantly more in the Geriatric departments (48%), the mercury column of the sphygmomanometer was not in vertical position ($p<0.001$)[15] In 9% of all equipment, the mercury column was not at zero before inflation[15 20].

The BP measurement

In 72% of all standing BP measurements, the patient's arm was at heart level An unsupported arm gives a falsely higher BP pressure[14,15,17]. Eye level position of the sphygmomanometer, were not achieved in 38% of all observed BP measurements in the lying position and in 49% of all standing measurements. The guidelines recommend that BP levels should always be recorded in even numbers and read to the nearest 2 mm Hg mark on the manometer[15]. Ten percent of all nurses, rounded BP readings up to the nearest 2 mm Hg, the others to 5 mm Hg[15,20].

Table 2. *Results of BP measurements for diagnosing OH by nurses*

		Nurses working at the departments of		
	Total group	Geriatric Medicine	Internal Medicine	Surgery
	n = 170	*n* = 80	*n* = 50	*n* = 40
Supine rest for at least five minutes	84% ± 4%	89%	80%	84%
Arm at heart level during recording BP	81% ± 7%	76%	77%	90%
Use of appropriate cuff size	98% ± 2%	95%	98%	100%
Cuff placed correctly on brachial artery	54% ± 10%	51%	46%	66%
Mercury column vertical on wall or desk	78% ± 22%	52%†	93%	88%
Mercury column starting at zero	91% ± 8%	86%	100%*	86%
Record BP in the patients' chart	99% ± 1 %	98%	98%	100%
Record time between standing/recording	6% ± 5 %	12%	5%	2%
BP measured to the nearest 2 mm Hg	10% ± 4%	13%	5%	12%
Reading BP at eye level	62% ± 20%	40%†	80%	66%
Patients arm at heart level while standing	72% ± 17%	53%†	78%	86%
Measuring BP immediately after standing	31% ± 17%	24%	55%	26%
Measuring BP 1 minute after standing up	40% ± 15%	46%	20%	46%
Measuring BP 2 minutes after standing	13% ± 6%	18%	12%	6%
Measuring BP 3 minutes after standing	8% ± 6 %	6%	3%	16%
Measuring standing BP after > 3 minutes	18% ± 5%	16%	15%	24%
Measuring several times standing in one session	8% ± 3%	11%	5%	6%
Measuring several occasions on different days	90% ± 3%	93%	88%	88%

All departments are compared with the other departments * P < 0 05, † P < 0 001

BP = Blood Pressure

Measuring standing BP

The time between standing up and measuring the first upright BP varied from 0-30 minutes. Six of the 170 nurses walked out of the room and came back after 15-30 minutes with the intention to measure standing BP for diagnosing OH. In these cases, patients performed activities that could influence BP Ninety

percent of all nurses stated that they measured supine and standing BP on several occasions, on different times of day, and on different days for diagnosing OH

Documentation

Nurses measured supine and standing BP at variable times of the day, depending on their personal daily practice Of all nurses, 51% did not record the time of BP measurements in the patient's chart In the departments of Surgery and Internal Medicine, measurement time was reported in 53% and 64%, respectively, in the department of Geriatric Medicine it was significantly less (30%) ($p<0.001$) In university hospitals the time of BP measurements was reported in 68%, in general hospitals it was significantly less (25%) ($p<0.001$) Circumstances that could have influenced the BP recordings (such as medication) were documented in 65% of all cases Nurses made an inventory of the patients' complaints in 95% and documented symptoms in the patient's chart in 99%

Discussion

Accurate measurement of supine and standing BP plays an important role in the diagnostic process[14] and assessment of OH However, the findings of this study indicate that nurses show great differences in their skills and knowledge needed to measure orthostatic BP by sphygmomanometry This can lead to inaccurate BP readings for diagnosing OH in elderly patients The large range in time that elapsed between standing up and BP measurements indicates that strict procedures and protocols are lacking and standardization of the technique is needed

BP measurements can be influenced by patient factors[12 15 20 21], observer factors (such as sight or hearing problems)[15 20 21], factors related to skills and knowledge[12 16 20 21] or factors related to the BP measurement equipment[3 15 20 21] Previous studies, which evaluated knowledge and performance of BP measurements, only focussed on BP measurements in general[16 22 23] No studies were found on skills and knowledge of orthostatic BP measurements In

our study, we not only focussed on general BP measurement skills but especially on standing BP measurements for the detection of OH

In clinical practice, the first and third minute after standing are the most practical and most useful times to diagnose orthostatic BP changes[1 3 24] In this study, only 8 % of the nurses measured BP more than once after standing There was also a large variation in upright standing time intervals from 0-30 minutes The differences in measurement technique and timing of standing BP could interfere with the individual detection of OH and give a wrong estimate of the overall prevalence[1 2 6 7] This could also explain the range in prevalence of OH in performed studies[1 2 6 7]

Other important findings in this study were that despite the correct choice of cuff size, the cuff was placed incorrectly in 40% of the BP measurements, which overestimates the BP-readings[15 19] The great influence on BP of small deviations of the arm beyond heart level seems to be ignored in a quarter of the BP measurements the arm was not at heart level[17] This gives falsely high BP levels[14 15] The erratic position of the mercury column (no vertical position) also makes it difficult to assure accuracy of BP-readings With the growing interest of the use of automatic oscillometric devices, some of the errors in measurement technique could be reduced However, most of the major errors found in this study (such as at least five minutes of supine rest to reach baseline blood pressure and measuring at fixed time points after standing) are not related to the measuring device and remain very important Therefore, these major errors are not due to the use of equipment, but to the lack of knowledge and a standardized procedure for diagnosing orthostatic hypotension

An important limitation of our study is that there was no standard protocol for measuring standing BP, which could be used to evaluate the orthostatic BP measurements performed by nurses The significant differences between nurses and between departments regarding standing BP measurements underscore the importance of translating the recommendations of several authors on orthostatic BP measurements into guidelines, and implementing these guidelines in daily practice[1 3 4 11-13 24] Although the results of this study are restricted to the Netherlands and cannot be generalized to physicians, the

literature suggests that similar problems in BP measurement exist for qualified doctors, medical, and nursing students[22 23 25 26] Carney et al concluded that the knowledge of the medical and nursing staff and technical ability in sphygmomanometer use was similar in doctors and nurses[27]

We did not measure BP simultaneously with an Y-stethoscope to investigate if correct BP measurement technique leads to over- or underestimation of OH, as it would have influenced the procedure (for example by measuring BP at different time points) Because of the large day-to-day and within-day variability of OH[1 4 28], measurement of BP in the correct way on any other occasion to compare the results with the outcomes of the nurses' BP readings was also impossible Villegas et al did measure BP strictly following the AHA guidelines, directly after observing their subject's measurement[23] They found that 63% of the systolic BP readings and 53% of the diastolic readings were out of range and inaccurate, compared to BP measurements according to guidelines Although we tried to prevent preparation, the data were not completely independent because communication between colleagues could not be totally avoided

We conclude that BP measurement skills and knowledge of nurses working with elderly patients in different departments of Internal and Geriatric Medicine and Surgery can lead to inaccurate BP recordings for the diagnosis of OH The most important steps in the BP measurement routine which can lead to erroneous BP results or misinterpretation of the BP readings that most nurses failed were placing the cuff at the upper arm incorrectly and measuring standing BP only once at variable time points after standing OH is, if measurements are performed well, an easily obtained measurement to identify elderly patients at risk for stroke The variability of orthostatic BP should be examined rather than relying on one single blood pressure measurement[10] Choosing the right cuff size, correct documentation and recording patients' complaints were performed well by almost all nurses Uniform definition and measurement of the BP response to standing is critical for correct interpretation of BP data and diagnosing OH If the clinical practice of diagnosing OH is to improve, development and implementation of guidelines for the measurement of

orthostatic BP changes is needed, followed up by a continuing post-nursing school education program With a correct diagnosis, based on proper BP measurements, elderly patients with treatable OH could be discovered and OH-related co-morbidity could be prevented or alleviated

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Chapter 5

How to measure blood pressure in the elderly: recommendations to detect orthostatic hypotension

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Submitted

Abstract

Orthostatic hypotension (OH), a decline in blood pressure (BP) after standing up, is very prevalent in elderly patients, and often accompanied by serious symptoms like lightheadedness, instability, falls and syncope No guidelines on BP measurement to detect OH were available in the current literature A Medline search on BP measurement and OH was performed as of 1980 until 2002 The findings were compiled in a protocol, which was evaluated by ten experts in the field Applying the recommendations on BP measurement for OH, and education in clinical practice, can improve the diagnostic process of OH

Key words Blood pressure determination - diagnosis - orthostatic hypotension - aged - nurses

Introduction

Orthostatic hypotension (OH) is a common disorder in the elderly[1] OH is defined by the Consensus Committee of the American Autonomic Society and the American Academy of Neurology, as any reduction in systolic blood pressure (BP) of at least 20 mm Hg or a reduction in diastolic BP of at least 10 mm Hg within 3 minutes of standing[2] OH is caused by an impairment of the hemodynamic responses to upright posture (caused by e g medication, autonomic disorders or prolonged bed rest), or by depletion of the intravascular volume (e g by use of diuretics or blood loss)[3] OH may be present without symptoms[1] However, in yet unpublished data we found that OH was symptomatic in 61% of the frail geriatric patients (n=85) OH can be responsible for disabling symptoms that can cause dizziness, falls and several serious complications including falls, fractures, syncope, myocardial infarctions, transient ischemic attacks, cognitive impairment and difficulty in walking which all can lead to increased self-care deficits, hospitalization and impaired quality of life[4-7] OH is a predictor for stroke[8], and the risk for stroke further increases in elderly with highly variable orthostatic blood pressures[9] Moreover, OH is predictive for mortality in elderly men[10]

The prevalence of OH in the general population is unknown[1] OH prevalence increases with age[4] In community dwelling elderly the prevalence of OH ranges from 10-30%[4 7] The prevalence of OH is higher in institutionalized populations[11 12] We investigated the occurrence of OH in frail elderly patients admitted to the geriatric ward of a hospital (n=85) and found OH in more than half of these geriatric patients

The diagnosis of OH can easily be made by performing BP measurements before and after standing up[3] The diagnosis of OH is dependent of an accurate technique in BP measurement[3 13] Important factors affecting BP measurements for detecting OH are the day-to-day and within-day variability of BP, the limitations of the device being used, the accuracy of the equipment and the fact that BP is not as easily measured in some groups, such as elderly patients with standing problems[11 14] Unfortunately, there is no gold standard method for measurement of orthostatic BP and guidelines regarding appropriate BP

measurement techniques for OH are missing A consensus statement on the definition of OH has been described and several authors suggest optimal position and timing of orthostatic BP measurements for OH[2 3 11 15 16] However, we recently found that nurses are unaware of these suggestions for accurate measurement of OH in elderly subjects, and that the technique of nurses to measure BP was highly variable, e g a variation in elapsed time after standing up and taking the upright BP from 0 to 30 minutes[17] Inaccuracy of BP measurements for diagnosing OH and the lack of guidelines regarding proper BP measurement for OH can lead to mis- or under diagnosing OH Because, OH is a very common disorder in elderly people, with disabling and serious symptoms, the diagnosis must be made in an early stage

The purpose of this study was to collect evidence and practice-based recommendations in literature and from experts in clinical practice, about how to measure BP for diagnosing OH We aimed at making a protocol for diagnosing OH, grounded by scientific evidence The potential benefit of this protocol is to achieve more standardization of the procedure for orthostatic BP measurements, to increase the accuracy of the diagnosis OH and to improve the quality of care for patients with OH

Methods

In the literature several recommendations for proper BP techniques and measurement of OH are given We performed a systematic search of English language literature to identify all major evidence on measurements according to diagnose OH MEDLINE and CINAHL were searched for studies published between 1980 and 2002 with the following MeSH keywords hypotension, orthostatic, postural, blood pressure, low blood pressure, blood pressure determination, blood pressure monitoring, nurse*, nursing care, competence, skills, diagnosis, aged, protocol*, guideline*, recommendation* in various combinations of these words, and bibliographies of relevant articles Articles were selected by the first author based on abstract which had to focus on BP measurement or BP measurement for detecting OH, and the level of evidence of the study We included systematic reviews and meta-analyses, clinical trials,

cohort studies and the outcomes of consensus committees We classified the scientific literature into five levels of evidence[18]. Grade 1 are experimental studies (e g. based on randomized controlled trial), systematic review or meta-analyse, grade 2a are quasi-experimental studies (e.g well-designed experimental study without randomization) and grade 2b are controlled observational studies (e.g. based on well-designed cohort or case-control analytic studies). Furthermore, grade 2c contains observational studies without control groups; comparisons between times/places, cross-sectional studies, with or without interventions and literature with dramatic results in uncontrolled trials Finally, grade 3 includes expert opinions based on pathophysiology, bench research or consensus, clinical experience, and descriptive studies[18].

We compiled the recommendations based on scientific evidence into a protocol. This protocol, including the scientific ground for the recommendations from the literature, was presented to a panel of ten experts in the field. The panel was composed of three physicians, two geriatricians and an internist, an expert nurse specialized in elderly, two researchers with expertise on BP, OH and nursing, and four nurses with outstanding experience, and specialized education on elderly patients. They individually evaluated the written protocol on methodology, completeness, and practical applicability. They were invited to give their expert opinion on the scientific evidence of the recommendations, the relevance for clinical practice, the clearness and the presentation, and to submit suggestions for changes or supplements. Their comments and supplements were analyzed and adjusted into the protocol on how to measure BP for the detection of OH in the elderly. The modified version was returned to the panel for new feedback, until consensus was reached.

The final protocol with the best evidence-based technique on BP for diagnosing OH, developed after reviewing literature and consensus with experts, is presented in this article (Table 1).

Results

Literature

We included 20 articles on BP measurements for diagnosing OH. We included systematic reviews, quantitative study designs and results of consensus meetings including recommendations on how to detect OH. Furthermore, we found 11 articles providing important recommendations for BP measurement in general, or studies on major elements of the BP measurement procedure such as the position of the arm or the patient during measurement. In Table 2, the articles used in the recommendations and their levels of evidence are shown[18]

Expert panel

Scientific evidence from the literature was graded more important than clinical expertise. Three rounds with comments and adaptations were necessary to reach consensus on the protocol between the 10 experts, mainly based on the unambiguousness of the text, not on the scientific ground for evidence. The nurses in the panel wanted an explanation of the Korotkoff sounds included in the recommendations (e.g. Table 2, BP measurement step 4), whereas the physicians found it not essential to include an explanation. The scientific ground of all steps, as described in the next paragraphs, is now extensive and detailed, because mostly the nurses needed background information Subsequently, after three rounds, the protocol was finalized, and could be used for implementation in clinical practice.

Recommendations on BP measurement for diagnosing orthostatic hypotension.

In the following paragraphs an explanation and the scientific evidence for the recommendations in Table 1 will be described. (The numbers before the paragraphs refer to the recommendations in Table 1.)

Preparation

1. OH is most prevalent in the morning after an overnight rest before taking a meal or medications, and therefore BP should preferably be measured in the morning[11]. The influence of time, food, temperature, emotion, temperature,

bladder distention, pain or activity should be taken into account by interpreting the BP readings[14 19 20] Without agreements, or a protocol on the department, nurses measure orthostatic BP not at a fixed time during the day, but at the time most suitable for their own practice[17], and confounding will exist[21]

2 Anxiety can lead to increases in systolic BP (SBP)[13] The expectation of the coming BP measurement causes an alerting reaction that can lead to an artificially high SBP reading the first time BP measurement will be performed[13] The extent varies greatly among the patients, but comforting the patient and explaining the procedure is essential This alerting reaction (the so-called white coat hypertension) is less pronounced in repeated measurements In order to overcome this white coat hypertension, it is standard practice to measure BP on several occasions before making a diagnosis of e g hypertension[13] It is plausible that white coat hypertension can artificially increase the detection rate of OH, because of the increased baseline SBP and the larger drop in SBP after standing up

Furthermore, the patient has to be comfortable and quiet during the measurement, talking for example can raise SBP up to 17 mm Hg[22], reading induces an increase of SBP up to 7 mm Hg[22] Just like the patient has to be comfortable, the nurse should be relaxed and in a convenient position for measuring BP Giving the impression of hurry increases BP of the patients, and rushing increases errors in the reading for example by deflating the cuff too fast which leads to underestimation of the systolic BP and overestimation of the diastolic BP

During BP measurements in all positions the manchet should be at heart level because every 5 cm change of the manchet below heart level can lead to an overestimation of 3 to 4 mm Hg in systolic and diastolic BP, every 5 cm of the arm position above heart level leads to 3-4 mm Hg underestimation of the BP[23 24]

3 A period of supine rest for at least five minutes before taking the first BP reading is an essential requirement in the elderly to avoid the confounding factor of recent exercise and to establish reliable baseline BP values[25] The patient's body postures during BP measurement influences especially the

diastolic BP and heart rate, both of them being significantly higher in the sitting than in lying position Diastolic BP values obtained in subjects sitting or supine cannot be regarded as equivalent[26] This important condition of taking supine rest before BP measurement appears to be have been overlooked in the consensus definition of OH, resulting in a lack of standardization in clinical practice on this point[2 17] Not only is consideration of this point important to ensure that the readings are valid, it also has an impact on the time management in the clinical setting, for example the duration or planning of the physical screenings at an outpatient clinic

4 Miscuffing is a serious source of error that can give inaccurate BP readings, leading to incorrect diagnosis in clinical practice[27] A cuff containing a bladder that is too small ('undercuffing') leads to an overestimation of the BP, and that a too large or too wide bladder ('overcuffing') leads to an underestimation of the BP[14 27 28] Undercuffing is more common then overcuffing[14] Especially in lean frail elderly, cuff size should be carefully checked instead of using the standard size

5 The center of the bladder must be over the brachial artery to ensure a good occlusion of the brachial artery[23] To ensure that the antecubital fossa is easily accessible for auscultation with the stethoscope, the tubes of the bladder preferably should be placed superiorly[23] If the cuff is applicated too loosely, the BP is too high or if the cuff is applied over clothing, the reading is impaired[29]

6 Because BP can be different between arms, it is important that BP will be measured at both arms at the first examination If the difference in systolic BP is < 10 mm Hg between arms it is recommended in the literature that BP measurements should be taken at the non-dominant arm If the difference in systolic BP is ≥ 10 mm Hg, the arm with the highest BP readings should be used If the differences are larger than 20 mm Hg on three successive readings, additional diagnostic investigation is required[29] The arm from which the BP is recorded should be noted, so the same arm can be used in repeated measurements[23 29]

The equipment[1]

1. In clinical practice three types of devices are used to measure BP: sphygmomanometers, automated devices, and continuous devices measuring BP beat-to-beat Recently the European Society of Hypertension evaluated the validation of BP devices, and recommended equipment for clinical practice[30] To reduce potential sources of error in BP measurement due to the observer, automated devices should be preferably used[31]. This also applies for orthostatic BP measurement. Nevertheless, agreements on important elements of the BP measurement technique as included in our recommendations still have to be made, e g. the timing of the measurement, proper application of the cuff, arm at heart level during measurement. It is important to check the condition, and place of the equipment, before starting the measurement. For example, if the manometer is too far or readings are not taken at eye level errors will occur because the mercury column cannot be read precisely. If the mercury column is not in a vertical position, deflating will give false outcomes Furthermore, leaks in the hose or cracked or porous rubber make accurate readings difficult because the deflation of the mercury column cannot be regulated. Therefore, the BP measurement equipment should be checked and calibrated carefully, at least once a year[23]

The BP measurement

1. Estimation of the approximate level of the systolic BP pressure by palpitation of the brachial artery is important because Korotkoff I sounds sometimes disappear as the pressure decreases and reappear at a lower level (the auscultatory gap), resulting in an underestimated systolic BP unless already determined by palpitation[23]. Furthermore, this palpatory technique is useful in patients in whom auscultatory endpoints may be difficult to judge accurately, for example in elderly patients or patients in shock[23].

