



ORIGINAL RESEARCH PAPER

Cardiovascular

COMPARATIVE MEASUREMENT OF THE BLOOD PRESSURE BETWEEN ARM AND FOREARM USING DIFFERENT WIDTH OF BLOOD PRESSURE CUFF IN OBESE POPULATION

KEY WORDS: blood pressure in obese population, appropriate size bp cuff, forearm blood pressure

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ABSTRACT

INTRODUCTION: The erroneous use of the blood pressure (BP) equipment is the main source of inaccurate BP recording. The most common cause of inaccurate measurement is the use of an inappropriate cuff size [1]. The cuff length must encircle arm circumference from 75% to 100% and the arm circumference/cuff width ratio must be around 0.40, to avoid inaccurate BP recording [1].

OBJECTIVE: To compare the BP measurement in the arm with appropriate size BP cuff with standard size blood pressure cuff in the arm and forearm in obese patients.

MATERIALS AND METHOD: Patients who attended Yenepoya Medical College Outpatient department or Inpatients who had BMI above 25kg/m² participated in study. With mercury sphygmomanometer, arm BPs were recorded in right arm in sitting position by appropriate cuff size for that BMI. Following this, BP was recorded both of the arm as well as the forearm with the standard size BP cuff and values were compared.

RESULTS: Appropriate size BP cuff readings of arm were closer to forearm BP of the standard size cuff. So forearm BP may be used as a surrogate BP in obese patients.

INTRODUCTION

For measurement of appropriate blood pressure according to American association hypertension Guidelines, the sphygmomanometer cuff should be appropriate to the patient arm to ensure an accurate reading. The arm circumference measurement should be taken at the midpoint between acromion and olecranon. The cuff length must encircle arm circumference from 75% to 100% and the arm circumference/cuff width ratio must be around 0.40, to avoid inaccurate BP recording. [1]

The characteristic of cuff and bladder for blood pressure measurement in relation to arms size is still controversial. Measurement of blood pressure in obese patients remains a challenging task as appropriate size blood pressure cuff is not readily available in most of the hospital settings.

Standard blood pressure cuff does not usually fit obese patients. Even if it fits, it gives a higher value [2]. This difficulty can be overcome by checking the values by measuring the pressure at the wrist by standard cuff wrapped around the forearm and auscultation done over the radial artery [2]. With the growing obese population in India, it is important for physicians to have an idea to check accurate blood pressure in obese adults. In South Asia, obesity is defined when BMI is above 25 kg/m² [3] Obesity is a studied risk factor for cardiovascular disease. The Association of hypertension and obesity is also well established [4]. There is paucity of literature regarding the use of different sizes of blood pressure cuff in India. Since most of the hospitals are still using mercury sphygmomanometer instead of the electronic ones, this study is undertaken to find out if there is a variation in the use of standard blood pressure cuff in obese people compared to larger cuff and also the reliability between forearm and arm blood pressure. To find out which one of the two can be blood pressure value is closer to blood pressure measured by appropriate cuff in obese population is the purpose of the study.

OBJECTIVE

To compare the BP measurement in the arm with appropriate size blood pressure cuff with standard size blood pressure cuff in the arm and forearm in obese patients.

METHODOLOGY

Study design – cross-sectional study

MATERIALS AND METHODS –

Patients attending Yenepoya Medical College OPD or in patients who were above the age of 18years and had a Body Mass Index of above 25 kg/m² were selected to participate in this study. Study participants read the participant information sheet and informed consent was taken.

With mercury sphygmomanometer (standardized) arm blood pressure was recorded in right arm in sitting position by appropriate cuff size followed by blood pressure was recording of the arm as well as the forearm with the standard size blood pressure cuff. Comparison was done between the blood pressures. For all obese patients one large/appropriate (35- 44cm) cuff was used and one standard/smaller size (27-34cm) cuff was used [1].

INCLUSION CRITERIA –

age above 18years and BMI >25kg/m².

EXCLUSION CRITERIA –

less than 18 years of age, pregnancy, and volume overload state.

Source of data/Sampling method –

inpatient/outpatient based.

Sample size - N
$$= \frac{Z^2(1-\alpha/2) \sigma^2}{d^2}$$

$$= \frac{(2.58)^2 (18)^2}{(5)^2} = 86$$

At 1.1 test of significance and standard deviation 18 (from related article) and clinically significant difference 5mmHg the total sample size was fixed at 86.

Randomization – convenient sampling

RESULT AND ANALYSIS

There were total of 86 participants out of which 42 were males and rest were females.

Mean BMI of participants was 30 kg/m²

Mean average systolic blood pressure in forearm and arm with standard cuff was 128.3 ± 16.49 mmHg and 132.8 ± 16.09

mmHg respectively. Mean average in arm with large size BP cuff was 125.5 ± 17.13 mmHg. ($p < 0.05$).

Mean average diastolic blood pressure in forearm and arm with standard cuff was 81.7 ± 12.93 mmHg and 84.6 ± 12.52 mmHg respectively. Mean average diastolic pressure with large/appropriate cuff of arm was 80.4 ± 11.92 mmHg. ($p < 0.05$)

In majority of participants arm blood pressure measured with standard size BP cuff was higher than appropriate size blood pressure cuff with a difference of 7.3mmHg (systolic) and 4.2mmHg (diastolic) between them.

