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Effect of Head down Tilt on Cardiovascular Autonomic responses in males and females

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Abstract

Aim: The present study was done to evaluate the effect of Head Down Tilt (HDT) on Blood Pressure (BP) in males and females. The parameters which represent the cardiovascular autonomic function involved the Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) and Pulse Pressure (PP).

Materials and Methods: 100 healthy males and females were selected. There was a limit in the age group from 18-45 years. The effect of HDT on cardiovascular autonomic responses was conducted in them. Parameters like HR and BP were recorded at supine and 30^0, 60^0, 80^0 HDT. In each position the HR was determined by recording the ECG for 5 min in lead II. Niviquire software was used. BP was measured within 20 seconds of the change in tilt position.

Observation and Results: On HDT the HR, DBP, MAP, decreased. In contrast the SBP increased on HDT. These results were same in both males and females.

Conclusion: This study will help to know the cardiovascular autonomic differences in males and females. By conducting the HDT test it is easy for the medical students and the clinicians to understand and identify the cardiovascular reflex responses in healthy or diseased individuals.

Keywords: Autonomic nervous system, Posture, Tilt Table, Head down tilt, Tilt table testing.

Introduction

Central nervous system plays an important role in maintaining the blood pressure constant. It is mainly done through the baroreflexes. It is a challenge to regulate the blood pressure by change in the posture[1]. Human responses to upright tilt is a window on central autonomic integration. Among the various cardiovascular tests tilt table test is a standardized one for assessing the regulatory mechanisms for the change in the posture. By the head down tilt testing one can identify and understand the efficiency of the regulatory system[2].

The cardiovascular response to 4 hours of 6^0HDT was studied in 1990. Immediately on assuming HDT, the decrease in the HR was slightly less from baseline.There was a significant increase in the stroke volume and cardiac output in the first minute of HDT. These findings showed that on change in the position from HUT to HDT there was a change in the cardiovascular variables. These changes were generally transient with baseline values resumed by many variables within 30 min of exposure to 6^0HDT[3]. Early hormonal effects of HDT (-10 degrees) in humans was studied by Gharib C. He observed a decrease in DBP, plasma renin activity and plasma aldosterone, as compared to the sitting position[4]. The hormonal effects during 10 hrs HDT tilt on HR and BP variability was explained. There was no significant change in the resting R-R interval. There was an increase in the stroke volume and cardiac output in first 1-2 hr of HDT. Total variability in each of R-R interval was reduced during HDT[5]. In physically fit men a study was done to assess the effect of head down bed rest on the neuroendocrine response to orthostatic stress. It was observed that after head down bed rest BP was elevated, while resting HR did not change. The increase in the plasma rennin was also observed[6]. The differences in responses to short term head down position on cardiovascular responses was observed in healthy young and older adults. Absolute differences existed between the two age groups for all variables at rest. There was no age time interaction for any variable in the head down position. The decrease in the HR and mean arterial BP was significant. Meanwhile cardiac cycle time increased on HDT when compared with rest. This study concluded that head down postural drainage may be of concern for chest physiotherapy recipients with reduced cardiac reserve or impaired baroreflex function[7].

Methodology

100 normal healthy males and females between the age group of 15-45 years are selected from general population randomly. The subjects were informed about the procedure which had to be followed by them. Consent was taken. The study was conducted before lunch between 12 noon to 2 pm. After the completion of procedure fruit juice was offered to all subjects.

Inclusion Criteria:

- Normal healthy males aged 15-45 years
- Normal healthy Females aged 15-45 years

Exclusion Criteria:

- Obese
- Alcoholics
- Smokers
- Hypertensives
- Age below 15 and above 45 yrs
- Subjects taking any medication
- Subjects suffering from any medical illness.
- Diabetic individuals

Method of Collection of Data: 100 males and 100 females between the age group of 15 to 45 were selected randomly from general population. A pretested structured proforma was used to collect the relevant information. Subjects were familiarized with a HDT procedure.

Preparation for Tilt Table Test (TTT): Generally, there was no eating or drinking 4-6 hours prior to the test to limit symptoms of nausea/ vomiting. Manually operated tilt table with foot plate support is used. Additional straps are applied at the level of knee, waist and shoulders. The metal arc is attached to the table where holes are made at various angles. The table is locked at particular angles by the iron rod. The angles used were 30^0, 60^0, $80^0$for HDT.

ECG leads were fixed at right arm, left arm, left foot and right foot. ECG recordings were observed over the monitor. When normal lead II ECG was obtained, these recordings were saved for aduration of 5 minutes.

In supine position BP was recorded by using Sphygmomanometer. BP was recorded within 20 sec after the change in posture. Pulse rate is recorded by 5 min ECG. Respiratory rate was recorded for 1 minute. The table is tilted to 30^0, 60^0 and 80^0 HDT position. Before the change in the tilt angle the subject was brought to the supine position for 5 mins rest. The subject was asked for any symptoms such as nausea, sweatiness, pallor, light headedness, palpitation and fainting. Repeated measures ANOVA will be used for analysis at different tilts. Followed by Tukeys post hoc test and paired 't' test. Niviquire software was used for recording heart rate.