[1] The references 30 and 31 are not included in the search described in Table 2, because they describe the validation and use of automated BP devices This was not the primary subject of our review

Table 1. *Recommendations*

Recommendations for blood pressure (BP) measurements to diagnose OH.		
Preparation		*Level of evidence*
1	Perform BP measurements in the morning after an overnight rest, before the patient leaves bed and before breakfast, before use of medication, smoking or exercise	1-3
2	Situate the patient in a supine position in a warm, quiet environment. Make sure that the arm to measure BP is at heart level Comfort the patient and explain the procedure	1-3
3	Let the patient lie down for at least five minutes of supine rest before BP measurement	1-3
4	Measure the circumference of the upper arm and select the correct cuff size The bladder width should be at least 40% of the arm circumference and the bladder length at least 80% of the arm circumference	1-3
5	Place the cuff smoothly around the bare upper arm, which is unrestricted by clothes. The bladder of the cuff should be centered over the brachial artery, which is located by palpating the inner upper arm with the lower margin of the cuff 2,5 cm above the antecubital fossa.	3
6	BP should always be measured at the same arm Measure at the arm with the highest blood pressure, if both arms have the same pressure, the non-dominant arm is preferred	3
The equipment		
1	Place the sphygmomanometer at eye level Put the device close enough to read the mercury column or pointer Check the connection of the tubes, the vertical position of the mercury column and if the column starts at zero before inflation Check if there are no leaks from cracked or perished rubber tubing	3
The BP measurement		
1	Locate the brachial artery by palpitation. Determine the level for maximal inflation of the cuff by adding 30 mm Hg at the pressure at which the radial pulse is no longer palpable	3
2	Place the stethoscope below the cuff over the brachial artery Push the stethoscope lightly to ensure the skin has contact at all points	3

Recommendations for blood pressure (BP) measurements to diagnose OH.		
3	Inflate the cuff rapidly and steadily to the point calculated in step 1	3
4	Release the valve slowly and gently Deflate the cuff slowly (2-3 mm Hg per second) The appearance of the first clear repetitive sound (Korotkoff I) is the systolic pressure Record the diastolic pressure at the complete disappearance of the repetitive sounds (Korotkoff V), unless the recording is zero, in which case Korotkoff IV should be documented	3
5	Both measurements should be recorded in even numbers, and read to the nearest 2 mm Hg on the manometer Listen for 10 to 20 mm Hg below the last sound heard to confirm disappearance of the sound, and then deflate the cuff rapidly and completely	2c,3
6	Wait at least 1 minute before reinflating the cuff, if the recording needs to be repeated	3
Measuring BP in standing position		
1	Measure supine and standing BP in one joint session After measuring supine BP, let the patient stand up within 30 seconds (if needed, help with transfer) Do not remove the cuff	1,2c
2	Check the time when the patient is standing completely	2a
3	Ask the patient to hold the arm at heart level, or support the patient's arm on the shoulder of the nurse or doctor or health-care worker who measures BP	1
4	Follow BP measurement step 2-5 Measure BP in standing position at exactly 1 minute after standing up Perform second BP measurement after exactly 3 minutes of standing	1-3
5	Observe the patient during the BP measurement procedure Ask the patient if there are any symptoms or complaints such as dizziness or instability	1,2b
Documentation		
1	Record systolic BP and diastolic BP supine, after one and after three minutes of standing Record cuff size, arm used for measurement and time of measurement and symptoms	1,2c
2	Repeat the whole procedure at least on two mornings under identical conditions	1,2b

2 Too heavy pressure on the stethoscope (and therefore on the brachial artery) will distort the artery and produce sound heard below diastolic pressure and therefore give false low diastolic readings[29]

3 If the cuff is inflated too high, to unnecessary high pressure, the procedure is painful to the patient and may give falsely high BP readings[29] If the maximum inflation level is not high enough, mistakes can be made in the start of phase I Korotkoff, because it can be missed, misinterpreted in the auscultatory gap or mistakenly phase III is used[29]

4 If the deflation rate is too fast (>2-3 mm Hg per second), the systolic BP readings will be too low and the diastolic BP too high[29]

About which Korotkoff phase to use for the diastolic pressure, recommendations were uncertain for many years Because the difference between phase IV (distinct abrupt muffling of sounds, which become soft and blowing in quality) and complete disappearing sounds (phase V) can be greater in certain groups of patients (children, pregnant women, anemic or elderly patients), there is now a general consensus that phase V should be taken as diastolic pressure because it more closely matches with the arterial monitored diastolic BP[14]

5 It seems that health care professionals round off to the digit of their choice, most often to a zero or five[17 23 29] This can lead to a bias of 3 to 12 mm Hg in the readings in favor of the end digit zero, which has serious implications for the accuracy of the reading and the decisions on a diagnose or treatment[23 29]

6 If a BP measurement is repeated without waiting 1-2 minutes, or before the mercury column is deflated completely, blood can be trapped in the forearm, which can lead to inaccurate readings[29]

Measuring BP in standing position

1 Removal of the cuff between two BP measurements disrupts the baseline condition of the patient[21] If the cuff has to be positioned again after standing up, too much activity has taken place which disturbs the readings, and too much time has elapsed before measuring BP[21] Although it seems obvious that measurement of BP in supine and standing position of the patient should be

performed during one session for diagnosing OH, clinical practice shows that this combined BP measurement in supine and standing position is not evident[17]

2 Because of a correct timing of the BP measurement in standing position, the time the patient stands erect has to be noted[11].

3. The measured BP decreases if the arm is higher than heart level, and increases if the arm is lower than heart level, with 8 mm Hg for every 10 cm out of range[24] An unsupported arm gives rises in systolic BP of 2 mm Hg or more[21]. (See also preparation, recommendation 2).

4. There are many debates in the literature about the best timing of the BP measurement following the standing position. Several studies on the patterns of OH indicated that the best timing of BP measurement are at 1 and 3 minutes after standing up, especially in the morning when OH is most prevalent[3 9 11,16 32,33]. However, OH is highly variable, and reliance on a single BP measurement may over- or underestimate the significance of a given BP change[9]. Moreover, a given orthostatic BP change may not reflect the underlying pathology, namely impairment of BP regulation[9]. Hossain et al. presented an algorithm that can be used to identify persons with a large variability in orthostatic BP change from two or more measurements. They concluded that unstable patients continue to maintain highly variable within subject orthostatic BP changes over time, which is associated with the development of stroke during, follow up. Therefore, they suggest that the identification of elders at risk of stroke may be improved by examining orthostatic BP variability rather than relying on single (static) BP change measures. If possible, some precautionary measures should be taken for patients with large fluctuations in orthostatic systolic BP, by early treatment of OH, in order to prevent serious outcomes such as stroke[9]. The importance of agreements on time of measurement and the device used was more emphasized by Caine et al.[34] who showed a threefold difference in detection rate of OH in elderly patients with a history of falls. The OH detection rate was 75% using a digital photoplethysmography, which measures BP continuously, whereas just 25% and 37% of these cases were detected by sphygmomanometry or automated devices, respectively. Caine concludes that

routine BP measurement without automated devices was not adequate to diagnose OH because a delay of at least 30 seconds has occurred before a BP reading is obtained Caine et al. suggest that any drop in BP after standing with sphygmomanometry or automated devices should raise the suspicion of OH[34] Unfortunately, the authors only measured once after standing up and their conclusion is not a practical one, because automated devices with continuous BP measurement are not common use on every hospital ward and certainly not in community care Use of sphygmomanometer, provides a discontinuous measurement[3] Measuring several times at fixed timepoints after standing up with an automated device to exclude most of the observer errors should be the best alternative. Some studies showed the greatest decline in BP after 30 seconds[15,35]. Others reported the largest decrease after 1 minute of standing or three minutes of standing[9 11] Discussions are also made about measuring after two or three minutes of standing[15,36,37] Recent studies indicated that in healthy elderly BP decreases no earlier than after two minutes of standing and still is present after 3 minutes of standing[38]. Therefore, in the light of the definition of OH, which states BP decreases occurring within 3 minutes after standing up, a late decrease of BP when only measured after 1 minute of standing might be missed[22] Accordingly, the proposed standard technique for BP measurement is repeated measurements after 1 and 3 minutes of continued standing[1,3 11].

5. Although OH can be a-symptomatic, observing symptoms such as dizziness, lightheadedness, instability, tendency to fall, or falls can help diagnosing OH and give indications to the importance of treatment[1,5,33].

Documentation

1. The BP readings should be documented immediately after performing the BP measurement in the patient's chart. Vloet et al.[17] indicated that mistakes appeared in copying or readings remained on working notes. If guidelines on BP measurement are followed, only the BP readings, symptoms and deviations of the normal optimal conditions have to be noted[21]. In making decisions about diagnosis and treatment the physician can take these into consideration.

2 The diagnosis of OH should not be based on a single orthostatic BP measurement because of the large day-to-day and within-day variability[1 9 11 16 39 40] The BP measurement should be repeated under identical circumstances for at least two mornings[9]

Discussion

Although the diagnosis of OH can be simply made by performing BP measurements in supine and standing position[3], BP measurements are sensitive for errors of the observer, in the technique or in the equipment[21 29] By recognizing the potential confounders and standardizing the procedure, by means of a guideline, the likelihood of making diagnostic or therapeutic decisions based on inaccurate BP readings can be minimized[21] It is of great importance that every hospital brings uniformity in the method used to measure BP to detect OH If one fails to make agreements about a standardized method, an enormous variation in BP measuring skills and the potential inaccuracy of BP readings, as shown in our recent study[17], continues to exist[21]

The principal benefit of recommendations for the detection of OH, as described in this article, is the improvement of quality of care by performing accurate BP measurements and diagnosis of OH, as received by patients at risk for hypotension[41] Compliance of recommendations in clinical practice is dependent on multiple factors[42] Guidelines should be compatible with existing values and routines, not be controversial and they should be defined precisely[42] Moreover, the scientific basis of the recommendation is important Grol et al found that recommendations were followed more if an explicit description of the scientific evidence was available, straightforward and not conflicting[42] Furthermore, it appeared that recommendations were used less when compliance affected the organization in clinical practice, when it demanded extra resources, or new knowledge and skills or when it provoked negative reactions in patients[42]

In the development of the recommendations we took these attributes for good compliance in clinical practice into account[42] For the recommendations on BP measurement in general, studies with a high grade of scientific evidence are used e g systematic review, and clinical trials Expert opinions and consensus

were graded as level 3 evidence. The recommendations about detecting OH are derived mostly from grade 2 evidence in scientific literature such as clinical trials without randomization, or cohort studies, and also from systematic reviews.

With the introduction of the recommendations, nurses have to refresh and structure their skills and routine on BP measurements, and follow the agreements on timing of BP measurements in standing position The BP screening procedure for the detection of OH is easy to learn and not very time-consuming With little changes in the BP measurement procedure, great improvement on the accuracy of BP readings for detecting OH in clinical practice is to be expected. In fact, it is structuring and standardizing a procedure of BP measurement that has been applied on every ward for years. An early diagnosis is beneficial for the patient because interventions are applicable such as avoiding sudden head-up postural changes or prolonged bedrest. High expenses because of fractures, complications and (prolonged) hospital admission can be saved or reduced.

In conclusion, because of the high prevalence of symptomatic OH, we advise screening for OH of elderly patients at risk, according to the recommendations described in this article[1,3]. Implementation of a standardized method to measure orthostatic BP combined with continuous education and training can improve the skills and knowledge of nurses to detect OH. This can lead to further professionalism of the nursing staff and improvement of the diagnostic process for OH to benefit the patient. The described easily applicable, non-invasive method for diagnosing the common, but highly troublesome OH can improve the care for all elderly patients at risk for OH.

Table 2. *Scientific evidence in reviewed studies*

Level of evidence Grade 1 Experimental studies (e g based on randomized controlled trial), systematic review or meta-analyse, Grade 2a Quasi-experimental studies (e g well designed experimental study without randomization), Grade 2b Controlled observational studies (e g based on well designed cohort or case-control analytic studies), Grade 2c Observational studies without control groups, comparisons between times/places, cross-sectional studies, with or without interventions Dramatic results in uncontrolled trials, Grade 3 Expert opinion based on pathophysiology, bench research or consensus, clinical experience, descriptive studies[18]

Chapter 5, Table 2

Table 2. *Scientific evidence in reviewed studies*

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
1	Mathias, 1999	Systematic review, no search period indicated, 55 references	1	-	OH	To describe causes, symptoms, diagnosis and management of OH	Symptoms of OH
2	Consensus Committee, 1996	Expert committees, Conference in 1995, 1 reference	3	-	OH	Definition of OH, autonomic failure and multi system atrophy	Decrease in BP within 3 minutes of standing
3	Carlson, 1999	Systematic review, no search period indicated, 70 references	1	-	OH	Review of pertinent recent medical literature on OH measurement	BP measurement in more body positions combined in 1 session
5	Craig, 1994	Cohort (retrospective)	2b	50 elderly	OH	Identify the presentation, circumstances and consequences of OH in elderly patients	Symptoms and influencing circumstances

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
9	Hossain, 2001	Cohort (prospective)	2b	673 nursing home residents	OH	To assess the relation between intra- individual variability of systolic orthostatic blood pressure change and cardiovascular outcomes	1 minute after standing, within day variability
11	Ooi, 1997	Clinical trial	2a	911 long-stay nursinghome residents > 60 y	OH	Determine the patterns of within-day orthostatic variability	1 and 3 minutes after standing, most prevalent in morning, day-to-day and withinday variability
13	Mc-Alister, 2001	Systematic review, no search period indicated, 34 references	1	-	BP	A comprehensive literature search identified all studies describing potential sources of bias in measurement of blood pressure	Potential sources of bias in measurement of BP The studies were evaluated using a standard hierarchy of evidence (that of the Centre for Evidence-Based Medicine, Oxford, UK
14	Beevers, 2001	Review / expert opinion, no	3 [2]	-	BP	To describe factors in BP measurement influencing sphygmomanometer	The technique of BP measurement and confounding factors

[2] The grade of evidence of this systematic review was classified as level 3, expert opinion, because the authors indicated no search criteria, and used a few references

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
		search period indicated, 13 references				technique	
15	Kennedy 1984	Controlled observation	2b	10 healthy subjects (age 21-35 yrs), and 10 male subjects with angina pectoris (age 40-70 yrs)	OH	To determine the timing and position of BP and HR measurements to detect OH, with and without nitrate	Initial orthostatic changes occur at 0 5 minutes after changing position, the maximum change after two minutes of position change, in standing position more marked than in sitting position
16	Mader, 1989	Cohort (prospective)	2b	300 elderly	OH	To determine the effect of timing and number of baseline BP measurements on OH	A single baseline supine BP measurement is adequate for determining the postural BP response
17	Vloet, 2002	Observation	2c	170 nurses working in a hospital	OH	To determine the skills and knowledge of nurses on orthostatic BP measurement in elderly patients	Large variation in skills and knowledge on BP measurement
19	Jonsson 1990	Cohort (prospective)	2b	38 recurrent fallers (age, 87 +/- 6 yrs), 20 nonfallers (age,	OH	To determine the frequency and magnitude of hypotensive responses to	Institutionalized elderly have large variability in BP variability during the day, and hypotensive responses to

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
				85 +/- 5 yrs), and 10 healthy young controls (age, 24 +/- 3 yrs).		common daily activities, and their potential relationship to falls in the elderly.	meals and nitroglycerin. A decline in BP during stressors such as standing up may predispose elderly people to falls
20	Mader, 1989	Controlled observation	2b	10 young and 16 elderly subjects	OH	To evaluate the effect of age, meals, and time of day on supine and standing BP and heart rate in healthy young and elderly subjects	The BP response to standing is similar in young and elderly subjects and is not impaired by overnight rest or meals.
21	Baker, 1995	Systematic review, no search period indicated, 65 references	1	-	BP	To review the current recommendations of BP measurement, and sources of error	Confounders of auscultatory BP measurement
22	Le Pailleur, 1998	Cohort (prospective)	2b	50 hypertensive patients	BP	To explore the mechanisms of the "white coat" phenomenon, and the effects of activity on BP	Effect of walking, talking and other circumstances on BP

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
23	Beevers, 2001	Review / expert opinion, no search period indicated, 13 references	3 [2]		BP	To describe the technique of ausculatory BP measurement	Observer error, training techniques, guidelines on BP measurement, what to write down
24	Netea, 1998	Clinical trial (RCT)	1	16 healthy men	BP	Determine the influence of the arm position on intra-arterial BP	each 5 cm change in the arm level is accompanied by a 3-4 mm Hg change in the BP value
25	Mehag-noul-Schipper 2000	Controlled observation	2b	17 healthy subjects, 18 heart failure patients with normal systolic function + 24 geriatric patients, aged >70 yrs	BP	To determine the minimum period required for obtaining hemodynamic baseline values in elderly subjects during supine rest	A span of 5 min of supine rest ensured achievement of reliable and reproducible baseline BP values by Finapress in elderly subjects
26	Netea, 1998	Clinical trial (RCT)	1	245 subjects (171 hypertensives), both sitting and supine	BP	To test whether there is any difference between the blood pressure readings with	The subject's body posture influenced especially the diastolic BP and heart rate, both being

[2] The grade of evidence of the systematic review was classified as level 3, expert opinion, because the authors indicated no search criteria, and only a few references

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
				BP measurements		patients sitting and supine	significantly higher with patients sitting rather than supine. This effect decreased with age. For indirect BP measurement, DBP values obtained with subjects sitting and supine cannot automatically be regarded as equivalent
27	Manning 1983	Observational study	2c	200 BP determinations on 167 unselected adult outpatients	BP	To study cuffing habits of staff members and compare them with newly revised AHA guidelines on BP measurement	In miscuffing, undercuffing large arms is the most frequent error. The accuracy of our BP determinations can be improved by remarking the cuffs and using guidelines
28	O'Brien, 1996	Systematic review, no search period indicated, 57 references	1		BP	Review of the literature on the error that may be introduced to BP measurement by using a cuff with a bladder of inappropriate dimensions for the arm for which it is intended	A detailed review of the literature permits a definitive statement on bladder dimensions for a given arm circumference and indicates that substantial error is caused by the use of inappropriate cuffs.

