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# Blood Pressure Measurement in Obese Patients

**Q** What is the best way to measure blood pressure in obese patients? If the cuff does not fit around the patient's arm, should I use a larger cuff or just use the standard cuff on the patient's forearm? Which method is the most accurate?

**A** Jennifer McFarlane, RN, MSN, CCRN, CNRN, CBN, replies:

Measuring blood pressure in patients with obesity presents a number of challenges centered on the selection of the right size cuff. Multiple techniques for blood pressure measurement in patients with morbid obesity have been described; however, no evidence is available to support a preference for one method over another, and expert consensus varies.

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The most common site for measurement of blood pressure is on the upper arm of the patient. The upper arm is defined as the part of the upper extremity extending from the shoulder to the elbow. Standards have been established by the American Heart Association and adopted by several national forums on blood pressure measurement. These standards advise that the length of the bladder (the part inside the covering that inflates) of the blood pressure cuff should be 80% of the circumference of the patient's arm and the bladder width should be 40% of the length.<sup>1</sup> In general, the standard of bladder length and width would apply to any extremity on which blood pressure is being measured.

Research findings show that blood pressure measurements taken with a standard cuff instead of a large cuff in obese patients are significantly higher.<sup>2</sup> As the arm circumference gets bigger, the bladder of the cuff must get longer and wider. The trouble with this standard,

from a practical standpoint, is that the arms of obese people are no longer than the arms of nonobese persons of a similar height. Because of this discrepancy, following the standard for selecting cuff size results in a poor fit. Additionally many people who are obese have arms that are shaped like an inverted cone, which adds to the difficulty in finding the right sized cuff.

Some experts recommend that if the correct size cuff for the upper arm is unavailable or if it is difficult to fit a large adult or thigh cuff, the forearm should be used as an alternative.<sup>3</sup> However, measurements of blood pressure in the forearm have been noted to vary by a mean of 7 to 15 mm Hg.<sup>4</sup> Fonseca-Reyes et al<sup>2</sup> reported that for each 5-cm increase in arm diameter, systolic blood pressure is overestimated by 2 to 5 mm Hg and diastolic blood pressure is overestimated by 1 to 3 mm Hg when a "standard" cuff is used on the patient's forearm.

One question to be considered is how to determine what variance is clinically acceptable. Many reports on blood pressure measurement use a standard of 9 mm Hg or less, originally proposed by Gibbs et al.<sup>5</sup> This standard was obtained by a survey of anesthesiologists at 1 hospital in 1991. A more appropriate standard is the International

Standards Organization's ISO 81060-2:2009. This standard is used by manufacturers of noninvasive blood pressure devices to test their devices against mercury sphygmomanometers. It was also used by one cuff manufacturer's (Philips') tests of their cuffs on other vendor's devices (B. D. Duller, C. Monroe, unpublished data, 2008). This standard calls for a difference of  $\pm 5$  mm Hg with a standard deviation of no more than 8 mm Hg.

Currently, health care providers noninvasively measuring blood pressure in morbidly obese persons have 3 cuff choices: standard adult, large adult, and thigh. Several years ago, extra long standard adult cuffs began to be produced by the various manufacturers of blood pressure cuffs. Using the guidelines for bladder circumference and length mentioned earlier, the provider has a variety of imperfect choices. The large adult cuff may just barely fit around an obese patient's arm. This situation results in measurements that are too high. The thigh cuff may result in a poor fit, and the accuracy of those measurements is questionable.

Fitting a thigh cuff on a patient's arm presents several challenges. One challenge is related to the length of the arm. Most obese people do not have an arm that is any longer than the arms of nonobese persons. The thigh cuff may be the correct diameter for the patient's arm, but the cuff is usually pushed up into the axilla and extends down beyond the ante-cubital area. This situation results in a possibly appropriate bladder fit with a poor actual fit (Figure 1).

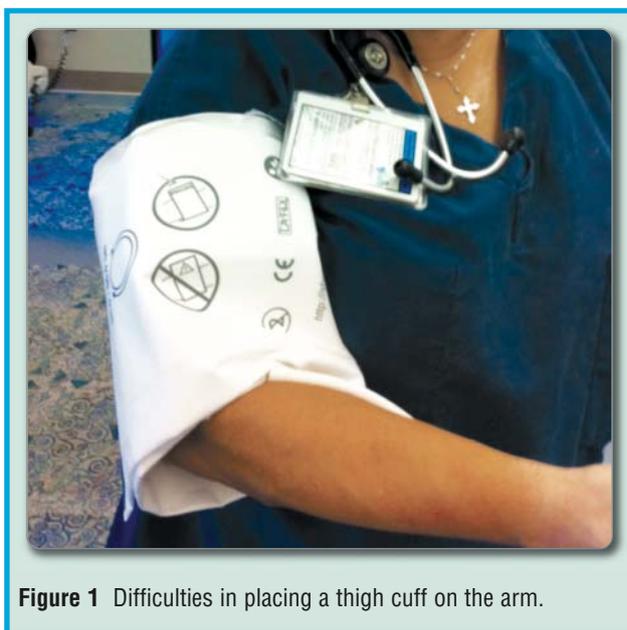
Another challenge related to all cuffs is that many obese patients have cone-shaped arms. The diameter at

the top of the arm is larger than the diameter of the arm in the region of the brachial artery. This shape results in a poor fit over the brachial artery and also results in inaccurate measurements. A third area of challenge in using a thigh cuff is that of treating

obese patients respectfully and with sensitivity. People who are obese often avoid health care because of embarrassment about their weight.<sup>6</sup> "Hang on—your arm is too big, so I will have to get a thigh cuff" is an example of an insensitive remark.

