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ORIGINAL ARTICLE

Variation of blood pressure during change of posture

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Abstract

Background: *Many factors can influence blood pressure, one of which is body position. The aim of present study was to establish a specific pattern of blood pressure (BP) changes in accordance with posture changes in healthy adults.*

Objective: *Aim of present study was to establish a specific pattern of blood pressure (BP) changes in accordance with posture changes in healthy adult male and females.*

Methods: *Blood pressure was recorded by aneroid sphygmomanometer in supine, sitting and standing posture on both arms. Mean ± standard deviation of the observation for all the parameters were calculated and comparison in supine, sitting and standing position was done by repeated measures Analysis was done by ANOVA test and tukey's post hoc test.*

Results: *Fifty healthy males and fifty healthy female took part in this study. BP varies according to body position. Both Systolic blood pressure and diastolic blood pressure was significantly decreased (P<0.05) while changing posture from supine to standing. But blood pressure changes during change of posture from supine to sitting or from sitting to standing was not significant (P>0.05).*

Conclusions: *Change in body posture changes systolic blood pressure as well as diastolic blood pressure.*

Key words: *Hypertension; Blood Pressure; Posture.*

Introduction

Hypertension affects hundreds of millions of people worldwide and currently represents a major public health issue. For the identification and clinical management of hypertensive subjects, the accurate measurement of blood pressure (BP) is an essential step. Current guidelines suggests that BP can be measured in supine or sitting position although it has been repeatedly documented that diastolic (DBP) and, less commonly, systolic (SBP) BP can be higher if measured in supine position.[1] The effect of position is not commonly considered in clinical practice. But even a mean difference of a few millimeters of Hg may have significant impact on treatment decisions. As an example, an individual's BP may have been measured in sitting position at first visit and patient received anti hypertensive drugs. In subsequent visit blood pressure may be measured in supine position and it seems blood pressure remains unchanged despite anti-hypertensive drugs. So the next treatment decision may be inaccurate. For this reason more accurate quantification of the differences in BP according to the body position may be of extreme interest. The objective of the present study was to evaluate the changes of blood pressure in sitting, supine and standing position in normotensive patients and in hypertensive patients without medications.

Materials and methods

This is a cross sectional study of 100 patients in private chamber from March to June in 2018. Blood pressure was measured in supine, sitting and standing positions using standard method and same aneroid sphygmomanometer.

Inclusion criteria were :

1) Aged >18 years 2) Voluntarily give consent to participate in study

Exclusion criteria were:

1) Patient on antihypertensive treatment 2) Patient on drugs causing postural hypotension 3) Diabetic patients (chances of autonomic neuropathy) 4) Acutely ill patient

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This study was conducted in a private chamber after the informed consent from the volunteers of the study. Hundred healthy adults with age > 18 years had taken part in this study. A brief history and general physical examination of all the volunteers were carried out and recorded in pre structured Proforma. Subjects having a history of acute illness, on antihypertensive treatment taking drugs causing postural hypotension and diabetic patients (chances of autonomic neuropathy) were excluded from the study. The study was carried out between 4 pm-9 pm. The procedure was explained and informed consent was obtained after the subjects had read a description of the experimental protocol. Height & weight of the subject was measured with measuring inch tape & weight machine respectively. The subject was asked to sit down comfortably and then baseline blood pressure was recorded by aneroid sphygmomanometer on both arms. For measurement of blood pressure the following standard steps were performed:

1) A well maintained, validated and calibrated machine was used 2) Removal of tight clothing was done 3) Blood pressure lowered slowly (2 mm/second) 4) Blood pressure was read to the nearest 2 mm Hg 5) Blood pressure was measured in both hands and highest one was recorded.

Now the subject was asked to lie down (change his posture from sitting to supine). When the subject comes in lying posture blood pressure was measured after 2 minutes. Now after measuring the blood pressure in lying posture, subject was asked to stand up and blood pressure was measured after 2 minutes of standing.

