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Research article

BARORECEPTOR REFLEX RESPONSE IN PARAPLEGIA DURING HEAD-UP TILT POSITION

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ABSTRACT: Paraplegia is one of the most common spinal cord lesions seen in spinal cord injury patients below 4th thoracic vertebra and is associated with autonomic loss below the level of lesion with intact vagal cardiac nerves. It occurs due to lesion of spinal cord at an appropriate level. i.e., sparing superior extremities and involving inferior extremities. The common causes of paraplegia are accidents such as gunshot injuries, spinal cord injuries, autonomic injuries and dislocation of spine. The degree of cardiovascular control impairment is related to the level and severity of the lesion. This study was to investigate the autonomic control of cardio vascular functions in paraplegia patients in response to head up tilt following spinal cord injury. The parameter studies were in head up tilt response on resting heart rate and blood pressure changes in paraplegic subjects. The results show an abnormal response to head – up tilt in paraplegia patients with decrease in diastolic blood pressure but the heart rate showed normal response. Thus, in patients of paraplegia, sympathetic reflexes below the level of the lesion induce vasoconstriction. These results indicate that increased sympathetic activity in controls during Head up tilt and decreased sympathetic activity in paraplegia. This suggests that patients with paraplegia maintain cardiovascular homeostasis during Head up tilt without increase in sympathetic activity.

Key words: Spinal cord injury, Heart rate, Head up tilt, Paraplegia, Blood Pressure.

INTRODUCTION

Paralysis of both lower extremities is referred as "Paraplegia". It occurs due to lesion of spinal cord at a particular level i.e. sparing superior extremities and involving lower extremities (Legramante JM 2001). The common causes of paraplegia are accidents such as gunshot injuries, Spinal cord injuries and dislocation of spine. Spinal cord injury results in decreased stimulation of arterial baroreceptors. Spinal cord injury patients with lesions below 4th thoracic vertebra experience loss of autonomic control of circulation below the level of spinal lesion. The degree of cardiovascular control impairment is related to the level and severity of the lesion. When the lesion is below T_4, sympathetic and vagal outflows to the heart and vagal afferents from the baroreceptors are preserved. Consequently, they show an attenuated or absent increase in sympathetic activity. Therefore, cardiac autonomic control is intact and heart rate can be modulated by autonomic outflows from higher cardio motor centers. By contrast, the vascular neural control is blunted in several lower body vascular segments innervated by sympathetic preganglionic fibers leaving the medulla oblongata (Adams and Victors). As the sympathetic nervous system activity decreases, systolic blood pressure decreases. These alterations in blood Pressure control may contribute to cardiovascular risk in paraplegic patients. The sedentary lifestyle of paraplegic subjects also plays an important role in increasing the risk of cardiovascular events. Paraplegic patients also had significantly lower baroreflex effectiveness and greater blood pressure variability. Diminished vasomotor regulation due to decreased sympathetic activity may be major contributors to decreased orthostatic tolerance following injury.

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The changes of sympathetic vascular conductance can be assessed by tilting position. The present study evaluates the baroreceptor reflex response in paraplegics during head-up tilt position.

AIM AND OBJECTIVES

To study the effect of head-up tilt on sympathetic nervous system activity and cardiovascular responses in paraplegic patients with spinal cord injury and to compare the results with normal persons.

MATERIAL AND METHODS

The present study was carried in Physiotherapy department of Balaji Institute of Rehabilitation of Disability Research centre, after taking permission from Medical Ethical Committee of the Institute. Consent was obtained from selected subjects and the controls after explaining the details of the study.

Control group: - Ten normal healthy volunteers were selected as controls in age group of 20-35 years. All controls were normotensive, taking no medication, and free from any known disease based on medical history and physical examination at the time of the study.Postural changes in Blood pressure were studied by using electronically driven Tilting table.

