

Postprandial Hypotension in Elderly Patients With Unexplained Syncope

Rene W. M. M. Jansen, MD, PhD; Carolyn M. Connelly, PhD; Margaret M. Kelley-Gagnon, RN; J. Anthony Parker, MD, PhD; Lewis A. Lipsitz, MD

Background: Syncope in older patients may be caused by a variety of disorders, including hypotension, but frequently remains unexplained. Postprandial hypotension is a common disorder of blood pressure regulation in the elderly.

Objective: To determine the pathogenic mechanisms and potential role of postprandial hypotension in elderly patients with otherwise unexplained syncope.

Methods: We studied 16 elderly patients with unexplained syncope and nine elderly controls. Blood pressure, heart rate, forearm vascular resistance, plasma norepinephrine level, and cardiac and splanchnic blood volumes were measured before and after a 1680-kJ meal.

Results: Eight elderly patients with syncope had postprandial hypotension, with a decline in supine mean arterial blood pressure of 17 ± 2 mm Hg after a meal ($P < .001$). The blood pressure remained unchanged after the meal in the other patients with syncope and the controls. In patients with postprandial hypoten-

sion, systemic vascular resistance fell after the meal, while it remained unchanged in the other groups. Heart rate and plasma norepinephrine level increased to a similar extent in all three groups. Forearm vascular resistance increased only in the control subjects. Splanchnic blood volume increased by 26% ($P < .01$) in patients with syncope who had postprandial hypotension and by 22% ($P < .01$) in control subjects. Splanchnic blood volume remained unchanged in the patients with syncope without postprandial hypotension.

Conclusions: Postprandial hypotension may be an important causative factor in elderly patients with unexplained syncope. The evaluation of syncope in elderly patients should therefore include blood pressure measurements surrounding a meal. Elderly patients with syncope who have postprandial hypotension fail to maintain systemic vascular resistance, probably because of splanchnic blood pooling without a compensatory increase in peripheral vascular resistance.

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SYNCOPE IS a common symptom in elderly patients that remains unexplained in 30% to 50% of cases, despite extensive and expensive medical evaluations.¹⁻³ Elderly persons are particularly vulnerable to syncope because of the accumulation of multiple age- and disease-related abnormalities that impair cardiovascular adaptation to hypotensive stresses. Accordingly, hypotension and syncope may occur in response to seemingly minor stimuli not ordinarily expected to produce syncope. In more than one third of syncope cases, hypotension in response to common situational stresses, such as drug ingestion, posture change, meal digestion, defecation, and micturition, has been implicated as a causative factor.⁴ These daily situations, alone or in combination with

each other, and superimposed on comorbid diseases, may threaten cerebral oxygen delivery and subsequently result in a syncopal event.

During the past decade, postprandial hypotension (PH) has become recognized as a common disorder of blood pressure (BP) regulation in the elderly,^{5,12} in patients with autonomic failure,^{13,16} and in patients with end-stage renal disease during hemodialysis.¹⁷ In most elderly persons, meal-associated declines in BP are modest and asymptomatic; however, in hypertensive elderly patients,^{7,9,10} patients with Parkinson's disease¹⁶ or autonomic

From the Hebrew Rehabilitation Center for Aged (Drs Jansen, Connelly, and Lipsitz and Ms Kelley-Gagnon), Division of Gerontology, Department of Medicine (Drs Jansen and Lipsitz), and Department of Radiology (Dr Parker), Beth Israel Hospital, and Harvard Medical School (Drs Jansen, Parker, and Lipsitz), Boston, Mass. Dr Jansen is now with the Department of Geriatric Medicine, University Hospital Nijmegen (the Netherlands).

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SUBJECTS AND METHODS

SUBJECTS

Sixteen elderly patients with unexplained syncope were recruited from the Hebrew Rehabilitation Center for Aged, Boston, Mass, an academic long-term care facility (seven patients), from the Beth Israel Hospital, Boston (one patient), or from referrals by primary care physicians (eight patients). All patients underwent a full medical evaluation, including a careful history, physical examination, blood studies, an electrocardiogram, cardiac monitoring, and an echocardiogram and cardiac Doppler study. In all cases syncope remained unexplained after this evaluation.

Syncope was defined as a sudden transient loss of consciousness associated with an inability to maintain postural tone and with spontaneous recovery. All patients had one or more syncopal episodes, and all of these episodes occurred during a 2-hour period after a meal. Although several of the subjects were taking medications on a long-term basis, there was no temporal relationship between medication administration and syncope or other clinical evidence that syncope could be attributed to medication effects. None of the subjects had orthostatic hypotension. One patient with a demand pacemaker continued to have unexplained syncopal episodes and was included in this study. He was not in a paced rhythm during the study.