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
29	Frohlich, 1988	Consensus, no search period indicated, 31 references	3		BP	Present recommendations of the American Heart Association (AHA) for BP determination	AHA guideline with recommendations on BP determination
32	Ooi, 2000	Cohort (prospective)	2b	844 elderly>60 years	OH	Determine whether OH, including timing and frequency was associated with falls	OH independent risk for falls, precautionary measures are needed
33	Onrot, 1986	Systematic review, no search period indicated, 71 references	1		OH	Review on the management of OH	The goal of managing OH is to minimize symptoms Therapy is based on the underlying pathophysiology and the risk/benefit ratio of interventions.
34	Caine, 1998	Clinical trial	2a	80 patients (age unknown) and 3 measurement devices.	OH	Validity of routine BP equipment to measure OH	Routine equipment is not adequate to diagnose OH because of a delay of 30 sec before the measurement is obtained
35	Dossa, 1993	Controlled observation	2b	24 patients with cardiac disease	OH	To conduct the optimal time to measure OH, the effect of	Greatest systolic BP decreases were at 30 seconds after position

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
				(postmyocardial infarction and CABG), mean age 74 yrs		position on OH and the effect of cardiac drugs on OH	change Absence of a drug-mediated effect in this group
36	Ward, 1996	Controlled observation	2b	40 outpatients (mean age 77+/- 8 years; 24 women), with a symptomatic OH	OH	To evaluate the reproducibility of orthostatic blood pressure changes in patients with documented symptomatic OH	Orthostatic BP responses may not be reproducible in patients with symptomatic OH, particularly if autonomic function is normal and measurements are taken in the afternoon Repeated SBP measurements in the morning may be necessary to make a diagnosis in older patients with suspected OH
37	Belmin, 1997	Controlled observation	2b	53 consecutive elderly patients (43 women and 10 men aged 83 7 +/- 9 5 years) of an intermediate care geriatric ward.	OH	To investigates the within-day and day-to-day variability of the BP response to orthostatism and the reproducibility of the diagnosis of OH in this population	Within-day and day-to-day reproducibility of the diagnosis of OH, were found to be poor.

Chapter 5, Table 2

Ref nr	Author / year	Design	Evidence level[18]	Subjects	Focus	Aim of the study	Scientific evidence for
38	Mehag-noul-Schipper 2000	Clinical trial	2a	18 healthy elderly subjects (aged 70-83 yrs) and 10 healthy young subjects (aged 22-45 yrs)	OH	To quantify postural changes in cerebral oxygenation and systemic hemodynamics in healthy elderly and young subjects	In healthy elderly BP decreases no earlier than after two minutes of standing and still is present after 3 minutes of standing
39	Jansen, 1995	Clinical trial	2a	22 nursing home residents, mean age 89 +/- 5 (SD) years	OH	To determine the reproducibility of OH and postprandial hypotension, their relationship to each other, and the association with chronic use of cardiovascular medications	Patterns of systolic BP response to meals or postural change are reproducible, and seem to be unaffected by potentially hypotensive medications in chronic users
40	Lipsitz, 1985	Clinical trial	2a	15 elderly institutionalized elderly, mean age 87 ± 7 yrs	OH	To evaluate the day-to day variability of OH and relative contributions of BP elevation and abnormalities in extracellular volume regulation to OH	A wide day-to-day variability in postural SBP and a strong negative correlation between each day's postural change in SBP and basal supine BP

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Chapter 6

The influence of low-, normal and high carbohydrate meals on blood pressure in elderly patients with postprandial hypotension

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Abstract

Background: Postprandial hypotension (PPH) is a common and serious disorder of blood pressure (BP) regulation in elderly people. It has been suggested that primarily the carbohydrate (CH) content of a meal induces the BP decrease. Therefore, we examined the relation between the CH amount in meals and postprandial BP responses in elderly patients diagnosed with PPH

Methods: Twelve geriatric patients, aged 75 to 91 years (6 men) who were previously diagnosed with PPH received standardized liquid meals with low- (25 gram), normal- (65 gram) and high- (125 gram) CH content (Nutrical®) in random order on 3 separate days. Systolic BP (SBP), diastolic BP (DBP) and heart rate (HR) were measured every 5 minutes from 20 minutes before until 75 minutes after each meal. Postprandial symptoms were recorded every 15 minutes.

Results: The maximum decrease in SBP was significantly smaller after the low CH meal (-28 ± 5 mm Hg) than after the normal (-39 ± 7 mm Hg) and high CH meal (-40 ± 5 mm Hg) ($P < .050$ between groups). In addition, the duration of PPH was significantly shorter ($P < .010$) and postprandial symptoms were less frequent and less severe after the low CH meal.

Conclusions: Reducing the CH amount in meals induces significantly smaller decreases in SBP, shorter duration of PPH and reduction of PPH-related symptoms. Therefore, limiting the CH content of a patient's meal can be a clinically very effective non-pharmacological treatment for PPH in elderly patients and can reduce the risk of developing symptomatic PPH

Introduction

Postprandial reductions in blood pressure (BP) are very common in elderly people and associated with serious morbidity such as dizziness, falls, and syncope[1-7] Postprandial hypotension (PPH) is generally defined as a decrease in systolic blood pressure (SBP) ≥ 20 mm Hg within 75 minutes of the start of a meal[1]. PPH is distinct from orthostatic hypotension (OH) and might occur more often than OH and infrequently together with OH in elderly patients[8]. Studies of elderly people living in long-term healthcare facilities have shown that nearly all elderly subjects experience some decline in SBP after eating a meal, and 24 to 36% of these subjects have a postprandial decline in SBP ≥ 20 mm Hg[3,9]

The pathophysiology of PPH in elderly people is not fully understood, but several hypotheses have been suggested[1] Factors that might contribute to the occurrence of PPH are: impaired cardiovascular compensation, reduced baroreflex sensitivity, impaired activation of the sympathetic nervous system, reduced compensatory peripheral vasoconstriction, and humoral factors such as gut peptides[1 6,10-12]. Finally, oral carbohydrate- or glucose-mediated factors are involved[1]

Jansen et al. have demonstrated that the postprandial BP response depends on the composition and particularly the carbohydrate (CH) content of the meal ingested[1,13] Oral glucose and the subsequent insulin release primarily cause the BP effects of CH. Other CHs, such as oral fructose, oral xylose, and intravenous glucose do not or only minimally affect BP, just like fat and proteins[13-16]

Lowering the CH content in meals by adjusting the size and frequency of meals has been suggested as an important and clinically relevant non-pharmacological treatment of PPH[1] However, studies demonstrating the effect of adjusting the CH amount in meals on postprandial BP responses in elderly patients with PPH, have not been reported to date. Therefore, the present study was designed to examine the effect of different amounts of CH in meals on postprandial BP responses in elderly patients with PPH to determine the value of the advise to reduce the CH amount in meals in the treatment of PPH.

Methods

Subjects

Twelve geriatric patients with previously diagnosed PPH were recruited from the (outpatient) clinic of the department of Geriatric Medicine of the University Medical Center Nijmegen, the Netherlands Preset inclusion criteria were age ≥ 70 years, a diagnosis of PPH and possibility of complete medication withdrawal for at least 12 hours Preset exclusion criteria were acute diseases, insulin dependent diabetes mellitus, chronic atrial fibrillation, fixed pacemaker, problems with oral food ingestion, and moderate or severe cognitive impairments that would prevent the patient from cooperating with the study protocol All subjects gave their written informed consent to this study The investigation was approved by the ethics Committee for Research on Human Subjects of the University Medical Center Nijmegen, the Netherlands

Procedure and instrumentation

Three meal studies with different amounts of CH were performed in a single-blinded design in random order on 3 separate mornings within a maximum period of 10 days The tests took place in a quiet room at an ambient room temperature of 21-24°C All participants had an overnight fast and medication withdrawal from midnight the night before The subjects voided and were familiarized with the study protocol, and the BP equipment was put on before start of the test Each test consisted of 20 minutes of rest, ingestion of a liquid test meal within 10 minutes, and 75 minutes of rest after the start of the meal, all in the sitting position to simulate a common eating situation The standardized test meals consisted of Nutrical® (Nutricia, Zoetermeer, the Netherlands), which is a liquid CH meal composed of glucose-syrup, completed with water up to a total volume of 200 ml The meals were served at a temperature of 22°C to avoid potential temperature effects on BP[17] The 3 different meals had CH contents of 25 gram, 65 gram or 125 gram, corresponding to respectively small, regular or large meals for elderly subjects Meals with 65 gram of CH are also used in diagnostic tests for PPH[18]

SBP, Diastolic BP (DBP) and Heart Rate (HR) were measured every 5 minutes with a Dinamap (Critikon 1846 SX, Critikon Inc., Tampa, FL) from 20 minutes before until 75 minutes after the start of the meal Postprandial symptoms and changes in the patients' baseline condition in relation to BP changes were recorded every 15 minutes during the test. A standardized list with symptoms related to PPH according to the literature was used and patients were observed continuously by the researcher. Symptoms were scored on a four-point scale absent, mild, moderate or severe

Statistical analysis

Statistical analysis was performed with SPSS for Windows 8.0 (SPSS Inc , 1998). A *P*-value < .050 was taken as the level of significance. The results are expressed as mean and standard error of the mean (SEM).

Baseline values of SBP, DBP and HR were defined as the values measured just before the meal ingestion after 20 minutes of rest in sitting position. Differences in baseline values or maximum changes in BP or HR between the tests were tested by paired *t*-tests. Two-way repeated measures ANOVA was applied to examine the overall effects of time, CH amount in meals, and the time-by-CH amount interaction on BP changes versus baseline over the 3 tests. The correlation between BP responses and OH, hypertension, weight and age were determined by Pearson's correlation test and stepwise linear regression analysis.

Results

Subject characteristics

The clinical characteristics of the12 patients with PPH are presented in Table 1.

Postprandial changes in systolic blood pressure, diastolic blood pressure and heart rate.

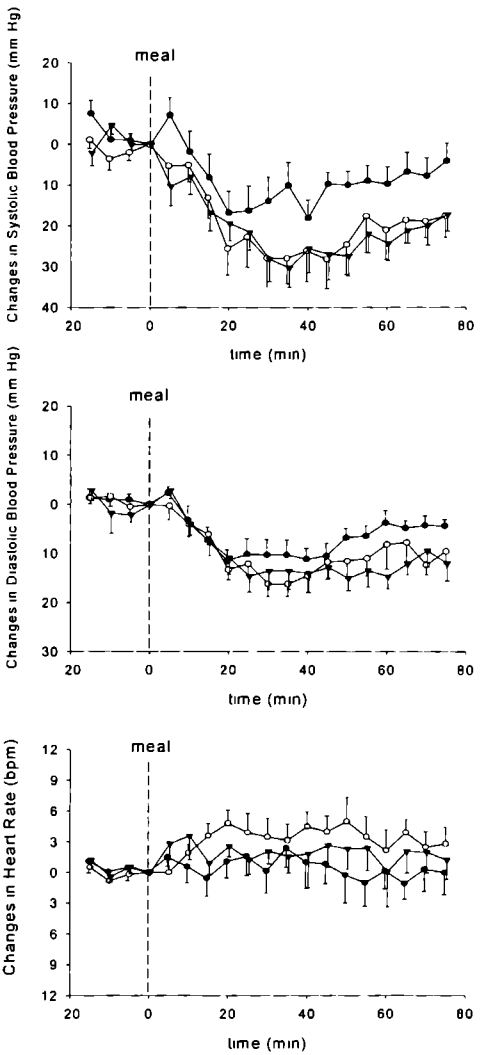
Figure 1 shows the group-averaged changes in SBP, DBP and HR versus baseline after the low-, normal-, and high CH meals.

Table 1. *Baseline clinical characteristics of 12 geriatric patients diagnosed with postprandial hypotension*

Characteristic	Value	Characteristic	Value
Age (years) *	80 ± 4	Systolic blood pressure *	159 ± 32
Gender (male/female)	6 / 6	Diastolic blood pressure *	83 ± 12
Quetelet index (kg/m2) *	22 3 ± 1 9	Heart Rate (bpm) *	70 ± 11
Medical history		Number of medication *	4 ± 1
Cardiovascular problems	6	Cardiovascular medication	6
- Hypertension	4	- ACE-inhibitors	1
- Orthostatic hypotension	6	- Beta-blockers	1
- Heart failure	2	- Diuretics	2
Respiratory problems	2	- Glycosides	1
- COPD	2	- Anticoagulants	5
Neurological problems	2	Respiratory medication	1
- Parkinson's disease	2	- Corticosteroids	1
- Dementia	-	Levodopa/benseraside	1
Digestive problems	3	Laxatives	3
- Constipation	3	Antacids	2
Peptic Ulcer Disease	2	Psychiatric medication	
Psychiatric problems	10	- Benzodiazepines	1
- Anxiety	1	- Antidepressant drugs	4
- Depression/ mood disorders	5	- Antipsychotic drugs	1
- Agitation	1	Other agents	
- Memory disturbances	3	Analgesics	3
Urinary problems	3	Vitamin B12	3
- Prostate problems	2	Eye drops	2
- Urinary incontinence	1	Antiemetics	2
Mobility problems	4		

COPD = chronic obstructive pulmonary disease, ACE = angiotensin converting enzyme * Value is mean ± SEM

Figure 1. *Changes in systolic blood pressure (SBP) (upper part), diastolic blood pressure (DBP) (middle part), and heart rate (HR) (lower part) in 12 elderly patients with PPH after ingestion of standardized liquid meals with low- (closed dots, •), normal- (open dots, °) and high (closed triangles, ▼) carbohydrate contents Data are presented as mean (SEM)*



After each meal, SBP decreased significantly over time ($P < 050$). The maximum reduction in SBP was significantly smaller after the low-CH meal (-28 ± 5 mm Hg) compared with the normal- (-39 ± 7 mm Hg) and high-CH meals (-40 ± 5 mm Hg) ($P = 043$, $P = 005$ between groups). The SBP responses after the normal- and high CH meals were similar

DBP decreased significantly after each meal ($P < .050$), but a significant difference between the DBP responses after the 3 different CH meals was only present between the low and high CH meal (P = .009).

The HR changes over time were not significant after any of the 3 meals. Significant differences between the HR responses after the low-, normal-, and high CH meals were not present either, although HR tended to increase more after the normal CH meal than after the low CH meal ($P = .065$).

Group-averages of the maximum individual changes in SBP and group-averages of the simultaneous individual changes in DBP and HR are presented in Table 2. Individual DBP differed significantly at the maximum individual SBP decreases, between the low and high CH meal ($P = .044$). In the low CH meal, HR differed significantly on the time of maximum SBP decrease compared to the normal CH amount ($P = .044$).

***Table 2**: Maximum individual changes in SBP and simultaneous changes in DBP, HR, and duration of PPH*

CH amount	ΔSBP (mm Hg)	ΔDBP (mm Hg)	ΔHR (bpm)	Duration of PPH (min)
Low CH	-28 ± 5* §	-13 ± 2 ‖	-2 ± 2 †	18 ± 6 ‡ ¶
Normal CH	-39 ± 7	-17 ± 2	3 ± 2	37 ± 7
High CH	-40 ± 5	-19 ± 4	1 ± 2	43 ± 6

Note SBP = systolic blood pressure, DBP = diastolic blood pressure, HR = heart rate, PPH = postprandial hypotension, CH = carbohydrate. * P = 043, † P = 044, ‡P = .003 versus normal CH meal, § P = 005, ‖ P = .044, ¶ P = 002 versus high CH meal

Duration of postprandial hypotension

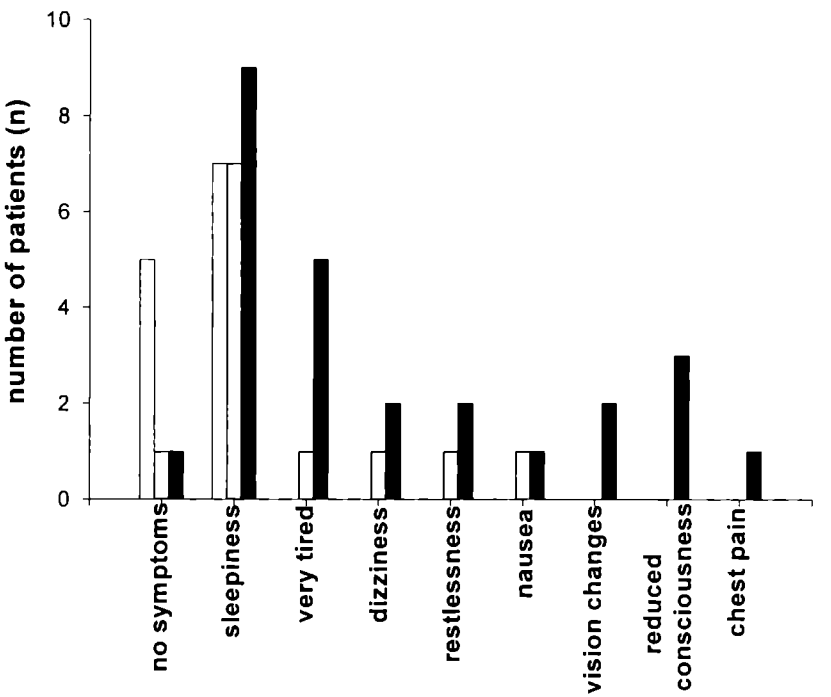
The total period during which PPH, defined as a SBP decrease ≥ 20 mm Hg versus baseline, was present, was significantly shorter after the low CH meal

(18 ± 6 minutes) than after the normal-CH meal (37 ± 7 minutes) and the high-CH meal (43 ± 6 minutes) (P = 003 and P = .002 between groups) (Table 2)

Presentation of symptoms

The postprandial symptoms varied in frequency and severity after the 3 meals with different CH amounts (Figure 2).

