Use of noninvasive procedures in the cardiovascular risk assessment of hypertensive and normotensive individuals

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Background: Arterial hypertension is associated with a high prevalence of vascular alterations. The use of noninvasive procedures to assess peripheral arterial diseases in the ranking of cardiovascular risks has been increasingly valued in clinical practice and should be adopted in nursing.

Objective: To identify the cardiovascular risk of hypertensive and normotensive individuals through the use of different noninvasive procedures to assess the vascular function and integrity: ankle-brachial index, pulse pressure, and delta brachial-brachial and delta ankle-brachial indexes.

Methods: Quantitative, descriptive, and cross-sectional study undertaken at a health service in a Brazilian city. The research variables were age, sex, blood pressure, abdominal circumference, body mass index, ankle-brachial index, pulse pressure, and delta brachial-brachial and delta ankle-brachial indexes.

Results: Fifty-four (43.1%) normotensive and 69 (56.9%) hypertensive individuals participated in the study. Alterations were identified in ankle-brachial index, corresponding to mild and moderate arterial obstruction, among hypertensive individuals only (7.2%), with higher pulse pressure indices ($P < 0.0001$*). The assessment of the correlation between the ankle-brachial index and pulse pressure showed no correlation in the normotensive group and a statistically significant correlation among hypertensive patients (Pearson's coefficient =* -0.45*,* $P < 0.0001$*,* $r^2 = 0.21$*). A statistically significant difference (*$P < 0.05$*) was found in the analysis of the mean delta brachial-brachial (*6.2 ± 0.71 *mm Hg for normotensive and* 10.16 ± 1.45 *mm Hg for hypertensive individuals) and delta ankle-brachial index (*0.06 ± 0.01 *for normotensive and* 0.11 ± 0.01 *for hypertensive individuals).*

Conclusions: The use of the proposed cardiovascular risk predictors shows more frequent alterations among hypertensive than normotensive individuals. (J Vasc Nurs 2016;34:17-23)

In the last two centuries, as a result of the changes derived from the epidemiologic and demographic transition processes, nontransmissible chronic diseases and their complications have become increasingly frequent, including cardiovascular diseases (CVDs),[1] which represent the main cause of death all over the world and represent about 30% of global deaths and 20% of all deaths in individuals aged older than 30 years in Brazil.[2,3]

Hypertension is one of the main CVDs and is also considered a relevant risk factor for the occurrence of other morbid events. The boundary that defines hypertension considers systolic blood pressure (SBP) ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg when measured in the doctor's office. It is estimated that 1.56 billion adults will be living with hypertension in 2025, which is why the disease is qualified as an increasing and global public health problem.[4] In Brazil, the prevalence of hypertension ranges between 22.3% and 43.9% of the population.[5]

Recently, many studies have appointed the effective use of noninvasive procedures for the clinical assessment of cardiovascular risk, including the measuring of the ankle-brachial index (ABI) and the determination of the pulse pressure (PP).[6-8]

The ABI is a noninvasive measure to detect blood pressure changes in the lower limbs, being a simple and cost-effective method.[9] In Brazil, measuring the ABI is indicated for individuals aged ≥70 years or individuals aged between 50 and 69 years with clinical characteristics and risk factors specified in the Brazilian Hypertension Guidelines (2010).[5] According to the Brazilian guidelines, the ABI is considered normal when superior to 0.90; lower levels indicate arterial obstruction.[5] Despite these recommendations, this method has not been applied in daily clinical practice, which can be justified by the need to use specific equipment and training.[10]

The American Heart Association encourages the exploration of more feasible alternative methods for routine ABI assessment in clinical practice, with a view to reducing the application costs

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and enhancing its implementation in primary health care.[11] From that perspective, studies have demonstrated the efficacy of using automated oscillatory sphygmomanometers (AOS) to determine the ABI,[7,10] which for many years was restricted to the use of the vascular Doppler only.

More recently, nurses have been developing research, demonstrating satisfactory results when this resource is used.[10,12,13] Arevalo-Manso et al[10] observed that the sensitivity and specificity of an automatic blood pressure device detecting ABI <0.90 shows acceptable levels when nurses perform the technique. Nelson et al[12] determined the level of agreement between a conventional ABI measurement (using Doppler and mercury sphygmomanometer taken by a research nurse) and ABI measure (using an oscillometric device taken by a practice nurse). They concluded that the ABI measure using automated equipment may be used as a screening tool for high risk and CVDs of patients in primary care. Romero-Vilaplana et al[13] showed that the assessment of ABI should be part of the exploration of chronic patients who come periodically to nursing consultations, particularly those ones with a moderate or high cardiovascular risk.