Subject characteristics are summarized in **Table 1**. The patients with syncope were divided into two groups according to their BP response after a meal. Eight of the patients with syncope had PH, defined as a decline in supine systolic BP of 20 mm Hg or more within the 90-minute study period. Nine healthy elderly subjects with no history of medical illness, smoking, or medication use were recruited from the local Boston community through newspaper advertisements. These healthy elderly subjects were also included in another study.²⁶

The study was approved by the Institutional Review Boards of the Beth Israel Hospital and Hebrew Rehabilitation Center for Aged. All subjects provided written in-

formed consent after the nature of the study had been fully explained.

STUDY PROTOCOL

Meal studies began at 7:30 AM after an overnight fast from midnight the night before. If subjects were taking long-term medications, these were withheld for as long as it was safe to do so: a minimum of 12 hours before the study for medications routinely given two to four times daily and 24 hours before the study for those given once daily.

The meal was a 1680-kJ drink (Carnation Instant Breakfast in lactose-free whole milk) that contained 40% carbohydrate, 45% fat, 15% protein, and 12 mEq of sodium. It was served at a temperature of 22°C to avoid potential temperature effects on BP.²⁴ This meal composition represents that of a mixed breakfast.

Each subject was studied in the nuclear medicine laboratory of the Beth Israel Hospital, where radionuclide imaging studies were performed to measure cardiac and splanchnic blood pools. A 21-gauge angiocatheter with heparin lock was placed in one antecubital vein for blood sampling throughout the study. This intravenous catheter was also used to withdraw a 3-mL blood sample during each radioventriculogram to determine biologic clearance of the tracer. A second temporary angiocatheter was placed in the opposite antecubital vein for collection and reinjection of autologous red blood cells that were labeled with 740 MBq of technetium Tc 99m. This line was removed after labeled red blood cell injection. After this injection and a minimum of 30 minutes of supine rest, 10 minutes of basal measurements were performed. Subjects then sat for 10 minutes to ingest the liquid meal, after which they resumed a supine position for the duration of the study. Room temperature remained constant (23 ± 1°C) throughout the study.

The BP and heart rate (HR) were measured on one arm at 5-minute intervals throughout the study with an automated oscillometric device (Dinamap, Critikon, Tampa, Fla). The three BP and HR measurements at 10, 5, and 0 minutes before the meal were averaged and considered the baseline value. This value and the means of the three values around the 15-, 30-, 45-, 60-, 75-, and 90-minute time points

dysfunction,^{13,14} and especially in the nursing home population,^{5,12,18} postprandial declines in BP may be of sufficient magnitude to result in syncope.

In a previous study we found that in 31 of 97 elderly patients with syncope, fainting occurred within 1 hour of the beginning of meal ingestion.⁴ In eight of these subjects, hypotension was documented immediately on fainting and marked PH was later reproduced.¹⁸ Although these data suggest a causative relationship between PH and syncope, meal-related hypotension is rarely sought during the evaluation of syncope in the elderly. In a study that evaluated 210 elderly patients with syncope, no meal-associated syncope was reported.³ In the absence of a careful search for PH, patients with syncope who have this problem may be inappropriately labeled as having "unexplained syncope" or subjected to unnecessary invasive tests. Therefore, one aim of the current investigation was to assess the potential clinical significance of PH in elderly patients with unexplained syncope.

Several pathophysiologic mechanisms of PH have been proposed, including age- and/or BP-related impairments in baroreflex function,^{5,10,19} insulin-induced vasodilation or baroreflex impairment,^{10,19} inadequate sympathetic nervous system compensation for meal ingestion,^{5,10,13} excessive splanchnic blood pooling during digestion,²⁰ hypotensive effects of vasoactive gastrointestinal peptides,^{14,20-25} and failure to maintain systemic vascular resistance after a meal.²⁶ In patients with autonomic dysfunction, impaired peripheral vascular responsiveness probably plays an important role.²⁶ Until now, no clear pathophysiologic mechanism of PH in the elderly has been defined. Therefore, the present study was designed also to determine the pathophysiologic mechanisms of PH in elderly patients with syncope. Accordingly, we compared the hemodynamic, neurohumoral, and splanchnic blood pool responses to a standardized mixed meal in elderly patients with syncope with and without PH, and in healthy elderly controls.