Data are presented as mean ± standard deviation with their reference units. Mean and standard deviation of the observation for all the parameters were calculated and comparison in supine, sitting and standing position was done by repeated measures ANOVA test. After this multiple comparison in between supine to sitting posture, supine to standing posture and sitting to standing posture was done by tukey's post hoc test. Statistical analysis was done by MS Excel and SPSS version 21. P-value <0.05 is taken as significant and P-value <0.001 is taken as highly significant.

Result

The study was conducted in a private chamber (Islami Bank Hospital, Khulna) from March 2018 to June 2018. Fifty healthy adult males with mean B.M.I. 25.07 ± 2.37 and fifty healthy adult females with mean BMI 27.31 ± 4.48 took part in this study. [Table 1]

Table I
BMI of male and female patients

Sex	Total patients	BMI ± SD
Male	50	25.07 ± 2.37
Female	50	27.31 ± 4.48

The mean systolic blood pressure in supine, sitting and standing postures in males is 127 ± 21.02, 122.7 ± 19.56 and 117.12 ± 24.98 mm Hg respectively [Table II]. The mean diastolic blood pressure in supine, sitting and standing postures in males is 80.2 ± 14.10 ; 76.6±12.75 and 72 ± 11.518 mm Hg respectively. [Table II]

Table II
Mean systolic and diastolic Blood Pressure (Male)

BP (mm Hg)	Mean BP	SD
Systolic		
Supine	127	21.02
Sitting	122.7	19.56
Standing	117.12	24.98
Diastolic		
Supine	80.2	14.10
Sitting	76.6	12.75
Standing	72	11.51

SD- Standard deviation

The mean systolic blood pressure in supine, sitting and standing postures in females is 136.4 ± 25.63, 128.58 ± 24.55 and 121.1 ± 24.48 mm Hg respectively [Table 1II].

Table III
Mean systolic and diastolic blood pressure (Female)

BP (mm Hg)	Mean BP	SD
Systolic		
Supine	136.4	25.63
Sitting	128.58	24.55
Standing	121.1	24.48
Diastolic		
Supine	85.7	16.81
Sitting	80.8	15.26
Standing	76.4	15.90

The mean diastolic blood pressure in supine, sitting and standing postures in females is 85.7 ± 16.81; 80.80±15.25 and 76.4±15.90 mm Hg respectively. [Table III]

The mean difference in systolic blood pressure for males between supine and sitting positions is 4.3 (Insignificant P>0.05). The mean difference in systolic blood pressure for males between supine and standing positions is 9.88 (significant P< 0.05). The mean difference in systolic blood pressure for males between sitting and standing positions is 5.58 (Insignificant P> 0.05). [Table IV].

Table IV
Changes of blood pressure in different posture (Male)

Differences Positions (mm Hg)	Mean	P Value	Inference
Systolic			
Supine vs sitting	4.3	>0.05	Insignifi
Sitting vs standing	5.58	>0.05	Insignifi
Supine vs standing	9.88	<0.05	Significant
Diastolic			
Supine vs sitting	3.6	>0.05	Insignifi
Sitting vs standing	4.6	>0.05	Insignifi
Supine vs standing	8.2	<0.05	Significant

The mean difference in diastolic blood pressure for males between supine and sitting positions is 3.6. (Insignificant P> 0.05). The mean difference in diastolic blood pressure for males between supine and standing positions is 8.2 (significant P<0.05). The mean difference in diastolic blood pressure for males between sitting and standing positions is 4.6 (Insignificant P> 0.05) [Table IV].

The mean difference in systolic blood pressure for females between supine and sitting positions is 7.82 (Insignificant, P> 0.05). The mean difference in systolic blood pressure for females between supine and standing positions is 15.3 (Significant, P< 0.05). The mean difference in systolic blood pressure for females between sitting and standing positions is 7.481 (Insignificant, P > 0.05). [Table V].

The mean difference in diastolic blood pressure for females between supine and sitting positions is 4.9 (Insignificant, P> 0.05). The mean difference in diastolic blood pressure for females between supine and standing positions is 9.3 (Significant P<0.05). The mean difference in diastolic blood pressure for females between sitting and standing positions is 4.4 (Insignificant, P > 0. 05). [Table. V).