Study group: - Ten chronic paraplegic patients with spinal cord injury below the level of T_4 were selected as subjects in the age group of 20-35years. The subjects who were on ambulation for minimum period of 8 – 12 weeks were included. All subjects were non-smokers and not involved in regular physical activity. All subjects underwent a thorough clinical examination, sphygmomanometric measurements of blood pressure. No subject showed any symptom or sign of cardio respiratory disease or of other pathological conditions (diabetes or hypertension) that might affect the autonomic cardiovascular control.

Experimental procedure: Subjects and controls were given Head-up Tilt position at 70°, blood Pressure and heart rate changes was recorded in Supine position and in HUT position. The table was equipped with straps and footboard to secure patients. Tilt table is the only way to get a person into standing and to stay there for a sufficiently long period to stretch soft tissue at risk of shortening. The upright position results in decreased cerebral blood flow. If auto regulation is compromised, monitoring of blood pressure and intracranial pressure should be done during initial attempts of standing. Patients were monitored for symptoms like giddiness.

RESULTS

Table -1. Represents the heart rate and blood pressure changes in supine position in control and subject.

Parameter	Mean		Std .deviation		P value
	Control	Subject	Control	Subject	
Resting heart Rate (pulse/min)	81.8	85.1	7.62	8.86	NS
Systolic blood Pressure (mm/Hg)	119.9	116.4	10.07	8.03	NS
Diastolic Blood Pressure (mm/Hg)	75.0	78.8	12.1	9.7	NS

NS-Non Significant

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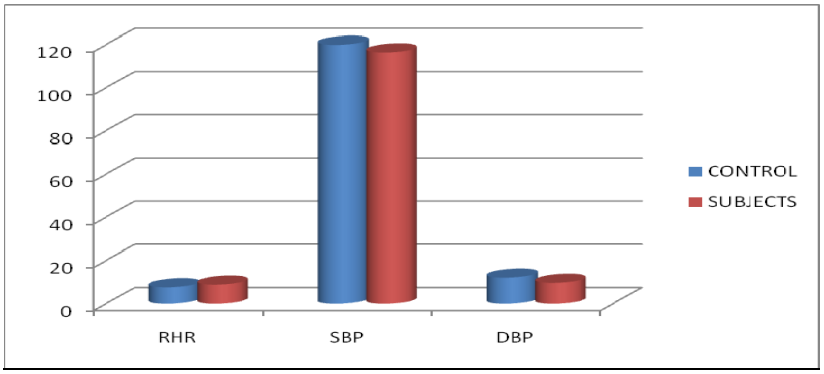

Fig 1. The graph represents the heart rate and blood pressure changes in supine position.

Table - 2 Represents the heart rate and blood pressure changes in head up tilt position in control and subjects

Parameter	Mean		Std .deviation		P value
	Control	Subject	Control	Subject	
Resting heart Rate (pulse/min)	90.20	98.60	9.00	17.97	NS
Systolic blood Pressure (mm/Hg)	114.5	73.5	12.29	7.62	NS
Diastolic Blood Pressure (mm/Hg)	77.4	77.85	8.40	7.762	< 0.01*

***Significant, NS-Non Significant**

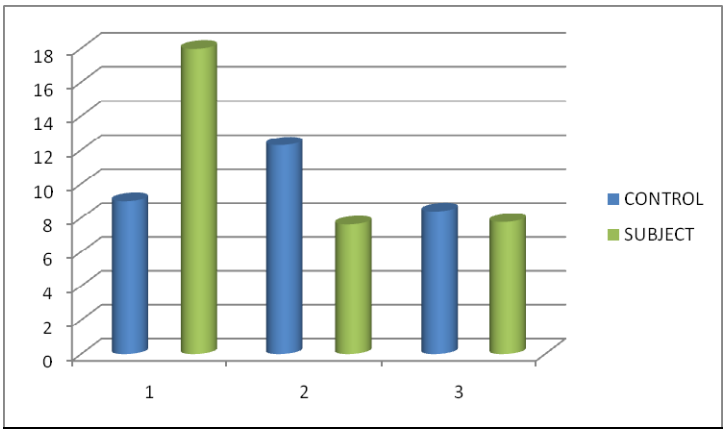

Fig 2. The graph represents the heart rate and blood pressure changes in Head-up tilt position.