Figure 2. *Meal-induced symptoms in 12 geriatric patients with PPH after ingestion of standardized liquid meals with low- (open bars), normal- (grey bars) and high (black bars) carbohydrate contents. Data columns present the number of patients with symptoms*



After the low-CH meal, 5 patients had no symptoms and 7 patients felt somewhat sleepy After the normal-CH meal only 1 patient had no symptoms or complaints, whereas 7 patients felt sleepier and some patients noted restlessness, dizziness, or nausea After the high-CH meal, all but 1 patient felt very sleepy and 2 patients felt dizzy and restless In addition, even more severe symptoms such as vision changes (n = 2), reduced consciousness (n = 3), and chest pain (n = 1) were noted These symptoms were related to the hypotensive periods with SBP declines ≥ 20 mm Hg in the patients, although 2 patients felt sleepy at the end of the test while their SBP had recovered again The chest pain in one patient resolved as the BP returned to normal

Correlation between blood pressure and patient characteristics

Baseline SBP was significantly correlated with the duration of PPH in the low- (r= 627, P = 029) and normal-CH meal (r = 715, P = 009), but not in the high-CH meal (r = 420, P = 174) Significant correlation was also found between hypertension and the duration of PPH in the normal-CH meal (r = 702, P = 011) No significant correlation was found between OH and the duration of PPH, neither with declines in SBP, DBP and HR in all meal sizes

Discussion

The main findings of this study are that low CH meals induce significantly smaller SBP declines, significantly shorter periods with SBP declines ≥ 20 mm Hg, and less frequent and less severe symptoms compared to normal- and high-CH meals in elderly patients with PPH

Although the physiology of postprandial BP responses has not been fully understood, it has been suggested that the type of food plays an important role in PPH[1] The amount of CH, and in particular oral glucose, primarily causes the BP effect of meals[12 13 15 19] In healthy subjects, these hemodynamic changes result in increases in HR, plasma norepinephrine, cardiac output, and peripheral vascular resistance to compensate for splanchnic blood pooling and to prevent significant BP reductions[6] PPH can occur if compensatory mechanisms fail[1] After meals, hypertensive elderly have a smaller increase in HR than

normotensive elderly persons[13], whereas in frail elderly persons PPH is associated with the absence of an acceleration of cardiovascular responses[2] The significant drops in BP with only small compensatory increases of HR seen in this study could be due to the frailty of our subjects, hypertension or impairments of the autonomic nervous system Further studies should consider whether the hemodynamic changes are explicable on the basis of the amount of CH or on different rates of gastric emptying based on the calorie delivery in the small intestine[20]

Because any decline in SBP ≥ 20 mm Hg can be dangerous due to symptoms such as syncope, dizziness or falls, prevention of postprandial hypotensive periods is very important[1] Unfortunately, there are only a few studies on the treatment of PPH[1] Pharmacological interventions in the treatment of PPH are restricted Octreotide, a somatostatin analog, has been shown to be effective, but it is expensive and must be given parenterally[21] Well-considered treatment of hypertension could also reduce the risk for PPH[1 18] Although caffeine is often recommended as treatment for PPH, available data do not support its use[7 22] Because of the limited usefulness and possibilities of pharmacological treatment of PPH, non-pharmacological interventions become more prominent Several nonpharmacological empirical advises for the treatment of PPH have been suggested such as maintaining the patient's intravascular volume or for instance lie down after a meal for 1 to 2 hours On the other hand, it has been demonstrated that walking restore the postprandial BP declines, this effect disappears immediately after a patient stops walking[1 23] One of the most important suggested measures in the treatment of PPH seems to be adjusting the size or composition of a meal

Three studies investigated reduction of meal size or reducing the CH amount in meals in young healthy adults and adults with primary autonomic failure[24-26] They found that in healthy adults, a high-CH meal induced larger and more prolonged blood flow responses than a small meal In addition, there were substantial peripheral and central cardiovascular changes after food ingestion that suggested a relationship between meal size and cardiovascular responses[24 26] Changing three large meals into six small meals with an identical

daily caloric intake reduced PPH and symptoms of post-meal postural dizziness in adults with primary chronic autonomic failure[25] In this study in elderly patients over 75 years with PPH, reducing the amount of CH in meals was successful because of a significant smaller decrease in SBP, a significantly shorter duration of PPH and fewer and less severe symptoms Although we used liquid meals, and the conclusions cannot be extrapolated to solid meals, application of reducing regular meals in clinical practice, and in patients with autonomic failure reduced PPH and showed less symptomatic patients[25] In a study of healthy men, no significant changes in SBP or DBP were shown after solid or liquid meals[27] Indeed, further research is warranted to compare the effects on reducing CH in liquid and solid test meals and regular meals in elderly for clinical application This study indicates that reducing the amount of CH in a meal can be an easy, inexpensive but successful intervention in the overall non-pharmacological treatment to reduce postprandial declines in SBP and can improve hypotensive symptoms and shorten the period at risk in elderly patients with PPH

Several limitations of this study need to be pointed out First, we performed our tests in the sitting position Although orthostatic changes in BP during prolonged sitting might contribute to the postprandial decreases in BP, we found it more physiologic to give patients their meals in a sitting position Six of our patients were diagnosed with OH before inclusion in this study OH was not correlated with the duration of PPH, neither with declines in SBP, DBP and HR Second, some of the patients' complaints during the test were very general For example, some patients complained of nausea, which could have been due to the sweet taste of the testmeal However, all symptoms were related to declines in SBP Tiredness at the end of the test could be due to the length of the measurements Only two subjects complained about fatigue while their SPB had already recovered

In conclusion, lowering the CH content in meals results in significantly smaller SBP declines, significantly shorter periods with SBP declines ≥ 20 mm Hg, and less frequent and less severe symptoms than after normal- and high-CH meals in elderly patients with PPH Further research is warranted to establish if

limiting the CH content in regular meals by reducing the size and increasing the frequency of meals, can be an easy, inexpensive but successful intervention in the overall non-pharmacological management of PPH in elderly patients.

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Chapter 7

The effect of meals at different mealtimes on blood pressure and symptoms in geriatric patients with postprandial hypotension

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Abstract

Background The variability of postprandial hypotension (PPH) during the day in elderly patients is unknown We examined the effect of meals administered at different mealtimes on postprandial blood pressure (BP) responses in geriatric patients

Methods In fourteen geriatric patients (6 male, age 66-97), previously diagnosed with PPH, standardized liquid test-meals were given in random order at breakfast, lunch- or dinnertime on 3 separate days Systolic BP (SBP), diastolic BP (DBP) and heart rate (HR) were measured every 10 minutes from 20 minutes before until 90 minutes after each meal with an ambulatory BP device (Spacelab 90207) Postprandial symptoms were observed continuously

Results Significant decreases in SBP and DBP were present after each meal ($P< 050$) The maximum SBP decrease was significantly smaller at dinnertime (-18 ± 3 mm Hg) than at breakfast- (-29 ± 2 mm Hg) or lunchtime (-34 ± 4 mm Hg) ($P< 005$ between groups) Eight patients showed no PPH in the evening, whereas all patients had PPH after breakfast and lunch The duration of PPH was significantly shorter ($P< 001$) and postprandial symptoms were less frequent and less severe after dinner compared to breakfast and lunch

Conclusions In geriatric patients, postprandial BP responses show a variation during the day, with significantly less PPH and symptoms in the evening Clinical implication is that in the diagnostic process and management of PPH the variation of the occurrence of PPH during the day should be taken into account Through adjustment of BP decreasing activities to the time PPH is least prevalent the risk of developing symptomatic PPH can be reduced

Introduction

In elderly people, postprandial hypotension (PPH) is a very common and serious finding[1]. PPH is associated with dizziness, falls, syncope, coronary events, stroke and total mortality[1-4] Nearly all elderly show some decline in systolic blood pressure (BP) after eating a meal and one-third of nursing home patients show postprandial declines ≥ 20 mm Hg[3,5]. Recently, we found PPH in 41% of healthy elderly subjects, in 82% of geriatric patients with Parkinson's disease and in 55% of elderly patients with heart failure[6,7].

Important mechanisms and age- and illness-related factors contributing to PPH have been discussed extensively elsewhere[1,8-12]. Because pharmacological treatments of PPH are limited, non-pharmacological interventions become more important[1]. Several empirical non-pharmacological treatments for PPH have been suggested, such as lying down after a meal for 1 to 2 hours, to prevent falling[1]. It has also been demonstrated that walking after a meal restores the postprandial BP declines[13]. However, this compensatory effect on BP disappears immediately after the patient stops walking[13] Other measures in the treatment of PPH are adjustment of the size or composition of a meal e g by reducing the amount of carbohydrates[14 15].

Most studies investigating the effects of meals on BP have been performed in the morning[6 7,14]. For diagnosis and treatment of PPH, however, it is important to know whether there is a variation in postprandial BP changes during the day From orthostatic hypotension (OH) it is known that the prevalence is highly variable over time[16]. It has been shown that meals and physical activities are the major factors that influence the daytime variation in BP in the elderly[17] Variability of PPH during the day could have clinical implications for the timing of tests to diagnose PPH and for the treatment of PPH. Therefore, the aim of this study is to examine the effect of different mealtimes on postprandial BP responses in elderly patients with PPH

Methods

Subjects

During their first week of admission to the Geriatric department of the University Medical Center Nijmegen, the Netherlands, all patients are screened for OH and PPH as part of a standard geriatric evaluation Patients with PPH defined as a post-meal reduction in SBP ≥ 20 mm Hg, were selected from this evaluation to participate in the present study Pre-set inclusion criteria were ages ≥ 65 years, diagnosed with PPH, and the possibility of complete medication withdrawal for 24 hours Pre-set exclusion criteria were acute diseases, diabetes mellitus, chronic atrial fibrillation, pacemaker dependency, and problems with oral food ingestion, and cognitive impairments such that a subject was unable to understand the study protocol All subjects gave their informed consent The Ethics Committee for Research on Human Subjects of the University Medical Center Nijmegen, the Netherlands, approved this study
A sample size of 14 patients was required to identify differences in postprandial BP responses between breakfast, lunch or dinner of 10 mm Hg or more (Standard Deviation of BP-responses 10 mm Hg, power 80%, significance level 5%) Sixteen consecutive patients with PPH started the series of three meal-studies One patient was discharged from the hospital and chose not to complete the protocol, one patient dropped out because of an intercurrent pneumonia between the tests Fourteen patients completed the study

On three separate days, a test-meal was given in random order at breakfast-, lunch- or dinnertime, at 8 30 AM, 1 00 PM, 5 30 PM respectively Testing days were separated by an interval of three days (range 2-5 days) All tests took place in a quiet room with an ambient temperature of 21-24°C The participants had medication withdrawn from midnight the night before until after their test For all tests at lunch- or dinnertime, patients refrained from oral intake four hours before the test For the test at breakfast, all participants had an overnight fast For the lunchtime test, all patients took a small breakfast consisting of 1 slice of bread, with butter and ham or cheese, 1 cup of milk and 1 cup of tea without sugar, containing approximately 25 gram of glucose, and approximately

210 kcal. For the dinnertime test, all participants ate a small breakfast and a lunch as described in the breakfast test Although recent studies showed that both tea and coffee do not prevent PPH, drinking coffee was not allowed on all testing days until the measurements were performed, to avoid any potential effects of caffeine on the BP[18,19]. Each test consisted of 20 minutes of rest, ingestion of a test-meal within 10 minutes, and 90 minutes of rest after the start of the meal, all in the sitting position to simulate a common eating situation for most people as much as possible[1]

The standardized liquid test-meals consisted of 100 ml of Nutrical® (Nutricia, Zoetermeer, the Netherlands), which is a liquid CH meal composed of glucose-syrup, and 100 ml lactose-free whole milk, containing 292-kcal, 65 g carbohydrate, 2 g fat and 4 g protein. This meal composition has been used as diagnostic tests for PPH[7]. The meals were served at a temperature of 22°C to avoid potential temperature effects on BP[20].

SBP, Diastolic BP (DBP), Mean Arterial Pressure (MAP) and Heart Rate (HR) were measured every 10 minutes throughout the test with an ambulatory automatic BP device, (Spacelab 90207, Spacelabs Medical Inc, Redmond, WA, U.S.A)[21].

Patients were asked for their complaints before the meal to document the patients' baseline condition. During the test the researcher observed the patients continuously. A standardized list with symptoms related to PPH according to the literature was used[1-3]. Symptoms were scored on a four-point scale and coded (absent = 0, mild = 1, moderate = 2 and severe = 3) The time symptoms appeared and disappeared was recorded.

Statistical analysis

Statistical analysis was performed with SPSS for Windows 10 0 (SPSS Inc., 2000, Chicago, USA). A P-value <.050 was taken as the level of significance. The results are expressed as mean and standard error of the mean (SEM).

Baseline values of SBP, DBP, and HR were defined as the last value measured before the meal ingestion Differences in baseline values or maximum changes in BP between the tests were tested by paired t-tests. Two-way repeated

measures ANOVA was applied to examine the overall effects of time, time of meal ingestion, and the time-by-meal interaction on BP changes versus baseline over the 3 tests Pearson's correlation test was used to determine the correlation between BP responses and patient characteristics

Results

The characteristics of participants of this study are summarized in Table 1

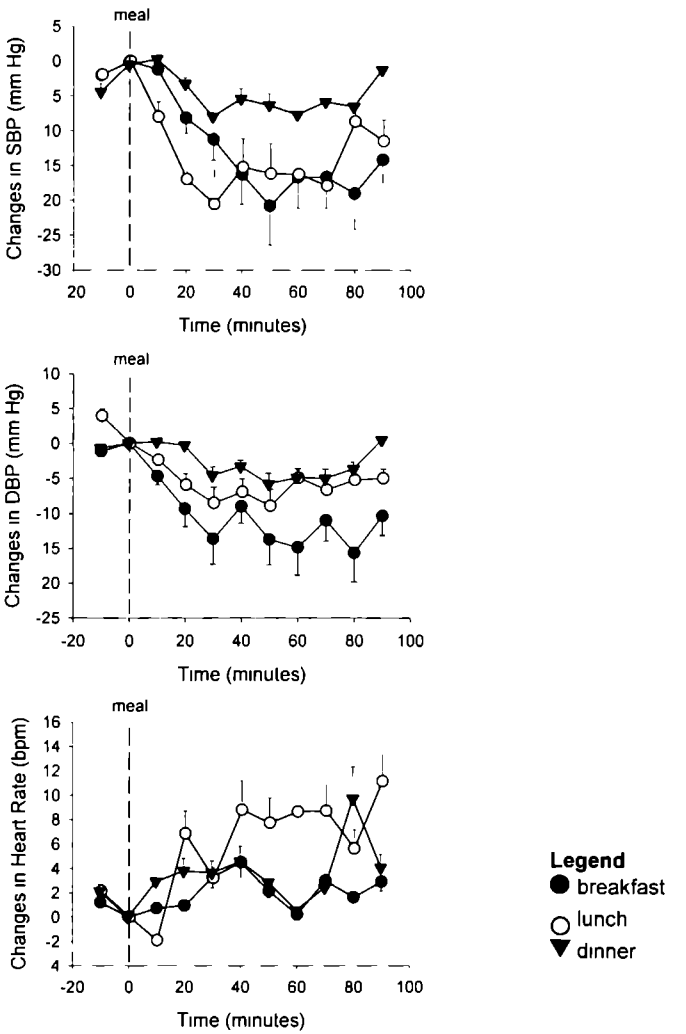
Table 1. *Patient characteristics (n = 14)*

Parameter	Mean ± SEM
Gender (male / female)	6 / 8
Age (years)	82 ± 2
Systolic blood pressure (mm Hg)	149 ± 5
Diastolic blood pressure (mm Hg)	80 ± 5
Heart rate (bpm)	75 ± 3
Height (cm)	165 ± 3
Weight (kg)	63 ± 3
Body mass index (kg/m^2)	23 ± 1
Orthostatic hypotension *(n)*	6
Cardiovascular disorders *(n)*	8
Respiratory disorders *(n)*	5
Neurological disorders *(n)*	3
Gastrointestinal disorders *(n)*	5
Psychiatric disorders *(n)*	9
Total amount of prescriptions per patient	6 ± 1
Cardiovascular medication *(n)*	8
Respiratory medication *(n)*	4
Gastrointestinal medication *(n)*	5
Neurological medication *(n)*	1
Psychiatric medication *(n)*	12
Analgesics *(n)*	11

Postprandial hemodynamic changes

Figure 1 shows the group-averaged changes in SBP, DBP, and HR

Figure 1. *Mean changes in Systolic Blood Pressure (SBP) (upper part), Diastolic Blood Pressure (DBP) (middle part) and Heart Rate (HR) (lower part) in 14 geriatric patients with PPH after ingestion of standardized liquid meals at breakfast- (closed dots), lunch- (open dots) and dinner- (closed triangles) time Data are presented as mean ± SEM*



Group-averages of the maximum individual hemodynamic changes are presented in Table 2

Table 2 *Maximum individual changes in Systolic Blood Pressure (ΔSBP), Diastolic Blood Pressure (ΔDBP), and Heart Rate (ΔHR), and changes in Diastolic Blood Pressure (DBP), Heart Rate (HR) at the time of maximum SBP decrease, and duration of PPH (mean ± SEM)*

Time of meal	ΔSBP mm Hg	DBP mm Hg	HR bpm	ΔDBP mm Hg	ΔHR mm Hg	Duration Minutes
8 30 AM	-29 ± 2 *	-12 ± 3 ‡	3 ± 1 §	-20 ± 3 ‖	9 ± 1	31 ± 5 ¶
1 00 PM	-34 ± 4 †	-12 ± 2	6 ± 2	-16 ± 2	17 ± 4	31 ± 6 **
5 30 PM	-18 ± 3	- 6 ± 3	9 ± 4	-13 ± 3	13 ± 4	9 ± 4

* P = 001 breakfast (BK) vs. dinner (DN), † P = .004 lunch (LN) vs DN, ‡ P = 031 BK vs DN, § P = 034 BK vs LN, ‖ P = .031 BK vs DN; ¶ P = .003 BK vs DN, ** P = < 000 LN vs DN

After each meal, SBP decreased significantly over time (P<.050). The reduction in SBP was significantly smaller after evening meals compared to breakfast- (P=.001) and lunchtime meals (P= 004) Eight of the fourteen participants (57%) had no postprandial decrease ≥ 20 mm Hg after dinner, whereas all patients showed PPH at breakfast and lunchtime. The maximum individual decrease in SBP after breakfast correlated significantly with baseline SBP (r= -.595, P=.025).

DBP decreased significantly after each meal (P<.050), with a significant difference in DBP-decline after breakfast and dinner (P= 031). No significant differences in DBP-decrease were present between breakfast and lunch (P= 112) or between lunch and dinner (P=.292).

HR increased after any of the 3 meals, but did not change significantly. At the time of maximum decrease in SBP, HR increased significantly less after breakfast than after lunch (P=.034). HR tended to increase more after dinner than after lunch and breakfast (P= 061).

