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Research Article

Prevalence of pseudoresistant hypertension due to inaccurate blood pressure measurement

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Abstract

The prevalence of pseudoresistant hypertension (HTN) due to inaccurate BP measurement remains unknown. Triage BP measurements and measurements obtained at the same clinic visit by trained physicians were compared in consecutive adult patients referred for uncontrolled resistant HTN (RHTN). Triage BP measurements were taken by the clinic staff during normal intake procedures. BP measurements were obtained by trained physicians using the BpTRU (VSM Med Tech Ltd. Coquitlam, Canada) device. The prevalence of uncontrolled RHTN and differences in BP measurements were compared. Of 130 patients with uncontrolled RHTN, 33.1% (n = 43) were falsely identified as having uncontrolled RHTN based on triage BP measurements. The median (inter-quartile range) of differences in systolic BP between pseudoresistant and true resistant groups were 23 (17–33) mm Hg and 13 (6–21) mm Hg, respectively ($P = .0001$). The median (inter-quartile range) of differences in diastolic BP between the two groups were 12 (7–18) mm Hg and 8 (4–11) mm Hg, respectively ($P = .001$). Triage BP technique overestimated the prevalence of uncontrolled RHTN in approximately 33% of the patients emphasizing the importance of obtaining accurate BP measurements. J Am Soc Hypertens 2016;10(6):493–499.

Keywords: Blood pressure; blood pressure measurement technique; pseudoresistant hypertension; resistant hypertension.

Introduction

Uncontrolled RHTN is defined as systolic blood pressure (SBP) ≥ 140 mm Hg and/or diastolic blood pressure (DBP) ≥ 90 mm Hg with the use of at least 3 antihypertensive medications.[1–3] Falsely elevated BP levels contribute to pseudoresistant HTN, that is, BP levels that appear uncontrolled, but actually are not. The prevalence of pseudoresistance among persons with apparent RHTN is estimated to be as high as 50%.[3,4] The most common causes of pseudoresistance are inaccurate BP measurement technique, medication nonadherence, undertreatment, and white coat HTN.[2,3] Of these, only pseudoresistance secondary to inaccurate BP measurement has not been previously quantified.

Proper technique is essential to accurately measure BP. However, during delivery of routine health care, guidelines for accurate BP measurement are rarely followed.[5] Errors commonly made during routine BP measurements include: use of an incorrectly sized cuff; placing the cuff over clothes; relying on standing or supine BP measurements; deflating BP cuff too fast; omitting 3–5 minutes of rest before BP measurement; taking the BP simultaneously with other ongoing activities like completing forms or answering questions; and introduction of operator biases associated with nonautomated devices.[6–13] The combined effects of these errors in technique may over or under estimate BP levels resulting in the misdiagnosis and mismanagement of uncontrolled RHTN.

Quantification of the degree of error in measurement related to inaccurate BP technique has not been previously reported. In the present study, we determined the prevalence of pseudoresistance attributed to measurement

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error during routine BP measurement in consecutive patients referred for uncontrolled apparent RHTN to our hypertension specialty clinic. We further attempted to identify patient characteristics more commonly associated with pseudoresistant HTN due to inaccurate BP measurement.

Methods

Participants and Study Design

Consecutive adult patients referred to the University of Alabama at Birmingham (UAB) HTN Clinic for evaluation and treatment of RHTN between June 2013 and November 2015 were retrospectively analyzed. Patients with SBP $\geq$140 mm Hg and/or DBP $\geq$90 mm Hg obtained during routine intake measurement while prescribed 3 or more antihypertensive medications at the time of their initial visit were considered as having uncontrolled apparent RHTN. For the purposes of this study, routine intake or triage BP measurements obtained by clinic staff were compared with BP measurements obtained in the same patient at the same visit by trained physician examiners. Falsely elevated or peudoresistant HTN was identified if the triage BP was elevated (SBP $\geq$ 140 mm Hg and/or DBP $\geq$ 90 mm Hg) but controlled (SBP $<$ 140 mm Hg and DBP $<$ 90 mm Hg) when measured by trained physicians. True uncontrolled RHTN was identified if the triage BP was concordant with the trained physician measurement (SBP $\geq$ 140 mm Hg and/or DBP $\geq$ 90 mm Hg). Data on patient demographics, medication use, cardiovascular risk factors, and BP measurements during the initial and subsequent clinic visits were collected. The protocol was approved by UAB's Institutional Review Board.

Routine Intake BP Measurements

Triage BP measurements were taken as part of intake procedures by clinic staff using an automated BP device (Welch Allyn, New York, USA) with adult small, regular, and large sized cuffs available. Typically, a single BP reading is obtained as part of the electronically documented vital signs for the visit. The clinic staff had not had any special training in BP technique beyond what that they learned during their respective professional education and on-the-job instruction from fellow staff members and no standardized BP measurement protocol was used. The BP is generally measured with patients sitting in a common, often busy, intake area and often while being asked questions related to their current medical history and medication use. The BP measurement is usually taken almost immediately after having the patient sit adjacent to the nurses' station. Blood pressure cuffs are variably placed directly on the skin or over clothes.

BP Measurements by Trained Physicians

BP measurements were taken by physicians following AHA recommendations.[5] These measurements were obtained using an oscillometric device BpTRU (VSM Med Tech Ltd. Coquitlam, Canada) that automatically obtains serial BP measurements. BpTRU is a validated device which has passed the standards of the British Society of HTN and the Association of Advancement of Medical Instrumentation and is more consistent with the ambulatory BP readings compared with single office visit measurements.[14–16] The BpTRU device takes six consecutive BP measurements one minute apart providing an average based on the last 5 measurements. BP measurements were taken following a standard protocol: having patients sit for 5 minutes in a quiet room, back supported, feet on the floor, with the arm used for measurement supported at chest level and placing the appropriately sized cuff (adult small, regular, or large) directly on the skin on the nondominant arm. Once the device was appropriately in place, the physician left the room and allowing for unobserved BP measurements.

Statistical Analysis

Summary statistics were obtained and non-normally distributed data displayed as median and inter-quartile range (IQR). The prevalence of pseudoresistant HTN was calculated for the initial and follow-up visits in patients with uncontrolled BP levels as measured by BpTRU (primary analysis). The differences between SBP and DBP measurements taken at triage intake and by trained physicians were obtained in this group. Mann-Whitney test was used to compare BPs between pseudoresistant and true resistant groups as determined by BP measurement technique with $P < .05$ considered significant. Individual associations of age, sex, and race with differences in SBP and DBP between the two measurement techniques were assessed. A secondary analysis including the entire study cohort was conducted to compare the difference between triage and BpTRU SBP across different triage SBP categories. All statistical calculations were performed using SPSS (IBM, USA) software.

Results

Of 192 patients prescribed 3 or more medications during their initial clinic visit, 58 patients with controlled triage and expertly obtained BP measurements, and 4 patients with controlled triage and uncontrolled expertly obtained BP measurements were excluded. As a result, 130 patients with uncontrolled apparent RHTN were included in the primary analysis. Of those, 115 and 68 patients had second and third follow-up visits, respectively. Overall, patients referred for uncontrolled RHTN were more likely female