

**Title: MISCUFFING: INAPPROPRIATE BLOOD PRESSURE CUFF APPLICATION**

**Authors: D.M. Manning, C. Kuchirka, J. Kaminski**

**OBJECTIVE:** To study the cuffing patterns of the staff at a teaching hospital outpatient clinic and to determine the variance between prevailing cuffing habits and those recommended by the American Heart Association (AHA).

**DESIGN:** Pre-measurement of the patients' midarm circumference was measured without the staff's knowledge, so as not to alert them to the studies intent. Standard and large adult cuffs were available at each examination site; thigh cuffs and small adult cuffs were available nearby. The blood pressure (BP) of 60 patients was prospectively measured to assess the magnitude of the BP error induced by miscuffing. These 60 patients had arm circumferences that would require a large adult cuff (33 – 42 cm). Two BP readings were taken for each patient, one with a large adult cuff and one with a standard adult cuff.

**SETTING AND PATIENTS:** A multispecialty outpatient clinic, at a teaching hospital was chosen as the site of the study. Patients were chosen without regard to their prior BP status. A total of 167 patients were chosen to participate in the overall study, with midarm circumferences measuring between 20 and 47 cm girth.

**RESULTS:** Two hundred individual BP determinations were taken. The proper cuff size was used in 69% of 170 measurements taken by nurses and 63% of 30 measurements taken by house staff physicians, for an overall cuffing

accuracy of 68% in 200 determinations. There were 85 patients that required a nonstandard cuff, of these the proper cuff size was used in only 24 (28%). None of those requiring a small adult size or thigh size were properly cuffed. Of the 64 cuffing errors, 54 were undercuffings and 10 were overcuffings.

The average error resulting from undercuffing was an increase of 8.5 mm Hg systolic and 4.6 mm Hg diastolic, with a wide individual variance.

**CONCLUSIONS:** The researcher points out that several researchers have proven, by comparison to direct intra-arterial pressure measurements, that undersized cuff overestimates and oversized cuff underestimates the true BP by as much as 10 to 30 mm Hg. Under cuffing can lead to the over treatment of hypertension and over cuffing to its under treatment. They also mention that the current AHA guidelines for cuff sizing (at the time of this publication) is as outlined in the following table:

AHA Circumference (cm)	AHA Cuff Size
<24	Small Adult
24 – 32	Standard Adult
33 – 42	Large Adult
>42	Thigh size

*(Circulation, 1983 Oct; 68(4); 763-6).*

**Title:** DOES BLOOD PRESSURE CUFF SIZE MAKE A DIFFERENCE IN BLOOD PRESSURE READINGS?

**Authors:** W. C. Nicholas, R. L. Watson, T. Y. Barnes, C. Goodnow, E. Russel

**OBJECTIVE:** This study was conducted to determine whether or not blood pressure cuff size affected blood pressure readings.

**DESIGN:** Systolic and diastolic pressures were measured on each subject with two different sized cuffs. Arm circumference was measured midway between the elbow and the acromion (shoulder tip). In patients with normal sized arms, regular and large adult cuffs were used. Patients with large arms were divided in two groups. Large adult and thigh cuffs were used in one group and regular and large adult cuffs were used in the other group. Both cuffs were applied twice in alternating order on the same arm with one-minute intervals between readings.

**SETTING AND PATIENTS:** The study was performed in a hospital setting. The patients were predominantly black and female. A total of 90 hospitalized patients were studied. Thirty of these were defined as having normal sized arms with circumference between 22-32 cm. The other sixty patients were defined as having large arms, 57 with circumference between 22-32 cm and 3 greater than 32 cm circumference. Only patients in stable condition, with normal

higher readings. On large arms, the regular cuff gave a 7.0 mm Hg systolic and a 2.73 mm Hg diastolic higher reading than the large adult cuff. The estimated mean cuff differences varied from a low of 1.53 mm Hg to a high of 7.00 mm Hg. Statistical significance was reached in four of six readings.