Table V
Changes of blood pressure in different posture (Female)

Differences Positions (mm Hg)	Mean	P Value	Inference
Systolic			
Supine vs sitting	7.82	>0.05	Insigni
Sitting vs standing	7.48	>0.05	Insignifi
Supine vs standing	15.3	<0.05	Significant
Diastolic			
Supine vs sitting	4.9	>0.05	Insignifi
Sitting vs standing	4.4	>0.05	Insignifi
Supine vs standing	9.3	<0.05	Significant

Discussion

When body position is changed from a supine or sitting position to standing, due to gravitational effect there is pooling of blood in lower extremities, as a result venous return to heart decreases which implies decrease in stroke volume with a fall in systolic blood pressure. To maintain normal blood pressure body have two types of regulatory mechanism. Short Term regulatory machanism and Long term regulatory mechanism. The Short term regulatory mechanism is also called baro reflex. Moreover the effect of gravity on blood pressure is influenced by the density of the blood, the acceleration of gravity, and the vertical length between the heart and the measured site. In normal blood density there are pressure variations per vertical length between heart and the measured site, which are 0.77mm Hg/cm. For example, if the average pressure at the heart level is 100 mm Hg the pressure of the cerebral artery which is 50 cm higher than heart should be 62 mmHg (=l00- [0.77x5O]) and the pressure at the foot, 105 cm lower than heart should be 180 mm Hg (=100+[0.77x 105]).

Several studies compared BP values when measured in sitting or supine or standing positions, reporting variations, which ranged from 0 to a maximum of 10 mm Hg.[2,3] In most studies, the average BP was higher when measured in supine than sitting or standing position.[4] Our sample of hypertensive subjects showed the same trends for SBP and DBP, although the differences in SBP and DBP across positions were different.[4]

In our study we compared the change in systolic blood pressure and diastolic blood pressure in supine, sitting and standing postures among both males and females.

In male group, systolic blood pressure was decreased while changing posture from supine to standing which was statistically significant. Similarly comparing between supine and sitting posture in male group there was decreased in systolic blood pressure but this fall in SBP was not statistically significant. While comparing sitting to standing posture in male group there was fall in systolic blood pressure which was not statistically significant again.

In male group, diastolic blood pressure was also decreased while changing posture from supine to standing which was statistically significant. Similarly comparing between supine and sitting posture in male group there was decreased in diastolic blood pressure but this fall in DBP was not statistically significant. While comparing sitting to standing posture in male group there was fall in diastolic blood pressure which was not statistically significant again.

In female group, systolic blood pressure was decreased while changing posture from supine to standing which was statistically significant. Similarly comparing between supine and sitting posture in female group there was decreased in systolic blood pressure but this fall in SBP was not statistically significant. While comparing sitting to standing posture in female group there was fall in systolic blood pressure which was not statistically significant again.

In female group, diastolic blood pressure was also decreased while changing posture from supine to standing which was statistically significant. Similarly comparing between supine and sitting posture in female group there was decreased in diastolic blood pressure but this fall in DBP was not statistically significant. While comparing sitting to standing posture in female group there was fall in diastolic blood pressure which was not statistically significant again.

Our result was similar with study by Ismet Eser, Varshitha, R.T. Netea and Ranjan.[2,5,6,7] In their study blood pressure fall when posture was changed from supine to standing. In the study by Olufsen, Murata blood pressure was significantly decreased when posture was changed from sitting to standing.[8,9] In our study the blood pressure also decreased when posture was changed from sitting to standing position, but the changes were not statistically significant.

The results of Remy C showed that when posture was changed from supine to standing in normal young subjects there was a drop in systolic and diastolic blood pressures and an increased heart rate which is in concordance with our result.[10]

The limitation of this study was- All the participants were patient of different diseases; none was normal population. The number of participants should be more and paediatric patients were not included in this study.

Conclusion

This study confirms that BP significantly varies according to body position. Despite a minor degree of BP variation in most of the people, a small proportion of subjects showed large differences in BP from one position to another, suggesting that more emphasis should be posed on body position by clinicians before starting or changing anti hypertensive treatment.

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