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The Effects of Therapeutic Passive Movement on Cardiovascular Response in Stroke Patients

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Abstract: Patients with cerebrovascular accident who are especially still in coma secondary to hypertension require some passive movement to prevent complications that may arise from immobility. There could be consequential effects of passive movement on the blood pressure of such patients. The aim of the study therefore, is to investigate the effects of Repetitive Passive Movements (RPM) on the cardiovascular parameters of stroke patients. Thirty subjects, who were purposefully selected, participated in the study. Fifteen hypertensive hemiplegic patients (sex: 3 males, 12 females; age: 64.2±13.66; side: 10 right, 5 left) served as stroke group. Fifteen normal age-matched (normotensive) subjects (sex: 5 males, 10 females; age: 58.33±12.89) served as the control group. Each subject was asked to lie on supine position on a plinth or bed. Fifty RPM was then carried out on the affected lower limb for the stroke group and any lower limb for the Normotensive (NT) group. Pre and post cardiovascular parameters (SBP, DBP and HR) were then taken using a non invasive blood pressure (sphygmomanometer and stethoscope) apparatus. The MAP was then computed from the variables. RPM caused a decrease in cardiovascular parameters, which were not statistically significant ($p>0.05$). However, there was significant reduction in MAP of the stroke group as well as in DBP of the NT group ($p<0.05$). The independent t-test analysis revealed that pre-RPM (SBP and HR) and post RPM (HR) were more significantly reduced in stroke patients than NT subjects ($p<0.05$). Therapeutic passive movement causes a decrease in blood pressure and an increase in blood flow to the immobilized tissues of the stroke patients with an enhanced efficient heart functions. Studies on its effects on congestive heart failure should begin to arouse ones interest.

Key words: Repetitive passive movements, stroke, blood pressure, cardiovascular parameters

INTRODUCTION

As generally stated, Akinbo and Giwa (2002) explained that the single most important risk factor for Cerebrovascular Accident (CVA) patients is hypertension, which accounts for 10% of all deaths. Fifty percent of those, who survived are rendered disabled. Rehabilitating such patients to enable them live independent life as much as possible requires a form of exercise by the therapist.

It can be deduced from Hopegood (2005) that exercises are generally grouped into two. They are, Active exercises. These are exercises carried out by the individual (subjects) themselves without external assistance. Active exercise could be dynamic (isotonic) or static (isometric) (Akinbo and Giwa, 2002). Dynamic exercises are aerobic exercises (Barbo, 1987), which include swimming, walking, jogging, running cycling etc. Static exercises are exercises, which involve the one the subject does himself, while on a stationary position. Examples are weight lifting, press-up, hand grip, movement of the limbs (flexion and extension) on a spot etc. Passive movements conversely are exercises done on the individual by another person. This exercise is therapeutic and often employed clinically by therapists in the prevention and curative of various disease conditions in essentially immobilized patients.

Passive movement is used for prevention of joint deformities and stiffness, deep venous thrombosis, muscle contractures and hypotonicities. Continuous Passive Motion (movement) (CPM) has been reported to be effective in preventing the development of stiffness if full motion is applied immediately following surgery and continued until swelling that limits the full motion of the joint no longer develops (O'Driscoll and Giori, 2000). Diego (2006) stated that passive joint movement features the use of range of motion to help functional anatomy and re-educate the nervous system. It also, helps relieve blood stagnation. Salter *et al.* (1965) reported the deleterious effects of immobilization on the articular cartilage of the rabbit knee joints and they termed the resultant lesion as Obliterative degeneration of articular cartilage. Patients who suffer stroke are often rendered immobilized in the initial phase of their attack and hence, may suffer some or all of the conditions mentioned above as complications. Therefore, such patients will benefit immensely from passive movement.