Duration of PPH

The postprandial hypotensive period was significantly shorter after dinnertime meals than after breakfast and lunch (P< 010, between groups) (Table 2) The mean maximum SBP decline after breakfast occurred at 50 minutes after the meal (-21 ± 2 mm Hg), whereas SBP decreased maximally at 30 minutes after lunch (-21 ± 4 mm Hg) and after dinner (-8 ± 3 mm Hg) Significant correlation was found between maximum decrease in SBP and the duration of PPH after breakfast (r= - 715, P= 004) and dinner (r= - 590, P= 026)

Symptoms

The postprandial symptoms varied in frequency and severity at different mealtimes After breakfast, five patients had no symptoms, and six patients felt sleepy One patient was restless, one patient turned pale, a third patient had a blurred vision After lunch, five patients felt very tired, four participants were sleepy, two noted dizziness, and one patient looked pale One person had disturbed speech, a headache, was sweating and lost consciousness when SBP decreased with 74 mm Hg, 20 minutes after lunch A physical examination was performed, and the patient's wheelchair was tilted into a supine position This patient, who was familiar with syncope, regained consciousness within 10 minutes when BP had returned to basal BP Only three patients had no symptoms following lunch After dinner, six patients noted sleepiness and eight patients had no symptoms All described symptoms were concurrent with SBP declines ≥ 20 mm Hg, although at all mealtimes 2 patients felt sleepy at the end of the test although their SBP had recovered again

Discussion

The main finding of this study is that we demonstrated a clinically relevant variation of postprandial BP responses during the day in elderly patients with PPH Postprandial declines in SBP were significantly larger at breakfast- and lunchtime than at dinnertime In more than half of our study-population PPH was absent after dinner In addition, test-meals at dinnertime induced significantly shorter hypotensive periods and patients had almost no symptoms

compared to meals at breakfast- or lunchtime. This variation during the day has implications for the timing of diagnosis and treatment of PPH

The diagnosis of PPH should be based on BP measurements around breakfast or lunch, because of the postprandial variation over the day and the frequent absence of PPH after dinner. The postprandial SBP responses in the morning have been shown to be reproducible[22]. Interventions such as BP-decreasing activities or cardiovascular medication should preferably be prescribed in the evening, to reduce the risk of developing symptomatic PPH in the elderly

Possible explanations for the differences in postprandial BP during the day include baseline SBP and impaired BP-regulation[1]. Kohara et al. found that hypertensive patients with PPH showed more profound awakening-related increases in SBP before breakfast, and therefore had larger postprandial SBP decreases, which can be explained by baroreflex dysfunction[23]. We found a significant correlation between baseline SBP and large postprandial SBP decreases after breakfast indicating that higher baseline SBP and large postprandial decreases are both markers of impaired BP-regulation. Although our population was very heterogeneous, Puisieux et al. confirmed that postprandial decreases in SBP in elderly were higher after breakfast than after lunch and dinner[24] Unfortunately, they used non-standardized meals and permitted medication at breakfast[24]. Because we used identical test-meals at all mealtimes and prohibited medication, the meal composition or drugs cannot explain the differences in cardiovascular responses at different times of the day. Although the rate of nutrient delivery into the small intestine is a significant determinant of the postprandial fall in BP[25], the variation of PPH during the day cannot be explained by prior nutrient intake A postprandial fall in BP is almost immediately evident[1]. Our patients used a small comparable meal at both breakfast and lunch and subsequently had a standardized period of fasting before both the lunch-time and dinnertime test, so it can be expected that the potential additional effect of food remaining in the small intestine is the same at lunch and dinner. The differences in postprandial BP decrease between lunch and dinner are significantly evident, and cannot be explained by the prior intake of nutrients. There is a substantial variation in the volume and duration of

individual flow pulses in gastric emptying, which starts at approximately 1 minute after ingestion[26] Spiegel et al [27] calculated a rate of gastric emptying after mixed (solid and liquid) meals of 2 2 ± 0 4 kcal/min, when patients were seated In our study, it would take 133 minutes to empty the stomach With an interval of more than 4 hours between the meals, we believe the additional effect of the previous meal on PPH is very small

The study was carried out in a randomized fashion at three different days, but could not be blinded because all participants knew the time of the day the test was performed

The diagnosis of PPH can be difficult since most symptoms are non-specific Tiredness at the end of the test could also be due to the duration of the measurements This study was performed on patients diagnosed with PPH based on BP measurements during admission to the geriatric ward A few of these patients were a-symptomatic However, their postprandial BP decline in the evening was significantly less than after breakfast and lunch Although postprandial declines in BP imply a period of risk in all patients, the results of this study can be even more important for symptomatic PPH patients

Jansen et al indicated previously that OH and PPH were distinct mechanisms[22] Although orthostatic changes in BP during prolonged sitting might contribute to the postprandial decreases in BP, we found it more physiologic to give patients their test-meal in a sitting position OH was not correlated with alterations in postprandial BP at all mealtimes Accordingly, OH cannot explain the differences in PPH during the day

In conclusion, this study showed a variation of postprandial BP responses during the day in elderly patients with PPH After dinner, postprandial SBP declines are significantly smaller and the elderly subjects experience fewer and less severe symptoms than after breakfast or lunch Furthermore, at dinnertime the duration of PPH is significantly shorter, which shortens the period at risk for hypotension and cerebral hypoperfusion Clinical implication of these findings is that the diagnostic tests and the treatment of symptomatic PPH should be adjusted to the variation of PPH during the day

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Chapter 8

Discussion

Introduction

Postprandial- and orthostatic hypotension are, despite of their high prevalence, often not recognized in the elderly[1-3].

The studies presented in this thesis had the goal to investigate how extensive the problems of postprandial and orthostatic were in geriatric patients and how they were presented by elderly patients Furthermore, the studies intended to investigate how familiar nurses were with the diagnosis and treatment of these problems, to develop an evidence based guideline for blood pressure measurement to diagnose orthostatic hypotension, and to get evidence for some non-pharmacological interventions for the treatment of postprandial hypotension, that could be applied by nurses.

The studies in this thesis cover the whole nursing process of postprandial and orthostatic hypotension: identification of the problem, signs and symptoms, diagnosis, and possible interventions. Three studies on diagnosis and interventions were performed in geriatric patients admitted to acute care hospitals (chapters 2, 6 and 7) In two studies, skills and knowledge of nurses on postprandial hypotension and orthostatic hypotension were investigated (chapters 3 and 4). In chapter 5, a guideline was developed after review of the literature, and consulting a panel of experts. The current knowledge of the problem, etiology, symptoms and interventions of postprandial and orthostatic hypotension, important for nurses, are compiled in two nursing protocols on these diagnoses (Figures 8.1 and 8.2).

In this chapter, the studies that are described in chapters 2 through 7, and that are summarized in chapter 9, will be discussed in the light of previous studies and some methodological issues. An outline of the major conclusions and implications for nursing care will be described.

Conclusions, discussed in the light of previous studies

The first conclusion that could be derived from the studies in this thesis was that both postprandial and orthostatic hypotension were very prevalent in elderly patients admitted to the geriatric ward of acute care hospitals. Several authors have described the prevalence of postprandial or orthostatic hypotension either

in the elderly or in specific categories of patients, running to 36% and 30%, respectively[1,2,4-10]. The expectation was that geriatric patients would have increased prevalence rates compared to these earlier studies, because both postprandial and orthostatic hypotension increase with age, co-morbidity, and use of multiple drugs, that are characteristics of geriatric patients[11].

We found out that postprandial hypotension was present in 67% of the geriatric patients, and orthostatic hypotension in 52%. These percentages were much higher than previously described, indicating that hypotensive syndromes are very common in geriatric patients, and therefore important to recognize.

The second important finding was that orthostatic and postprandial hypotension occurred together in over one-third of the geriatric patients (37%). In a small study in 22 nursing home residents, indications were given that postprandial and orthostatic hypotension occur infrequently together in the same patient[12]

Our observation of the presence of orthostatic hypotension in slightly more than half of the patients with postprandial hypotension, was exactly as could be expected by a distribution of probability. This argues for independent underlying mechanisms for orthostatic and postprandial hypotension. Our results are in agreement with other authors suggesting that the underlying mechanisms are at least partly different[10,12], although there is a large similarity in etiology and circumstances influencing orthostatic and postprandial hypotension such as autonomic failure, hypertension, age, (cardiovascular) medication, and co-morbidity[1,2,12-14] (Fig. 8.1, 8.2)

The intensive monitoring of the symptoms during all tests has lead to important findings. We found an unexpected high number of symptomatic patients. Remarkably, the presentation of symptoms of orthostatic hypotension was distinct of the symptoms in postprandial hypotension Dizziness was absent in postprandial hypotension, whereas this was the most important symptom in orthostatic hypotension (96%). Sleepiness, which was the most common symptom in postprandial hypotension (78%) was absent in orthostatic hypotension, and nausea was present in 38% of the patients with postprandial hypotension and in only 4% of the patients with orthostatic hypotension The tendency to fall in patients with orthostatic hypotension was only 15% during the

test. Probably because patients only had to stand for 3 minutes, and did not have to walk Furthermore, in postprandial hypotension syncope was present in 14%, but not in orthostatic hypotension

The cerebral symptoms of postprandial hypotension and orthostatic hypotension probably depend on the extent to which cerebral perfusion is decreased[1 2 15]. The major differences in presentation of symptoms between orthostatic hypotension and postprandial hypotension could not be explained by the blood pressure declines alone Probably the different position of the patient during the standing or meal-test, the different duration of the blood pressure declines in postprandial and orthostatic hypotension, and the duration of the test can also play a role in the different presentation, severity and experience of symptoms in geriatric patients in postprandial and orthostatic hypotension. The variation in symptoms of postprandial hypotension and orthostatic hypotension argues again that these phenomena have different pathophysiological backgrounds, and therefore a distinct presentation[1,2]. The large and striking differences can be important in evaluating the patient's history with respect to the presence of orthostatic or postprandial hypotension.

Because postprandial and orthostatic hypotension are very prevalent in geriatric patients admitted to acute care hospitals, we assumed that nurses had to encounter many of these patients, and therefore needed skills to diagnose hypotensive syndromes and to perform interventions. In chapters 3 and 4 we concluded that the skills and knowledge of nurses on the diagnosis and treatment of hypotensive syndromes were alarmingly bad. Two-third of the responding nurses had never heard of postprandial hypotension Although almost all nurses knew that orthostatic hypotension was a decline in blood pressure after standing up, knowledge deficits existed about the way of diagnosing orthostatic hypotension. Furthermore, it remained unclear if nurses knew which interventions were evidence-based. For example, applying elastic stockings was mentioned several times, despite available evidence that only waisthigh stockings were effective[16].

That nurses do not know much about postprandial hypotension is not surprising Through literature search, besides our own publications, we only found one study conducted by a nurse that was published in a nursing magazine[17] Furthermore, postprandial hypotension was described once in a nursing manual, but only within the framework of orthostatic hypotension, explaining the additional influence of food on postural blood pressure[18]. Moreover, in the Netherlands, nursing education on postprandial hypotension is only given at one course of continuing professional geriatric nursing education, but not in basic nursing education. The paucity of available nursing literature on postprandial hypotension, and the lack of attention on the subject in nursing schools, make it hard for nurses to acquire knowledge about symptoms, diagnosis and interventions of postprandial hypotension The better knowledge of nurses on orthostatic hypotension can be explained by the presence of nursing literature on the subject, and the attention for orthostatic hypotension in nursing education.

However, we also found large differences in skills and knowledge of nurses in performing blood pressure measurement for diagnosing orthostatic hypotension leading to inaccurate readings (chapter 4). The large variety in blood pressure measurement procedures, indicated that strict procedures and protocols were lacking, and underscored the importance of translating the recommendations of several authors on orthostatic blood pressure measurements into a guideline, and implementing these in daily practice[2 12,16,19-21].

The differences in measurement technique could interfere with the individual detection of orthostatic hypotension and give a wrong estimate of the overall prevalence, and might explain the large difference in prevalence in previous studies[6 19 22,23]. The absence of a standardized way of measuring blood pressure can also give false outcomes in research Recently, a study of Weiss et al. reported on the prevalence of orthostatic hypotension at an acute geriatric ward[24]. Unfortunately, they measured blood pressure in supine and standing position at 30 minutes after a meal. We question if they only measured the effect of standing on blood pressure, or also the meal-related effects. Jansen et al previously found that postprandial hyoptension is almost immediately present

after a meal, and in 70% of the patients is prevalent between 30 and 60 minutes after a meal[1] In 13% to 17% of the patients, systolic blood pressure reaches its minimum before 15 minutes after eating, and in 11% to 13% later than 75 minutes after meal ingestion[1 4 25]. Furthermore, they did not exclude the additional effect of medication. If Weiss et al intended to measure the prevalence of orthostatic blood pressure during the day, they should have measured blood pressure after a period of fasting of at least two hours, and should have taken the variation of orthostatic hypotension during the day into account[24] Our findings, and the study of Weiss et al however confirm that agreements on the way of blood pressure measurements are highly necessary, to make the right diagnosis.

Although the results of our studies are restricted to the Dutch situation and to nurses, and cannot be generalized to physicians, the literature suggests that similar problems in blood pressure measurements exist for qualified doctors, medical, and nursing students, and that the knowledge of the medical and nursing staff and technical ability in sphygmomanometer use was similar in doctors and nurses (Chapter 3 and 4)[26-30]

Because of the limited usefulness of pharmacological treatment for postprandial hypotension, non-pharmacological interventions become more prominent[1] Several nonpharmacological empirical advises for the treatment of postprandial hypotension have been suggested such as for instance lie down after a meal for 1 to 2 hours to reduce the risk for hypotension and preventing falls[1]. In chapter 6 and 7 we described two studies to collect evidence for new treatment options in postprandial hypotension.

In chapter 6, we described the reduction of the amount of carbohydrates consisting of a glucose solution on blood pressure and symptoms We concluded that reducing the carbohydrate amount in meals by reducing the amount of glucose reduced the declines in blood pressure and symptoms. Therefore, limiting the carbohydrate content by of a patient's meal by reducing the glucose, can be an effective non-pharmacological treatment of elderly patients with postprandial hypotension. Jansen et al previously have

demonstrated that the postprandial blood pressure response depends on the composition of the meal ingested, particularly on the carbohydrate content[1 31] Oral glucose and the subsequent insulin release primarily cause the blood pressure effects of carbohydrates Other carbohydrates, such as oral fructose, oral xylose, and intravenous glucose do not or only slightly affect blood pressure, just like fat and proteins[1 31 36]

Three other investigators described a reduction of meal size or reducing the carbohydrate amount in meals in young healthy adults and adults with primary autonomic failure[36 38] In healthy adults, a large carbohydrate meal induced larger and more prolonged blood flow responses than a small meal suggesting a relationship between meal size and cardiovascular responses[37 38] In our study we used liquid meals, and the conclusions cannot be extrapolated to solid meals However, in a study in healthy men, no significant changes in systolic or diastolic blood pressure were shown after solid or liquid meals[39] Application of reducing regular large meals into frequent small portions in clinical practice, and in patients with autonomic failure, reduced postprandial hypotension and the frequency of symptoms[36] Therefore, it can be expected that the results of our study can be extrapolated to regular meals

In chapter 7, we studied the variation of postprandial hypotension during the day A clinical implication of the variation that we found during the day, with significantly smaller blood pressure declines in the evening, is that the diagnostic tests and the treatment of symptomatic postprandial hypotension should be adjusted to the variation of postprandial hypotension during the day Interventions, such as administration of cardiovascular medication, or consuming a large carbohydrate meal should preferably be done in the evening, to reduce the risk of developing symptomatic postprandial hypotension in the elderly Because of the frequent absence of postprandial hypotension after dinner, the diagnosis of postprandial hypotension should be based on blood pressure measurements around breakfast or lunch In our study, we used identical test-meals at all mealtimes and prohibited medication during the days of the test from midnight the night before Therefore, the meal composition or drugs cannot explain the differences in cardiovascular responses at different

times of the day. Other investigators confirmed that postprandial decreases in systolic blood pressure in elderly are higher after breakfast than after lunch and dinner[10]. Unfortunately, they used non-standardized meals and permitted medication at breakfast, so the amount of glucose or medication could have influenced the results[10].

Limitations of the studies

The studies in this thesis have a few limitations. First, our study group was, as can be expected in geriatric patients, very heterogeneous. In the study of the prevalence of postprandial and orthostatic hypotension, the characteristics of the patients were too diverse to demonstrate significant outcomes to be indicative for developing postprandial or orthostatic hypotension, except for high baseline systolic blood pressure. The relatively small number of patients in the subgroups, and the characteristics such as high co-morbidity and use of medication in all geriatric participants can explain this.

A second limitation could be that we performed all meal tests in the sitting position (Chapters 2, 6 and 7). Although it has been suggested that orthostatic changes in blood pressure during prolonged sitting might contribute to the postprandial decreases in blood pressure[1], we found it more analogue to the usual eating position, to give patients their meal in a sitting position. A third limitation at the start of the study was that some of the symptoms of orthostatic and postprandial hypotension we observed are very general (e g the frequently mentioned tiredness could also be due to the duration of the mealtest), and therefore could be due to other factors than hypotension. However, all symptoms we scored were related to declines in systolic blood pressure. Moreover, in chapter 2 we found a differentiation of symptoms between orthostatic- and postprandial hypotension that can be helpful together with the patient's history, to discriminate between both forms of hypotension.

A limitation of the study described in chapter 3 was that we used mailed questionnaires, with open-ended questions The risk of mailed questionnaires can be, that many people fail to answer to them, which can lead to a biased sample. To reduce this risk, we used follow-up reminders, and more important,

we had a key-contact person on each department. With those measures the response rate was 84%, which is high for questionnaire methodology.

With open-ended questions, we tested the active knowledge of nurses. Probably, if we had tested passive knowledge, for example by multiple-choice questions or propositions that are right or false, the outcomes would have been less bad. However, to recognize symptoms and to apply interventions in clinical practice, nurses need to have prepared knowledge at their disposal. We tested the knowledge of nurses working on departments of Geriatric Medicine throughout the Netherlands. Although the Dutch nursing education is not identical to the nursing training in other countries, we assume that the knowledge of nurses on postprandial and orthostatic hypotension in other countries is comparable

A limitation of the intervention studies in patients with postprandial hypotension (chapter 6 and 7) is that the total number of geriatric patients with postprandial hypotension on which the results are based, is small. Nevertheless, significant and very interesting results are found.

Implications for nursing care / Recommendations

A substantial part of the geriatric population has symptomatic hypotension and experiences difficulties because of decreases in blood pressure after eating or standing up. This underlines the importance of recognizing the problems and difficulties of patients with postprandial or orthostatic hypotension by health-care providers Unfortunately, we showed that the knowledge of nurses on postprandial hypotension is very limited, and that deficits in knowledge are present for orthostatic hypotension and the way of diagnosing it.

Because of the lack of knowledge of nurses, hypotensive syndromes can be under-diagnosed. As a consequence, there will be a treatment delay, and known evidence or best practice based interventions will not be applied. Therefore, hypotension will remain in these frail patients at risk for injury, falls and syncope.

The discovery of postprandial or orthostatic hypotension offers an opportunity for nurses to provide appropriate interventions to reduce symptoms or prevent

potentially dangerous hypotensive situations. However, accurate management is only possible with sufficient knowledge of nurses regarding hypotensive syndromes, diagnostic principles and (evidence-based) treatment of postprandial and orthostatic hypotension.

Unfortunately, there is a scarcity of published nursing research on postprandial hypotension. In nursing education, this phenomenon is underexposed. Therefore, we plea for an improvement of the availability and accessibility of information by paying more attention to postprandial hypotension in nursing literature, and by focussing on hypotensive syndromes in (continuing) nursing education in order to enhance the knowledge of nurses More attention for this issue in the literature, and in continuous nursing education could improve the knowledge of nurses and subsequently improve the diagnostic process and care for patients with postprandial hypotension.

