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RESEARCH ARTICLE

Prevalence of cuff hypertension among overweight and obese subjects

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ABSTRACT

Background: "Obesity is a lifestyle affliction, it is a side effect of poor habit and it can be reversed." Obesity is defined either by increased waist circumference, waist-hip ratio, and/or body mass index. Overestimation of blood pressure (BP) using an inappropriately small cuff is well documented. Using a BP cuff small for midarm circumference (AC) in obese patient's results in higher BP readings. Therefore, it was felt that there is a requirement to study the effect of different cuff sizes for different arm circumferences in obese individuals. The purpose of this study is to determine if cuff hypertension (HTN) is present in obese subjects. **Aims and Objective:** To determine the presence of cuff HTN in obese subjects. **Materials and Methods:** A total of 200 obese and 200 non-obese subjects between 20 and 50 years of age reporting to OHRC were included in the study. Systolic and diastolic BP were measured using a mercury sphygmomanometer with two cuff sizes, i.e., standard cuff 12 cm width (for MAC <32 cm) and large cuff 15 cm width (for MAC >32 cm). **Results:** A total of 56 subjects were diagnosed as systolic HTN with standard cuff, i.e., 28% but with large cuff, it was only 24 subjects, i.e., 12% only, a difference of 16% between the prevalence of systolic HTN. Diastolic HTN diagnosed with standard cuff was 20% compared to large cuff 7.5%, a difference of 12.5%. The above differences are demonstrating "cuff HTN" in the obese subjects. **Conclusion:** In this study of 200 obese and 200 non-obese subjects, it was found that "cuff HTN" is present in obese subjects.

KEY WORDS: Body Mass index; Midarm Circumference; Hypertension

INTRODUCTION

"Obesity is a lifestyle affliction, it is a side effect of poor habit and it can be reversed." Obesity is defined either by increased waist circumference, waist-stature ratio (WSR), waist-hip ratio, and/or body mass index (BMI). As individuals in developing countries consume more quantities of high energy food and have less physical activity so the number of overweight and obese individuals are increasing in these countries.[1-3]

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Obesity has a potential detrimental effect on blood pressure (BP) and increases cardiovascular events. BMI has been traditionally promulgated by the World Health Organization as a useful epidemiological measure of obesity. Overweight and obesity represent a rapidly growing threat to the healthy populations in a number of countries, and obese individuals tend to have a larger midarm circumference (mid-AC) than non-obese individuals. Therefore, there is a need for caution in measuring BP in the obese. Cuff characteristics, i.e., the cuff bladder width and length, can bias measurement of BP in the obese.[4-6]

Overestimation of BP using an inappropriately small cuff is well documented using a BP cuff small for mid-AC in obese patient's results in higher BP readings. A bladder width that is too narrow for the mid-AC will tend to overestimate BP, called cuff hypertension (HTN). The most important adjustment for measuring BP in the obese derives from choosing the

correct cuff width-AC (CW) ratio. The recommendation is that the cuff width should be at least 40% of AC, i.e., a ratio of 0.40. However, for larger ACs, a ratio of 0.46 has been recommended.[2] The increasing prevalence of obesity and its associated conditions such as HTN, accentuates the importance of the recognition of the relationship of an appropriate sized cuff, and accurate BP measurement.[7-11]

Objective

The objective of this study was to assess, if cuff HTN is present in obese subjects.

MATERIALS AND METHODS

Source of Data

A minimum of 200 obese subjects among age group between 20-50 years of age in and around Hyderabad who visited the medicine outpatient department of Owaisi Hospital and Research Centre were selected. This study was started after obtaining approval of the institutional review board (IRB).

Study Period

This period was from April 2017 to October 2017.

Inclusion Criteria

Obese subjects were selected based on BMI.

Exclusion Criteria

- Subjects on antihypertensive medication.
- Secondary causes of clinically identifiable HTN.
- Diabetic subjects who are known hypertensives or with complications of DM.
- Pregnant women.
- Known cases of ischemic heart disease.

Method

Calculation of BMI: It was calculated as weight in kilograms divided by height in meters squared (kg/m^2).

Systolic and diastolic BP were using a mercury sphygmomanometer and two cuff sizes.

