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Clinical Research

The Gap Between Manual and Automated Office Blood Pressure Measurements Results at a Hypertension Clinic

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ABSTRACT

Background: Blood pressure (BP) readings taken in clinics are often higher than BP readings taken in a research setting. Recent guidelines and clinical trials have highlighted the necessity of using automated office blood pressure (AOBP) devices and standardizing measurement procedures. The goal of the present study was to compare AOBP vs manual BP measurement in both research and clinical environments in which operators and devices were the same and measurement procedures were standardized and optimal.

Methods: Clinical manual BP and AOBP measurement estimates were gathered from a retrospective cohort of patients followed in a hypertension clinic. Research AOBP and manual BP measurement data were obtained from past research studies. Descriptive statistics and agreement analyses with Cohen kappa coefficients were developed. The AOBP/manual BP measurement gap between clinical and research follow-up was compared using an unpaired *t* test.

Results: Two hundred eighty-eight patients were included in the clinical cohort, and 195 patients contributed to research-grade BP

RÉSUMÉ

Introduction : Les mesures de pression artérielle (PA) prises en clinique sont souvent plus élevées que les mesures de la PA prises dans un cadre de recherche. Les dernières lignes directrices et les essais cliniques ont souligné la nécessité de procéder à la mesure de la PA en clinique - oscillométrique en série (MPAC-OS) et d'uniformiser les méthodes de mesure. Le but de la présente étude était de comparer les MPAC-OS et les mesures manuelles de la PA en milieu de recherche et en milieu clinique où les opérateurs et les appareils étaient les mêmes, et où les méthodes de mesure étaient uniformisées et optimales.

Méthodes : Les estimations des mesures manuelles de la PA et des MPAC-OS en milieu clinique provenaient d'une cohorte rétrospective de patients suivis dans une clinique d'hypertension. Les données des MPAC-OS et des mesures manuelles de la PA en milieu de recherche provenaient d'études de recherche antérieures. Les statistiques descriptives et les analyses de concordance à l'aide des coefficients kappa de Cohen ont été élaborées. Le test de t non apparié a comparé

Hypertension, a major cardiovascular risk factor, occurs in 22.6% of Canadians.[1] Its treatment has been shown to reduce stroke, ischemic heart disease,[2] and mortality.[3] To address the disease adequately, clinicians must have reliable tools to estimate blood pressure (BP). Manual BP measurement by sphygmomanometer has historically been considered the reference method to evaluate other types of BP measurement, but its validity depends on operator expertise and standard measurement procedures. Its use has been found to be associated with many biases,[4] such as suboptimal adherence to measurement recommendations, preferential recording of 0 and 5 end digits, or inappropriate patient preparation and installation. Others, mainly the "white coat effect," are inherent to operator presence.

In the past 10 years, there has been rising interest in automated office BP (AOBP) measurement. AOBP essentially refers to serial BP measurements taken by a device that

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data. All patients had hypertension. AOBP averages were lower than manual measurement averages in both clinical (−3.6 ± 14.9 mm Hg / −3.0 ± 8.8 mm Hg) and research (−2.7 ± 10.0 / −2.4 ± 6.3 mm Hg) environments. The gap between measurement methods did not differ between research and clinical data. Cohen kappa coefficient was lower in the clinical context because of greater variability and more time between BP measurements (5.5 ± 2.9 months).

Conclusions: Manual BP readings were slightly higher than AOBP estimates. The difference was not influenced by the real-world context of clinical practice. Office nonautomated BP measurements may still be valuable if measurement procedures are well standardized and performed by trained nurses.

l'écart des MPAC-OS et des mesures manuelles de la PA entre le suivi en milieu clinique et le suivi en milieu de recherche.