In diagnosing orthostatic hypotension and specifically the measurement of blood pressure, much improvement can be made, to reduce the existing large differences in measurement techniques. Uniform measurement of the blood pressure responses to standing up is critical for a correct interpretation of blood pressure readings to diagnose orthostatic hypotension With a correct diagnosis, based on proper blood pressure measurements, elderly patients with treatable orthostatic hypotension could be discovered and hypotension related co-morbidity could be prevented or alleviated. Implementation of the recommendations of the best way of measuring blood pressure to diagnose orthostatic hypotension in elderly patients in hospitals, other care institutions, and in home-health care would make the measurements more accurate and fast and would optimize the diagnostic process. Incorrect diagnosis or a delay in the diagnostic process of postprandial- or orthostatic hypotension can have far-reaching consequences for elderly patients.
In chapter 5, we only developed a standardized way to measure blood pressure for the detection of orthostatic hypotension. We recommend that, in the near future, a standardized procedure to diagnose postprandial hypotension will be

described too. The large variety in postprandial blood pressure responses during the day, as presented in chapter 7, pleas for agreements on the diagnostic procedure of postprandial hypotension. The developed guidelines for diagnosing of orthostatic and postprandial hypotension need to be implemented in clinical practice

The results of chapter 6 indicate that reducing the amount of carbohydrate in a meal, particularly the amount of glucose, can be an easy, inexpensive and successful intervention in the treatment of postprandial hypotension, improving hypotensive symptoms and shorten the period at risk in elderly patients with postprandial hypotension However, the necessary and recommended daily intake of food and nutrients for patients should be taken into account. Therefore, reducing the amount of carbohydrate by taking more frequent but small meals in stead of large meals should be preferred. In the diagnosis and treatment of postprandial hypotension, health-care providers should reckon the variation of postprandial hypotension during the day.

Implications for further research

Implementation of the recommendations developed for the blood pressure measurement of orthostatic hypotension needs to be performed on a large scale. Further research to develop guidelines for detecting postprandial hypotension, and implementing these guidelines in clinical practice are warranted. Furthermore, more interventions for postprandial hypotension, up till now primarily based on common sense, need to be tested in clinical trials. Future research of interventions should be directed towards investigating the effect of variation in carbohydrate amount on blood pressure with regular meals instead of test meals, towards the time of medication use during the day in relation to meals, blood pressure changes and symptoms, or towards the effect of having the carbohydrate-rich meal in the evening on postprandial hypotension. Moreover, the implementation of guidelines and evidence-based interventions needs to be performed and evaluated

With this thesis, the first step in the prevention of the very serious problems of orthostatic and postprandial in the elderly population is made, by recognizing and indicating the importance of these problems for geriatric patients and the nursing profession Furthermore, we showed the lack of knowledge of nurses on the problem postprandial hypotension, and deficits in the knowledge on orthostatic hypotension. We indicated that guidelines are missing, nursing literature on postprandial hypotension is unavailable, and education is limited or absent. We developed a guideline for measuring blood pressure in order to diagnose orthostatic hypotension that needs further implementation. Furthermore, we tested two interventions that are applicable in the treatment of postprandial hypotension in clinical practice, namely reducing the amount of carbohydrates in meals and taking the variation of postprandial hypotension into account in diagnosis and treatment.

Nurses are in a strategic position to recognize the problems of patients and should consider evaluating postprandial and orthostatic hypotension in all elderly patients They should also be capable and the right person to educate elderly and to initiate, conduct and evaluate practical interventions to minimize the impact of hypotension in every-day life. A prescription of the problem, etiology and symptoms of postprandial and orthostatic hypotension, important for diagnosing them, could be learned from this thesis. Moreover, a description of nursing interventions could be derived from this research as presented in figure 8.1 and 8.2. Parts of the study could be implemented to improve the nursing care for elderly with postprandial or orthostatic hypotension.

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Figure 8.1. *Nursing protocol POSTPRANDIAL HYPOTENSION*

Definition: Postprandial hypotension, is a decrease in systolic blood pressure ≥ 20 mm Hg within 90 minutes after the start of a meal, which may result in serious symptoms and consequences such as syncope, falls, dizziness, weakness, angina pectoris and stroke

Potential Causes	**Risk Factors**	**Cirucumstances**
- Mechanisms not yet fully understood - Physiological processes associated with age-related changes in blood pressure regulation - Pathologic process related to specific diseases that impair the autonomic control of blood pressure - Splanchnic blood pooling after a meal - Type of food ingested - Effect of carbohydrates, primarily caused by glucose, which stimulates Insulin release - Vasodilatory effect of Insulin - Absence of Heart Rate increase after meals - Inadequate sympathetic response to meal-induced splanchnic vasodilatation - Inadequate vascular compensation for the shift of blood volume into the splanchnic system - Osmotic shift of fluid into the gut and consequent reduction in intravascular volume - Impairment in baroreflex functioning	- Presence of multiple illnesses - Impaired cardiovascular adaptation to meal ingestion - Old age/ physiological aging - Age-associated illnesses - Some diseases *Autonomic Failure *Peripheral neuropathy *Parkinson's disease Diabetes Mellitis - Hypertension - Combination with medication with hypotensive side-effects - Renal failure during hemodialysis - Dehydration - Rate of gastric emptying	- Postition of the body while eating - Day to day fluctuations of the blood pressure - Nutrient composition of meals, carbohydrates (specifically glucose) play a significant role, fructose or xylose have no or minimal effect on blood pressure - Size of the meal - Foodtemperature, (roomtemperature or warm meals cause a decrease in blood pressure, blood pressure reamins unchanged with cold meals - Time of day, and time after meal ingestion in which blood pressure was measured after meal may detect or miss postprandial hypotension - Time that medication with a hypotensive effect were given - Hypotension in response to common daily situational stress, such as medication, posture change, meals, defeacation, micturation, exercise, fear, alone or in combination with eachother

Signs and symptoms		
Asymptomatic	Headache	Sleepiness
Alterations in consciousness	Lightheadedness	Stroke
Angina pectoris	Malaise	Syncope
Apathy	Nausea	Tendency to faint
Black spots in visual field	Pale	Tiredness
Decrease in SBP ≥ 20 mm Hg	Palpitations	Transient ischaemic attack
Disturbed speech	Restlessness	Vision changes blurred vision
Dizziness	Sweating, clammy	Weakness
Falls	Shaking, trembling	Yawning
Flushing		

Goal Prevent periods of postprandial hypotension and (reduce) the risk for injury due to postprandial hypotension in geriatric patients

Suggested interventions in postprandial hypotension

- Health teaching
  - explain the potential causes and provoking circumstances of the health problem (meal, medication e g)
  - Inform the patient about the dangers associated with postprandial hypotension, particularly the risk for falls and syncope within 90 minutes after eating meals
  - Instruction on interventions (e g preventive measures for falls, against exposure to hypotensive stressors
  - Explain the reason for a therapy (to maintain normal blood pressure) and the importance of compliance Be alert on signs and symptoms of postprandial hypotension
- Measure BP around meals according to a protocol to confirm the suspicion of PPH
- Make an inventory of the risk factors of the indiviual patient for PPH
- Consider circumstances that influence the occurence of PPH
- Make a plan for the patient to avoid risk for hypotension and risk for injury
- Adapt or modify lifestyles to minimize the presence of the causative circumstances
- Be aware of the hypotensive (side-)effects of medications
- Explain medication (working, side-effects, time and way of taking them in)
- Ask the physician if he/she will consider if therapy with unnecessary medications that lower blood pressure can be discontinued

Suggested interventions in postprandial hypotension continued

- Have the patient avoid sitting for prolonged periods or standing still after meals Frail elderly patients with postprandial hypotension are able to increase their blood pressure and heart rate in response to a postmeal walking exercise, but this effect is limited to the exercise period only and is not sustained during subsequent rest Therefore, check blood pressure after a postprandial walk, if it returns to normal, the patient should walk and continue walking after meals Otherwise, the patient should lie down for 90 minutes to reduce the risk for hypotensive periods and falls
- Consider with the physician if medications with hypotensive effects can be administered between meals rather than during meals Consider also if medication with hypotensive effects can be prescribed in the evening rather than in the morning, because PPH is least common in the evening, with lower decreases in SBP, less symptoms, and less severe symptoms If possible, nurses should give medications at deviating times
- Adjust the size of the patient's meal Encourage frequent small meals, for example 6 small meals instead of 3 large meals a day
- Adjust the composition of the patient's meal Carbohydrates, especially oral glucose have been proved to provoke postprandial decreases in blood pressure Therefore, limit the amount of glucose in the meals Other carbohydrates, such as xylose and fructose or intravenous glucose, have no or only minimally effect on blood pressure There is no effect on blood pressure after intake of water, protein or fat
- Avoid dehydration by ensuring an adequate fluid intake and registration, and by (after consultation of the physician) advising liberal salt intake if possible
- Advise avoiding meals during hemodialysis
- Advise avoiding alcoholic drinks before and after meals
- Give hot coffee (2 cups, ≈ 250 mg caffeine) before a meal Controversial, but worth giving a try, because the prepressor effect of caffeine might benefit some patients, and reduce the postprandial fall in blood pressure
- Place the bed of the patient in the foot-elevated-head lowered (Trendelenburg) position
- Encourage adequate rest
- Nursing observations
    - frequent blood pressure measurements around meals,
    - observe for symptoms,
    - observe for shock or syncope,
    - call a physician and give emergency treatment if shock occurs,
    - in- and output registration

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Figure 8.2. *Nursing protocol ORTHOSTATIC HYPOTENSION*

Definition: Orthostatic hypotension (OH) , is a decline in systolic blood pressure of 20 mm Hg or more within 3 minutes after changing from a supine or sitting position to a standing posture OH can be accompanied by symptoms like dizziness, instability or falls

Potential Causes	**Risk Factors**	**Cirucumstances**
- Unknown etiology - Autonomic failure syndromes - Volume depletion e g hemorrhage, diuresis - Cardiac dysrhytmias -Vasodilation - Mitral valve prolapse - Central nervous system tumor - Upper spinal cord lesion - Guillain-Barre syndrome - Infections * Bacterial (e g tetanus) * Viral (e g human immuno-deficiency virus) - Connective tissue disorders (rheumatiod arthritis, systemic lupus erythematosis) - Surgery regional sympathectomy (splanchnic denervation) - Neurally mediated syncope (vasovagal syncope, carotid sinus hypersensitivity)	- Presence of multiple illnesses - Impaired cardiovascular adaptation to posture change - Old age / physiological aging - Age-associated illnesses - Some diseases *Autonomic Failure *Peripheral neuropathy *Parkinson's disease *Diabetes Mellitis *Hypertension *Chronic renal failure *Chronic liver disease - Combination with medication with hypotensive side-effects such as antihypertensives, diuretics, tricyclics, nitrates, tranquilizers, anti-depressives - Dehydration - Pregnancy - Fever - Vitamin deficiency (B1,B12)	- Postition of the body - Day to day fluctuations of the blood pressure - Time of day in which blood pressure was measured after standing up may detect or miss orthostatic hypotension - Time period elapsed between standing up and blood pressure measurement - Time that medication with a hypotensive (side-effect) were given - Daily situations, alone or in combination with eachother - Hypotension in response to common situational stress, such as * exercise, * hot environment, * medication, * meals, * defeacation, * micturation, * coughing, * swallowing - Prolonged recumbancy

Signs and symptoms

Asymptomatic	Instability	Syncope
Angina Pectoris (due to cardiac hypoperfusion)	Lower back pain (muscle hypoperfusion)	Tendency to faint
Changes in cognitive functioning	Looking pale	Tendency to fall
Changes in consciousness	Lightheadedness	Tiredness
Decrease in SBP ≥ 20 mm Hg	Palpitations	Visual changes blacking out
Dizziness	Renal hypoperfusion, Oligurea	Visual changes color defects
Falls	Restlessness	Visual changes tunnel vision
Headache	Speech disturbaces	Weakness
Insecurity	Symptoms due to cerebral hypoperfusion	

Goal Prevent periods of orthostatic hypotension, symptoms and to reduce the risk for injury due to orthostatic hypotension in geriatric patients

Suggested interventions in orthostatic hypotension

- Health teaching
  - explain the causes or provoking circumstances of orthostatic hypotension (standing bedrest, medication e.g)
  - instruct to change position gradually, advise against exposure to extreme heat, advise not to take hot baths (vasodilation causes further hypotension)
  - explain the reason for a therapy (to maintain normal blood pressure), the therapy itself, and the importance of cooperation
- Make an inventarisation of the risk factors of the patient
  - Adapt or modify lifestyles to minimize the presence of the causative factors and to reduce the risk for hypotension and the risk for injury
- Fall prevention
- Explain medication (working, side-effects, time and way of taking them in), and be aware of the hypotensive (side-)effects of medications
- Ask the physician if he/she will consider if therapy with unnecessary medications that lower blood pressure can be discontinued
- Measures to increase the total blood volume:
  - Discontinuation of diuretics
  - Head-up tilt (Place the bed of the patient in the foot-elevated-head lowered (Trendelenburg) position during the night) This also reduces nocturnal diuresis
  - Liberalize salt intake

Suggested interventions in orthostatic hypotension continued

- Avoid supine hypertension:
  - head up tilt
  - lounge chair during the day
- Measures to increase the central blood volume.
  - Head-up tilt during the night
  - Elastic stockings (only waisthigh stockings are effective)
  - Anti-gravity suit (not a very practical solution)
  - Standing with crossed legs
- Be careful for circumstances that can increase and worsen the risk for orthostatic stress such as Prolonged recumbency; Exacerbation of the blood pressure decrease in the morning; Day-to-day and within day variability of blood pressure; Avoid sudden position changes (especially on waking up), Avoid physical activity, Lifting heavy objects, Climbing stairs; Straining in case of coughing, defeacation, micturation; Standing motionless; Working with the arms above the head, Influence of food (especially large, carbohydrate meals); Avoid alcohol, Influence of certain medication, Exposure to a hot environment; Hot bath, sauna, shower, Fever.
- Introduce
  - head-up tilt during sleeping
  - high salt intake
  - swimming
  - body positions to reduce the risk of hypotension, such as crossed legs, bending knees, rocking your body while standing instead of standing motionless, changing position gradually.
- Encourage adequate rest, but be aware of the risks of prolonged bedrest
- Dangling
- Give hot coffee or hot tea, or > 500 ml of water
- Call a physician, if hypotension persists or evolves into a shock, and give emergency treatment if shock occurs
- Nursing observations
  - frequent blood pressure measurements,
  - observation of symptoms
  - observation of circumstances
  - inspect for hemorraghe,
  - observe for shock,
  - in- and output registration

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Chapter 9

Summary

Samenvatting

Summary

Mrs B is a 94 -year old woman, who was admitted to the geriatric ward of our hospital for one month because of several periods of syncope, frequent falls and difficulties in mobility Mrs B had a history of M Parkinson and uses levodopa The patient had been well until last year, when she fell a few times Three days before admission she was brought into the emergency-unit because she lost consciousness for approximately 90 minutes She recovered spontaneously In the hospital, at the geriatric department, she was observed during her daily activities No abnormalities were established after several resting electrocardiograms and Holter monitoring Twice she had a period of staring with glossy eyes, inaudibly mumbling, followed by syncope Closer examination of circumstances, blood pressure and symptoms revealed that this occurred approximately half an hour after meals, and that she had symptomatic declines in postprandial blood pressure, sometimes resulting in syncope Blood pressure also decreased more than 20 mm Hg after standing up Postprandial and orthostatic hypotension were diagnosed

In the treatment of postprandial hypotension, we advised her to take supine rest after meals in order to compensate decreases in blood pressure, and to ingest levodopa between meals instead of with meals to prevent additional blood pressure declines Furthermore, after consultation with the dietician we advised Mrs B to divide her meals into small portions, to reduce the amount of carbohydrate in the meals, and also to use the meal with the largest carbohydrate content in the evening when BP decrease were least present To reduce the symptoms of orthostatic hypotension, Mrs B learned to rise slowly and to avoid sudden postural change, to elevate the head of her bed to sleep with head-up tilt and to introduce safety measures to prevent falls With these measures, the symptoms of hypotension reduced, and Mrs B returned to her own home with home-visits of a nurse every morning She visited to the outpatient clinic after 3 months and had had no recurrent falls or syncope during that period

Introduction and research questions

The difficulties in diagnosing the symptoms and circumstances in postprandial and orthostatic hypotension and in choosing interventions by nurses in the above-mentioned patient were reason to initiate nursing research on postprandial and orthostatic hypotension, in close collaboration with medical research.

Postprandial or orthostatic decreases in systolic blood pressure in the elderly may predispose the subject to symptomatic hypotension and to falls, dizziness, weakness, angina pectoris, stroke and syncope. Postprandial hypotension is defined as a meal-related decline in systolic blood pressure of 20 mm Hg or more, within 90 minutes after ingestion of a meal Orthostatic hypotension is generally defined as a decrease in systolic blood pressure of 20 mm Hg or larger, within 3 minutes after standing up. Some authors define a decline in diastolic blood pressure of more than 10 mm Hg after standing up as orthostatic hypotension too The prevalence of orthostatic hypotension described in previous studies ranges from 10 to 50 % depending from the group studied The prevalence of postprandial hypotension reaches to 36% in elderly patients. The pathophysiology of postprandial hypotension is not fully understood. However, postprandial hypotension is more common in patients who use certain medication, in particular cardiovascular medication by its effect in blood pressure and for example anti-depressives by its side effects on blood pressure. Furthermore, certain groups of patients with diseases such as diabetes, autonomic dysfunction, systolic hypertension and Parkinson's disease have an increased risk for postprandial hypotension.

Important risk factors for orthostatic hypotension, as well as in postprandial hypotension, are autonomic failure such as in Parkinson's disease, the use of certain drugs such as anti-hypertensive agents, levodopa, and patients with diabetes mellitus, hypertension or renal failure. The prevalence of both postprandial and orthostatic hypotension increases with age, co-morbidity, and the use of multiple drugs and the presence of cardiovascular diseases, autonomic failure and cardiovascular and anti-depressive agents. Therefore, the prevalence of postprandial and orthostatic hypotension in geriatric patients is

probably high and the clinical implications large, because geriatric patients often use multiple drugs and have more premorbid conditions that predispose them to hypotensive syndromes

Because postprandial and orthostatic hypotension are common problems in older, frail, institutionalized patients, all nurses (and physicians) caring for elderly patients should be aware of the hypotensive effects of food intake or standing up, and should consider both postprandial and orthostatic hypotension, in the evaluation of falls, syncope and other ischemic cerebral symptoms If the diagnosis of postprandial- or orthostatic hypotension is made early, and interventions are evidence-based, applicable and known by nurses the risk for postprandial-, orthostatic hypotension and related symptoms can be diminished

Because little is known about the prevalence of postprandial and orthostatic hypotension in the geriatric population, and on the knowledge of nurses about these diagnoses and the application of workable interventions, the main questions in our nursing research-program were

1 What is the prevalence of orthostatic and postprandial hypotension in geriatric patients admitted to the hospital?
2 To recognize the symptoms and problems of geriatric patients with postprandial and orthostatic hypotension, nurses need certain skills and knowledge The following research questions were formulated
    a What is knowledge of nurses about postprandial and orthostatic hypotension?
    b What are the skills and knowledge of nurses to measure blood pressure for the diagnosis of orthostatic hypotension in clinical practice compared to recommendations in literature?
    c How to measure blood pressure in order to diagnose orthostatic hypotension?
3 The options for evidence-based non-pharmacological treatment of postprandial hypotension are limited Most interventions are based on empirical data or common sense To study the effect of two potential non-evidence based interventions for the treatment of postprandial hypotension,

implying composition of meals and timing of intake, manageable by nurses, the next research questions are formulated:

a. What is the effect of reducing the amount of carbohydrate in meals on blood pressure and symptoms in geriatric patients with postprandial hypotension?
b. Is there a variation in time of day and the effect of meals on blood pressure and symptoms in geriatric patients with postprandial hypotension?