To look for alternatives applicable to the clinical routine of cardiovascular risk assessment, Kawamura,[7] departing from the premise that the similarity between the sides of the human body should assume highly similar pressure levels, except in case of anatomic–pathologic abnormalities, elaborated two new risk assessment forms, obtained when the blood pressure and ABI are measured: the delta brachial-brachial index (delta-BB) and the delta ankle-brachial index (delta-ABI). These innovative assessment forms, when altered (>8 mm Hg for delta-BB and >0.13 for delta-ABI), showed very high prevalence levels in patients having peripheral arterial disease (PAD), constituting an interesting complementary cardiovascular risk assessment method that can be further explored in future studies.

Besides the use of the clinical indicators mentioned, the PP should also be highlighted, being a useful predictor of coronary artery disease or total CVD, mainly in middle-aged or elderly people.[14,15] Investigators also suggest PP as a marker of preclinical CVD.[16]

The use of noninvasive procedures to assess atherosclerosis in the cardiovascular risk ranking has been increasingly valued, especially the use of ABI.[17] In the literature, recommendations are found for research that combines the use of different noninvasive procedures to assess the vascular function and integrity, as the different measuring methods reflect the distinct stages of the vascular alteration process that leads to cardiovascular events.[18]

Based on the importance and increasing use of these clinical indicators to identify cardiovascular risks, the objective in this study was to identify the cardiovascular risk in hypertensive and normotensive individuals through the determination of the ABI, PP, and delta-BB and the delta-ABI, using AOS. Altered levels of the research variables are expected in hypertensive patients.

METHODS

Quantitative, descriptive, and cross-sectional approach, developed at a preventive health service in a Brazilian city between August 2011 and June 2012.

The patients were invited to take part in the sample when they attended the service for routine care. The exclusion criteria were age <18 years, pregnancy and puerperal period, preliminary diagnosis of diabetes mellitus, counterindication for BP measuring on the ankles, patients with cardiac arrhythmia, and use of antiplatelet aggregation and anticoagulation drugs. The participants were divided in two groups (normotensive and hypertensive), according to the medical diagnosis obtained from their patient history.

The researcher held the interview in a private room and collected the following information: age, skin color, and education.

The age was based on the birth date registered on the identity card or on the participant's information. The skin color was self-referred and ranked as white or nonwhite. To assess the education, the individual informed the number of years of study.

The following anthropometric data were measured: weight, height, body mass index (BMI), and abdominal circumference (AC). The BMI and AC were calculated and ranked according to the cutoff points established by World Health Organization[19] and the Brazilian Obesity Guidelines,[20] respectively.

To measure the BP by means of the indirect oscillometric method, automated portable OMRON equipment was used, Model HEM 705 CP. All technical requirements for appropriate BP collection (resting before taking the BP, proper size and/or placement of cuff, did the patient smoke prior, machines calibrated), followed the specifications of the Brazilian Arterial Hypertension Guidelines (2010).[5]

The PP was equivalent to the difference between the SBP and diastolic blood pressure in mm Hg on the arm with the highest SBP. The reference values were ≥50 mm Hg for outpatient measures.[21] When the SBP values were identical on both limbs, the right arm was elected.

To determine the ABI, the pressure levels were measured on the four limbs during the routine clinical examination, using two AOS, according to the technique described by Kawamura.[7] The reference values adopted in this research followed the indications of the Brazilian Arterial Hypertension Guidelines.[5] The ABI used for the data analysis was the lowest index obtained on the right and left limbs.[22]

The delta-BB was obtained by means of the absolute difference in mm Hg between the SBP on the arms measured simultaneously and the delta-ABI by the absolute difference between the ABI on both ankles. The reference values used ranged between 0 and 8 mm Hg for delta-BB and between 0 and 0.13 for delta-ABI.[7]

The research development complied with the Brazilian and international ethical standards for research involving human beings. Approval was obtained from the Institutional Review Board at the University of São Paulo at Ribeirão Preto College of Nursing. All patients agreed to participate in the study and signed the informed consent form.

The descriptive analyses, involving the calculation of absolute frequencies and percentages, were developed in the statistical software Statistical Package for Social Science (SPSS, version 15.0). To compare the data between the two groups, Student's t test for independent samples was used. The linear regression analysis was used to identify the correlation between the variables. The results were expressed as means ± standard errors of the means, and the differences were considered statistically significant when $P < 0.05$.

RESULTS

The study participants were 123 individuals, including 54 (43.9%) normotensive and 69 (56.1%) hypertensive patients.