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Original Study

Hypertension and Its Treatment at Age 90 Years: Is There an Association with 5-Year Mortality?

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A B S T R A C T

Objective: To determine the association between hypertension at age 90 years, treatment, and 5-year mortality.
Design: A prospective observational study of a representative community-dwelling birth cohort (born 1920–1921) by the Jerusalem Longitudinal Study (1990–2015).
Setting: Home-assessment.
Participants: 480 subjects aged 90, examined 2010–2011.
Measurements and Main Outcome: Hypertension was defined as treatment with antihypertensive medication, and/or sitting blood pressure (BP) > 140 mmHg systolic or >90 mmHg diastolic. Subjects were categorized as normotensive (NORMO), untreated hypertensive (NonTx-HTN), and treated hypertensive (Tx-HTN); assessment included activities of daily living (ADL), handgrip strength, and all-cause mortality (2010–2015).
Results: NORMO, NonTx-HTN, and Tx-HTN prevalence was 12.3% (59/480), 12.7% (61/480), and 75% (360/480). Tx-HTN had higher rates of low education, depression, low physical activity, chronic heart failure, ischemic heart disease, chronic kidney disease. Five-year survival was lowest among Tx-HTN and highest among NonTx-HTN versus NORMO among all subjects (51%, 72%, 61%; $P = .01$), and subgroups with ADL independence (64%, 91%, 74%; n = 265, $P = .01$), ADL dependence (37%, 55%, 48%; n = 194, $P = .36$), high grip strength (66%, 85%, 83%; n = 227, $P = .04$), low grip strength (38%, 60%, 61%; n = 149, $P = .06$), low comorbidity (64%, 84%, 70%; n = 219, $P = .13$), and high comorbidity (42%, 60%, 54%; n = 257, $P = .12$). Unadjusted mortality hazards ratios (HR) were higher for Tx-HTN [HR 1.38; 95% confidence interval (CI) 0.89–2.15] versus NonTx-HTN (HR 0.7; 95% CI 0.37–1.31) compared to NORMO (HR 1.0). After adjusting for medical and functional covariates, adjusted HRs were higher for Tx-HTN (HR 1.39; 95% CI 0.83–2.33) versus NonTx-HTN (HR 0.67; 95% CI 0.31–1.45) compared to NORMO (HR 1.0). Findings were consistent in subsets according to ADL status, grip strength, and comorbidity.
Conclusions: Untreated hypertension at age 90 years was not associated with increased mortality risk among community-dwelling elderly, irrespective of comorbidity, functional status, or muscle strength.

J. Stessman and M. Bursztyn contributed equally to the study.
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High blood pressure (BP) is common among the elderly, affecting as many as 75% of people aged >75 years in the United States.[1] Nonetheless, debate continues regarding the definition and treatment goals for hypertension among elderly people. Current lack of consensus is rooted in the apparent contradiction of findings between randomized controlled interventional trials and observational studies, which respectively provide evidence favoring the benefits of treatment compared to lack of benefits or even potential harm among the elderly.

Indeed, the term *elderly* is problematic, because people aged >65 years cannot be considered a homogenous group. Aging is typified by increasing heterogeneity between people within the same age group, and even more so across different ages. Accordingly, a recent expert opinion of the European Society of Hypertension–European Union Geriatric Medicine Society (ESH-EUGMS) Working Group on the management of hypertension in very old, frail subjects[2] advises special consideration and caution when treating hypertension among subjects aged ≥80 years. Rising burden of comorbidity, frailty, functional dependence, cognitive decline, and lack of autonomy may serve to modify the potential benefits of antihypertensive treatment, and evidence supports their association with poorer clinical outcomes following treatment for hypertension compared to nontreatment in this age group.[3–8] In contrast, the Hypertension in the Very Elderly double-blind trial (HYVET),[9] aimed at subjects aged ≥80 years, found that treatment of hypertension led to a reduced risk of major cardiovascular events and all-cause mortality when compared to placebo. Furthermore, recent findings from the SPRINT (Systolic BP Intervention Trial),[10] in particular the subanalysis of subjects aged ≥75 years,[11] emphasized the benefits of an intensive systolic BP (SBP) treatment target of <120 mmHg, which was associated with decreased cardiovascular morbidity and all-cause mortality. Not only were these BP treatment goals significantly lower than those suggested by previous guidelines[12,13] but post hoc data analyses from both studies maintained the continued benefits of treatment after adjusting for measures of frailty.[11,14,15]

Although designed to include older subjects, the HYVET and SPRINT included fewer subjects aged >90 years. However clinicians are inevitably required to contend with the dilemma of treatment decisions concerning BP levels among this growing population.