Results

The present study entitled "Effect of head down tilt on cardiovascular autonomic responses in males and females", showed a significant changes. On HDT the HR, DBP, MAP, decreased. In contrast the SBP increased on HDT. The mean heart rate (beats/min) in supine position in males was 73.3±4.9. The mean heart rate in females was 70.8±3.3 (Tables 1, 2).

On head down tilt the mean heart rate in males at 30^0, 60^0, and 80^0 was 71.1±5.4, 68.5±5.0 and 66.8±4.8 respectively (Table 1). In females with head down tilt the mean heart rate was 68.8±3.7, 67.9±3.7 and 64.7±3.5 respectively (Table 2). On head down tilt the decrease in heart rate in males and females is statistically significant ($p < 0.001$) (Table 3, 4)

Systolic Blood Pressure: The mean resting systolic blood pressure (mm Hg) was 113.7±6.0 in males and 112.3±5.4 in females (Tables 1, 2). On head down tilt in males, there was a gradual increase in systolic blood pressure. The mean values being 116 .5±6.1, 120.1±5.3 and 123.7±5.3 on 30^0, 60^0 and 80^0 respectively (Table 1). In females on head down tilt the mean values of systolic blood pressure were 111.8±5.3, 116.7±5.8, 120.7±5.4 at 30^0,60^0 and 80^0 respectively (Table 2). On head down tilt the increase in systolic blood pressure in males and females is statistically significant ($p < 0.001$) (Table 3, 4)

Table 1: Head down tilt in Males

Parameters	Supine		30 Deg		60 Deg		80 Deg	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HR (bts/min)	73.3	4.9	71.1	5.4	68.5	5.0	66.8	4.8
SBP (mm of Hg)	113.7	60	116.5	6.1	120.1	5.3	123.7	5.3
DBP (mm of Hg)	78.2	8.3	73.7	8.1	72.9	8.4	70.9	8.2
PP (mm of Hg)	34.8	8.9	42.8	9.8	47.2	10.0	52.7	9.9
MAP (mm of Hg)	88.1	2.2	87.9	5.9	86.9	5.8	85.3	5.7

Table 2: Head down tilt in Females

Parameters	Supine		30 Deg		60 Deg		80 Deg	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HR (bts/min)	70.8	3.3	68.8	3.7	67.0	3.7	64.7	3.5
SBP (mm of Hg)	112.3	5.4	111.8	5.3	116.7	5.8	120.7	5.4
DBP (mm of Hg)	78.2	6.6	74.7	6.4	72.7	6.4	70.7	6.4
PP (mm of Hg)	34.5	7.0	37.0	6.6	44.0	7.1	50.1	7.1
MAP (mm of Hg)	89.1	9.8	87.1	5.2	87.4	5.2	87.4	5.0

Table 3: Comparison of cardiovascular parameters between supine and various degrees of HDT in males

Parameters	Supine I	30 Deg II	60 Deg III	80 Deg IV	P* Value
HR (bts/min)	73.3	71.1	68.5	66.8	p <0.001 HS
SBP(mm of Hg)	113.7	116.5	120.1	123.7	p <0.001 HS
DBP(mm of Hg)	78.2	73.7	72.9	70.9	p <0.001 HS
PP(mm of Hg)	34.8	42.8	47.2	52.7	p <0.001 HS
MAP(mm of Hg)	88.1	87.9	86.9	85.3	p <0.001 HS

HS – Highly significant

Table 4: Comparison of cardiovascular parameters between supine and various degrees of HDT in females

Parameters	Supine I	30 Deg II	60 Deg III	80 Deg IV	P* Value
HR (bts/min)	70.8	68.8	67.0	64.7	p <0.001 HS
SBP(mm of Hg)	112.3	111.8	116.7	120.7	p <0.001 HS
DBP(mm of Hg)	78.2	74.7	72.7	70.7	p <0.001 HS
PP(mm of Hg)	34.5	37.0	44.0	50.1	p <0.001 HS
MAP(mm of Hg)	89.1	87.1	87.4	87.4	p <0.001 HS

HS – Highly significant

Diastolic blood pressure: The mean supine diastolic blood pressure (mm of Hg) in males was 78.2±8.3 and in females was 78.2±6.6 (Table 1, 2). With head down tilt the mean values in males were 73.7±8.1, 72.9±8.4 and 70.9±8.2 at 30^0, 60^0 and 80^0 respectively (Table 1). In females the mean values were 74.7±6.4, 72.7±6.4 and 70.7±6.4 at 30^0, 60^0 and 80^0 respectively (Table 2). On head down tilt there was decrease in diastolic blood pressure and it was statistically significant ($p < 0.001$) (Table 3, 4)

Pulse pressure: The mean pulse pressure (mm of Hg) in males was 34.8±8.9 and in females the value was 34.5±7.0 (Table 1). On head down tilt the mean values in males were 42.8±9.8, 47.2±10.0 and 52.7±9.9 at 30^0, 60^0 and 80^0 respectively (Table 1, 2). In females on head down tilt the mean values were 37±6.6, 44±7.1 and 50.1±7.1 at 30^0, 60^0 and 80^0 respectively (Table 2). With head down tilt the pulse pressure increased both in males and females (Table 1, 2). The increase was more in males as compared to females. The pulse pressure value was highly significant on head down tilt in males and females $p< 0.001$.(Table 3, 4).

