

Level of Agreement Between Forearm and Upper Arm Blood Pressure Measurements in Patients With Large Arm Circumference

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Purpose: *The purpose of the study was to determine if forearm blood pressures (BPs) measured in three different locations agree with the recommended upper arm location for noninvasive BP measurement.*

Design: *A method-comparison design was used.*

Methods: *In a convenience sample of postanesthesia care unit patients with large upper arm circumference, BP's were obtained in three different forearm locations (lower forearm, middle forearm, and upper forearm) and compared to upper arm BP using an automated BP measuring device. The level of agreement (bias \pm precision) between each forearm location and the upper arm BP was calculated using standard formulas. Acceptable levels of agreement based on expert opinion were set a priori at bias and precision values of less than ± 5 mm Hg (bias) and ± 8 mm Hg (precision).*

Findings: *Forty-eight postanesthesia patients participated in the study. Bias and precision values were found to exceed the acceptable level of agreement for all but one of the systolic and diastolic BP comparisons in the three forearm BP locations. Fifty-six percent of all patients studied had one or more BP difference of at least 10 mm Hg in each of the three forearm locations, with 10% having one or more differences of at least 20 mm Hg.*
Conclusions: *The differences in forearm BP measurements observed in this study indicate that the clinical practice of using a forearm BP with a regular-sized BP cuff in place of a larger sized BP cuff placed on the upper arm in postanesthesia care unit patients with large arm circumferences is inappropriate. The BPs obtained at the forearm location are not equivalent to the BPs obtained at the upper arm location.*

Keywords: *noninvasive blood pressure, forearm blood pressure, large size arms, blood pressure location, large blood pressure cuffs.*

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1089-9472/\$36.00

<http://dx.doi.org/10.1016/j.jopan.2014.08.145>

A VARIETY OF ANATOMIC LOCATIONS are available for obtaining the measurement of noninvasive blood pressure (BP) in postanesthesia care unit (PACU) patients. Recommendations from the American Heart Association (AHA) indicate the ideal location as being the upper arm.¹ Critical to obtaining an accurate BP is the size of the BP cuff in relation to the circumference of the cuff site. BP device manufacturers and the AHA have issued guidelines for the size of BP cuffs to be used for various upper arm circumference sizes.

For patients with large upper arm circumferences (greater than 34 cm), the standard-sized BP cuff used in clinical practice arenas usually is not appropriate, requiring clinicians to use a larger cuff. As these cuffs are sometimes unavailable, some clinicians choose to use the standard-sized BP cuff but place it around the forearm as a substitute for obtaining BP measurements at the recommended upper arm site. Concerns arise with this substitution, including the degree of agreement between upper and lower forearm measurement.

Limited studies have been published on the accuracy of using the forearm, rather than the upper arm, for BP measurement.²⁻¹⁰ However, most of these studies had serious methodological problems (ie, poorly described procedures for BP measurement^{2-4,6}; incorrect positioning of the BP cuff in relation to the heart^{6,9}; inappropriate statistical analysis^{2,4-9}), making generalization of their findings difficult. Additional studies are needed to determine if forearm BP can be used to replace upper arm BP.

The issue of location for the forearm BP cuff also needs to be addressed because AHA guidelines on the proper measurement of BP do not give any guidance on where to locate the forearm BP cuff, despite lengthy directions for upper arm BP cuff location.¹ In prior studies evaluating forearm BP, investigators described specific BP cuff locations of the lower^{8,10} and middle forearm^{5-7,9} for placement of the BP cuff above the radial artery.

The purpose of this study was to determine the level of agreement in BP values obtained in three different forearm locations (lower, middle, and upper forearm) with BP obtained with an upper arm BP cuff in patients with large arm circumference.

Materials and Methods

This study was conducted on a 29-bed PACU in a 485-bed, not-for-profit hospital in the Pacific Northwest. The study was approved by the Institutional Review Board for the Health System. Before data collection, investigators were trained in data collection methods, and all noninvasive BP devices were calibrated by biomedical engineering, with recalibration every 12 months until study completion.

Study Design

A method-comparison design was used to compare three differing locations for forearm BP cuff placement in relation to BP obtained in the upper arm. Each subject served as their own control, with BP measured in all locations. The primary dependent variables were the differences in systolic and diastolic BP measurements between the upper arm and each forearm BP cuff location. The order of BP measurements was randomly assigned in the computer-generated randomization scheme.

Instruments

Upper arm BPs were obtained with a large adult BP cuff (#M1575A; Philips Medical, Andover, MA) as recommended in the AHA guidelines for arm circumferences greater than 34 cm.¹ Forearm BPs were obtained with a regular-sized adult BP cuff (#M1574A; Philips Medical) as recommended by the AHA guidelines for arm circumference 27 to 34 cm.¹ Forearm and upper arm BP cuffs were connected to an automated BP device (MP50 IntelliVue; Philips Medical) and operated according to manufacturers' directions.

Sample Selection

Subjects included in the study were adult PACU patients (18 years of age and older) with an upper arm circumference of 35 to 43 cm, requiring use of a large cuff for BP determinations. Inclusion criteria were no contraindications or physical impediments to obtaining a noninvasive BP in the upper arm and forearm of at least one extremity; forearm circumference of 27 to 34 cm and length 16 cm or more from olecranon to wrist; upper arm length 19 cm or more from acromium to

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