**CONCLUSIONS:** The study findings suggest and several other studies referenced agree that regular size cuffs on large arms give falsely elevated levels and large cuffs on normal arms tend to give falsely lower levels. The study concludes stating that it is essential we do not misclassify patients by using the wrong size cuff, thus causing patients to be taking medications needlessly. Using regular adult cuffs on large arms is the most likely error since the regular adult cuff is not only the cuff most frequently used regardless of arm size, but in many situations is the only cuff readily available. (*Journal of Mississippi Medical Association, February 1985, Volume XXVI, Number 2*)

cardiac rhythms were studied.

**RESULTS:** Findings revealed that on large arms the regular cuff gave progressively

**Title:**            **AGREEMENT BETWEEN LARGE AND SMALL CUFFS IN SPHYGMOMANOMETRY: A QUANTITATIVE ASSESSMENT**

**Authors:**        **Y. Iyriboz, C. M. Hearon, K. Edwards**

**OBJECTIVE:** The objective of this study is to quantify agreement and differences between blood pressure (BP) measurements by large cuffs (15 X 33cm) and small cuffs (12 X 23cm) in a representative sample of the U. S. population with varying arm circumferences. The purpose is to examine whether the two cuffs are quantitatively similar and interchangeable.

**DESIGN:** Arm circumferences were measured midway between the acromion process and antecubital fossa and were classified as a large arm (>29cm) or a small arm ( $\leq$ 29cm). Pressures were measured using a mercury column sphygmomanometer. Each subject had a total of 12 readings obtained. The blood pressure was measured in triplicate by two observers with a small cuff and a large cuff.

**SETTING AND PATIENTS:** Eighty- five subjects (44 males and 41 females) participated in the study. The sample was clustered by age to represent the hypertensive population in the United States (according to the Advancement of Medical Instrumentation [ AAMI]).

the large cuff. Therefore, the results of the study found that the small cuff overestimates blood pressure compared with the large cuff. The differences between cuffs were as high as 14.33 mm Hg and 12.00 mm Hg, for SBP and DBP respectively.

**CONCLUSIONS:** The study concludes stating that using an inappropriate cuff, the most common error in indirect blood pressure measurement, can significantly distort blood pressure readings. The study states that errors of just a few mm Hg can result in serious financial and mental burdens to patients, misleading research, and, possibly, physician liability.

*Journal of Clinical Monitoring, 1994  
March, Vol 10, No. 2: 127-133.*

**RESULTS:** The statistical plots and the mean plots of equality and difference were compared. For the large arm circumference and the small arm circumference groups all plots indicated that the small cuff overestimates blood pressure compared with

**Title:** CUFF BLADDER WIDTH AND BLOOD PRESSURE MEASUREMENT IN CHILDREN ADOLESCENTS.

**Authors:** Gomez-Marin O, Prineas RJ, Rastam L

**OBJECTIVE:** The objective of this study was to estimate the independent contribution of the blood pressure cuff bladder width: mid-upper arm circumference (CW:AC) ratio to the variability in systolic blood pressure (SBP), diastolic blood pressure phase 4 (DBP4) and diastolic blood pressure phase 5 (DBP5) in children and adolescents, and its impact upon the estimate of prevalence of high blood pressure diagnosed at screening.

**DESIGN:** It is well established that blood pressure cuffs with a CW:AC ratio of 40% causes overestimation of the true blood pressure and higher CW:AC ratios results in underestimation of the blood pressure. The American Heart Association recommends a CW:AC ratio of approximately 40%, but no consistent recommendations exist for children.

**PATIENTS AND MEASUREMENTS:** Systolic and diastolic blood pressure were measured for phase 4 and 5 in 811 boys and 771 girls aged 10–17 years. In each subject the blood pressure was measured with a cuff

**RESULTS:** Smaller cuffs gave significantly higher blood pressure readings. With the larger cuff there were significant mean decreases. The differences were independent of the blood pressure level obtained with the recommended cuff. The impact upon the estimate of the prevalence of high blood pressure was substantial.

**CONCLUSIONS:** Selection of the proper cuff size is important for children and adolescents, in order to avoid both over and underdiagnosis of hypertension.