The objective of the present study was to investigate the relationship between BP level, antihypertensive treatment, and mortality among a representative sample of community-dwelling 90-year-olds. Using data from an ongoing observational cohort study of aging, we compared the survival rates and likelihood of mortality among normotensive, untreated hypertensive, and treated hypertensive subjects, and examined the influence upon these findings of functional status, handgrip strength, and comorbidity.

Methods

Study Population

The study population is part of the Jerusalem Longitudinal Study (1990–2015), a prospective observational longitudinal study previously described.[16,17] The sample frame is the birth cohort born June 1, 1920, through May 31, 1921, resident in Western Jerusalem, all of whom were eligible for inclusion. There were no exclusion criteria. Subjects were randomly chosen from the national electoral register, and the sample has been proven to be representative, as shown by similar morbidity, mortality, and hospitalization rates when comparing between study subjects, those declining to enroll, and subjects from the birth cohort not approached.[18,19] The sample size of 480 reflects the number of nonagenarians enrolled during the fourth study wave (2010–2011). Participant, or legal guardians, provided informed consent. Proxy informants, with consent from legal guardians, were used in the case of demented or extremely frail subjects. Subjects received a summary of the personal data collected, with recommendations for their family physician if necessary. The Hadassah-Hebrew University Medical Center Institutional Review Board approved the study.

Measurements

Home assessment by study personnel, with structured interview, lasted 1.5 hours. Data collected included gender; education (years); alcohol usage; smoking (defined as ever vs never smoked); body mass index (BMI) (calculated as kilograms/height^2); self-rated health (good vs poor); fatigue; depression using the Brief Symptom Inventory[20]; Mini-Mental State Examination (MMSE) score, with a score ≤24/30 for cognitive impairment[21]; physical activity level (low activity being <4 hours/week vs active being ≥4 hours/week, or vigorous sports ≥2 times/week[22]; 2 measures of functional status based on self-report, the first defined as dependence/independence on another person in performing ≥1 of 6 activities of daily living (ADL) (transferring, dressing, bathing, using the toilet, eating, and remaining continent),[23] and the second measure defined as ease/difficulty in ≥1 of 6 ADL[24]; handgrip strength (kilograms) measured as the highest of 3 measurements by a portable handheld dynamometer (Takei 5001 Grip-A, Japan), from strongest hand, elbow flexed 90° while sitting,[25,26] with low grip defined <26 kg for men and <16 kg for women, according to the Foundation for the National Institute of Health Sarcopenia Project[27,28]; history of major diseases defined according to the *International Classification of Disease, Ninth Edition*,[29] including ischemic heart disease (a composite history of myocardial infarction/acute coronary syndrome, pathologic coronary catheterization, previous coronary revascularization, positive stress test, angina pectoris); chronic heart failure; stroke; diabetes mellitus; chronic kidney disease; neoplasm (excluding skin cancer); number of antihypertensive medications, defined as diuretics, beta blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers, vasodilators, and nitrates.

High comorbidity was defined as ≥1 of the following: diabetes mellitus, stroke, chronic heart failure, cognitive impairment (MMSE score ≤24), weight loss ≥5 kg in last year, and SBP hypotension <110 mmHg after standing 2 minutes. These 6 parameters approximate the SPRINT exclusion criteria, which also excluded nursing home status and life expectancy <3 years.[10,11]

BP Measurement and Hypertension Diagnosis

Sitting BP with arm supported at heart level measured 3 times on 2 occasions using validated electronic sphygmomanometer (Omron 705IT, Omron Corporation, Kyoto, Japan) according to European Society of Hypertension recommendations[12] and mean systolic and diastolic BP was calculated. Pulse rate (beats per minute) was measured and the mean calculated. Hypertension was defined as treatment with antihypertensive medication, and/or sitting BP > 140 mmHg systolic or >90 mmHg diastolic. Subjects were categorized as normotensive (NORMO), untreated hypertensive (NonTx-HTN), or treated hypertensive (Tx-HTN).

Study Outcome

Mortality was determined from the time of assessment during 2010–2011 to December 31, 2015. All-cause mortality data from Ministry of Interior, based on obligatory notifications of death, provided 100% surveillance for subjects remaining in Israel.

Statistical Analyses

Descriptive statistics were performed using χ^2 tests for categorical variables and *t* test for continuous variables. Kaplan-Meier survival curves and log-rank test examined survival data, and Cox proportional hazard models determined unadjusted and adjusted mortality