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Research Article

The influence of auditory perception in measurement of blood pressure among specialist physicians

Davood Karimi Hosseini[1*], Ramtin Moradi[2], Mojtaba Meshkat[2],
Hadi Behzad[3] and Saeed Nazemi[4]

1- Otolaryngology Head and Neck Surgery Department, Stanford University, Palo Alto, CA, USA.
2- School of Medicine, Islamic Azad University of Mashhad, Mashhad, Iran.
3- Echo Audiological Clinic, Mashhad, Iran.
4- Department of Cardiology, Razavi Hospital, Mashhad, Iran.
*Corresponding Author: Davood Karimi Hosseini; Email: davoodkh@stanford.edu

ABSTRACT

Assessment of blood pressure is one of the basics of physical examination usually performed by indirect auscultatory method using a mercury manometer. Several factors may cause observational error in assessment of blood pressure. Correct and reliable evaluation of blood pressure has a great role in diagnosis and treatment of diseases. So, the aim of the current study was to evaluate the role of auditory perception in measurement of blood pressure after excluding or matching of other interventional factors. 70 specialists in Aria and 22 Bahman hospitals were enrolled in this study. 41 cases were selected randomly using the table of randomized numbers by SPSS software. All cases underwent PTA and tympanometry in order to exclude those with hearing problems. A standard method for assessment of blood pressure was explained for remaining cases and then they recorded the blood pressure of four patients and presented in a film. Each film was repeated 10 times in a randomized pattern so observers were compared with others and also themselves. According to the data significant differences was detected between observers. Mean interobservers standard error for systolic blood pressure, diastolic blood pressure and mean blood pressure were 9.4, 20.5 and 16.1 mmHg, respectively. No significant difference detected in comparing observer's recordings for each case by themselves. these results suggested it seems, independent of observers' auditory perception can use as new method for assessment of blood pressure.

Keywords: Blood pressure measurement, auditory perception, Specialists

INTRODUCTION

Blood pressure measurement is requires assessment for determine cardiovascular health, including screening for hypertension and monitoring the effectiveness of treatment in patients with hypertension. In the routine outpatient setting, blood-pressure measurement is obtained indirectly and proper techniques are important to ensure consistent and reliable measurements [1]. The measurement of blood pressure by the auscultatory method is one of the commonest and reliable diagnostic procedures in medicine, in the treatment of patients and in large-scale surveys undertaken to estimate the incidence of hypertension in a population [2].

The gold standard for clinical blood pressure measurement has always been readings taken by a trained health care provider using a mercury sphygmomanometer and the Korotkoff sound technique, but there is increasing evidence that this procedure may lead to the misclassification of large numbers of individuals as hypertensive and also to a failure to diagnose blood pressure that may be normal in the clinic setting but elevated at other times in some individuals [1-2]. Normal adult physiologic blood pressure (BP) is defined as a systolic pressure less than 120 mm Hg and a diastolic pressure less than 80 mm Hg. Higher blood pressures are considered to indicate prehypertension (systolic BP=120–139mmHg and diastolic BP=80–89mmHg) and hypertension (Stage I: systolic BP=140–159mmHg and diastolic BP= 90–99mmHg; Stage II hypertension: systolic BP≥160 and diastolic BP ≥100) [3]. So it is obvious the small error in blood pressure measurement may displace a patient from one group to another that needs different management [4].

Indirect measurement of blood pressure is subject to errors from many sources. Quite apart from the uncertainties in interpreting the Korotkoff sounds, particularly in estimating the diastolic pressure [4], there are many factors relating to the instrument and the observer that can introduce both random and systematic error. Among them, the cuff size and placement, stethoscope quality and placement, background and artefact noise, gauge accuracy, parallax error in reading gauges, observer bias toward expected values, observer bias and error in rounding off readings, misreading of the gauge and erroneous recording of the reading are the most important factors.

