Original article

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Comparison of Haemodynamic Responses of Different Balance Training Exercises in Hypertensive Elderly Adults

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Abstract

Objective: This study was carried out to find the difference in haemodynamic responses of different balance training exercise in hypertensive elderly adults. **Methods:** Elderly adults between the age of 60-80 years (n=80) with controlled hypertension allocated into two groups. Group 1 underwent specific balance training and group 2 general balance training exercises for a single session. They were measured for systolic blood pressure, diastolic blood pressure, heart rate and rate pressure product before the exercise, immediately after the exercise and 5 minutes after the exercise. The hemodynamic responses were compared between the groups for difference. **Results:** The study showed a significant difference in all haemodynamic parameters such as blood pressure, heart rate and rate pressure product immediately except diastolic blood pressure and after 5 minutes of exercise between the groups. **Conclusion:** The general balance exercise is safe in terms of hemodynamic changes in elderly hypertensives.

Keywords: hypertension, elderly adults, balance exercises.

Introduction

Hypertension is a common problem in community. Study update shows that prevalence of hypertension is about 70% in elderly.[1] Some reports from India indicate that the prevalence ranges from 60 to 70%.[2] Hypertension is defined as systolic blood pressure greater than 140 mm Hg or a diastolic blood pressure greater than 90 mm Hg. Hypertension results due to loss of arterial wall elasticity major vessels including aorta become stiff and less distensible and there is loss of beta adrenergic receptors also. Both these factors raise peripheral vascular resistance and aortic impedance to overcome this there is a need of a powerful systolic ejection of left ventricle. Which result in rise in systolic blood pressure (SBP) and increase in left ventricle (LV) mass with compromised cardiac output and renal blood flow.[1]

High blood pressure may cause impaired exercise intolerance in elderly, so it is important to evaluate the haemodynamic response before any exercise training.[3] The anticipation of exercise increases the heart rate through activation of the sympathetic nervous system. As exercise begins, the heart rate increases rapidly because of a reduction of vagal tone, followed later by a further increase in sympathetic tone and circulating catecholamine levels. Stroke volume (about 70 mL at rest), increases early and then levels off at approximately one third of the maximal oxygen uptake, or half of the maximal cardiac output. This is due to an increased venous return, an increased end-diastolic volume, and the sympathetic nervous system stimulation of myocardial contractility and active myocardial relaxation.[4] As exercise progresses in normal persons, the systolic pressure increases by 50 mm Hg to 70 mm Hg, whereas the diastolic blood pressure remains unchanged or decreases by 4 mm Hg to 8 mm Hg as a result of vasodilatation and decreasing total peripheral resistance. Resting cardiac output

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(5 to 6 L/min) increases to as high as 20 to 25 L/min during peak exercise, an increase proportional to the workload and exercise demand. The rate-pressure product (RPP) or double product is highly related to oxygen consumption and coronary blood flow in healthy subjects over a wide range of exercise intensities, and therefore is an index of relative cardiac work. The rate-pressure product makes use of product of peak systolic blood pressure (SBP), as measured artery, and heart rate (HR). It is computed as RPP = SBP x HR / 100.The product of SBP and HR is divided by 100 in order to reduce the value to a smaller number and to closely agree with the oxygen consumption (mL/min) of the heart. The RPP is not meant to reflect differences in stoke volume between individuals, but is an accurate reflection of the myocardial oxygen demand and the myocardial workload.[4]

Increasing age is associated with a reduction in the increase in heart rate , cardiac output and stroke volume either remains the same or declines, blood pressure during exercise increases more steeply and the maximal heart rate decreases. Filipovsky and colleagues studied blood pressure reactivity in hypertensive and normotensive persons and found that peak systolic blood pressures are often greater than 200 mm Hg because of higher baseline blood pressures in hypertensives.[4] Montain et al reported that that older hypertensive persons have an altered cardiovascular response to exercise as compare with age matched normotensive subjects.[5]

Researchers have shown that elderly having history of hypertension were significantly associated with falls.[1] Several fall prevention strategies have shown effectiveness in preventing fall or injuries &decreases risk of falling. Previous studies shown that exercise such as strength, flexibility, balance training and combination of these activities have increased strength, improve balance and improved functional ability in addition to reducing risk of falls. Thus balance-training interventions have an important place in fall prevention. Geriatric balance training included conventional coordination exercises, aerobic training, muscle strengthening exercise regime, and specific strategy exercise protocol.[6] There is lack of studies which investigated the haemodynamic response of these exercises in geriatric population. This study will provide the information regarding physiological response of different exercise used for balnce retraining in gelderly adults.

