ORIGINAL ARTICLE

PREVALENCE OF RAISED INTER-ARM BP DIFFERENCE IN YOUNG HEALTHY ADULTS –A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Inter-arm difference (IAD) in blood pressure (BP) has been observed in various general populations and in individuals with increased risk of cardio vascular disease and peripheral vascular disease. The prevalence of raised IAD in BP in young healthy adults has not been well addressed in most prior studies.

Objectives: To estimate the prevalence of raised IAD in BP in young healthy adults, to find the gender difference in mean IAD and mean arterial BP, to find the difference in mean arterial BP according to the presence of IAD in BP.

Methods: A cross sectional study was carried out among 284 medical students. BP was measured twice in each arm, using an automatic device that was calibrated according to the manufacturer's recommendations and the values were averaged. IAD in BP is defined as difference between average BP in right arm and average BP in left arm.

Results: Prevalence of raised IAD in BP in the study group was 16.5% (47). None had IAD in BP ≥ 20 mm of Hg. Mean systolic IAD in BP was 5.915(±3.81) mm of Hg and mean diastolic IAD in BP was 3.18 (±2.44) mm of Hg. The mean values of systolic and diastolic IAD in BP were almost similar in males and females , but the mean values of mean arterial BP in both arms were significantly different ($P<0.05$) in males and females. Mean values of Mean arterial BP in both arms were higher in those with raised IAD in BP and this was statistically significant ($P<0.05$).

Interpretation & conclusion: Significant IAD in blood pressure (≥ 10 mm of Hg) is common in young healthy adults. The clinical significance of raised IAD in BP in young healthy adults requires long term follow up.

Key words: Inter-arm difference in blood pressure, mean arterial blood pressure, cardio vascular disease, peripheral vascular disease**.**

INTRODUCTION

Inter–arm BP difference (IAD) has received increasing attention recently since it has been found to be associated with peripheral vascular disease[1] and is identified as a risk factor for cardiovascular morbidity[2]. A difference in BP readings between arms can be observed in various general populations, healthy women during antenatal period and in population with an increased risk of cardiovascular disease (CVD), such as people with hypertension, diabetes mellitus, chronic renal disease or peripheral vascular disease. The prevalence of IAD in young healthy adults is not well addressed in most of the studies although the prevalence in older adults and hypertensives are well documented. WHO has predicted that by 2030 almost 23.6 million people will die from CVD, mainly from heart disease and stroke[3]. Over 80 % of CVD deaths occur in low and middle income countries. Most of the risk factors for cardiovascular diseases are high in young adults[4] which supports the fact that nearly half of the deaths due to CVD are occurring in young and middle aged individuals .

A recent study[5] found that participants with higher inter-arm Systolic BP (SBP) difference were at much higher risk for future CVD than those with less than 10 mm difference between arms. The prevalence of raised IAD in BP in young adults is not well addressed since only few studies[6,7] were performed in this population. The prevalence of systolic IAD ≥ 10mm of Hg was 12.6% in a study done on young healthy adults.[7]

IAD differences ≥ 20 mm of Hg systolic and/ or 10 mm of Hg diastolic warrant specialist referral.

Hence prevalence of raised IAD in BP in young adults should be identified. If IAD in BP is high, it should be investigated.

Aims & Objectives: The primary objective was to estimate the prevalence of raised IAD in BP in young healthy adults. Second objective was to find the gender difference in mean IAD in BP as well as gender difference in right and left mean arterial BP .Third objective is to find the difference in mean arterial BP according to the presence of inter-arm difference in BP.

MATERIALS AND METHODS

A medical institution based cross- sectional study was conducted among MBBS students in a tertiary care centre in central Kerala during the period July 2015 to November 2015, after approval by the institutional ethics committee. The study population consisting of 300 MBBS students enrolled for the course during the academic years 2013, 2014 and 2015. Sample size was estimated using the formula $n= 4 \times p \times q / d^2$. n=sample size, P = the prevalence, q = 100 – p, d=the relative precision .

The calculated sample size was 265 , but annual intake of students of this institution is 100 and it was decided to cover three batches of medical students(300 students).

Exclusion criteria: The exlcusion criteria for the study were students less than eighteen years of age, with any major illness, on any regular drugs and found to have hypertension on clinical examination were excluded. On clinical examination, 9 students were found to have hypertension and were hence excluded.7 students did not participate in the study.

Total 284 students participated in the study and response rate was 94%. Height and weight were measured using standard equipments. BP measurement was done in a quiet room with subject in sitting position following at least five minutes of rest. The subject was refrained from taking food or drinks half hour before BP measurement. The apparatus was kept at the level of heart and hands were supported during BP measurement. BP was measured twice in each arm .BP was measured first in the arm first presented without prompting , using an automatic device (OMRON –Model-HEM-7130) that was calibrated according to the manufacturer's recommendations and the values were averaged. Cuff was then swapped to the other arm and two readings were taken with five minutes interval. Inter-arm BP difference is defined as difference between average BP in right arm and average BP in left arm.

