ACCURATE BLOOD PRESSURE RECORDING: IS IT DIFFICULT?

A. BHALLA, R. SINGH, S. D'CRUZ, S. S. LEHL, A. SACHDEV

ABSTRACT

BACKGROUND: Blood pressure (BP) measurement is a routine procedure but errors are frequently committed during BP recording. AIMS AND SETTINGS: The aim of the study was to look at the prevalent practices in the institute regarding BP recording. The study was conducted in the Medicine Department at Government Medical College, Chandigarh, a teaching institute for MBBS students. METHODS: A prospective, observational study was performed amongst the 80 doctors in a tertiary care hospital. All of them were observed by a single observer during the act of BP recording. The observer was well versed with the guidelines issued by British Hypertension Society (BHS) and the deviations from the standard set of guidelines issued by BHS were noted. The errors were defined as deviations from these guidelines. STATISTICAL METHODS: The results were recorded as percentage of doctors committing these errors. RESULTS: In our study, 90% used mercury type sphygmomanometer. Zero error of the apparatus, hand dominance was not noted by any one. Every one used the standard BP cuff for recording BP. 70% of them did not let the patient rest before recording BP. 80% did not remove the clothing from the arm. None of them recorded BP in both arms. In out patient setting, 80% recorded blood pressure in sitting position and 14% in supine position. In all the patients where BP was recorded in sitting position BP apparatus was below the level of heart and 20% did not have their arm supported. 60% did not use palpatory method for noticing systolic BP and 70% did not raise pressure 30–40 mm Hg above the systolic level before checking the BP by auscultation. 80% lowered the BP at a rate of more than 2 mm/s and 60% rounded off the BP to nearest 5–10 mm Hg. 70% recorded BP only once and 90% of the rest re inflated the cuff without completely deflating and allowing rest before a second reading was obtained. CONCLUSION: The practice of recording BP in our hospital varies from the standard guidelines issued by the BHS.

Key words: blood pressure measurement-accuracy; blood pressure measurement-optimum technique; hypertension; observer errors.

Department of Medicine, Post Graduate Institute of Medical Education and Research, Chandigarh, India

Correspondence
A. Bhalla
Assistant Professor (Tropical Medicine),
E-mail: doc_ab@sify.com and ashish_ritibhalla@yahoo.com

The blood pressure (BP) measurement is one of the commonly performed procedures by the doctors. Raised blood pressure (hypertension) is a common condition that does not have specific clinical manifestations until target organ damage develops.[1] Routine

screening of all the patients, especially high risk patients, is the only way of detecting hypertension early and initiate treatment before target organ damage becomes evident.[2] Accurate measurement of BP is importance for labeling a patient as hypertensive. Consistently underestimating the BP by 5 mm Hg could result in two-thirds of hypertensive patients being missed and over estimating it by 5 mm Hg could more than double the number of patients being diagnosed as hypertensive.[3] Missing the diagnosis in a hypertensive patient could result in significant morbidity and mortality due to lack of treatment. Over diagnosisresults in inappropriate labeling and treatment of healthy individuals. Most of us are aware of the exact methodology of recording of BP, yet most of us commit errors frequently resulting in erroneous high or low recording.

The measurement of BP in clinical practice is done by a century old Riva-Rocci/Korotkoff technique. The accurate measurement is dependent on the accurate transmission and interpretation of a signal (Korotkoff sound or pulse wave) from a subject via a device (the sphygmomanometer) to an observer.[4] Errors in measurement can occur at each point but the commonest fallible component is the observer.[4]

Despite the clear guidelines on BP measurement technique, there seems to be large inter-observer variations, both among nursing staff and physicians as well as between the two groups. In an article by Graves and Ships in the *American Journal of Hypertension*, the authors are of opinion that 'physicians do not measure BP well, and even if they do, the usefulness of their BP measurements is significantly compromised by the white coat effect.'[5] The general belief amongst the researchers is that Physicians dealing with diagnosis and treatment of hypertension do not follow the international society guidelines.[6] In a study by Perloff et al.[7], it was found that nursing staff abided by 40% of the recommended procedures while medicine teachers, physicians and residents abided by approximately 70%.[8]