The many sources of observer error in measuring blood pressure have been discussed by a number of authors [5, 6], but there have been few studies conducted to measure these errors. In 1961, Wilcox reported a motion picture film of a sphygmomanometer with accompanying Korotkoff sounds was used to test a group of observers simultaneously [7, 8]. Also, Nielsen et al. studied of observer bias in blood pressure readings taken by physicians in hospitals [8-10]. Patient’s awareness regarding the use of blood pressure home measuring monitors was found high in this study, as majority of the participants were using the monitors to measure their blood pressure at home. Regular home blood pressure monitoring is a good indicator towards better compliance and hence disease controls [11]. However, in response to high blood pressure readings, only 20 % of participants in this study adjusted their medication dose or contacted a health care professional. The level of patient involvement in their treatment have been said to be essential in obtaining goal blood pressure [12]. Failure to take the needed antihypertensive medication results in higher incidence of disease progression and stroke rates [12].

Although the mercury sphygmomanometer is widely regarded as the “gold standard” for office blood pressure measurement, the ban on use of mercury devices continues to diminish their role in office and hospital settings. To date, mercury devices have largely been phased out in hospitals. This has led to the proliferation of non-mercury devices and has changed (probably forever) the preferable modality of blood pressure measurement in clinic and hospital settings. In this article, the basic techniques of blood pressure measurement and the technical issues associated with measurements in clinical practice are discussed. The devices currently available for hospital and clinic measurements and their important sources of error are presented. Practical advice is given on how the different devices and measurement techniques should be used.

So, the aim of the current study was to isolate the observer error by performing a demonstration and presenting a single film to each subject in order to assess the role of auditory perception error in measurement of blood pressure.

MATERIAL & METHODS

A series of 41 specialists were enrolled from Aria hospitals and 22 Bahman hospitals were randomly selected among 70 specialists. Pure tone audiometry and tympanometry were performed for all these cases. 8 physicians had no cooperated and 7 cases had auscultation difficulties, so they excluded from our study. Four films were prepared from process of blood pressure measurement in 4 different patients and Korotkoff sounds recording was done by a sonicaid which is used in gynecology and obstetrics exams. Finally 20 specialists accepted invitation for this trial. Blood pressure measurements determined by computer-generated display of a mercury manometer by data projection while listening to recorded Korotkoff sounds synchronized with the fall of the mercury column that was processed by an amplifier and a monotone sound was being heard through a headphone. Each film was repeated 10 times in a randomized pattern and each observer saw and heard the same events. The readings of systolic and diastolic values can then be compared between different specialists to evaluate observer error and the role of auditory perception without the influence of other variables. Comparing blood pressure recordings for each observer for each film during repeated sessions helped to evaluate personal observer error.

Statistical analysis

Statistical analysis was done by SPSS software (Ver 13) and Statistica. P<0.05 was considered as significant difference.

RESULTS

The result of the influence of auditory perception in measurement of blood pressure among specialist physicians is presented in table 1. According to the results, the male/ female ratio included into the study was 1:1. In order to assess intra observer error and role of auditory perception error in measurement of blood pressure, recordings of specialists for each single patient and all four cases were compared together. For the first case, standard deviation of systolic blood pressure, diastolic blood pressure and blood pressure were 4.7mmHg (p=0.000), 11.7mmHg (p=0.000) and 7.9mmHg (p=0.000), respectively. For the second case, systolic blood pressure was 5.9mmHg (p=0.000), diastolic blood pressure was 11.6mmHg (p=0.000) and mean blood pressure were 8.6mmHg (p=0.000). In the third case, the systolic blood pressure, diastolic blood pressure and mean blood pressure were 3.4mmHg (p=0.482), 4.2mmHg (p=0.000) and 3.0mmHg (p=0.000), respectively. In the case 4, mansystolic blood pressure was 4.9mmHg (p=0.000), diastolic blood pressure 11.2mmHg (p=0.000) and blood pressure 7.9mmHg (p=0.000).

As seen, among 4 cases, standard deviation of systolic blood pressure, diastolic blood pressure and mean blood pressure were 9.4mmHg (p=0.0002), 20.5mmHg (p=0.0047) and 16.1mmHg (p=0.0246), respectively. In the 68% of observers recorded systolic blood pressure, diastolic blood pressure and mean blood pressure were detected in range of ±9.4, 20.5 and 16.1mmHg respectively. Also, 95% of observers recorded systolic blood pressure in a range of ±18.8mmHg, diastolic blood pressure in a range of ±32.2mmHg and mean blood pressure in a range of ±16.1mmHg.