4 What are the implications of the results of the study for nursing care for elderly patients with postprandial and/or orthostatic hypotension?

Because the prevalence of postprandial and orthostatic hypotension increases with age, co-morbidity and multiple prescriptions, it can be expected that the prevalence of these hypotensive syndromes is high in geriatric patients, who are of old age, and often use several medication for multiple disorders. In a small study in nursing home residents, it appeared that postprandial hypotension occurred more frequently than orthostatic hypotension and that they infrequently occur together in the same patient Whether these preliminary findings also hold in a large group of geriatric patients was investigated in our study. In **Chapter 2** we report the prevalence of postprandial hypotension in comparison to orthostatic hypotension, and their combined occurrence in geriatric patients. In all patients admitted to the departments of geriatric medicine of University hospitals Nijmegen and Utrecht during a period of 9 months, changes in blood pressure were measured with an ambulatory automatic blood pressure device (Spacelab 90207), after a standardized liquid test meal and twice after standing up During the whole test patients were observed for symptoms by the researcher. Eighty-five patients (44 men), aged 60-98 year, were included. Postprandial hypotension was present in 57 geriatric patients (67% of the study population). In patients with postprandial hypotension, mean systolic blood pressure declined significantly after meals with 34 ± 4 mm Hg, and diastolic blood pressure with 15 ± 1 mm Hg, whereas heart rate increased significantly with 4 ± 2 bpm. Orthostatic hypotension was

found in 44 geriatric patients (52%), with a mean decline in systolic BP of 44 ± 4 mm Hg after standing up Thirty-two geriatric patients (37%) had both postprandial and orthostatic hypotension. Only sixteen patients (19%) had neither postprandial nor orthostatic hypotension. Symptoms of postprandial hypotension were present in 37 patients (65%), with syncope in 5 patients; symptoms of orthostatic hypotension in 27 patients (61%).
We concluded that postprandial and orthostatic hypotension are very prevalent in geriatric patients, and occur frequently together, but not more than by chance, in the same patient Postprandial hypotension is more prevalent than orthostatic hypotension, in respectively two-third and half of the geriatric patients. Only one-fifth of the geriatric patients had neither orthostatic nor postprandial hypotension Both postprandial and orthostatic hypotension are symptomatic in over 60% of the patients

Because of the high prevalence of symptomatic postprandial and orthostatic hypotension found in the geriatric patients, blood pressure measurements for diagnosis of postprandial and orthostatic hypotension should be part of the comprehensive geriatric assessment at admission The diagnosis of postprandial and orthostatic hypotension can easily be made from the patients' history e.g. in case of dizziness, falls or syncope, asking for a possible relation of symptoms with food or standing up, by observing the patient, and by performing blood pressure measurements before and after meals or standing up, respectively. In all health-care-facilities and in the community, nurses working with elderly people are the most appropriate group to screen for the occurrence of postprandial or orthostatic hypotension in daily practice because of their intensive contact with the elderly patient. However, to diagnose hypotensive syndromes, nurses should be able to recognize the symptoms, causes, circumstances and consequences of postprandial and orthostatic hypotension. Without delay in the diagnostic process, interventions can be assessed early, to prevent symptoms of postprandial and orthostatic hypotension.

In **Chapter 3** we describe the knowledge of nurses on postprandial hypotension and orthostatic hypotension The familiarity of nurses with postprandial hypotension was disappointing, because two-third of the nurses have never heard of it One-third of the nurses knew it was a meal-related decline in systolic blood pressure, but the knowledge of the problem, etiology, symptoms, the way of diagnosing and interventions was limited. There is a deficit of attention for postprandial hypotension in nursing literature and in nursing education. Although orthostatic hypotension was known to almost all nurses, well described in the nursing literature, and trained in nursing school, knowledge deficits existed on diagnosing and evidence based interventions Because of these knowledge deficits on postprandial and orthostatic hypotension, these syndromes can be under-diagnosed, which can lead to a treatment delay and maintain the risk for hypotension and injury in geriatric patients.

To diagnose orthostatic hypotension, blood pressure measurements before and after standing up have to be performed Many physicians rely on blood pressure measurements performed by nurses to make the diagnosis orthostatic hypotension Therefore, accurate measurement of blood pressure is very important. Since we found out that nurses had knowledge deficits in the methodology of diagnosing orthostatic hypotension, we wanted to know how their skills on blood pressure measurements were in clinical practice In **Chapter 4** we describe the results of an observational study under 170 nurses working at 17 departments of Surgery, Geriatric or Internal Medicine throughout the Netherlands. To evaluate the nurses' skills and knowledge on blood pressure measurements to diagnose orthostatic hypotension, we performed standardized observations, with a preliminary guideline based on published recommendations, of supine and standing blood pressure determination in patients over 65 years. The most important deviations in technique of orthostatic blood pressure measurement from the published guidelines were: time between measuring supine and standing blood pressure varied from 0-30 minutes; in one-fourth of the measurements the arm position was not at heart level during standing blood pressure measurements, and almost half of the

times the cuff was placed incorrectly. We concluded that the skills and knowledge of nurses to measure supine and standing blood pressure were inaccurate for diagnosing orthostatic hypotension in elderly patients. Large differences in measurement technique and timing of standing blood pressure could influence the individual detection and treatment of orthostatic hypotension and the reported prevalence of orthostatic hypotension. The blood pressure measurement procedure to diagnose orthostatic hypotension needs more standardization and implementation of guidelines in daily practice

However, in the current literature no guidelines on how to measure blood pressure to detect orthostatic hypotension were available. With the enormous variation in nurses' skills of measuring blood pressure and the inaccuracy of the results, guidelines are highly needed. In **Chapter 5** we describe the process of collecting scientific evidence for the proper technique to measure BP for diagnosing orthostatic hypotension through literature review. The findings were compiled in a protocol, which was evaluated by ten experts in the field until consensus was reached. With the use of these recommendations and implementation of the guideline and continuous education in clinical practice, the knowledge and skills on blood pressure measurements and therefore the diagnostic process of orthostatic hypotension can be improved

After diagnosing a problem, we want to treat a patient. For the management of orthostatic hypotension several non-pharmacological interventions such as head-up tilt during sleep and avoiding prolonged recumbancy and sudden postural changes are extensively described in the literature. For the treatment of postprandial hypotension, the pharmacological therapy is limited, and therefore non-pharmacological interventions become more important. However, most of these interventions are based on common sense such as taking smaller and more frequent meals It has been suggested that primarily the carbohydrate content, especially the glucose content, of a meal induces the blood pressure decrease. Therefore, we examined the relation between this amount in meals and postprandial blood pressure responses in elderly patients diagnosed with

postprandial hypotension. **Chapter 6** shows that in twelve geriatric patients, aged 75-91 years, the maximum decreases in systolic blood pressure were significantly smaller after the low carbohydrate meal than after a normal or high carbohydrate meal. In addition, the duration of postprandial hypotension was significantly shorter and postprandial symptoms were less frequent and less severe after the low CH meal. We concluded that reducing the carbohydrate amount in meals induces significantly smaller decreases in SBP, shorter duration of PPH and reduction of PPH-related symptoms. Therefore, limiting the carbohydrate content of a patient's meal (primarily glucose) can be a clinically very effective non-pharmacological treatment of elderly patients with postprandial hypotension and thereby reducing the risk of developing symptomatic postprandial hypotension.

For the application of interventions it would be convenient to know the pattern of postprandial hypotension during the day. From orthostatic hypotension it is known it is highly variable during the day, and most prevalent in the morning, before breakfast after first arising after a night of rest. The variability of postprandial hypotension during the day in elderly patients was unknown Therefore, we examined the effect of meals at different mealtimes on blood pressure and symptoms in geriatric patients with postprandial hypotension. **Chapter 7** shows that in fourteen geriatric patients (6 male, age 66-97), previously diagnosed with postprandial hypotension, the maximum decrease in systolic blood pressure was significantly smaller at dinnertime than at breakfast- or lunchtime. In eight patients, no postprandial hypotension was present in the evening, whereas all patients had postprandial hypotension after breakfast and lunch. The duration of postprandial hypotension was significantly shorter and postprandial symptoms were less frequent and less severe after dinner compared to breakfast and lunch We concluded that in geriatric patients, postprandial BP responses show a variation during the day, with significantly less postprandial hypotension and symptoms in the evening. Clinical implication is that in the diagnostic process and management of postprandial hypotension

the variation of the occurrence of postprandial hypotension during the day should be taken into account.

In **Chapter 8** the findings of the study are discussed in the light of previous studies An approach to nursing protocols for postprandial and orthostatic hypotension is presented. Important conclusions of the whole project were that both postprandial and orthostatic hypotension are very common problems in elderly patients, and highly symptomatic. Therefore, alertness, extensive data-collection about the patient's history, observation of symptoms and blood pressure measurements for the diagnosis of postprandial and orthostatic hypotension should be part of the comprehensive geriatric assessment at admission.

The knowledge of nurses on hypotensive syndromes and in blood pressure measurement skills needs to be improved

With this thesis, the first step in the prevention of the very serious problems of orthostatic and postprandial in the elderly population is made, by recognizing and indicating the importance of these problems for geriatric patients and the nursing profession. With the implementation of the protocols on diagnosing the problem, etiologic factors, symptoms, blood pressure measurements and interventions, nursing care for patients with postprandial and orthostatic hypotension can be improved Further efforts have to be made to implement actual knowledge in daily practice, and more research is warranted to get more evidence-based interventions.

Samenvatting

Mevrouw B is een 94 jaar oude dame, die opgenomen werd op de afdeling Geriatrie gedurende 1 maand in verband met diverse periodes van wegrakingen, frequent vallen en problemen met haar mobiliteit Mevrouw B is bekend met de ziekte van Parkinson en gebruikt hiervoor het medicijn levodopa Haar gezondheid was altijd goed, tot het afgelopen jaar waarin ze een aantal keren is gevallen Drie dagen voor opname op de afdeling Geriatrie, is mevrouw naar de eerste hulp van het ziekenhuis gebracht omdat ze buiten bewustzijn was geraakt voor ongeveer anderhalf uur Ze kwam spontaan bij Tijdens de opname op de afdeling Geriatrie werd mevrouw geobserveerd tijdens haar dagelijkse levensverrichtingen Er werden geen bijzonderheden of afwijkingen vastgesteld bij herhaalde electrocardiograms (ECG) en een Holter-registratie Twee keer had mevrouw een periode waarin ze met glazige ogen voor zich uit staarde en onverstaanbaar mompelde, gevolgd door een wegraking Nader onderzoek van de omstandigheden waarin dit optrad, en van de bloeddruk en de symptomen, bracht aan het licht dat de bewustzijnsdaling telkens ongeveer een half uur na het eten optrad, en dat mevrouw symptomatische dalingen had van de systolische bloeddruk, soms resulterend in een wegraking Als mevrouw opstond daalde haar bloeddruk ook met meer dan 20 mm Hg De diagnoses orthostatische en postprandiale hypotensie werden gesteld

In de behandeling van postprandiale hypotensie werd mevrouw geadviseerd om na de maaltijd te gaan rusten op bed om de daling in bloeddruk te compenseren Ook werd aangeraden om de levodopa tussen de maaltijden in te nemen in plaats van gelijktijdig met de maaltijd, om het extra effect van een bloeddrukdaling na de maaltijd ten gevolge van de medicijnen, te verkleinen Na overleg met de dietiste werd mevrouw B geadviseerd om haar maaltijden in kleine porties te verdelen, om de hoeveelheid koolhydraten per maaltijd te reduceren, én om de meest koolhydraatrijke maaltijd 's avonds te gebruiken omdat dan het effect van eten op de bloeddruk het kleinste is Om de orthostatische hypotensie en de symptomen te reduceren kreeg mevrouw B de instructie om rustig overeind te komen, om plotselinge veranderingen van houding te vermijden, en om het hoofdeinde van haar bed te verhogen Daarnaast werden veiligheidsmaatregelen getroffen om valpartijen te voorkomen Met deze maatregelen verminderden de symptomen van de bloeddrukdalingen na het opstaan en na de maaltijd Mevrouw B werd ontslagen uit het ziekenhuis naar haar eigen woning en kreeg daar elke ochtend hulp van de thuiszorg Drie maanden na ontslag bezocht zij de polikliniek Mevrouw B was niet gevallen en had geen wegrakingen meer gehad tijdens deze periode

Introductie en onderzoeksvragen

De moeilijkheden bij het herkennen van de symptomen en omstandigheden voor het stellen van de diagnosen orthostatische en postprandiale hypotensie, en bij het kiezen van geschikte interventies door verpleegkundigen bij de hierboven beschreven patient, vormden de aanleiding om verpleegkundig onderzoek op te zetten naar postprandiale en orthostatische hypotensie, in nauwe samenwerking met medisch onderzoek naar deze problemen

Een daling van de systolische bloeddruk na opstaan of na inname van een maaltijd kan ouderen blootstellen aan een risico op vallen, duizeligheid, zwakte, pijn op de borst, herseninfarct of wegrakingen Postprandiale hypotensie wordt gedefinieerd als een maaltijd gerelateerde daling in de systolische bloeddruk van 20 mm Hg of meer, optredend binnen anderhalf uur na inname van de maaltijd Orthostatische hypotensie wordt over het algemeen gedefinieerd als een daling van de systolische bloeddruk met 20 mm Hg of meer, binnen 3 minuten na het opstaan Sommige auteurs hanteren ook het criterium van een daling in diastolische bloeddruk van 10 mm Hg of meer na opstaan, als orthostatische hypotensie De prevalentie van orthostatische hypotensie, die in diverse studies wordt beschreven, varieert van 10 tot 50%, afhankelijk van de bestudeerde populatie De beschreven prevalentie van postprandiale hypotensie loopt op tot 36% bij oudere verpleeghuis patienten De (patho)-fysiologische achtergrond van postprandiale hypotensie is niet volledig bekend Postprandiale hypotensie komt vaker voor bij patienten die bepaalde medicatie gebruiken, met name bij gebruik van cardiovasculaire medicatie door hun effect op de bloeddruk, en bij bijvoorbeeld antidepressiva door hun bijwerkingen op de bloeddruk Verder hebben bepaalde groepen patienten met bijvoorbeeld diabetes mellitus, autonome dysfunctie, systolische hypertensie en de ziekte van Parkinson, een verhoogd risico op postprandiale hypotensie

Belangrijke risicofactoren voor het ontstaan van orthostatische hypotensie zijn, evenals bij postprandiale hypotensie, autonome dysfunctie, diabetes mellitus, hypertensie en het gebruik van bepaalde medicijnen zoals antidepressiva en middelen tegen hoge bloeddruk of levodopa, naast bijvoorbeeld nierfalen en aandoeningen van het zenuwstelsel De prevalentie van zowel postprandiale

als orthostatische hypotensie neemt toe bij het stijgen van de leeftijd, bij het gebruik van meerdere medicamenten, met name bij cardiovasculaire middelen en antidepressiva, bij de aanwezigheid van hart- en vaataandoeningen, autonome dysfunctie, en bij co-morbiditeit Daardoor is te verwachten dat het voorkomen van postprandiale en orthostatische hypotensie bij geriatrische patienten hoog is en dat de gevolgen en effecten voor de klinische praktijk groot zijn, omdat geriatrische patienten over het algemeen meerdere medicijnen gebruiken en meerdere aandoeningen hebben die een verhoogd risico vormen tot het ontstaan van hypotensie

Omdat postprandiale en orthostatische hypotensie veel voorkomende aandoeningen zijn bij de kwetsbare, oudere patient opgenomen in een instelling, zouden alle verpleegkundigen (en artsen) met de zorg voor ouderen alert moeten zijn op de bloeddrukdalende effecten van een maaltijd of houdingsverandering Bovendien zouden ze de aanwezigheid van orthostatische en postprandiale hypotensie moeten overwegen als oorzaak van vallen, wegrakingen en andere symptomen van een verminderde hersendoorbloeding Wanneer de diagnose orthostatische of postprandiale hypotensie vroegtijdig gesteld kan worden, en interventies wetenschappelijk onderbouwd, toepasbaar, én bekend zijn bij verpleegkundigen, kan de kans op het ontstaan van postprandiale en orthostatische hypotensie en de daarbij horende symptomen verkleind worden

Omdat er weinig bekend is over het voorkomen van postprandiale en orthostatische hypotensie bij geriatrische patienten, over de kennis van verpleegkundigen met betrekking tot deze fenomenen en over de toepassing van werkzame interventies, werden de volgende verpleegkundige onderzoeksvragen geformuleerd

1 Wat is de prevalentie van orthostatische en postprandiale hypotensie bij patienten opgenomen op de afdeling Geriatrie van een ziekenhuis?
2 Om de symptomen en problemen van geriatrische patienten met postprandiale en orthostatische hypotensie te herkennen moeten verpleegkundigen bepaalde kennis en vaardigheden bezitten Daarom zijn de volgende onderzoeksvragen gesteld

a. Wat is de kennis van verpleegkundigen met betrekking tot postprandiale en orthostatische hypotensie?
b. Hoe zijn de kennis en vaardigheden van verpleegkundigen om bloeddruk te meten voor het stellen van de diagnose orthostatische hypotensie in de klinische praktijk?
c. Hoe meet je de bloeddruk voor het stellen van de diagnose orthostatische hypotensie?

3. De opties voor een evidence-based niet medicamenteuze behandeling van postprandiale hypotensie zijn beperkt. De meeste interventies zijn gebaseerd op 'gezond verstand en logisch redeneren' of op praktijkervaringen Om het effect van 2 potentiële interventies te bestuderen met betrekking tot de samenstelling en het tijdstip van inname van een maaltijd, die toepasbaar zijn voor verpleegkundigen in de behandeling van postprandiale hypotensie, werden de volgende onderzoeksvragen geformuleerd:
    a Wat is het effect van reductie van de hoeveelheid koolhydraten in een maaltijd op de bloeddruk en de symptomen bij geriatrische patiënten met postprandiale hypotensie?
    b Bestaat er een variatie in tijdstip van de dag en het effect van maaltijden op de bloeddruk van geriatrische patiënten met postprandiale hypotensie?
4. Wat zijn de consequenties van de resultaten van dit onderzoek voor de verpleegkundige zorg aan ouderen met postprandiale of orthostatische hypotensie?

