

Strategies to Reduce Pitfalls in Measuring Blood Pressure

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ABSTRACT

Errors in blood pressure (BP) measurement are common in the clinical practice. Inaccurate measurements of BP may lead to misdiagnosis and inappropriate treatment of hypertension. The preferred method of BP measurement in the clinical setting is auscultation, using the first and the fifth Korotkoff sounds. However, the use of mercury sphygmomanometer is declining. Automated oscillometric devices are an acceptable alternative method of BP measurements if the proper cuff size is used. Aneroid devices are suitable, but they require frequent calibration. There is increasing evidence that home readings predict cardiovascular events and are particularly useful for monitoring the effects of treatment. At 24 h ambulatory monitoring is also useful for diagnosing white-coat hypertension and resistance hypertension. There is increasing evidence that lack of nocturnal BP dipping during the night may be associated with increased cardiovascular event. This report attempts to address the need for accurate BP measurements in children and adolescents by reducing human and equipment errors and providing clinicians with the accurate measurement of BP, which is essential to classify individuals, to ascertain BP-related CV risks and to guide management.

Keywords: Blood pressure measurement, children, method, pitfalls

INTRODUCTION

Measuring blood pressure (BP) is one of the most common procedures performed by health care providers.^[1] Too often, this simple procedure is executed improperly, producing inconsistent or inappropriate readings that can lead to over- or under-treatment of a patient.^[2-6] The working group on high BP in Children and Adolescents recommends the following guidelines for more accurate BP measurements.^[7,8]

At least 2 readings are recommended (separated by as much time as possible); if the readings vary by >5 mm Hg, take additional readings until the measurement differential narrows. Patient should be relaxed with the arm bared (no constrictive clothing). The patient's back should be supported [Figure 1] In patients who are already on antihypertensive therapy, check for postural changes in BP by taking readings after 5 min supine, again immediately after standing and then 2 min later.

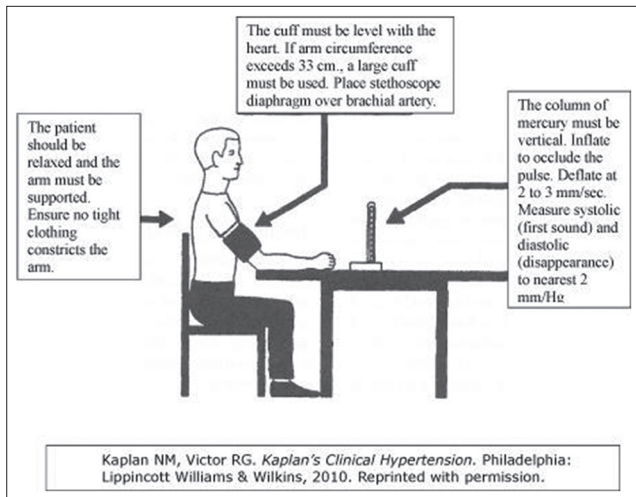


Figure 1: Technique of blood pressure measurement

Ensure that Korotkoff sounds are discernible through the stethoscope when one is used and use ambulatory BP monitoring (ABPM) when necessary. The ABPM offers critical information about BP levels during the daily activities and sleep and may be a better tool than clinic readings. With ABPM, patients wear a cuff attached to a small portable monitor (current models weigh less than a pound and can be attached to a belt) and the unit will take BP readings at preset intervals. Clinical situations in which ABPM may help include patients with suspected white-coat hypertension, labile hypertension, resistant hypertension or autonomic dysfunction. Monitoring BP over 24 h will provide you a more complete picture of a patient's BP values, taking into account the body's normal profile of higher BP levels when awake and active as well as lower levels at rest and sleep, plus early morning increases.^[6-8]