DISCUSSION

Obesity affects more than 135 million adults in India. Factors affecting the prevalence of obesity are multifactorial. Obesity prevalence rate is 11.8% to 31.3% and central obesity varies from 16.9%–36.3% respectively according to ICMR-INDIAB study in 2015[5]. Prevalence of hypertension in men (27.4%) was reported greater than women (20.0%) according to Fourth District Level Household Survey. It converts into 207 million persons (men 112 million, women 95 million) with hypertension in India [6].

A study done by Irving G et al [7], to 'find out concordance between arms and forearm blood pressures'. Their sample size included 54 patients with a body mass index > 26 kg/m2. BP measurement was done using an automated validated device OMRON 705CP in a randomized order 3 times in each arm and forearm. In the study mean differences between arm and forearm were observed to be 5.5 mmHg for SBP and 1.53 mmHg for DBP. Hence forearm BP recording was not recommended for measuring blood pressure. However different sizes of cuff were not used. In our study we used two different sizes of blood pressure cuffs and observed that measurement of BP with standard size cuff on forearm is closer to measurement of BP in the arm with appropriate size cuff.

In another study by Pierin et al [8] on 'BP measurement in obese patients: comparison between arm and forearm measurements' published in BP monitoring journal in England, arm and forearm BP measurements with an appropriate cuff and standard cuff respectively were compared by the Photoplethysmography (Finapres) method. The study showed that forearm BP measurement shows a higher BP measurement than arm BP. However different BP cuff were not used on the arm. In our study manual mercury sphygmomanometer was used as it is more readily available.

A study done by Leblanc et al. [9] on BP Measurement in Severely Obese Patients. This study assessed comparison between intra arterial BP values (gold standard) with forearm BP values in severe obese patients in different positions of the arm. Arterial line blood pressure was measured and compared to the oscillatory method of BP measurement in different arm position. The study concluded that Forearm systolic BP was in concordance with the gold standard (intra-arterial) in supine position. In our study blood pressure has been measured in sitting position and manual method is used. Our study revealed forearm BP values measured by standard size cuff in obese patients were closer to the BP values measured with appropriate size in the arm.

In the present study it was found that mean blood pressure of arm measured by standard BP cuff was higher by 7.3mmHg systolic and 4.2mmHg diastolic as compared to blood pressure measured by larger BP cuff in the arm. BP measured by standard BP cuff in the forearm of obese patients showed mean average systolic and diastolic BP closer to that of appropriate size cuff placed on the arm in obese people.

CONCLUSION

The blood pressure of the arm as measured by the

appropriate cuff is closer to the blood pressure measured by the standard size cuff of the forearm compared to the blood pressure measured by the standard size on the arm.

Hence, forearm blood pressure may be used as a surrogate blood pressure in obese patients when appropriate size BP cuff is not available.

The short coming of this study is a small sample size. A large sample size may be required to strengthen the data

TABLE

1. Mean Table with all BP Variations

Cuff Sizes	Mean Systolic BP	Mean Diastolic BP
Arm BP with Standard Cuff	132.8 ± 16.09 mmHg	84.6 ± 12.52 mmHg
Forearm BP with Standard Cuff	128.3 ± 16.49 mmHg	81.7 ± 12.93 mmHg
Arm BP with Appropriate Cuff	125.5 ± 17.13 mmHg	80.4 ± 11.92 mmHg

REFERENCES

- Muntner P, Shimbo D, Carey RM, Charleston JB, Gaillard T, Misra S, et al. Measurement of Blood Pressure in Humans. 2019. 35–66 p.
- DeDeGowin RL, Brown DD. Diagnostic Examination. 7th ed. New York (USA): McGraw-Hill Companies, Inc; c2000. Chapter 6, thorax; respiratory, cardiovascular and lymphatic system; p. 421.
- Misra A. Ethnic-Specific Criteria for Classification of Body Mass Index : 2015; 17 (9):667–71.
- Richard N. Re. Obesity-Related Hypertension. *Och J* 2009; 9(3):133–6.
- Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. *Diabetes Metab Syndr Clin Res Rev* [Internet]. 2019; 13(1):318–21. Available from: <https://www.sciencedirect.com/science/article/pii/S1871402118303655>
- Gupta R, Gaur K, S. Ram CV. Emerging trends in hypertension epidemiology in India. *J Hum Hypertens* [Internet]. 2019; 33(8):575–87. Available from: <https://doi.org/10.1038/s41371-018-0117-3>
- Irving G, Holden J, Stevens R, McManus RJ. Which cuff should I use? Indirect blood pressure measurement for the diagnosis of hypertension in patients with obesity: a diagnostic accuracy review. *BMJ Open*. 2016 Nov; 6(11):e012429.
- Pierin AMG, Alavarce DC, Gusmao JL, Halpern A, Mion DJ. Blood pressure measurement in obese patients: comparison between upper arm and forearm measurements. *Blood Press Monit*. 2004 Jun; 9(3):101–5.
- Leblanc M-É, Auclair A, Leclerc J, Bussièrès J, Agharazii M, Hould F-S, et al. Blood Pressure Measurement in Severely Obese Patients: Validation of the Forearm Approach in Different Arm Positions. *Am J Hypertens*. 2019 Jan; 32(2):175–8