*Journal of Hypertension, 1992, Oct; 10 (10): 1235-1241*

conforming to the 40% rule (recommended cuff size), with one smaller (mean decrease in the CW:AC ration: 7.4%), and with one larger (mean increase in the CW :AC ration of 10.2%). Cuffs were used in random order.

**Title: RATIO OF CUFF WIDTH/ARM CIRCUMFEREMCE AS A DETERMINANT OF ARTERIAL BLOOD PRESSURE MEASUREMENTS IN ADULTS**

**Authors: I. Rastam, R. J. Prineas, O. Gomez-Marin**

**OBJECTIVE:** Recommendations state that the optimum ratio of blood pressure cuff width/arm circumference (CW/AC) is about 4.0. This study analyzed the effect of CW/AC on blood pressure measurement variability.

**DESIGN:** Right arm circumference at the mid-point between acromion and olecranon was measured to the nearest half centimeter using a measuring tape. Depending on the arm circumference one of four available blood pressure cuffs was selected. Blood pressure was measured twice on the right arm, using a Hawksley Random Zero Sphygmomanometer. The subject was seated for five minutes of rest before the blood pressures were taken, and the time lapse between the two pressures was about two minutes.

**SETTING AND PATIENTS:** There were 2424 adult subjects studied. Subjects were parents of children enrolled in the longitudinal Minneapolis Children's Blood Pressure Study. A random sample were invited to participate. 1509 families participated, comprising a total of 940 men and 1480 women, age ranging from 22-78 years.

**RESULTS:** This study convincingly demonstrates an independent contribution to the variation in indirectly measured blood pressure by the CW/AC ratio, irrespective of the fact that efforts were made to minimize this variation by using different cuff sizes. The variability explained by CW/AC can be considered to give a strong indication of the effect of inappropriate cuff width. It should be noted that if only one cuff size had been used, for the entire arm circumference range, the impact of the CW/AC ratio would have been greater.

**CONCLUSIONS:** In conclusion, this study confirms that it is necessary to ascertain that a cuff of correct width is chosen relative to the subject's arm circumference. This is in agreement with several major guidelines that have recently emphasized this viewpoint. There is general agreement that of too small a cuff is used, the cuff method will provide spuriously high values. And that use of a larger cuff than necessary demonstrates the effect of underestimation.

**Title:** THE ERROR IN INDIRECT BLOOD PRESSURE MEASUREMENT WITH THE INCORRECT SIZE CUFF

**Authors:** L.A. Geddes, S.J. Whistler

**OBJECTIVE:** To illustrate the order of error to be expected with cuffs which are too small and too large. This study presents data which illustrates the amount of error to be expected when the cuff width departs from the optimum recommendation of 40 per cent of the circumference of the extremity to which it is applied.

**DESIGN:** Blood pressure was measured indirectly using three standard cuffs (9, 12, and 18 cm. wide). Cuffs were applied to the upper arm. Resting blood pressure was measured with each of the three cuffs using the auscultatory method. To illustrate the effect of cuff width on indirect blood pressure readings, the systolic and diastolic pressures were obtained on each subject with the 12 cm. cuff as a reference pressure. In most cases it was found that this width was very nearly 40 per cent of the arm circumference.

**SETTING AND PATIENTS:** Blood pressure was measured indirectly in 52 healthy adult subjects. The arms ranged from 21.5 to 36 cm. in circumference.

**RESULTS:** For both systolic and diastolic pressures the use of a cuff that was too narrow resulted in a higher indirect pressure. Similarly, with a cuff that was too wide the measured pressure was lower. A cuff width-

to-arm circumference ratio of 0.34 overestimates blood pressure by about 5 per cent; a cuff width-to-arm circumference ratio of 0.50 underestimates blood pressure by 5 per cent. For the same degree of mismatch the error is greater when the cuff width is narrower rather than larger.

**CONCLUSIONS:** The data in this report, and those presented in the published literature, show that the use of a cuff that is too narrow overestimates and one that is too wide underestimates indirect blood pressure.

*American Heart Journal, July, 1978, Vol. 96, No. 1*