THE MOST COMMON PITFALLS IN MEASURING BP

Poor office setting

Ideally, to reduce stress and offer a calmer atmosphere for any patient, BP measurements should be taken in a quiet room set at a comfortable temperature. Whenever possible, allow patients to sit and relax in a comfortable setting at least 5-10 min before BP measurement. Taking the BP in a cool room (12°C) or while the patient is talking can raise the measured value by as much as 8-15 mm Hg. The use of an automated device is

preferred as these can effectively eliminate variances created with a human observer.^[9] Patients should be also reminded to forgo a cigarette or a cup of caffeinated coffee less than 30 min before reading; the same advice holds for exercise. All 3 of these common activities will likely raise BP, contributing to an inaccurate reading by as much as 10 mm Hg or even more. Once at the office, give patients the opportunity to urinate before a BP check since bladder distension affects readings.^[9]

Time of the day may be important, too: Morning BP may be higher if the patient has sleep apnea.^[10,11] In general, BP levels surge in the morning when an individual begins to ambulate, but early morning readings may provide greater insights that could impact patient management. For example, cardiovascular events are more likely to occur in the early morning hours (after 6 am) than during the rest of the day; modulating morning surges with medication, such as with alpha blockade, may help prevent such events.^[10,11] Due to variations in BP that can occur at different times of the day, it's recommended that patients already diagnosed with hypertension take readings both early in the morning and at night.^[7,8]

Inadequate equipment

The working group on BP in children and adolescents recommends that children 3 years and older have their BP measured as part of a health care encounter.^[7,8]

Children with hypertension have been shown to demonstrate significant variability in office BP readings.^[4,8] Thus, it is crucial to confirm that the child's BP is truly elevated before making the diagnosis of hypertension and embarking on a diagnostic evaluation.

The first step is to ensure that BP is being measured properly. The working group recommends BP measurement should be obtained sitting position using oscillometric devices and the BP measurement should be repeated by auscultation if the oscillometric readings were elevated.^[7,8] Recent data from pediatric hypertension clinics demonstrate that readings obtained using oscillometric devices are not comparable with those obtained by auscultation wherefore confirming the recommendations of the working group.^[2,8,12]

The biggest problem with equipment is ensuring that the cuff size is long enough to accommodate your patient's arm. The length of the BP cuff

bladder should be 80% and the width at least 40% of the circumference of the upper arm.

If too small a cuff is used, the BP generated by inflating the cuff may not be fully transmitted to the brachial artery, which can lead to overestimation of the systolic pressure by as much as 15 mm Hg. Although the data are less clear, it appears that using a cuff that is too long can produce artificially low readings.^[7,8]

Recent data have shown that, in conjunction with the childhood obesity epidemic, arm sizes of children have increased, meaning that more adolescents will require the use of a “large adult” or even “thigh” cuff to obtain an accurate BP reading.^[2]

Incorrect positioning

To achieve the most accurate readings, have patients seated with their backs and arms both supported, preferably with the arm approximately at the level of the patient’s heart.^[4] The common practice of taking a BP reading with a patient sitting on the exam table with neither back nor arm support-produces questionable readings.

Watch the patient’s arm position carefully when taking BP readings. If the upper arm falls 15 cm below the level of the right atrium, readings can be artificially high by 10-12 mm Hg. Conversely, if the arm is above the level of the heart, readings will be falsely low.^[4] The mid-portion of the cuff should be placed over the brachial artery.^[4] A cuff that is too large or small can impact position as well as accuracy of reading; the patient may position his or her arm inappropriately if the cuff feels too loose or too tight.

White-coat effect

One reason to take BP measurements in a quiet, comfortable room is to reduce the “white-coat” effect as much as possible. White-coat effect defines an increase in BP readings due to the medical setting.^[4] This effect has been noted in 30-40% of children and adolescents referred for evaluation of mild hypertension.^[6] The increase is exacerbated when physicians taking the BP readings, it can also occur when nurses or other staff members perform the reading instead.^[13,14]

Home BP monitoring

Having patients take BP readings at home can eliminate many of the errors you see in an office setting: White-coat effect, sitting without support,

having the arm in an improper position, taking the reading after an activity that would raise BP levels (drinking coffee), or positioning the cuff improperly.