DISCUSSION

In the present study, the effect of head-up tilt on sympathetic nervous system activity and cardiovascular responses in paraplegic patients with spinal cord injuries was studied and compared with normal persons. The main findings were at the low level spinal cord injury affects blood pressure variability, at a degree depending on the level of sympathetic activity and the heart rate variability and the baroreflex control of the heart, despite the intact cardiac baroreflex arch and intact cardiac autonomic innervation (Adams and victors). According to the “Baroreflex resonance hypothesis”, the baroreceptors sense blood pressure changes and generate autonomic modulations on the vasculature.

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The results showed a transient drop in systolic blood Pressure and rise in diastolic Blood Pressure and heart rate in controls and a decrease in systolic and diastolic blood pressure with increase in heart rate in subjects. From supine to upright position the sympathetic nerve activity increases to a smaller degree during tilt. The systolic blood pressure increases immediately after tilt with a rise in peripheral resistance. In paraplegia, from supine to head-up tilt leg blood flow decreases due to lower sympathetic nerve activity, with minimal changes in diastolic blood pressure. Leg vasoconstriction may result from spinal sympathetic reflex, veno-arteriolar reflexes or myogenic response (Sevda C. Aslan, David C. Randall 2007). Rapid withdrawal will be the first line of defense leading to a rapid, immediate increase in heart rate.

The normal response to 60 to 80 degree HUT is a transient drop in systolic blood Pressure and rise in diastolic blood Pressure and heart rate. The abnormal response of tilting is early hypotension, which signifies inadequate sympathetic tone and bar receptor function (Anil Baran singha Mahapatra 2006) and a delayed hypotension and syncope, which indicates a neurocardiogenic mechanism or and idiopathic type. Orthostatic hypotension is a common problem, particularly in the acute phase of recovery (Illman A 2000, Jan T. Groothuis 2005). Short-term stability of arterial BP is achieved in large part by appropriate adjustments in sympathetic and parasympathetic outflow from the central nervous system to cardiovascular effector mechanisms .The cause of orthostatic drop in BP is hypovolaemia (Illman A 2000). Orthostatic hypotension has different effects on the occurrence of baroreflex sequences. The baroreflex sequences showed a marked increase in response to HUT in paraplegic subjects.

Tilt table is most sensitive means of inducing orthostatic changes and also elicits these changes prone to syncope from and oversensitive cardiac reflex, that produce vasodilatation. The reason for fall in blood Pressure is lack of sympathetic vasoconstrictor tone (Lehmann KG 1987). This suggests that although the cardiac autonomic control is intact, there is a blunted sympathetic response to HUT in subjects with paraplegia, which implicate an altered baroreceptor response to acute orthostatic provocation (Jan T. Groothuis 2005). Thus the study shows an abnormal autonomic function in patients of paraplegia with lesions of spinal cord below the T_4 level. When the lesion below T_4, sympathetic and vagal outflows to the heart and vagal afferents from the baroreceptors are preserved. Therefore, cardiac autonomic control is intact and heart rate can be modulated by baroreflex and by autonomic outflows from higher cardio motor centers.

CONCLUSION

The present study was done to study the effect of head-up tilt on sympathetic nervous system activity and cardiovascular responses in paraplegic patients with spinal cord injuries and compared with normal persons. The results show an abnormal response to head-up tilt in patients of paraplegia with a decrease in diastolic blood pressure but the heart rate showed normal response. Thus, in patients of paraplegia with lesions below T4, heart rate autonomic control is preserved whereas sympathetic vasomotor response below the level of lesion is blunted explaining the fall in diastolic blood pressure.

These results suggest that mixed autonomic responses to orthostatic stress, are mediated by both cardiopulmonary and arterial baroreflex mechanism (P.J vinken 1992). The independent of supra spinal sympathetic control in humans are able to maintain blood pressure during head-up tilt. Further studies are required on the subject to assess the autonomic involvement in paraplegics and to accordingly design the management protocols for the patients.

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