Résultats : Parmi les 288 patients qui faisaient partie de la cohorte clinique, 195 patients ont contribué aux données de la PA de qualité recherche. Tous les patients faisaient de l'hypertension. Les moyennes des MPAC-OS étaient plus basses que les moyennes des mesures manuelles en milieu clinique (3,6 ± 14,9 mm Hg / 3,0 ± 8,8 mm Hg) et en milieu de recherche (2,7 ± 10,0 / 2,4 ± 6.3 mm Hg). L'écart entre les méthodes de mesure ne différait pas entre les données de recherche et les données cliniques. Le coefficient kappa de Cohen était plus petit dans le contexte clinique en raison de la plus grande variabilité et de la longue période entre les mesures de la PA (5,5 ± 2,9 mois).

Conclusions : Les mesures manuelles de la PA étaient légèrement plus élevées que les estimations de la MPAC-OS. La différence n'était pas influencée par le contexte réel de la pratique clinique. Les mesures non automatisées de la PA au bureau peuvent encore être valables si les méthodes de mesure sont bien uniformisées et réalisées par des infirmières et infirmiers entrainés.

operates without human intervention between readings. AOBP has been shown to eliminate much of the white coat effect linked with office environments.[5,6] Systolic blood pressure (SBP) measurement with AOBP has been determined to be about 10 mm Hg lower than that with standard manual office BP. Recently, the Cardiovascular Health Awareness Program study demonstrated that AOBP measurements predicted cardiovascular events.[7] AOBP is recommended in Canada as the preferred in-office BP measurement method for hypertension diagnosis.[8]

In 2015, the **S**ystolic Blood **Pr**essure **Int**ervention Trial (SPRINT) redefined targeted BP in a large subset of hypertensive patients according to AOBP measurements.[9] Multinational and Canadian guidelines have acknowledged the SPRINT results and have recommended lower BP goals with AOBP-based measurement protocols. Many clinics have had to modify their BP measurement procedures for application of these recommendations. At the IRCM hypertension clinic, BP was quantified manually by 1 of 2 specially trained nurses (H.L.A. or M.G.) on the basis of 2 previous studies showing that in a research environment, they obtained manual BP estimates equivalent to 24-hour ambulatory BP measurement and monitoring with a BpTRU device (1 study with unpublished results).[10] In February 2016, BP measurement procedures were nonetheless reassessed, and AOBP was implemented as the mandatory BP measurement for all patient visits.

The general goal of the present study was to evaluate the performance of clinical AOBP measurements in an environment in which manual BP measurement was optimal. More specifically, the objective was to measure the gap between standardized manual BP and AOBP estimates and isolate the impact of the clinical environment on this gap. A change in the relationship from a research to a clinical perspective with otherwise the same factors would strongly suggest that even well-standardized BP measurement skills cannot compensate for the advantages of AOBP in real-world situations.

Methods

This chart-based retrospective cohort study assessed the gap between manual BP and AOBP measurements and compared the data obtained in research and clinical environments. It was performed at the IRCM hypertension clinic after approval by the local research ethics committee. Clinical BP estimates were taken from the hypertension clinic's patient files.

Inclusion criteria for the selection of clinic patients/charts were the following: (1) past regular follow-up at the hypertension clinic, with at least 1 visit before and after February 2016, (2) clinical manual BP recording by 1 of 2 specially trained nurses (H.L.A. and M.G.) before February 2016, and (3) clinical AOBP recording after February 2016. Patients with a change in hypertension treatment between the last medical visit before February 2016 and the first medical visit after February 2016 were excluded.

Manual BP data were collected during visits before the implementation of mandatory AOBP measurements in February 2016. AOBP data were obtained during visits after February 2016. For research environment data, study files from 2 past studies were reviewed (1 study with unpublished results).[10] These investigations were selected because they assessed manual BP and AOBP measurements in hypertensive patients, and all data were collected by the same 2 hypertension clinic nurses. When participants were included in both studies (6 patients), only data from the most recent study were retained. Patient charts and study files were reviewed to extract clinical manual BP and AOBP data.

For research data, 3 manual BP measurements were recorded, but only the first measurement was used to allow better comparison with single BP measurements in the clinical environment. Sociodemographic data, body mass index, and arm circumference were also collected. Information on length of follow-up, antihypertensive drug use, and number of past visits was collected from clinical patient charts.

All manual BP measurements were recorded with mercury sphygmomanometers. All clinical and research AOBP