Operational Definitions used

Raised systolic inter-arm BP difference - ≥ 10 mm of Hg difference between average systolic BP in right arm and average systolic BP in left arm

Raised diastolic inter-arm BP difference- ≥ 10 mm of Hg difference between average diastolic BP in right arm and average diastolic BP in left arm

Statistical Methods: The data was coded and entered in Microsoft excel and analysed using SPSS version 16.0. Prevalence of raised inter- arm BP difference would be expressed as percentage. Continuous variables were summarised as arithmetic mean and standard deviation. Difference in mean IAD and mean arterial BP in males and females were tested using student t test. For all statistical analysis the significance level was set at $p < 0.05$.

RESULTS

Systolic inter-arm difference in BP ≥ 10 mm of Hg was present in 15.4%(44) subjects. Diastolic inter-arm difference ≥ 10 mm of Hg was present in 1.7% (5) subjects.(Table 1)

Prevalence of raised inter-arm difference in BP in the study group was 16.5%(47). None had inter-arm BP difference ≥ 20 mm of Hg.

Descriptives of anthropometric parameters and BP are described in table 2.

Table 1: Prevalence of Raised Inter-arm BP difference

Gender	Inter-arm Difference		Total
	Present (%)	Absent (%)	
Male	15 (17.6)	70 (82.4)	85
Female	32 (16.1)	167 (83.9)	199
Total	47 (16.5)	237 (83.5)	284

Table 2: Descriptives of anthropometric parameters and BP of study subjects

Clinical/Anthropometric Measures	Mean (±SD) (n=284)
Height	162.97 (±10.386)
Weight	54.43 (±11.752)
BMI	20.249 (±3.094)
LSBA	105.4 (±10.774)
RSBA	109.121 (±11.85)
LDBA	67.54 (±6.49)
RDBA	69.02 (±6.88)
SIAD	5.915 (±3.81)
DIAD	3.18 (±2.44)

BMI-Body Mass Index; LBSA-Left arm Systolic BP Average; RSBA-Right arm Systolic BP Average; LDBA-Left arm Diastolic BP Average; RDBA-Right arm Diastolic BP Average; SIAD-Systolic Inter-arm Difference in BP; DIAD-Diastolic Inter-arm Difference in BP.

All variables were normally distributed.

Mean systolic inter-arm difference in BP was 5.915(±3.81) mm of Hg and mean diastolic inter-arm difference in BP is 3.18 (±2.44) mm of Hg.

Mean BP recorded from 284 subjects were 109.12 (±11.85) / 69.09 (±6.88) mm of Hg in Right arm and 105.04 (±10.77) / 67.5 (±6.4) mm of Hg in left arm.

The mean values of systolic and diastolic inter-arm BP differences were comparable in males and females and the slight difference observed was not statistically significant. But the mean values of mean arterial BP in both arms were higher in males than females and this difference was statistically significant (P=0.001 in both arms).) Similarly when subjects were grouped based on presence and absence of IAD, those with presence of IAD had higher mean values of mean arterial BP in both arms .This was also statistically significant.(Left arm-P=0.02 ,Right arm –P=0.01) (Table 3).

Table 3: Comparison of means of IAD and mean arterial BP according to gender and presence of raised IAD

Parameter	Factors	Mean±SD	p-Value
SIAD	Males	5.62(±4.39)	0.40
	Females	6.04(±3.53)	
DIAD	Males	3.27(± 2.15)	0.67
	Females	3.14(±2.56)	
LAM	Males	83.76(±5.99)	0.001
	Females	78.19(±7.36)	
RAM	Males	86.12(±7.02)	0.001
	Females	80.50(± 8.96)	
LAM	Raised IAD present (n=47)	82.01(±7.26)	0.02
	Raised IAD absent (n=237)	79.43(±7.39)	
RAM	Raised IAD present (n=47)	88.2(±8.2)	0.01
	Raised IAD absent (n=237)	80.98(±8.4)	

IAD-Inter- Arm Difference in BP; DIAD-Diastolic Inter-Arm Difference in BP; SIAD-Systolic Inter-Arm Difference In BP.LAM-Left Arm Mean arterial BP, RAM-Right Arm Mean arterial BP.

DISCUSSION

The present study done in young healthy adults showed the prevalence of raised IAD in BP as 16.5%. In a similar study done in young healthy adults[7] , the prevalence was 12.5%.Both studies used sequential method for BP estimation which may have resulted in higher prevalence rates. Mean systolic inter-arm difference in BP is 5.915(±3.81) mm of Hg and mean diastolic inter-arm difference in BP is 3.18 (±2.44) mm of Hg in this study. This result was almost similar to values obtained in other studies.[8,9] Many previous studies [10,11] have shown that mean IAD was unrelated to gender . Similarly, in the present study mean values of systolic and diastolic IAD does not vary much in males and females.