Exercises generally, have been reported to increase blood pressures as soon as they are done (McArdle *et al*., 1967; Akinbo and Giwa, 2002). The comparison of pre and post cardiovascular response of the intermittent group after aerobic exercise in type 2 diabetes patients showed an increase in blood pressure immediately after the exercise (Akindele *et al*., 2006). A higher heart rate at rest and post exercise (walking and running) was obtained for the poliomyelitis group compared to the age-matched normal group (Nwankwo and Hamsat, 1998). In their study Steuernagel *et al.* (2002), showed that active as well as passive clinical exercises caused an increase of cerebral blood flow velocity, which was attributed to cerebral activation and auto regulative mechanisms. Passive movements of the arms and legs were reported to increase pulmonary ventilation several fold (Guyton and Hall, 2003). However, the cardiovascular response to passive movement from the literature has been scanty. It may be, having its consequential effects on blood pressure of the immobilized stroke patients. The study aimed, at finding the effects of passive movement on cardiovascular response in the hypertensive stroke patients.

MATERIALS AND METHODS

Thirty subjects participated in the study. They include 15 hypertensive hemiplegic patients (3 males and 12 females) served as the stroke group and 15 Normotensive (NT) (5 male and 10 females) served as the control group. The stroke group (aged from 41-91 years) was patients of Irrua specialist teaching hospital, Irrua who were receiving physiotherapy. Ten of the patients had right sided and 5 had left sided hemiplegia. The normal age-matched NT subjects (aged from 47-92 years) were also patients of Irrua specialist teaching hospital who were attending physiotherapy Clinic without any complication that could affect the study. Subjects in both groups who had phobia about blood pressure apparatus, musculoskeletal abnormalities, diabetic foot ulcer, ischemia or neuropathy and cardiac problems such as congestive heart failure, coronary heart disease or patients with artificial pacemaker were screened out of the study. Informed consent was obtained from each of subjects or relatives having been approved by the ethic committee of the institution.

- Blood pressure Apparatus-Sphygmomanometer (Accoson made in England) as well as dual head type stethoscope was used to determine the blood pressure.
- A tape rule was used to measure the height.
- Nokia phone stop watch was used for the counting of the Heart rate.
- Weighing balance (Seca, made in Germany, calibrated from 0-130 kg) was used to measure the weight of the subjects.

Sex and age were recorded for all the subjects. The weight of the NT group was taken and recorded. However, the weight of the stroke group could not be taken because majority of them were still unconscious and hence, was not recorded in the study. Each subject was asked or put in supine position on the plinth or bed. An imaginary line was then drawn from the tip of the head of the patients to the side of one of the shoulders. Another imaginary line (15 cm) was drawn out from the heel. The edge of the 2 imaginary lines was then measured with a tape rule and was recorded as the height of the patient.

Fifty Repetitive Passive Movements (RPM) were then carried out on the affected lower limb for the stroke group and any lower limb for the NT group. Pre and Post Cardiovascular Parameters (CVP) were then taken. This includes SBP, DBP and HR. The HR of one of the stroke group was unable to be taken. The HR was counted as the pulse rate and MAP was computed from the variables as thus,

$$MAP = DBP + 1/3\ (SBP-DBP)$$

Where:

$$SBP-DBP = \text{Pulse pressure}$$

The MAP is the most important of the pressures described because it is the pressure driving blood into the tissues averaged over the entire cardiac cycle (Vander *et al*., 2001).

Data analysis: Descriptive statistics of all the variables were calculated.

Inferential statistics of paired t-test was used to find if there was any significant difference between pre and post RPM parameters of stroke patients and the NT subjects. Independent t-test was used to compare if a significant difference existed between stroke and NT values as well as their ages and heights.

RESULTS

Table 1 includes the physical characteristics of both groups. The age of the stroke patients ranged from 41-91 years (mean 64.2±13.66). While, that of the NT subjects ranged from 47-92 years (mean 58.33±12.89). The height of the stroke patients and NT subjects ranged from

Table 1: Physical characteristics of subjects

Variable	Stroke	NT	t-value	p-value
Age (years)	64.2±13.66	58.33±12.89	1.2100	0.2360*
Height (m)	1.63±0.070	1.63±0.070	-0.049	0.0936*
Weight (kg)	-	61.67±70.99	-	-