Comparing blood pressure recordings for case one, significant difference showed for systolic blood pressure (p=0.048), diastolic blood pressure (p=0.419) and mean blood pressure (p=0.598). The differences in systolic and diastolic and mean blood pressure were not significant for the cases 2 and 3 (P>0.05). Significant difference on comparing blood pressure recordings for case 4 in systolic blood pressure (p=0.311), diastolic blood pressure (p=0.068) and mean blood pressure (p=0.051) detected.

Table 1: comparing blood pressure measurements in all four patients between different observers (interobserver).

Observers	systolic blood pressure (mean ±sd)	diastolic blood (mean ±sd)	blood pressure (mean ±sd)
1	117.0±10.1	62.0±14.6	80.3±12.9
2	121.6±9.4	70.0±17.8	87.2±14.4
3	119.9±8.5	73.9±23.4	89.2±18.1
4	121.0±9.2	72.6±22.8	88.7±18.0
5	117.0±10.5	70.0±16.5	85.7±13.9

6	122.3±6.4	78.8±14.4	93.3±11.0
7	121.6±7.4	76.7±21.9	91.6±16.5
8	117.5±10.1	76.2±20.9	89.9±16.9
9	114.4±8.9	71.6±23.5	85.9±18.0
10	121.9±8.0	73.1±24.7	89.4±19.0
11	118.6±9.7	73.4±22.8	88.4±17.6
12	119.6±9.0	72.6±15.5	88.3±12.8
13	118.4±7.7	75.4±25.5	89.7±19.2
14	119.5±9.3	72.4±20.6	88.1±16.5
15	121.8±10.0	81.6±15.6	95.0±12.8
16	118.0±8.6	71.1±18.5	86.8±14.5
17	114.3±9.6	76.5±18.5	89.1±14.9
18	116.8±11.1	67.1±20.4	83.7±16.5
19	120.1±11.1	67.5±20.5	85.0±16.6
20	119.1±9.1	67.5±20.5	84.7±15.9
P value	0.0074	0.0002	0.0246

DISCUSSION

The primary purpose of this experiment was to evaluate the role of auditory perception in measurement of blood pressure and the accuracy of the readings. The accuracy of the readings would reveal any systematic errors or biases in the observer group. In order to exclude interventional factors, pure tone audiometry and tympanometry were performed for all cases and a demonstration about standard method of blood pressure measurement was showed [9, 10]. Evaluating intraobserver error didn't show any statistically difference between several measurements of a single observer from a single case. This may be explained by few number of sample volume of our study. Evaluating interobserver differences among specialists without any auditory impairment, 68% of observers recorded systolic blood pressure in a range of 9.4 mmHg, diastolic blood pressure in a range of 20.5 mmHg and mean blood pressure in a range of 16.1mmHg. Neufeld et al. reported standard deviations for both systolic and diastolic readings were roughly 3.5 to 5.5 mm Hg [11]. We had expected the standard deviation for the diastolic pressure to be greater because of the difficulty in judging when the sounds disappear.

Numerous surveys have shown that physicians and other health care providers rarely follow established guidelines for blood pressure measurement; however, when they do, the readings correlate much more closely with more objective measures of blood pressure than the usual clinic readings. It is generally agreed that conventional clinic readings, when made correctly, are a surrogate marker for a patient's true blood pressure, which is conceived as the average level over prolonged periods of time, and which is thought to be the most important component of blood pressure in determining its adverse effects. Usual clinic readings give a very poor estimate of this, not only because of poor technique but also because they typically only consist of 1 or 2 individual measurements, and the beat-to-beat blood pressure variability is such that a small number of readings can only give a crude estimate of the average level [12]. The measure of blood pressure that is most clearly related to morbid events is the average level, although there is also evidence accumulating that suggests that hypertensive patients whose pressure remains high at night (nondippers) are at greater risk for cardiovascular morbidity than dippers [13]. Less information is available for defining the clinical significance of blood pressure variability, although it has been suggested that it is a risk factor for cardiovascular morbidity [13].

