ORIGINAL RESEARCH PAPER

physiology

Volume - 7 | Issue - 3 | March - 2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

Comparison of Blood Pressure in different postures in young healthy males

KEYWORDS

Blood pressure, Systolic blood pressure, Diastolic blood pressure

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ABSTRACT

Aim: The aim of present study was to establish a specific pattern of blood pressure (BP) changes in accordance with posture changes in healthy adult males.

Background: It is known that many factors influence an individual's 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 adult males.

Methods: Fifty healthy young males with age 18-25 years and BMI 18-25 kg/m2 taken part in this study. Blood pressure was recorded by mercury sphygmomanometer in supine, sitting and standing posture on right arm within the 45 seconds. 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 ANOVA test and tukey's post hoc test.

Results: Systolic blood pressure (mmHg) was significantly increased ($p<0.001$) while changing posture from supine to sitting. Diastolic blood pressure (mmHg) was significantly ($p<0.001$) increased while changing posture from supine to sitting and supine to standing posture.

Conclusions: This study concludes that, change in body posture changes systolic blood pressure, diastolic blood pressure. The parasympathetic activity decreases and sympathetic activity increases with posture change from supine to sitting to standing.

INTRODUCTION

Blood Pressure means the force exerted by the blood against any unit area of the vessel wall.

There are various components of systemic arterial blood pressure like Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Pulse Pressure (PP), Mean Blood Pressure (MBP). Blood pressure is expressed as SBP/DBP. The normal average value of Blood Pressure in young healthy adult is 120/80 mm Hg.[(1)]

Various factors affect the arterial blood pressure like age, sex, body built, climate, diurnal variation, exercise, emotion, gravity, hereditary, meals, sleep and posture etc.[(1)]

Blood pressure (BP) is an important indicator in diagnosis and in assessing treatment of various diseases related to the cardiovascular system. Numerous factors influence an individual's blood pressure measurement, one of which is body position.[(2)]

Sudden postural change may lead to hypotension, syncope and even falls are symptoms of orthostatic hypotension. Orthostatic hypotension is defined as a decline of 20 mm Hg or more in systolic blood pressure (SBP) and of 10 mm Hg or more in diastolic blood pressure (DBP) on the assumption of an upright posture.[(3,4,5)]

The variations in blood pressure (BP) in accordance to posture vary from person to person. Both excessive postural blood pressure (BP) elevation and decline have been associated with an increased prevalence of silent cerebral infarctions in older hypertensive's. Orthostatic hypotension (OH) is associated with increased risk of ischemic stroke, but whether orthostatic blood pressure (BP) elevation increases the risk of incident ischemic stroke has yet to be determined.[(3,5)]

Stress increases heart rate, systolic and diastolic blood pressure and respiration rate, via the induction of the autonomic nervous system.[(18)] Psychological and physical stress is responsible for increase blood pressure which may be a risk factor for hypertension.[(19)]

Posture changes may affect blood pressure (BP) via the autonomic nervous system (ANS). Therefore, to establish a specific pattern of blood pressure (BP) changes in accordance with posture changes, this study was conducted in healthy adult males and females in department of physiology S.M.S. medical college, Jaipur, which could be useful for early diagnosis and assessing autonomic functions and dysfunctions.

METHODS

This study was conducted in the Upgraded Department of Physiology, SMS Medical College, Jaipur after obtaining approval from the ethical committee of our institute and the written informed consent from the volunteers of the study. Fifty healthy young adult males with age 18-25years and BMI 18-25 kg/m^2 taken part in this study. A brief history and general physical examination of all the volunteers were carried out and recorded in pre-structured Performa. Subjects having a history of acute or chronic illness, history of major surgery (Cardiac, pulmonary, abdominal) were excluded from the study. The study was carried out between 9.30 am – 12.00 pm after consuming a light standard breakfast 2 hrs before arrival. Subjects were instructed a day before to avoid all drinks containing caffeine and other stimulant 12 hrs before the study and strenuous exercise 24 hrs before the study. The procedure was explained and informed consent was obtained after the subjects had read a description of the experimental protocol, which was approved by the ethical committee of the college. The height, weight of the subject was measured with measuring inch tape, weighing machine respectively. The subject was asked to lie down in supine posture comfortably for 15 minutes and then baseline blood pressure was recorded by mercury sphygmomanometer in supine posture on right arm. Now the subject was asked to change his posture from supine to sitting, as the subject comes in sitting posture immediate blood pressure was measured within the 45 seconds after attaining the sitting posture. Now after measuring the blood pressure in sitting posture, subject was asked to stand up and blood pressure was measured within 45 second in standing posture.