- Standard cuff 12 cm width (for MAC<32 cm).
- Large cuff 15 cm width (for MAC>32 cm).

RESULTS

AC

For purposes of checking standard and large cuff BP measurements, AC of 32 cm was taken as the cutoff point, and therefore, distribution of AC <32 cm and >32 cm is shown in Figure 1.

Figure 1 shows distribution of AC in men and women among obese cases. Among men AC between 36 and 38 cm was maximum, i.e., 27, while in women the maximum were in 32–34 and 34–36 cm group, i.e., 21 each correlation of anthropometric variables with BP between males and females in obese cases.

BP

Tables 1 and 2 summarize the mean and standard deviation of both SBP and DBP in either sex in each decade. It showed that both SBP and DBP increased progressively in each decade both in men and women, both with standard cuff and large cuff. The difference between standard and large cuff SBP and DBP in each age group in males and females was statistically highly significant $P < 0.05$ as shown in Tables 1 and 2. However, the difference between SBP and DBP in males and females measured with standard and large cuff in each age group was not statistically significant, i.e., $P > 0.05$.

BMI

Table 3 summarizes SBP increased significantly with increase in BMI in both men and women, with both standard cuff and large cuff and there is statistically significant standard - large cuff differences for BMI ≥25, i.e., *P* value for males and females were 0.003 and 0.01 for BMI 25–29.9 and BMI 30-34.9, respectively. For BMI ≥ 35, p value was 0.1 for males and this could be attributed to the small numbers and small difference compared to females.

Using the JNC-7 criteria for the present study, it showed that:

- With BP. <120/80 mmHg the number of subjects with standard cuff was 24 only while with large cuff there were 74;
- With BP 120–139/80–89 mmHg there were 102 with standard cuff and 88 with large cuff;
- The subjects diagnosed with stage 1 HTN were 54 with standard cuff compared to 33 by large cuff;
- With stage 2 HTN there were 20 compared to 5 with large cuff.

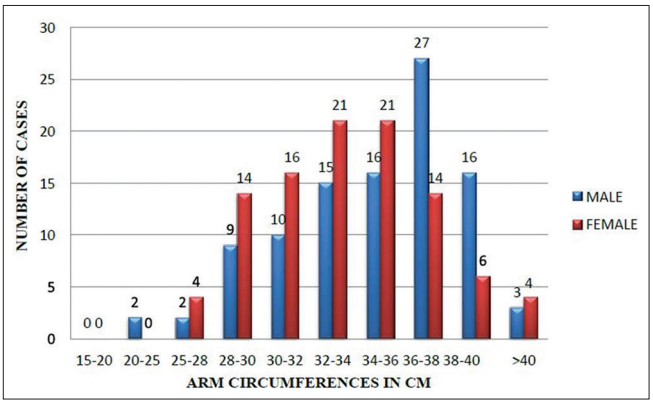

Figure 1: Arm circumference in obese

This data explain that in obese individuals with an increase in AC miscuffing happens, which leads to cuff HTN.

DISCUSSION

In 1983, Manning *et al*.[1] reported that the average error resulting from undercuffing was an increase of 8.5 mmHg systolic and 4.6 mmHg diastolic.

Nicholas *et al*.[3] found that on large arms, the regular cuff gave a 7.0 mmHg systolic and a 2.73 mmHg diastolic higher reading than the large adult cuff.

Table 1: Mean and SD of SBP with standard and large cuff in each decade in obese cases

Parameters		SBP, Mean±SD		
Gender	**Age groups**	**Standard cuff**	**Large cuff**	***P* value**
Male	20–30	132.6±10.1	124.5±8.9	0.001
	30–40	138.4±12.7	129.8±12.8	0.006
	40–50	138.4±15.9	127.4±15.8	0.006
Female	20–30	129.1±13.09	121.1±8.8	0.003
	30–40	133.6±11.06	124.0±12.3	0.001
	40–50	136.7±13.26	126.3±12.25	0.001

SBP: Systolic blood pressure, SD: Standard deviation

Table 2: Mean and SD of DBP with standard and large cuff in each decade in obese cases