It is surprising that nearly 100 years after it was first discovered, and the subsequent recognition of its limited accuracy, the Korotkoff technique for measuring blood pressure has continued to be used without any substantial improvement. The brachial artery is occluded by a cuff placed around the upper arm and inflated to above systolic pressure. The Korotkoff sound method tends to give values for systolic pressure that are lower than the true intra-arterial pressure, and diastolic values that are higher [14]. The range of discrepancies is quite striking: One author commented that the difference between the 2 methods might be as much as25 mm Hg in some individuals [14]. The mercury sphygmomanometer has always been regarded as the gold standard for clinical measurement of blood pressure, but this situation is likely to change in the near future, as discussed. The design of mercury sphygmomanometers has changed little over the past 50 years, except that modern versions are less likely to spill mercury if dropped. In principle, there is less to go wrong with mercury sphygmomanometers than with other devices, and one of the unique features is that the simplicity of the design means that there is negligible difference in the accuracy of different brands, which certainly does not apply to any other type of manometer. However, this should not be any cause for complacency. One hospital survey found that 21% of devices had technical problems that would limit their accuracy whereas another found 50% to be defective. The random zero sphygmomanometer was designed to eliminate observer bias but is no longer available [15].

The "gold standard" device for office blood pressure measurement has been the mercury sphygmomanometer, but these are being removed from clinical practice because of environmental concerns about mercury contamination. Mercury sphygmomanometers are already banned in Veterans Administration hospitals [16]. However, because there is currently no generally accepted replacement for mercury, it is recommended that, if available, a properly maintained mercury sphygmomanometer be used for routine office measurements. Mercury sphygmomanometers are critical for evaluating the accuracy of any type of nonmercury device. Nonmercury pressurometers that use electronic pressure transducers with a digital read-out are available for calibrating the pressure detection systems of aneroid or oscillometric devices [17]. One of our objectives in evaluating observer error was to assess the suitability of proposed requirements for the accuracy of sphygmomanometers under standards being developed by the Health Protection Branch of the Department of National Health and Welfare. If possible, the instrument error in a measurement ought to be smaller than the observer error.

The observer is the most critical component of accurate blood pressure measurement. For accurate blood pressure measurement, the observer must: (1) be properly trained in the techniques of blood pressure measurement; (2) use an accurate and properly maintained device; (3) recognize subject factors, such as anxiety and recent nicotine use, that would adversely affect blood pressure measurements; (4) position the subject appropriately; (5) select the correct cuff and position it correctly; and (6) perform the measurement using the auscultatory or automated oscillometric method and accurately record the values obtained. Observer error is a major limitation of the auscultatory method.98 Systematic errors lead to intra-observer and interobserver error. It is generally recommended that the observer should read the blood pressure to the nearest 2 mm Hg, but an inappropriate excess in the recording of "zero" as the last digit in auscultatory blood pressure determinations has been reported by multiple investigators in clinical and research settings [18].

In medical settings, physicians, nurses, nurses' aides, students, and pharmacists all measure blood pressure and record the values in a patient's records. Outside medical settings, patients, family members, or lay persons also measure blood pressure. The training given to lay observers should be as comprehensive and similar to that recommended for health care professionals in ambulatory and community settings [19]. With careful training even unpaid volunteers in large population surveys can measure blood pressure accurately. However, even with the newer automated devices, the accuracy of the readings can be optimal only if all observers are appropriately trained and retrained and conscientious about using appropriate techniques [20].

Our study indicates the low level of measurement accuracy because of the observer error especially in diastolic blood pressure measurement. In conclusion, despite excluding interventional factors such as instrumental error and calibration, method of recording of blood pressure by Korotkoff sounds in this trial, the accuracy of the current method of blood pressure measurement by mercury manometer wasn't acceptable so we suggest a new and more accurate method for blood pressure measurement that is independent of observer auditory perception.

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