The wide gaps in the basic theoretic and practical knowledge seem to be common among interns and first-year family practice residents resulting in erroneous measurements.[9] In an interesting observational study, carried out at the Westminster Medical School in London, showed that 33% out of 80 doctors in training grades/junior hospital doctors, acknowledged no formal education on how to measure BP, a finding confirmed further by the poor accuracy in BP measurement displayed by one-third of the study group.[10]

SUBJECT AND METHODS

Our objective was to notice the common errors committed during routine blood pressure recording by the residents and consultants. A prospective, observational study was performed amongst the 80 doctors (10 consultants and 70 residents). The consultants belonged to the department of medicine and the residents included interns, house physicians and senior residents form the departments of medicine, surgery and orthopedics. The study was conducted over

a period of 8 months. A single observer observed all of them during the act of BP recording without any one of them being aware of the fact that they were being observed. The common errors committed were noted in a Performa after having observed them (not in front of them). Some participants were observed again to note the practices that had been missed during the first observation.

The errors were defined as variations from the standard set of instructions issued by BHS.[11] This variation from the standard guidelines were further analyzed and recorded as percentage of doctors committing these individual errors. At the end of the study the erring doctors were apprised of the results of the study and were told about the standard guidelines. The follow-up study after was planned but could not be carried out as majority of the residents had change of duties or had left the institute.

RESULTS

A single observer observed 80 doctors (10 consultants and 70 residents) during the act of BP measurement. The majority of the residents belonged to the medicine department and the rest were working in the emergency area in orthopedics and surgery emergency at the hospital. The details of their qualifications and department are given in [Table 1]. All the consultants were observed while recording BP in the OPD while 30 residents were observed in the OPD. The rest were observed during the act by the observer during routine rounds in the wards or while attending a call to examine a patient in the surgical emergencies. They were asked to record the BP and were observed for the practices they follow during the act of BP recording. The rate of inflation and deflation of the cuff were observed carefully using a stopwatch in the wrist watch of the observer. Some participants had to be observed again to note the practices that had been missed during the first observation.

It was noted that 90% of the doctors used mercury type sphygmomanometer and 10% used the aneroid sphygmomanometer for recording BP. Zero error of the apparatus and hand dominance of the patient were not noted and recorded by any one. The time of recording BP was recorded in the case files by 60% doctors only (while recording BP in the wards). The time of last dose of antihypertensive medication taken by the patient was not noted by any one. Everybody used diaphragm of the stethoscope for listening Korotkoff sounds. Every one used the standard BP cuff for recording BP

Table 1: Baseline characteristics of all the participating doctors

Department	*Designation*	*Qualification*	*Observed in ward*	*Observed in OPD*
Medicine	Consultants	MD (7)MD, DM (3)		10
Medicine	Senior residents	MD (16)	6	10
	Junior residents	MBBS (12)	8	4
	Interns	MBBS (16)	7	9
Surgery	Junior residents	MBBS (8)	6	2
	Interns	MBBS (8)	4	4
Orthopedics	Junior residents	MBBS (4)	3	1
	Interns	MBBS (6)	6	

irrespective of the arm circumference of the patient but this fact was not recorded by any one of them in the case sheet. During recording of BP in the OPD, 70% of them did not wait and let the patient rest for some time before recording BP. 80% of all did not remove the clothing i.e., shirt sleeve, from the arm before recording BP. None of them recorded BP in both arms; 75% preferred right arm while 25% preferred left arm. Even this fact was not recorded by any of them in the case sheet. In the OPD, 80% recorded BP in sitting position and only 14% in supine position only. 6% recorded BP in both the positions. The position of the patient while recording BP was not recorded on the case sheet. In all the patients where BP was recorded in sitting position BP apparatus was below the level of heart and 20% did not have their arm supported. While recording BP in the ward 100% recordings were made in the supine position.