A home monitor also allows for more around-the-clock readings as needed and greater flexibility and relaxation than in an office.

If readings are taken to diagnose the baseline BP level, instruct patients to take as many readings as possible over the 48-72 h following the appointment, at various times and under various conditions. To check the adequacy of BP treatment, the most important home BP reading is soon after rising from sleep and a few minutes of ambulation, during the “morning surge,” when BP is at the highest level of the day. Once therapy is shown to be adequate, this early morning reading needs to be taken only once a week. To further ensure that therapy is neither inadequate nor excessive, an occasional evening BP reading should be taken.

CONCLUSIONS

Improper readings of BP can lead to over or under treatment of a patient. Health care providers can make measuring BP error free by avoiding the following pitfalls:

1. Inadequate BP equipment. Aneroid gauges should be calibrated every six months against a mercury manometer.
2. Incorrect positioning. The BP should be taken in a sitting position with the patient’s back supported for five minutes and the arm supported at the level of heart.
3. Improper cuff bladder size. The length of the BP cuff bladder should be 80 percent (two-thirds of the upper arm length, measured from the acromion to the olecranon process) and the width at least 60% of the upper arm circumference.
4. Incorrect technique. The cuff should be inflated quickly to 20 mmHg above the systolic pressure as estimated from the loss of brachial pulse and it should be deflated 3 mmHg per second.
5. At least two readings are recommended (separated by 10-15 minutes if possible).

REFERENCES

1. Flynn JT, Falkner BE. The importance of blood pressure screening in children. *J Pediatr* 2009;155:299.

2. Podoll A, Grenier M, Croix B, Feig DI. Inaccuracy in pediatric outpatient blood pressure measurement. *Pediatrics* 2007;119:e538-43.
3. Prineas RJ, Ostchega Y, Carroll M, Dillon C, McDowell M. US demographic trends in mid-arm circumference and recommended blood pressure cuffs for children and adolescents: Data from the National Health and Nutrition Examination Survey 1988-2004. *Blood Press Monit* 2007;12:75-80.
4. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, *et al.* Recommendations for blood pressure measurement in humans and experimental animals: Part 1: Blood pressure measurement in humans: A statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Hypertension* 2005;45:142-61.
5. Mitchell PL, Parlin RW, Blackburn H. effect of vertical displacement of the arm on indirect blood-pressure measurement. *N Engl J Med* 1964;271:72-4.
6. Pickering TG, Coats A, Mallion JM, Mancia G, Verdecchia P. Blood pressure monitoring. Task force V: White-coat hypertension. *Blood Press Monit* 1999;4:333-41.
7. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics* 2004;114:555-76.
8. Falkner B, Daniels SR. Summary of the fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Hypertension* 2004;44:387-8.
9. Assadi F, Czech K, Palmisano JL. Autonomic dysreflexia manifested by severe hypertension. *Med Sci Monit* 2004;10:CS77-9.
10. Lavie-Nevo K, Pillar G. Evening-morning differences in blood pressure in sleep apnea syndrome: Effect of gender. *Am J Hypertens* 2006;19:1064-9.
11. Muller JE. Circadian variation in cardiovascular events. *Am J Hypertens* 1999;12:35S-42.
12. Myers MG, Valdivieso M, Kiss A. Use of automated office blood pressure measurement to reduce the white coat response. *J Hypertens* 2009;27:280-6.
13. Pickering TG, Miller NH, Ogedegbe G, Krakoff LR, Artinian NT, Goff D, *et al.* Call to action on use and reimbursement for home blood pressure monitoring: Executive summary: A joint scientific statement from the American Heart Association, American Society Of Hypertension, and Preventive Cardiovascular Nurses Association. *Hypertension* 2008;52:1-9.
14. Falkner B, Lurbe E, Schaefer F. High blood pressure in children: Clinical and health policy implications. *J Clin Hypertens (Greenwich)* 2010;12:261-76.

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