Statistical analysis

Data are presented as mean ± standard deviation with their reference units. 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 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. The statistical analysis was done by MS-Excel and primer of Biostatistics (version 6.0) P-value<0.05 is taken as significant and P-value<0.001 is taken as highly significant.

Volume - 7 | Issue - 3 | March - 2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

RESULTS

The study was conducted in the electro-physiology lab in the Upgraded Department of Physiology of S.M.S Medical College, Jaipur from Oct. 2015 to March 2016. Fifty healthy young adult males with mean age 19.5 ± 1.29, mean B.M.I. 21.76 ± 3.06 were taken part in this study.

The mean systolic blood pressure in supine, sitting and standing postures in males is 115.8±7.63, 121.8±10.53 and 119±8.48 respectively. The result shows that the mean systolic blood pressure for males in three postures is significantly different ($p < 0.05$).**[Table 2]**

The mean diastolic blood pressure in supine, sitting and standing postures in males is 74.62±7.63, 81.04±9.55 and 79.04±8.2 respectively. The result shows that the mean diastolic blood pressure for males in three postures is significantly different ($p < 0.05$).**[Table 2]**

The mean difference in systolic blood pressure for males between supine and sitting positions is 6. [is significantly different ($p < 0.05$)] The mean difference in systolic blood pressure for males between supine and standing positions is 3.2 [is not significantly different ($p > 0.05$)] The mean difference in systolic blood pressure for males between sitting and standing positions is 2.8 [is not significantly different ($p > 0.05$)]. **[Table 3]**

The mean difference in diastolic blood pressure for males between supine and sitting positions is 6.42. [is significantly different ($p < 0.05$)] The mean difference in diatolic blood pressure for males between supine and standing positions is 4.42 [is significantly different ($p < 0.05$)] The mean difference in diastolic blood pressure for males between sitting and standing positions is 2 [is not significantly different ($p > 0.05$)]. **[Table 4]**

Table No.1: Mean values of Anthropometric parameters age, height, weight and B.M.I. in males.

Parameters	Mean ±SD
Age(years)	19.5±1.29
Weight (Kg.)	65.06±10.08
Height (meter)	1.73±0.064
B.M.I.(Kg/m^2)	21.74±3.06

Table No.2: Comparison of mean values of blood pressure (mm of Hg) in supine, sitting and standing posture in males by Repeated measures ANOVA test.

Parameter	Posture	Mean±SD	SEM	DF	P-value	Significance
Systolic blood pressure (mm of Hg)	Supine	115.8±7.63	1.08	2,147	0.004	S
	Sitting	121.8±10.53	1.48			
	Standing	119±8.48	1.19			
Diastolic blood pressure (mm of Hg)	Supine	74.62±7.63	1.08	2,147	<0.001	HS
	Sitting	81.04±9.55	1.35			
	Standing	79.04±8.2	1.16			

Table No. 3;Multiple comparison of mean values of Systolic blood pressure in between supine to sitting, supine to standing and sitting to standing postures in males by tukey's post hoc test.

Parameter	Posture	Posture	Mean difference	SEM	P<0.05
Systolic blood pressure (mm of Hg)	Supine	Sitting	6	1.26	S
	Supine	Standing	3.2	1.26	NS
	Sitting	Standing	2.8	1.26	NS

Table No.4: Multiple comparison of mean values of Diastolic blood pressure (mm of Hg) in between supine to sitting, supine to standing and sitting to standing postures in males by tukey's post hoc test.

Parameter	Posture		Mean difference	SEM	P<0.05
Diastolic blood pressure (mm of Hg)	Supine	Sitting	6.42	1.202	S
	Supine	Standing	4.42	1.202	S
	Sitting	Standing	2	1.202	NS

(NS) Non significant, (S) Significant P-value<0.05, (HS) Highly significant P-value<0.001

DISCUSSION

The present study was conducted to determine the effect of posture changes like supine to sitting and sitting to standing on blood pressure in young healthy adult males. 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 increased while changing posture from supine to sitting which was statistically significant. **[Table-3]** Similarly comparing between supine and standing posture in male group there was rise in systolic blood pressure but this rise in SBP was not statistically significant. **[Table-3]** While comparing sitting to standing posture in male group there was fall in systolic blood pressure which was not statistically significant again.**[Table-3]**

In male group, diastolic blood pressure was increased while changing posture from supine to sitting which was statistically significant. **[Table-4]** Similarly comparing between supine and standing posture in male group there was rise in diastolic blood pressure which was again statistically significant. **[Table-4]** While comparing sitting to standing posture in male group there was fall in diastolic blood pressure which was not statistically significant. **[Table-4]**

Our findings are in accordance with the studies of Srikanth S et al (2013)[6] and Victor Marchione (2016)[9] who studied change in blood pressure when posture was change from lying down to sitting, the result showed that the systolic blood pressure was high in sitting posture than supine. When we are in supine position, our head is about the same level as our heart, so our heart takes less work to pump blood to our brain. However, when we are in sitting position, our head is higher than our heart, which implies that the heart has to pump much harder to get blood to our brain, so as a result, blood pressure is higher in sitting posture than in the lying posture.