About 60% did not use palpatory method for noticing systolic BP and Seventy percent did not raise pressure 30–40 mm Hg above the systolic level before checking the BP by auscultation. About 80% lowered the BP at a rate of more than 2 mm/s and 60% rounded off the BP to nearest 5–10 mm Hg. 70% recorded BP only once and 90% of the rest (remaining 30%) re-inflated the cuff without completely deflating and allowing rest before a second reading was obtained.

Table 2: Practices observed during our study and comparison with available literature

Deviation from guidelines	*Our study (N = 80)*	*Literature*	*Reference*
Type of apparatus use	Mercury (90%) Anaroid (10%)	14.6% 67.8%	21
Zero error of the apparatus noted	0		
Hand dominance of patient noted	0		
Time of last antihypertensive medication noted	0		
Time of BP recording noted	In OPD 0 In ward 100%		
Diaphragm of stethoscope used	100%	Bell = diaphragm	23
BP cuff used	Standard 100%	Inappropriate 97%	24
Did not let patient rest before recording BP	70%	97%	24
Did not remove clothing from the arm	80%		
Blood pressure recorded in arm	Right (75%), left (25%), both (none)	Both 77%	19
Position of the patient while recording	OPD sitting (80%), supine (14%), both (06%), ward supine (100%)		
BP recording in sitting position	Apparatus below heart level (100%), Arm not supported (20%)		
Not using palpatory method	60%	61%	24
Cuff deflation by >2 mm/s	80%	82%	24
Only one reading taken	70%		
Cuff re-inflated without complete deflation	90% (of 30%)		
Rounding off the blood pressure	5–10 mm (60%), 2 mm (40%)		

DISCUSSION

The blood pressure in all the individuals varies considerably throughout the day. A variety of activities affects the BP and causes it to increase. Simple activities of daily routine like eating, dressing, commuting to work, talking on telephone and attending a meeting raises systolic BP by an average 10–20 mm Hg and diastolic BP by 8–15 mm Hg.[3] Numerous studies have proven time and again that the various exogenous factors also interfere with the accurate measurement of BP.[12–18] The important factors being talking, exposure to cold, ingestion of alcohol and medications especially antihypertensive drugs.[12–14] Errors during the process of BP measurement also contribute to the erroneous reading.

There are only three sources of errors while BP is being recorded. These are observer bias, faulty equipment and failure to standardize techniques of measurement.[19] While it may not be possible to do any thing for observer bias but following a standardized technique and using a good equipment may help to reduce the error rate to a great extant.

It is well known that mercury instruments provide the most accurate records and are the preferred instrument in hospital settings.[20] Aneroid sphygmomanometers are increasingly used due to ease of handling[21] but are a source of error if not maintained properly.[22] Since the majority recording apparatus in our hospital are mercury based, so 90% of our recordings were made on them.

The defective apparatus may give a false high or low BP reading. Similarly, the BP in the dominant hand is usually higher.[1] Failure to record these facts may lead to differences in the subsequent BP recordings. Unfortunately this fact is commonly ignored and not recorded, as was evident in our study.

It has been shown in a recent study that both the bell and the diaphragm give equal results when used for office measurement of BP[23] still the diaphragm is preferred in clinical practice, as was in our study. The reason for this lies in it being easier to secure with the fingers of one hand and also that it covers a larger area.[4]

In a survey of 114 doctors conducted by McKay et al. 97% doctors used inappropriate cuff size.[24] It indicates that it is a common mistake made by most of the doctors. It is known that if the cuff is too small as in the case of a fat patient the systolic BP will be recorded falsely low by up to 8 mm Hg and diastolic BP will be recorded high by up to 8 mm Hg.[17] Our findings are not different from these observations. The failure to remove the clothing further adds to the arm circumference, hence erroneous recording. A number of studies have shown that measurement of BP in obese and large muscular arms requires adjustments. Monograms for adjusting BP recording in the obese are inadequate. The most important factor is choosing the correct cuff width-arm circumference (CW/AC) ratio. Such action reduces the intersubject variability of BP measurement in clinical settings.[25]