Methods

A pre-post experimental repeated measure design was used in this study and the study was approved by research and ethical committee of department of therapies and health sciences, Faridabad Institute of Technology, Manav Rachna Educational Instituites, Faridabad. 80 elderly subjects were recruited from Faridabad and Delhi and they were randomly allocated into group A or group B. Subjects with following characteristics such as elderly adults between the age of 60-80 years living in the community, subjects with history of hypertension controlled by medication, not using any walking aid were included and subjects with following problems such as unstable cardiac problem, not able to understand the verbal information provided, hearing difficulty, permanent history of dizziness, acute pain and severe breathing difficulty were excluded. Materials used in the study were digital heart rate measuring device(A&DMOD UA-774) approved by British hypertensive society, stop watch ,wooden blocks of various heights chair of different heights with and without arm rest ,balls of various size,weights ,foam, shelves of various heights, mirror and Weights. The following procedure was followed in the study initially demographic data of the subject was collected then subjects were assessed on cardiac parameters such as systolic blood pressure ,diastolic blood pressure, heart rate and rate pressure product. Group A subjects received specific balance strategy training which consisted of endurance training, strengthening, co-ordination exercise, balance strategy practice, sensory integration and

added attentional demand during function and multitask practice. Various simple tasks were selected as sit to stand. This tasks were done using different chair heights with/ without upper limb assistance balancing cup with/without water on a saucer or while adding cognitive task to manual task. Each task was graded to cater to various level of ability and the level of difficulty progressed to increase the challenge.The exercises for group consisted of 8 components and 5 minute rest was provide after 4 components, while group B subjects received general balance and mobility exercise which consisted of active stretching and strengthening of the lower limb muscles, control exercises, endurance walking and repetitive muscle co-ordination exercise. Both programme initially started with a low level of frequency. It started from 5 – 10 repetition. The rest interval of 5 minute was provided between sets. The balance exercises lasted for 45 for both groups. Immediately after exercise the post evaluation had done for systolic blood pressure, diastolic blood pressure, heart rate and rate pressure product for both groups After completion of 5 minutes again the haemodynamic parameter were were measured. In this study the blood pressure and heart rate is measured with the help of automated device.

Data Analysis

Data analysis was performed using SPSS software. A student's unpaired t' test was used to analyze the difference between group 1 and 2 for systolic pressure, diastolic pressure, heart rate and rate pressure product. The haemodynamic parameters were compared before the exercise, immediately after the exercise and 5 minutes after the exercise. A significance level of p£ 0.05 was fixed.

Results

The data analysis revealed the following results. The group A consisted of 21 male and 19 female with a mean age of 68.50 ± 4.48 years. The group B consisted of 19 males and 21 female with a mean age of 66.85 ± 3.02.There was no significant difference between the groups on hemodynamic parameters such as systolic pressure, diastolic pressure, heart rate and rate pressure product before (Table 1, Figure 1) the exercise while there was significant difference between groups on systolic pressure (Table 1, Figure 1) heart rate(Table 1, Figure 2), rate pressure product (Table 1, Figure 3) and no significant difference between diastolic blood pressure immediately (Table 1, Figure 1) after the exercise and there was significant difference in systolic pressure, diastolic pressure, (Table 1, Figure 1) heart rate (Table 1, Figure 2) and rate pressure product (Table 1, Figure 3).

Table 1. Comparison of haemodynamic parameters between group 1&2 before exercise, immediately after exercise and 5 minutes after exercise

Variable			Group A	Group B	t value	p value
Blood pressure	Systolic	Before exercise	142.63±3.310	141.75±3.57	1.14	0.260 N.S
		Immediately after exercise	162.32±5.98	147.55±2.50	14.42	0.001*
		After 5 minutes of exercises	153.25±5.42	143.27±2.38	11.17	0.001*
	Diastolic	Before exercise	83.77±5.34	83.90±4.31	.13	0.900 N.S
		Immediately after exercise	89.56±5.71	88.80±4.32	.93	0.357 N.S
		After 5 minutes of exercises	87±5.34	84.77±4.20	2.26	0.027*
Heart rate		Before exercise	83.10±6.14	83.35±6.39	1.78	.588 N.S
		Immediately after exercise	104.87±7.91	91±5.95	8.59	.001*
		After 5 minutes of exercises	99.02±6.98	86.550±6.25	8.40	.001*
Rate pressure product		Before exercise	117.93±8.73	118.16±10.07	11.7	0.494 N.S
		Immediately after exercise	169.19±15.35	134.97±9.12	12.12	0.001*
		After 5 minutes of exercises	155.81±13.03	124.15±9.26	12.52	0.001*