The results of Rémy C.et al (2004)[5] and Kanho Hakhoe Chi (1989)[10] showed that when posture was change from supine to standing in normal young subjects there was a drop in systolic and diastolic blood pressures and an increased heart rate during the first 10 seconds followed by a rise of BP after 20 seconds which is in concordance with our result.

David sparrow et al (1984)[11] study showed that the upright position causes a transient drop in systemic blood pressure and diastolic blood pressure remains the same or is elevated slightly in the standing position relative to the supine position. This result was not according to our result which could be due to difference in sample population, their age group and some other confounding factors.

Ismet Eser et al(2007)[12] Studied the effect of posture change supine, sitting, standing and supine with crossed leg on blood pressure. There was a difference between systolic blood pressures in supine, sitting, standing and supine with crossed leg, this was statistically significant ($P<0.001$) which is similar to our result but the difference between diastolic blood pressure was not statistically significant ($P > 0.05$) which could be due to higher age group population in their study.

Nan fang li (2012)[13] DBP was lower in supine position than standing and sitting positions ($P<0.05$) which supports our study.

Our result was controversy with study by Ismet Eser et al (2007)[12], C. Borst (1984)[20], R.T. Netea et al (2004)[21] which could be due to some

Volume - 7 | Issue - 3 | March - 2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

confounding factors. In their study blood pressure fall when posture was change from supine to standing.

Our result was similar with study by Wenying Mu et al (2012)[4], Mette S. Olufsen et al (2005)[14], Jun Murata et al (2012)[15] their finding blood pressure was significantly drop when posture was change from sitting to standing.

The heart rate, peripheral arterial resistance of vessels and cardiac ejection volume determines the blood pressure. The central autonomic nervous system regulates and adjusts these three parameters according to situation.[(16)]

When body position is changed from a supine or sitting position to standing, due to gravitational effect there was 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.[15] To maintain normal blood pressure body have two type of regulatory mechanisms, Short Term regulatory mechanism and Long-term regulatory mechanism.[(15)] The Short term regulatory mechanism is also called baro-reflex, is much fastest then Long-term regulatory mechanism to maintain blood pressure.[(16)]

The arterial baroreflex seeks to regulate the absolute blood pressure and ultimately maintain circulation to the brain and other organs. Baroreceptors which lies in the walls of the carotid arteries and aorta senses systemic blood pressure indirectly by the extent of stretch of receptors. With change in blood pressure there occurs change in arterial baroreceptor afferent discharge which got transmitted to the central nervous system which trigger reflex adjustments that buffer or oppose the changes in blood pressure: increase in pressure elicits reflex parasympathetic activation and sympathetic inhibition, with subsequent decreases in heart rate (HR), cardiac contractility, vascular resistance, and venous return. Vice-versa, a fall in arterial pressure reduces baroreceptor afferent discharge and triggers response increases in heart rate, cardiac contractility, vascular resistance, and increased venous return to heart. Thus the baroreflex, by affecting blood pressure and HR control, provides powerful beat-to-beat negative feedback regulation of arterial blood pressure that minimizes short-term fluctuations in pressure. Besides the arterial baroreflex mechanism, endogenous nitric oxide constitutes a second system, which act through a feedback mechanism, and is involved in the short-term regulation of blood pressure, stimulated by the shear stress induced by increases in arterial pressure which results in action of potent vasodilator response rapidly in counteracting the initial rise in blood pressure.[(7)]

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 0.77mmHg/cm. For example, if the average pressure at the heart level is 100 mmHg the pressure of the cerebral artery which is 50 cm higher than heart should be 62 mmHg (=100-[0.77×50]) and the pressure at the foot 105cm lower than heart should be 180 mmHg(=100+[0.77×105]). Frohlich (1988) calculated that there is 0.8mmHg difference per 1cm between the heart and the measured site.[(8,17)]

CONCLUSION

This study has revealed that change in body posture changes systolic blood pressure, diastolic blood pressure. When posture change from supine to sitting to standing, there is decrease parasympathetic activity and increase sympathetic activity. The regular assessment of autonomic functions can be used as an important indicator because of its easy performance, non-invasive, cost effective method for early detection and subsequent management of cardiovascular morbidity and mortality in healthy young adults.

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