In our study BP in right arm tended to be higher than BP in left arm which was similar to the observation in a study by Adam J Singer[11].This may be due to the right handedness of majority of subjects. The larger muscle mass in right arm is less easily compressed by blood pressure cuff. This might not have occurred if direct intra arterial blood pressure monitoring was performed. In a study by Kimura etal [12] done in Japan, there is considerable difference in measured BP in left and right arm and systolic BP in right arm was slightly lower than the left arm .Large difference in absolute systolic BP was associated with risk factors of atherosclerosis like hypertension, hypercholesterolemia and obesity in the above study. According to a study by Rajiv Agarwal[13] , every 10mm difference in systolic BP between arms conferred mortality hazard of 1.24(95% CI:1.01 -1.52) after adjusting for average BP. Also his observation was that BP difference between arms are reproducible and carry prognostic information. In our study systolic IAD was present in 15.4%(44) of subjects which may also have prognostic significance . They have to be followed up as coronary artery disease development later is observed[5] in a community based cohort and documented in those with raised IAD in BP. Also greater than 10 mm Hg of IAD in BP was independently associated with future cardiovascular risks in a recent study.[14]

The mean values of mean arterial BP were significantly different in males and females in the present study. The mean values were higher in males than females. Mean values of mean arterial BP in both arms were high in those with raised IAD in BP . Mean arterial pressure is a major independent predictor of cerebrovascular events [15] .Raised IAD along with high values of mean arterial pressure in these subjects warrants their follow up for future cardio vascular events development.

LIMITATIONS

The study used sequential method for estimation of raised IAD in BP which might have resulted in higher prevalence rate .Influence of mid arm circumference on IAD in BP was not considered in the study.

CONCLUSION

Bilateral upper extremity blood pressure determined by automated indirect measurements has wide degree of inter-arm variation. So in a primary care setting blood pressure should be measured routinely in both arms to prevent under estimation of hypertension. Individuals with raised inter-arm difference in BP require long term follow up.

REFERENCES

1. Clark C E, Campbell J L, Powell R J, Thompson J F. The inter-arm BP difference and peripheral vascular disease:Cross sectional study-Fam Pract 2007;24:420-426.
2. Clark C E ,Taylor R S, Shore A C,etal. Association of a difference in systolic blood pressure between arms with vascular disease and mortality;a systematic review and meta analysis.Lancet 2012;379;905-914.
3. Global Atlas on Cardiovascular Disease Prevention and Control. Whorld Health Organisation Geneva 2011.Available at http://www.world-heart federation .org/fileadmin/user.../ Global _CVD-Atlas.PDF.Accessed on 15 th January 2015.
4. Simmy Kurian, Manjula V.D, Annamma , Jaimol Zakariah.A study on cardiovascular risk factor profile of medical students in a tertiary care hospital in central Kerala.National Journal of Medical Research 2015 Jan-March;5(1):11-17.
5. Ido Weinberg, Philimon Gons, Christophem J .O Donnel etal.The systolic Blood Pressure Difference Between Arms and cardiovascular disease in Framingham Heart Study. The American Journal of Medicine. 2014;127(3).
6. Martin D.Fotherby, Barnabas Panayiotou and John F Potter.Age related difference in simultaneous inter-arm BP measurements. Postgrad Med J 1993;69:194-196.
7. Alon Grossman, Alex Prokupetz , Barak Gordon, Nira MoragKoren, Ehud Grossman. Interarm BP difference in young healthy adults. The Journal of clinical Hypertension Aug 2013;.vol(15)/No 8.
8. Arnett D K, Tang W, Province M A,etal .Interarm difference in seated systolic and diastolic BP;The Hypertension Genetic Epidemiology Network study.J Hypertension 2005;23:1141-1147.
9. Verberk W J,Kessel A G,Thien T. BP measurement method and inter arm difference: A metaanalysis . Am J Hypertension 2011; 24(11) :1201-1208.
10. Lane D, Beevers M, Barnes N, Bourne J etal .Inter-arm difference in blood pressure:When are they clinically significant?.J Hypertens.2002 Jun;20(6):1089-95.
11. Adam.J.Singer, Judd . E. Hollander. Blood Pressure Assessment of Inter arm difference. Arch Intern Med. 1996;156(17) : 2005-2008.
12. Kimura A, Hashimoto J , Watabe D, Takahashi H, et al . Patient characteristics and factors associated with interarm difference of BP measurement in a general population in Ohasama , Japan.J Hypertens. 2004 Dec;22(12):2277-83.
13. Rajiv Agarwal, Zerihuu Bunaye, Dagis M . Bekele.Prognostic significance of between arm BP difference.Hypertension 2008;51:657-662.
14. Takanori Tokitsu , Eiichiro Yamamoto, Yoshihiro Hirata, Koichi Sugamura et al.Relationship between future cardiovascular events in coronary artery disease.J Hpertens 2015,33:1780-1790.
15. Verdecchia P. Schillaci G,Reboidi G, Franklin SS.Different prognostic impact of 24 hour mean BP and pulse pressure on stroke and coronary artery disease in essential hypertension.Circulation.2001;103:2579-2584