Mean Arterial Pressure (MAP): The resting mean arterial blood pressure in males was 88.1±2.2 and in females was 89.1±9.8 (Table 1, 2). The mean values in males on head down tilt were 87.9±5.9, 86.9±5.8 and 85.3±5.7 on 30^0, 60^0 and 80^0 respectively (Table 1). The mean values in females on head down tilt were 87.1±5.2, 87.4±5.2 and 87.4±5.0 on 30^0, 60^0 and 80^0 respectively (Table 2). The decrease in the mean arterial pressure was highly significant on head down tilt in males and females $p< 0.001$.(Table 3, 4).

Discussion

On head down tilt there is decrease in the leg volume and increase in central venous pressure. Consequent loading of baroreceptors decreases sympathetic nerve activity and decrease in heart rate. Similar findings were also observed by Cortney A[8].

On head down tilt he systolic blood pressure increased. This was mainly due to increase in cardiac output. The large rise of systolic pressure in this position is probably due to accumulation of blood in the dependent parts of the body and also that the blood pressure equating mechanism may not be very efficient in dealing with a large volume of circulating blood which suddenly fills the dependent parts. Similar findings were observed by Shanker Rao[9].

On head down tilt the diastolic pressure decreased in both males and females. It was statistically significant ($p < 0.001$). Similar findings were supported by Sabita Yograj[10].

On head down tilt the pulse pressure was increased with 30^0, 60^0 and 80^0. This increase can be explained by the fact that, decrease in diastolic blood pressure and increase in systolic blood pressure, increases the pulse pressure. Similar findings were reported by M.B. Dikshit[11].

On head down tilt the decrease in diastolic blood pressure and increase in systolic pressure, decreases the mean arterial pressure in males. Similar findings were also observed by Sabita Yograj[10].

Conclusion

On HDT there were changes in the cardiovascular parameters in both males and females. The cause need to be investigated by other specific tests .The changes in the cardiovascular parameters will help the medical students in understanding the various mechanisms involved in the regulation of blood pressure. Also help the clinicians to come to a conclusion in a diseased person.

References

1. Fritsch – Yelle JM, Charles JB, Jones MM, Beightol LA, Eckberg DL. Space flight alters autonomic regulation of arterial pressure in humans. J Appl Physiol 1994;77:1776-1783.
2. Esquivias GB, Rubio AM. Tilt table test : state of the art. Indian Electrophysiol J 2003 Oct-Dec;3(4):1-13.
3. Butler GC, Xing HC, Hughson RL. Cardiovascular response to 4 hours of 6 degrees head-down tilt or of 30 degrees head-up tilt bed rest. Aviat Space Environ Med 1990 Mar;61(3):240-6.
4. Gharib C, Gauquelin G, Pequignot JM, Geelen G, Bizollon CA, Guell A. Early hormonal effects of head-down tilt (-10 degrees) in humans. Aviat Space Environ Med 1988 Jul;59(7)624-9.
5. Hughson RL, Maillet A, Gauquelin G, Arbeille P, Yamamoto Y, Gharib C. Investigation of hormonal effects during 10-h head-down tilt on heart rate and blood pressure variability. J Appl Physiol 1995;78:583-596.
6. Koska J, Ksinantova L, Kvetnansky R, Marko M, Hamar D, Vigas M, et al. Effect of head-down bed rest on the neuroendocrine response to orthostatic stress in physically fit men. Physiol Res 2003;52:333-339.
7. Turner JR, Sherwood A. Postural effects on blood pressure reactivity: implications for studies of laboratory-field generalization. J Psychosom Res 1991;35(2-3):289-295.
8. Henderson AC, Levin DL, Hopkins SR, Olfert IM Buxton RB, Prisk GK. Steep head-down tilt has persisting effects on the distribution of pulmonary blood flow. J Appl Physiol 2006;101:583-589.
9. Rao S. Cardiovascular responsesto head-stand posture. J Appl Physiol 1963;18(5):987-990.
10. Yograj S, Sadhu AK, Kalsotra L, Bhat AN, Arora A. Effect of graded head-up tilt and head-reverse tilt on the sympathetic nervous system versus parasympathetic nervous system. J K science 2004 September 6(3):144-148.
11. Dikshit MB. Postural stress tests for the clinico-physiological evaluation of cardiovascular reflexes. Ind J Physiol Pharmac 1987 January-March;31(1):1-11.