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Clinical Column

Considerations for accurate blood pressure measurement in clinical care and research

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INTRODUCTION

Blood pressure measurement is an integral part of vital signs assessment. Blood pressure is directly related to vascular mortality after age 40 years and for blood pressure of 115/75 mm Hg.[1] All nurses learn this basic assessment skill; however, in our changing population and against the time constraints imposed by the health care system, performing an accurate and thorough blood pressure measurement can be challenging. The most recent blood pressure management guideline provides a detailed checklist of essential requirements needed to obtain an accurate blood pressure measurement (www-ahajournals-org).[2] Beyond these elements, challenges remain and are magnified in clinical practice and research. The purpose of this clinical column is to highlight common problems seen in practice and research using case examples, review disease processes associated with blood pressure abnormalities, and discuss implications of inaccurate blood pressure assessment. Common problems include 1) improper cuff size, 2) cuff placement, and 3) not measuring both arms.

Correct cuff size and correct application of cuff

Perhaps, the most problematic issue with blood pressure assessment is improper cuff size. According to the national guidelines, the circumference is to be measured at the midpoint between the acromion and olecranon processes and the bladder of the cuff is to encircle 80% of the patient's arm. Table 9 of the guidelines provides precise measurement parameters for cuff size. Despite these clear guidelines, blood pressure measurement may still be inaccurate depending on placement of a correctly sized cuff. This may be particularly problematic for patients who are obese. The shape of the arm may be more conical and less cylindrical, resulting in substantially different arm circumferences at the proximal and distal cuff borders. This results in unequal cuff inflation even when the correct cuff size is used. This has implications beyond hypertension assessment. For example, patients undergoing an ankle brachial index (ABI) can be falsely diagnosed with peripheral artery disease (PAD) if an ill-fitting cuff is used on the arms, and thus artificially inflating the blood pressure. Pain during measurement also contributes to inaccurate blood pressure measurement. Pain with blood pressure measurement is often related to pinching loose or excess skin with inflation of the cuff. The cuff must be applied in congruence with the national guidelines and manufacturers' instructions while minimizing discomfort. With conical arm habitus, it may be inaccurate to measure brachial pressures. Leblanc and colleagues have demonstrated high correlation of forearm blood pressure with intraarterial blood pressure measurement.[3] The guidelines do not address using alternative sites to obtain a blood pressure such as the foot or forearm, though forearm blood pressures have been documented to be widely used in primary care and emergency departments.[4] It is important to note that obtaining a blood pressure at the dorsalis pedis or posterior tibial arteries may be somewhat elevated compared to the brachial pressures in the absence of PAD, significantly higher relative to the brachial pressures with calcified vessels, and lower in those with PAD.[5] In general, the ankle pressure should not be used to obtain a blood pressure unless no other option is available.

Measure both arms

Atherosclerosis in the upper extremities can lead to lowering of the brachial pressure in one or both arms. According to the national guidelines, blood pressure should be obtained in both arms. Blood pressure may vary significantly between arms and antihypertensive therapies should be based on the highest blood pressure obtained. A brachial blood pressure difference of 15 mmHg is one clinical criterion for subclavian-vertebral artery steal syndrome.[6] Subclavian-vertebral artery steal syndrome

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occurs when a stenosis or occlusion of the subclavian or brachiocephalic arteries causes flow to the vertebral arteries to reverse, particularly during physical activity involving the upper extremities. Apart from steal syndrome, there are additional clinical implications of interarm pressure differences in the prediction and detection of coronary artery disease, peripheral artery disease, and mortality that have yet to be fully appreciated or explored in terms of screening potential. An interarm difference of ≥ 10 mm Hg in systolic blood pressure is associated with an increased risk of all-cause and cardiovascular-related mortality and morbidity.[7]

Case studies

We present a case of a study participant who was found to have significantly lower blood pressure in the physiology laboratory than in her primary care doctor's office. She was being treated for hypertension with typical blood pressures between 120 and 130 s/80 s mmHg when adherent to her antihypertension prescription. An ABI was conducted. Supine right and left brachial pressures were 88 mmHg and 92 mmHg, respectively. Following the ABI, seated pressure measurements were obtained according to the national practice guidelines. Her seated blood pressure was 104/72 mmHg. The participant reported dissatisfaction with extra skin on the posterolateral aspect of her arm, was obese, and had lost approximately 25 pounds over the past six months. Also of note, she reported that this was the first time she was not pinched by the cuff during blood pressure measurement (supine and seated blood pressure measurements) and reported that she often has light-headedness with change in position. It is possible that pain during clinic visit blood pressures may have artificially elevated her blood pressure and resulted in overprescription of antihypertensive medication.

This was a one-time visit and, according to the national guidelines, blood pressure level should be calculated using an average of at least two or more blood pressures obtained on at least two or more separate visits. Therefore, we do not suggest that this individual's treatment should be adjusted based on this sole encounter. However, this encounter provides valuable lessons and reminders that we should all consider when obtaining blood pressure in our own practices.

Another case was a 94-year-old woman undergoing an ABI for a study visit. Her right brachial arm pressure was 176 mmHg, and her left and right ankle pressures, measured at the dorsalis pedis and posterior tibial arteries, were 182 and 186 mmHg, respectively. During the measurement of her left arm pressure, she experienced transient left-sided pain and arm pain during cuff inflation, possibly due to, in part, pinched excess skin from the cuff. Her left systolic blood pressure rose to 204 mmHg. The standard calculation for ABI, according to the ABI guidelines, is to use the higher of the two brachial blood pressures in the denominator for the left and right legs.[5] Therefore, her left ABI would have been 0.89 and her right 0.91. The cuff was adjusted and her ABI was repeated to reveal no PAD. Her interarm blood pressures were within 6 mmHg. Though this woman was not obese, which may be associated with greater discomfort during blood pressure measurement, inflation of the cuff still caused pinching of extra skin and may have contributed to an inaccurate blood pressure measurement. Had her ABI not been repeated at this visit, she could have received a false diagnosis of PAD. This could have led to unnecessary, costly treatment and angst for the patient.

Finally, we report a case of a study participant who underwent an ABI. She reported no hypertension and was not on medication. Her right brachial blood pressure was 124 mmHg, which was reportedly her "usual" blood pressure. Her left brachial blood pressure was 202 mmHg and therefore was deemed ineligible for the study due to high blood pressure. Her health care provider treated her blood pressure based on the lower of the two arm pressures. Had both arms been assessed, this would have been revealed and prevented prolonged exposure to sustain high blood pressure in her left arm and elsewhere.

CONCLUSION

These cases reinforce the importance of proper blood pressure measurement, which includes but is not limited to selecting the correct cuff size for the patient, selecting the best approach to apply the blood pressure cuff, the location of where to apply the cuff, and the assessment of the blood pressure in both arms. Please refer to Table 8 from the latest national guidelines for a comprehensive checklist for proper blood pressure measurement. Blood pressure is one of the most important assessments health care teams measure. Although this measurement technique is tightly standardized, individualization is still necessary to ensure accurate results.

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