It is known that a number of activities of daily living raise the BP[3] and a period of rest before measuring BP may return it to normal level. Failure to do so may result in falsely high BP recording. Still 70% of our study group doctors did not wait and let the patient rest for some time before recording BP in the

OPD. In a study by McKay et al. this figure was 97%.[24] None of our study group doctors recorded BP in both arms, which is much more than 77% reported in the literature.[22]

It is well established that if the BP is only measured in the supine position the systolic BP may increase by 3 mm Hg and the diastolic BP will be recorded lower by 3–5 mm Hg.[15,26] It would be worthwhile to record BP in both supine and sitting position if possible or at least the position in which the BP is recorded should be mentioned in the records. This would be helpful in follow-up visits by the patient. Unfortunately this fact is taught in the clinics but not followed by majority of us while recording BP, especially in the outpatient department.

If the position of the arm is either above or below the heart level the BP may be recorded false high or low. For every 10 cm above or below the heart level the systolic BP decreases (if above) by 8 mm Hg and increases (if below).[15] Similar changes are seen in the diastolic BP with change in the position of arm in relation to the heart level.[15] If the arm is not supported the systolic and diastolic pressures will be recorded high by 2 mm Hg.[15] Our study showed that this fact is commonly forgotten during BP recording in the outpatient department.

About 60% of our study group doctors did not use palpatory method for noticing systolic BP initially and 70% did not raise pressure 30–40 mm Hg above the systolic level before checking the BP by auscultation. McKay et al. in their study noted similar figures, where the number of such doctors was 61%.[24]

About 80% in our study group deflated the cuff at a rate of more than 2 mm/s which is similar to 82% in another study.[24] Also 70% in our study group recorded BP only once and 90% of the rest reinflated the cuff without completely deflating and allowing rest before a second reading was obtained. This may further increase the incidence of erroneous recording in clinical practice. In one study by Jamieson et al. it was observed that the first systolic BP was on an average 3–4 mm Hg higher while the diastolic BP was not different when recorded twice.[26] Complete deflation of the cuff and allowing a few minutes rest between two consecutive measurements may circumvent this problem, however, this is not routinely done. The authors of this study have suggested an alternative, that taking two measurements and recording the average would help in reducing the errors, when the BP exceeds 155/90 mm Hg.[26]

There is tendency by physicians to expect either a high or low BP. This results in rounding off the systolic and diastolic BP to the nearest 5–10 mm Hg, which may result in erroneous high or low BP recording.[18] A British study carried out in 18 practices and 67 GP offices showed digit bias in systolic and diastolic readings to the nearest 10 mm Hg.[27] Also 60% of the doctors in our study group had a digit preference to the nearest 5–10 mm Hg. Both under estimation or over estimation of BP, due to this bias, could have enormous reflection on the sheer numbers of the patients either missed or over diagnosed.[3]

The most recent recommendations of AHA suggest that the auscultatory technique with

a trained observer and mercury sphygmomanometer to be the method of choice for measurement of BP. Proper training of observers, positioning of the patient, and selection of appropriate cuff size are all essential.[20] However, training can reduce, but not abolish, these inaccuracies. Taking multiple BP measurements before making clinical decisions can limit the effect of these inaccuracies.[28]

Reevs points out that 'The efficient practitioner can reserve the proper method for 10–20% of patients who have known or newly detected elevated BP, cardiovascular damage, other risk factors or are receiving antihypertensive therapy.'[29] This would go a long way in preventing the errors in patients where it matters the most.

CONCLUSION

Accurate measurement of the BP is very important in the clinical setting. It is a vital parameter to access and modify cardiovascular risk factors. Very commonly errors are committed during these simple procedures and efforts should be made to minimize them by following the international guidelines. This study looks at the practices prevalent in a teaching hospital and proves that accurate measurement of BP is not difficult provided we know the exact methodology and follow it too. The tendency to create shortcuts is likely to result in erroneous high or low recording. We can correct our mistakes only if we are made aware of them.

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