One author<sup>7</sup> alluded to the development of extra-long cuffs as a potential alternative. Technically, the extra-long cuff does not meet the American Heart Association standards in terms of correct sizing of the bladder. Only the outside material is extra long. The extra-long cuff actually has the same size bladder as a standard adult cuff. This design has led some nurses, aides, and physicians to believe that the extra-long cuff can be used for patients who are obese in place of a correctly sized cuff. This cuff has a standard adult width but about 6 inches (15 cm) extra of Velcro. The only part that is extra long is the outside material. The design of these cuffs promotes improper use (Figure 2).

In a study approved by the institutional review board, I compared



**Figure 1** Difficulties in placing a thigh cuff on the arm.

measurements of blood pressure obtained with an extra-long cuff on the patient's arm with measurements obtained with an appropriately sized cuff on the patient's arm and forearm (J. McFarlane, unpublished data, 2010). The results showed that blood pressure was overestimated with the extra-long cuff, and that the forearm measurement was closer to the measurement with the properly sized cuff on the arm than was the measurement with the extra-long cuff on the arm. Most of the participants in my study had a body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) between 36 and 40. Had the study been done on more persons with a BMI greater than 40, it is likely that the differences would have been greater, as noted by Fonseca-Reyes et al.<sup>2</sup>

Considering the matter from a practical standpoint, it is often best to use the forearm and hold it at the level of the patient's heart. On the forearm, both a bladder fit that meets the standards of the American



**Figure 2** Different-sized adult cuffs. The size of the bladder is the distance between the 2 black lines on each device. The first cuff (at the top) is the standard adult cuff (arm circumference range, 27.5-36.5 cm). The second one from the top is the extra-long adult cuff (arm circumference range, 27.5-36.5 cm). The third cuff is the large adult cuff (arm circumference range, 36.5-46.0 cm). The fourth cuff is the thigh adult cuff (arm circumference range, 44.0-56.0 cm). When applied to an arm with the appropriate circumference, the index edge along the right side of each cuff will fit into the indicated range. The extra-long adult cuff is considerably longer than the standard adult cuff, but it is not wider. Use of the extra-long cuff will result in an overestimation of blood pressure if the patient's arm is larger than the specified circumference.

Heart Association and an actual fit can be achieved. The hoses should exit over the radial artery, which is smaller and more distant than the brachial artery, and the measurement may vary as cited earlier.<sup>4</sup>

Recommended practices include holding the patient's arm at heart level, measuring the blood pressure in both arms of the patient on admission, making sure to use the appropriate sized cuff, and not using a noninvasive device to measure blood pressure in patients with irregular



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arrhythmias. Cuff size is important in all patients. A cuff that is too large will result in a falsely low blood pressure measurement. A cuff that is too small will result in a falsely high blood pressure measurement.<sup>2</sup>

The following pointers apply to all measurements of blood pressure:

- Choose the right cuff for the patient. Each cuff has an index edge and an index range to ensure proper fit.

A correctly sized

cuff is one of the most important factors in obtaining accurate measurements of blood pressure.

- Hold the limb for blood pressure measurement at the level of the patient's heart for accurate measurements in children and adults.
- Use forearm measurements in obese patients when a satisfactory fit cannot be obtained with the cuff on the patient's arm.
- Minimize factors that decrease the accuracy of blood pressure measurements, such as<sup>8</sup>:
  - Cuff placed loosely on patient's arm
  - Air in cuff before it is placed on the patient's arm

- Arm below or above level of patient's heart during measurement
- Kinks or loose connections
- Patient talking during measurement
- Any arm motion during measurement (passive or active)
- The patient's bladder should be emptied before measurement
- Putting the cuff on over clothing will result in inaccurate pressure measurements
- The patient's back should be supported during measurement
- The patient's arm should be supported during measurement
- Slow or repeated inflations of the cuff can result in venous congestion, which leads to inaccurate measurements.<sup>1</sup> If repeated measurements are needed, fully deflate the cuff, and wait at least 15 seconds between measurements.
- Do not use electronic noninvasive devices for measuring blood pressure on patients with irregular rhythms. Such devices rely on a regular heart rhythm for accuracy. They should not be used for patients with irregular heart rhythms such as atrial fibrillation or frequent ectopic beats. A manual cuff and sphygmomanometer should be used in patients with an irregular rhythm.
- When repeated measurements of blood pressure are required, the best practice is to perform in the same arm for accuracy.

Using proper technique is the easiest way to measure blood pressure accurately in all patients. Patients with obesity require adaptations of the standard, but consistent and reliable measurements are possible if the guidelines outlined here are used. **CCN**

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Financial Disclosures  
None reported.

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