Values are expressed as Mean±SD; *No significant difference at p>0.05

Table 2: Paired t-test analysis of pre and post RPM cardiovascular parameters of subjects

Stroke (n)	CVR	Pre-RPM	Post-RPM	Difference	t-value	p-value
15	SBP	151.87±28.60	142.53±30.81	-9.33±11.43	-3.162	0.453*
15	DBP	88.67±17.56	87.07±18.16	-1.60±5.460	-1.135	0.276*
14	HR	84.57±16.14	83.14±16.39	-1.43±4.330	-1.235	0.239*
15	MAP	109.73±19.70	105.55±21.36	-4.18±5.650	-4.180	0.013
NT(n)						
15	SBP	134.53±14.65	131.87±16.66	-2.67±7.510	-1.375	0.191*
15	DBP	81.07±11.08	77.87±10.32	-3.20±2.810	-1.645	0.001
15	HR	73.60±12.26	72.27±10.85	-1.33±4.419	-1.757	0.238*
15	MAP	98.02±11.49	97.82±1077	-0.20±8.040	-0.970	0.924*

Values are expressed as Mean±SD; *No significant difference p>0.05

Table 3: Independent t-test analysis between variables of the subjects

Subjects	Pre-RPM	t-value	p-value
Stroke and NT	SBP	2.115	0.043
	DBP	1.363	0.184*
	HR	2.070	0.048
	MAP	1.977	0.580*
	Post-RPM		
Stroke and NT	SBP	1.179	0.248*
	DBP	1.706	0.099*
	HR	2.121	0.043
	MAP	1.252	0.221*

*No significant difference at p>0.05; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; MAP = Mean Arterial Pressure; HR = Heart Rate; CVP = Cardiovascular Parameters; NT= Normotensive

1.50-1.76 (mean 1.63±0.75) and 1.45-1.74 (mean 1.63±0.07), respectively. There was no significant difference in age and height of the 2 groups (p>0.05).

Table 2 shows the statistical profile obtained of Pre and Post RPM variables of the subjects. The paired t-test analysis showed that reduction existed in all CVP of both groups, but significantly reduced in MAP (stroke) and DBP (NT) groups (p<0.05). However, there were no significant difference in other variables of each group (p>0.05).

Table 3 shows the statistical profile obtained using independent t-test to compare variables of the subjects. It revealed that pre-RPM, SBP and HR and post-RPM, HR are more significantly reduced in stroke patients than NT (p<0.05).

DISCUSSION

Results showed that RPM caused a decrease in CVP, which were not statistical significant (p>0.05). However, the significant difference in MAP of the stroke group (p<0.05) implied that passive movements brought about a statistical reduction in MAP (indicative of reduction of blood pressure following RPM). This could be as a result of increase in blood flow to the disuse exercised muscle. Steuernagel *et al.* (2002) reported that active as well as passive clinical exercises caused increase in cerebral blood flow velocity. It was also, reported that passive movement helps to relieve blood stagnation and the blood supply may be improved throughout the tissues (Hopegood, 2005; Diego, 2006).

The significant reduction of DBP in NT group further suggested that passive movement could cause a reduction in blood pressure. This is contrary to the short term effect of Dynamic Exercises, which increase blood pressures immediately after the exercise as shown by Akinbo and Giwa (2002). They however reported of a significant reduction in resting systolic blood pressure but not for diastolic after a bicycle ergometry in hemiplegic patients after the end of the 4th week.

The more reduced SBP in stroke patients than the NT subjects could be as a result of the effects of anti-hypertensive drugs in stroke patients. However, the reduced HR in stroke patients suggested that their heart functions become more increasely efficient than the NT subjects during passive movements.

CONCLUSION

The study showed that therapeutic passive movement cause decrease in blood pressure as evidenced from statistical reduction of MAP and DBP. It causes an increase in blood flow to the immobilized tissues of the stroke patients with an enhanced efficient heart functions.

It is therefore, strongly recommended that passive movements should be carried out on all immobilized stroke patients except in diagnosed hypotensive patients.

Further studies, are recommended on its effects on congestive heart failure.

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