Omdat de prevalentie van postprandiale en orthostatische hypotensie toeneemt met de leeftijd, co-morbiditeit en het gebruik van meerdere medicamenten, kan worden verwacht dat de prevalentie van deze hypotensieve syndromen hoog is bij geriatrische patienten Zij hebben een hoge leeftijd, gebruiken vaak meerdere medicijnen, voor hun veelvuldige aandoeningen. In een kleine studie bij verpleeghuispatiënten bleek postprandiale hypotensie vaker voor te komen dan orthostatische hypotensie en zelden gelijktijdig bij dezelfde patiënt Of dat

ook het geval is bij een grote groep geriatrische patiënten werd onderzocht in onze studie.

In **Hoofdstuk 2** beschrijven we de prevalentie van postprandiale hypotensie in vergelijking met orthostatische hypotensie en het gecombineerd voorkomen bij de geriatrische patiënt. Bij alle patiënten die gedurende 9 maanden werden opgenomen op de afdelingen Geriatrie van het Universitair Medisch Centrum Nijmegen en Utrecht werden veranderingen in bloeddruk gemeten met een automatische bloeddrukmeter (Spacelab 90207) na inname van een gestandaardiseerde maaltijd en tweemaal na het opstaan. Gedurende de hele test werden de patiënten geobserveerd door de onderzoeker voor eventuele symptomen. Vijfentachtig patiënten (44 mannen), in de leeftijd van 60-98 jaar werden geïncludeerd Postprandiale hypotensie werd vastgesteld bij 57 geriatrische patiënten (67% van de studiepopulatie) Bij deze patiënten, daalde de gemiddelde systolische bloeddruk significant na de maaltijd met 34 ± 4 mm Hg, en de diastolische bloeddruk met 15 ± 1 mm Hg, terwijl de hartslag significant versnelde met 4 ± 2 slagen per minuut. Orthostatische hypotensie werd vastgesteld bij 44 geriatrische patiënten (52%) met een gemiddelde daling van de systolische bloeddruk met 44 ± 4 mm Hg na het opstaan Tweeëndertig geriatrische patiënten (37%) hadden zowel postprandiale als orthostatische hypotensie. Slechts 16 patiënten (19%) had geen van beiden. Symptomen van postprandiale hypotensie waren aanwezig bij 37 patiënten (65%), met een wegraking bij 5 patiënten. Bij 27 patiënten met orthostatische hypotensie werden symptomen geobserveerd (61%).

We concludeerden dat postprandiale en orthostatische hypotensie zeer veel voorkomen bij geriatrische patiënten. Ze zijn vaak gezamenlijk aanwezig bij dezelfde patiënt, maar niet vaker dan op basis van toeval. Postprandiale hypotensie komt vaker voor dan orthostatische hypotensie, in respectievelijk tweederde en de helft van de geriatrische patiënten. Slechts een-vijfde deel van de geriatrische patiënten heeft geen orthostatische of postprandiale hypotensie. Zowel postprandiale als orthostatische hypotensie zijn symptomatisch in meer dan 60% van de patiënten.

Omdat de prevalentie van symptomatische postprandiale en orthostatische hypotensie hoog is bij geriatrische patienten, zouden bloeddrukmetingen om deze aandoeningen te diagnosticeren standaard deel uit moeten maken van het uitgebreide geriatrisch onderzoek bij opname De diagnose postprandiale of orthostatische hypotensie kan eenvoudig gesteld worden aan de hand van gegevens uit de anamnese in geval van problemen als duizeligheid, vallen of wegrakingen, en door het vragen naar een eventuele relatie van klachten met maaltijden of houdingsveranderingen, door observatie van de patient en door uitgebreide bloeddrukmetingen voor, tijdens en na maaltijdinname of na opstaan

In alle gezondheidszorginstellingen en in de thuiszorg zijn verpleegkundigen de meest aangewezen groep om patienten te screenen op de aanwezigheid van postprandiale of orthostatische hypotensie, omdat zij tijdens hun dagelijkse werkzaamheden een intensief contact hebben met de patient en daardoor een goed overzicht Om echter hypotensieve syndromen te kunnen diagnosticeren moet de verpleegkundige de symptomen, oorzaken en omstandigheden waaronder deze fenomenen optreden kunnen herkennen, en de gevolgen van orthostatische en postprandiale hypotensie weten Met een snelle diagnostiek van orthostatische en postprandiale hypotensie, kunnen interventies snel worden toegepast om symptomen te voorkomen of te verminderen

In **Hoofdstuk 3** beschrijven we de kennis van verpleegkundigen met betrekking tot postprandiale en orthostatische hypotensie De bekendheid van verpleegkundigen met postprandiale hypotensie was gering tweederde van de verpleegkundigen had er zelfs nooit van gehoord Eenderde van de verpleegkundigen wist dat het een maaltijdgerelateerde daling van de bloeddruk is, maar had beperkte kennis van de problemen, etiologie en symptomen, alsmede van de wijze van diagnostiek en mogelijke interventies Er bestaat een gebrek aan aandacht voor postprandiale hypotensie in verpleegkundige literatuur, en in de opleidingen tot verpleegkundigen Hoewel het probleem orthostatische hypotensie bij nagenoeg alle verpleegkundigen bekend was, en ook uitgebreid beschreven werd in de verpleegkundige literatuur en onderwezen in de opleiding tot verpleegkundige, bestonden er onder

verpleegkundigen kennistekorten op het gebied van de wijze van diagnostiek en over wetenschappelijk onderbouwde interventies Vanwege het gebrek aan kennis over deze fenomenen bij verpleegkundigen kunnen orthostatische en postprandiale hypotensie onder-gediagnosticeerd worden Dit kan leiden tot een vertraging in behandeling, en het risico voor hypotensie en gevaar voor letsel in stand houden bij geriatrische patienten

Om de diagnose orthostatische hypotensie te stellen, moeten bij een patient bloeddrukmetingen voor en na het opstaan worden verricht, en symptomen geobserveerd Veel artsen gaan bij het stellen van de diagnose orthostatische hypotensie af op bloeddrukmetingen die uitgevoerd zijn door verpleegkundigen Een betrouwbare meting is hierbij belangrijk Omdat we hadden vastgesteld dat er bij verpleegkundigen een kennistekort bestond over de wijze van diagnostiek, vroegen we ons af hoe de praktische vaardigheden van verpleegkundigen zijn om de bloeddruk te meten voor de diagnose orthostatische hypotensie In **Hoofdstuk 4** beschrijven we de resultaten van een observationele studie bij 170 verpleegkundigen die werkzaam zijn op 17 afdelingen Chirurgie, Interne Geneeskunde of Geriatrie verspreid over Nederland Om de kennis en vaardigheden van verpleegkundigen op het gebied van bloeddrukmetingen ten behoeve van de diagnose orthostatische hypotensie te beoordelen, verrichtten we gestandaardiseerde observaties van de uitvoering van een bloeddrukmeting in liggende en staande houding bij patienten ouder dan 65 jaar, aan de hand van een voorlopige richtlijn die gebaseerd was op gepubliceerde richtlijnen en aanbevelingen Er waren belangrijke verschillen in de techniek van de metingen in vergelijking met de richtlijn de tijd die verstreek tussen een meting in liggende houding en het meten van de bloeddruk in stand varieerde van 0 tot 30 minuten, in een-vierde van de metingen was de arm van de patient niet op het niveau van het hart tijdens de staande meting, en in bijna de helft van de metingen was het manchet niet juist om de arm geplaatst We concludeerden dat de kennis en vaardigheden van verpleegkundigen om een liggende en staande bloeddruk van de patient te meten onbetrouwbaar waren voor het stellen van de diagnose orthostatische hypotensie Grote verschillen in de

meettechniek en het tijdstip van meten van de bloeddruk na het opstaan van de patiënt kunnen de individuele vaststelling van orthostatische hypotensie, de behandeling, en de gerapporteerde prevalentie beïnvloeden. De procedure om bloeddruk te meten voor de diagnostiek van orthostatische hypotensie behoeft meer standaardisatie, en implementatie van richtlijnen in de praktijk.

Echter, in de huidige literatuur waren geen richtlijnen voorhanden over hoe de bloeddruk voor het stellen van de diagnose orthostatische hypotensie gemeten diende te worden De enorme variatie in vaardigheden van verpleegkundigen om de bloeddruk te meten, en derhalve de onbetrouwbaarheid van de resultaten geeft de noodzaak van richtlijnen aan. In **Hoofdstuk 5** beschrijven we een onderzoek naar het bewijs en overeenstemmingen in de wetenschappelijk literatuur over de wijze waarop de bloeddrukmeting voor het vaststellen van orthostatische hypotensie dient plaats te vinden. De bevindingen werden verwerkt in een protocol, dat beoordeeld werd door 10 experts uit het veld tot er overeenstemming was bereikt. Met het gebruik van deze aanbevelingen, implementatie van de richtlijn in de praktijk, en continue bijscholing, kunnen de kennis en vaardigheden om bloeddruk te meten en daarmee het diagnostisch proces van orthostatische hypotensie worden verbeterd.

Nadat een probleem is vastgesteld, willen we de patiënt behandelen Voor de behandeling van orthostatische hypotensie zijn diverse niet medicamenteuze interventies voorhanden, zoals het slapen met een verhoogd hoofdeinde, het voorkomen van langdurige bedlegerigheid, en het vermijden van plotselinge houdingsveranderingen. Deze interventies zijn ook uitgebreid beschreven in de literatuur. De farmacologische behandelmogelijkheden voor postprandiale hypotensie zijn beperkt, daarom zijn de niet medicamenteuze interventies erg belangrijk. Helaas zijn de meeste interventies gebaseerd logisch redeneren, zoals bijvoorbeeld het gebruik van meerdere kleinere maaltijden op een dag. Zo werd ook gesuggereerd dat vooral de koolhydraten, primair de glucose component, in een maaltijd verantwoordelijk zou zijn voor een bloeddrukdaling

na een maaltijd. Wij bestudeerden de relatie tussen de hoeveelheid koolhydraten in een maaltijd en postprandiale bloeddrukveranderingen bij ouderen met postprandiale hypotensie. **Hoofdstuk 6** laat zien dat bij 12 geriatrische patiënten in de leeftijd variërend van 75-91 jaar, de maximale daling in systolische bloeddruk significant kleiner is na het nuttigen van een maaltijd met een lage hoeveelheid koolhydraten, dan na een normale of koolhydraatrijke maaltijd. Verder is de duur van de postprandiale hypotensie significant korter en symptomen minder frequent en minder ernstig na een koolhydraatarme maaltijd. We concludeerden dat reductie van de hoeveelheid koolhydraten in maaltijden een kleinere daling in systolische bloeddruk teweegbrengt, met een kortere duur van de postprandiale hypotensie en een reductie van de postprandiale symptomen. Daarom kan het verminderen van de hoeveelheid koolhydraten in een maaltijd (specifiek glucose), een effectieve niet medicamenteuze behandeling zijn voor ouderen met postprandiale hypotensie, om zo de kans op symptomatische maaltijdgerelateerde hypotensie te verkleinen.

Voor het toepassen van interventies zou het nuttig zijn om het patroon van postprandiale hypotensie over de dag te kennen. Van orthostatische hypotensie is bekend dat het in hoge mate varieert over de dag, en het meest voorkomt in de ochtend voor het ontbijt, direct na de eerste maal opstaan na een gehele nacht bedrust. De variabiliteit van postprandiale hypotensie over de dag is onbekend. Derhalve onderzochten we het effect van maaltijden op verschillende tijdstippen van de dag op de bloeddruk en symptomen in geriatrische patiënten met postprandiale hypotensie. **Hoofdstuk 7** beschrijft dat bij veertien geriatrische patiënten met postprandiale hypotensie (6 mannen, leeftijd 66-97 jaar), de maximale daling van systolische bloeddruk significant kleiner is na de avondmaaltijd, dan na het ontbijt of de lunch. Bij 8 patiënten trad na de avondmaaltijd geen postprandiale hypotensie op terwijl dit na het ontbijt en de lunch bij alle patienten aanwezig was. De duur van de postprandiale hypotensie was significant korter, het aantal symptomen aanmerkelijk minder en minder ernstig na de avondmaaltijd in vergelijking met

het ontbijt of de lunch We concludeerden dat bij geriatrische patienten de postprandiale hypotensie een variatie over de dag vertoont waarbij het significant minder optreedt in de avond met minder symptomen Voor de praktijk betekent dit dat er bij de diagnostiek en behandeling van postprandiale hypotensie rekening gehouden dient te worden met de variatie in voorkomen over de dag

In **Hoofdstuk 8** worden de bevindingen van de hele studie bezien in het licht van eerdere onderzoeken Verpleegkundige protocollen voor postprandiale en orthostatische hypotensie worden hier gepresenteerd Belangrijke conclusies van het gehele project waren dat zowel postprandiale- als orthostatische hypotensie veel voorkomende problemen zijn bij ouderen, en in hoge mate symptomatisch zijn Derhalve zouden alertheid voor hypotensieve syndromen, een uitgebreide anamnese van de voorgeschiedenis van een patient, observatie van symptomen, en bloeddrukmetingen deel uit moeten maken van het uitgebreide geriatrisch onderzoek bij opname De kennis van verpleegkundigen met betrekking tot hypotensieve syndromen en de vaardigheden om bloeddrukken te meten zouden verbeterd moeten worden

Met dit proefschrift is de eerste stap gezet in de preventie van de ernstige problemen van orthostatische en postprandiale hypotensie bij ouderen, door het erkennen van het belang van deze problemen voor de geriatrische patient en de verpleegkundige professie Met de implementatie van de protocollen met betrekking tot de diagnostiek van deze problemen, etiologie, symptomen, bloeddrukmetingen en interventies, kan de verpleegkundige zorg voor patienten met postprandiale en orthostatische hypotensie worden verbeterd Verdere inspanningen moeten worden verricht om de huidige kennis in de praktijk te implementeren Toekomstig onderzoek is noodzakelijk om meer interventies met wetenschappelijk bewijs te onderbouwen

List of publications

Publications included in this thesis

Vloet LCM, Jansen RWMM Is orthostatic hypotension a consistent finding in the acute geriatric ward? *Archives of Internal Medicine* 2003,163(10) 1239-1240 (partly)

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Station promotoren

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Station onderzoekers Geriatrie

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Station cluster zenuw-, ziel en ouderdomsspecialismen (CZZO)
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Station verplegingswetenschappers
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Station CWZ

In mei 2003 ben ik gestart als medewerker van het Wetenschapsbureau en onderzoeker in het Canisius Wilhelmina Ziekenhuis te Nijmegen Ik wil al mijn nieuwe collega's bedanken voor de leuke start en de prettige samenwerking tot nu toe Dat belooft veel goeds voor de toekomst, en ik verheug me erop

Station thuis Beginpunt, eindpunt, en rustpunt van deze reis

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Dit is het eindstation van deze leerzame reis "U kunt allen uit- of overstappen"

Curriculum Vitae

Lilian Vloet is geboren op 25 augustus 1968 te Overloon, gemeente Vierlingsbeek. Na de 'St Jozef' lagere school in Overloon ging zij vanaf 1980 naar 'Scholengemeenschap Jerusalem' in Venray waar zij in 1986 haar VWO – Atheneum B diploma behaalde. Van 1986 tot 1989 studeerde ze Geneeskunde aan de Katholieke Universiteit te Nijmegen. De verpleging trok meer haar interesse en in 1989 maakte ze de overstap naar de HBO-V, waar ze 'cum laude' haar diploma behaalde in 1992. De schrijfster werkte als verpleegkundige in diverse velden van de gezondheidszorg en vanaf 1994 op de afdeling Geriatrie van Universitair Medisch Centrum St. Radboud Nijmegen. Tegelijkertijd studeerde zij Gezondheidswetenschappen aan de Universiteit van Maastricht. Het doctoraalexamen in de Verplegingswetenschap behaalde ze 'cum laude' in 1996. In 1997 startte Lilian als research verpleegkundige op een medisch onderzoeksproject naar orthostatische en postprandiale hypotensie op de afdeling Geriatrie van UMC St Radboud Nijmegen. Als snel wijzigde haar functie in die van zelfstandig verpleegkundig onderzoeker op een verpleegkundig project naar orthostatische en postprandiale hypotensie. De resultaten van dit onderzoek zijn beschreven in dit proefschrift. Voor haar onderzoek ontving de schrijfster de Jan-Bastiaanse prijs 2000. Daarnaast werd ze genomineerd voor de Anna Reynvaan prijs 2002 voor het beste wetenschappelijke artikel gepubliceerd door een verpleegkundige. Na het beëindigen van haar onderzoek werkte Lilian Vloet als onderzoeker op de afdeling Geriatrie van Universitair Medisch Centrum St Radboud Nijmegen. Vanaf 1 mei 2003 is zij werkzaam bij het Wetenschapsbureau en als verpleegkundig onderzoeker in het Canisius Wilhelmina Ziekenhuis te Nijmegen.

De schrijfster is getrouwd met Erik Wouters, en moeder van Lieke (5) en Teun (2).

Stellingen

Behorende bij het proefschrift

Postprandial and Orthostatic hypotension in elderly patients.
Implications for nursing care.

Door Lilian Vloet

1 Orthostatische en postprandiale hypotensie komen zeer vaak voor bij geriatrische patienten Slechts een-vijfde deel van deze patienten heeft geen van deze aandoeningen en ruim een-derde deel beiden gelijktijdig Verpleegkundigen en anderen werkzaam met geriatrische patienten dienen bekend te zijn met deze problemen (dit proefschrift)

2 Orthostatische hypotensie kan relatief eenvoudig worden vastgesteld door het meten van een liggende en staande bloeddruk en observatie van symptomen In de praktijk blijken deze meting en de diagnostiek echter niet eenvoudig door het ontbreken van kennis en richtlijnen (dit proefschrift)

3 Nurses do not make a meal out of meal-induced hypotension (dit proefschrift)

4 Het feit dat ouderen over het algemeen niet zoveel eten is gunstig voor de preventie van postprandiale hypotensie De reductie van de hoeveelheid koolhydraten in een maaltijd (bijvoorbeeld door het nuttigen van kleinere, frequentere porties) verkleint de mate en de duur van een bloeddrukdaling na een maaltijd en de hoeveelheid en ernst van de klachten (dit proefschrift)

5 Het spreekwoord 'eet 's ochtends als een keizer, 's middags als een werknemer en 's avonds als een zwerver' geldt niet voor mensen met postprandiale hypotensie Zij zouden 's avonds keizerlijk moeten dineren omdat dan het effect van een maaltijd op de bloeddruk het kleinste is (dit proefschrift)

6 Wanneer we efficienter willen werken in de verpleging moeten we de zorg zo afstemmen dat de dokter niet juist een wond wil zien als de verpleegkundige net een half uur besteed heeft om een ingewikkeld verband te plaatsen

7 Veel kennis is nog geen wijsheid

8 Netwerken is net werken

9 Ability is what you're capable of doing Motivation determines what you do Attitude determines how well you do it

10 Het is gemakkelijker een lach te delen dan een traan te delen

11 Het lawaai dat kinderen produceren tijdens een telefoongesprek van hun ouders is omgekeerd evenredig met het belang van dat gesprek

12 Het feit dat er aan het einde van een reeks stellingen bij een academisch proefschrift een grappige stelling wordt toegevoegd wil nog niet zeggen dat al het voorgaande niet serieus moet worden genomen

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