Parameters		DBP		
		Standard cuff	**Large cuff**	
Gender	**Age groups**	**Mean±4**	**Mean±SD**	***P* value**
Male	20-30	81.5±8.4	76.5±7.5	0.01
	30-40	84.2±9.2	78.3±8.7	0.007
	40-50	86.8±12.02	79.1±11.12	0.008
Female	20–30	79.8±4.5	75.3±4.9	0
	30–40	84.3±9.1	78.4±9.05	0.01
	40–50	84.46±10.0	78.2±9.10	0.009

DBP: Diastolic blood pressure, SD: Standard deviation

Nicholas C *et al*.[3] found that small cuff overestimates BP compared with large cuff. The differences between cuffs were as high as 14.33 mmHg and 12.00 mmHg, for SBP and DBP, respectively.

In our study, there is a difference of 9.3 mmHg systolic and 5.97 mm Hg diastolic for individuals with an AC > 32 cm as shown in Table 3 given below. The difference was statistically highly significant, i.e., $P = 0.000$.

Comparison of HTN Prevalence with Standard and Large Cuff in Obese Participants

In 1998, Guagnano *et al*.[10] did a study on 1791 overweight or obese women, randomly selected and stratified by age (41–60 years). BP was taken with casual measurement in the morning. The entire study group was divided into two subgroups. In the first one, causal BP was measured with a standard-size cuff (RCS), while an appropriate large size cuff was used for the second one (LCS). Patients of the latter subgroup were also divided by type of obesity (android and gynoid), based on their waist-to-hip ratio.

It was found that in the LCS subgroup, the HTN prevalence rate was strikingly lower among overweight and obese women, both in the younger and older age groups, when compared with the corresponding RCS subgroups ($P < 0.001$). The HTN prevalence rate was higher for all android obese subjects (53%), including younger (34%) and older (64%) groups, when compared with gynoid obese patients (29%, 18%, and 42%, respectively). They concluded that even after adjusting for the above-mentioned variables, two significant confounding factors, cuff HTN and the prevalence of android obesity in the obese study population, could be responsible for overestimating the prevalence of HTN. In the present study, both systolic HTN and diastolic HTN were more prevalent with the standard cuff compared to large cuff. Results showed 56 subjects were diagnosed as systolic HTN with standard cuff, i.e., 28% but with large cuff, it was only 24 subjects, i.e., 12% only, so there was difference of 16% between the prevalence of systolic HTN. Similarly with

Table 3: Difference in measurements made with a standard cuff compared with large cuff with respect to BMI in obese cases

Parameters			Standard cuff	Large cuff	Difference mean	Significance of difference
BMI	**Gender**	***n***	**SBP mean**	**SBP mean**		***P* value**
25–29.9	Male	46	130.7±12.6	122.8±12.5	7.9	0.003
	Female	31	125.9±11.4	118.2±11.5	7.7	0.01
30–34.9	Male	40	139.0±11.4	128.7±10.3	10.3	0.00
	Female	57	133.4±9.3	124.0±9.5	9.4	0.00
35–39.9	Male	5	150.0±8.5	141.8±8.7	8.2	0.1
	Female	11	150.3±15.4	136.8±6.8	13.5	0.01
>40	Male	3	146.8±15.5	126±25	20.8	0.2
	Female	1	140.6±0	137.3±0	-	-

SBP: Systolic blood pressure, BMI: Body mass index

standard cuff, 20% diagnosed as diastolic HTN compared to large cuff 7.5%, suggestive of that both systolic HTN and diastolic HTN more prevalent with standard cuff compared to large cuff in obese cases.

It is established that obesity is a risk factor for HTN.

In usual clinical practice, standard cuff size use for assessing HTN for obese individual also, in such a situation many obese individuals will fall in category of HTN as per JNC-7 criteria though their BP recording with appropriate cuff size will classify them in normotensive category.

This entity is known as "cuff HTN."

Which create a false alarm of pseudo HTN resulting in unnecessary therapeutic interventions which may have implications on individual health and economic burden on health-care system.

CONCLUSION

Cuff HTN is present in obese subjects. The systolic and diastolic differences between obese cases with the standard cuff and large cuff were statistically significant, $P < 0.05$ in each variable, reemphasizing that obesity is a risk factor for HTN, both systolic and diastolic.

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