*Significant, NS-Not Significant

Figure 1. Comparison of blood pressure changes between the groups

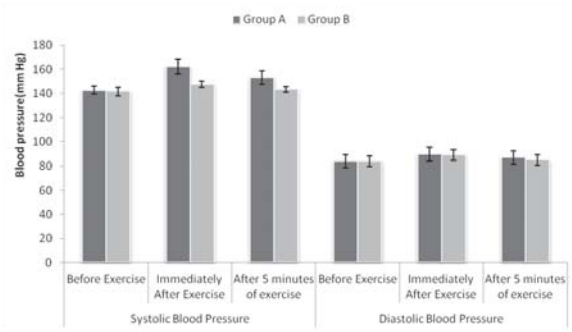


Figure 2. Comparison of heart rate changes between the groups

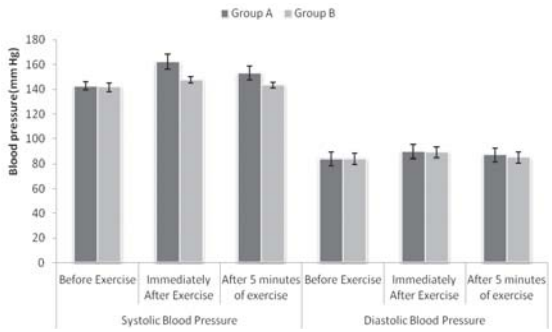
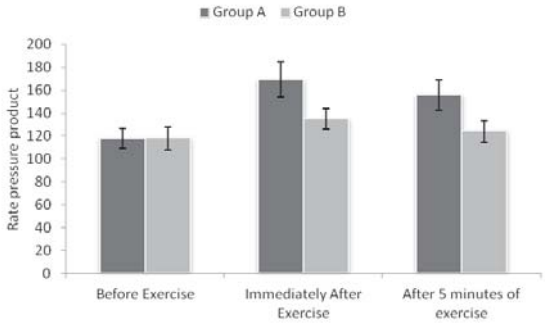


Figure 3. Comparison of rate pressure product changes between the groups



Discussion

The result obtained showed that there is significant difference between the values of systolic blood pressure, heart rate, diastolic blood pressure and rate pressure product between two groups immediately after the exercise. In this study the systolic blood pressure rise more steeply immediately after specific strategy balance training exercise as compare to general balance and mobility exercises. The reason for steep rise of systolic blood pressure more in group 1 could be due to more intensity of exercises provided to subjects which lead to increased sympathetic activity. The results showed that there was significant difference between immediate and recovery systolic blood pressure which was taken after 5 minute of exercise in specific strategy balance training and general mobility and balance exercises. The reason might be due to less reduction in sympathetic activity in specific strategy balance training as compare to general mobility and balance exercises.Forjaz et al found a significant decrease in muscle sympathetic nerve activity after acute exercise in hypertensive and normantensives humans.[7]

The results also showed that the blood pressure did not recover to their resting level in subjects performing specific strategy balance training however in general mobility and balance exercises the blood pressure had reached closer to their resting level. The reason of delayed recovery in specific strategy balance training may be due to autonomic dysfunction and vasoreactivity abnormalities. Also there could be chances of decreases in NO synthase activity which is responsible for decreases in exercise blood pressure by increasing the capacity of endothelial cells to evoke vasodilatation. In the present study there is no significant difference in mean value of diastolic blood pressure immediately after exercise between groups. These results are in confirmation of study done by Faranz, however some researcher have observed significant rise in diastolic blood pressure.[8] The results also confirmed that there is delayed recovery of diastolic blood pressure in performing specific balance strategy training protocol as compare to those subjects performing general balance and mobility exercises .The reason may be due to autonomic dysfunction and vasoreactivity abnormalities, due to hypertension thus there may be delayed vasodilatation.

In this study the mean of heart rate rise more steeply immediately after specific

strategy balance training exercise as compare to general balance and mobility exercises. The reason for steep rise of heart rate could be due to more intensity of exercises. The heart rate response to dynamic exercise follows a well-defined pattern, which is primarily modulated by the autonomic nervous system. During the first few seconds of exercise, there is a rapid heart rate increase, known as the initial transient that is exclusively mediated by vagal inhibition, regardless of exercise intensity. As the exercise continues, there is increasing sympathetic activity, proportional to the intensity of the exercise, which progressively accelerates the heart rate. Immediately after exercise, a final transient period represented by a decreasing heart rate response is observed. This is a result of vagal reactivation and a reduction in the sympathetic stimulation, with the latter contributing more effectively to the slow or late deceleration phase of post exercise heart rate. In this study we found that the protocol having general balance and mobility exercise show normal level of heart rate immediately after exercise and better heart rate recovery as compare to specific balance training protocol .The reason may be related to sympathetic activity which is proportional to intensity of exercise which influences the vagal tone.

The results showed that there was elevated mean level of rate pressure product in performing the specific strategy training protocol as compare to general balance and mobility exercises, there were also delayed recovery of rate pressure product performing the specific strategy training protocol. The present study demonstrated that general mobility and balance exercise group, besides producing lower increases in rate pressure product during exercise, the level also reaches closer to resting level, hence it reduces the myocardial oxygen consumption and consequently the cardiovascular risks after exercise .In contrast the specific balance strategy training group produces greater increases in rate pressure product during exercise. The rate pressure product does not recover near to baseline during recovery period. Forjaz suggested that moderate and high intensity exercise bouts produced greater increases in rate pressure product during exercise and fail to reduce below base line during the recovery period.[7] This study was done for a single session. Future research can be done involving a longer duration comparing two-intervention programme.

Conclusion

These findings of the study suggest that the general balance and mobility exercise is safer in terms of their physiological response in community dwelling older adults as compared to specific balance training exercises.

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