

Effect of inspiratory and expiratory muscle training to reduce hypertension among Stage I and II hypertensive patients; A Randomized Control Trial

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Objective: To determine the effect of inspiratory and expiratory muscle training on systolic and diastolic blood pressure among hypertensive subjects.

Methodology: This randomized control trial included 66 patients with stage I & II hypertension enrolled through convenient sampling technique. It took six months to complete the study at Pakistan Railway Hospital, Rawalpindi. Random allotment of the subjects was done through envelope method into two groups (n= 33 each); inspiratory muscle training group (Group B) and expiratory muscle training group (Group A). Group A received forced inspiration training with relaxed expiration and Group B received forced expiration training with relaxed inspiration (approx. 16 breaths/min X15 minutes X2 times/day for 2 weeks). Systolic and diastolic blood pressure, heart rate and estimated peak VO₂ were measured. The data was analyzed at baseline and after two weeks of the treatment with SPSS

version 21.

Results: We had 42 males and 24 females with mean age of 46.83±8.68 years. After two weeks of interventions there was significant reduction (P=0.03) in heart rate from 77.49±6.74 to 70.79±6.04 in Group B. Systolic blood pressure was also significantly decreased in Group B (P=0.002) from 143.33±6.0 to 139.36±5.54. In aspect of pulmonary functions, there was significant improvement in FEV₁ (P=0.02), FVC (P=0.02), FEV₁/FVC (P=0.03), and PEF (P=0.02), in Group A. Estimated peak VO₂ was improved in Group A but statistically not significant (P=0.06).

Conclusion: Inspiratory muscles training in hypertensive subjects was effective in reducing blood pressure and heart rate as compared to expiratory muscle training. (Rawal Med J 202;45:261-264).

Keywords: Breathing exercises, hypertension, inspiratory muscle training.

INTRODUCTION

High blood pressure is important modifiable risk factor for many cardiovascular diseases cerebrovascular disease, chronic kidney disease.¹ The severity of hypertension is directly proportioned to the risk of mortality or morbidity.² In 2009, prevalence of hypertension in men was 32.2% in developing countries and 40.8% in developed countries and among women, mean prevalence was 30.5% and 33.0% in developing and developed countries, respectively.³ In 2010, HTN was labeled as leading single risk factors for global burden of disease.⁴

Multiple treatment options are available to treat hypertension including pharmacological and non-pharmacological management. Pharmacological management of hypertension includes use of beta-

blockers, ACE inhibitors, diuretics and calcium channel blockers.⁵⁻⁷ Antihypertensive drugs carry side effects and could be the cause for increase economic burden for many patients. Non-pharmacological interventions being used to reduce blood pressure comprise respiratory exercises, yoga exercises like, '*Sukha Pranayama*,⁸ aerobic exercises,⁹ endurance training,¹⁰ and resistance training.¹¹

In aspect of respiratory and breathing exercises, different studies have reported that breathing exercise are effective in reducing blood pressure.^{12,13} Particularly, inspiratory muscle training is helpful in reducing blood pressure and heart rate in hypertensive patients.¹⁴ During inspiration, the intrathoracic pressure decreases and venous return increases that increases the preload and these

physiological responses are reversed in expiration.¹⁵ So it could be suspected expiratory training could be useful in reducing blood pressure. Therefore, the purpose of this study was to determine the effect of expiratory muscle training and inspiratory muscle training on blood pressure, heart rate and peak VO₂ in hypertensive patients of stage I and stage II.

METHODOLOGY

This was as randomized control trial in which 66 hypertensive subjects between age 40 to 60 years of both genders of stage I and II hypertension without any other cardiopulmonary complications were included. The study was carried out at Pakistan Railway General Hospital, Rawalpindi from August 2017 to February 2018 through non-probability convenient sampling technique. Subjects were randomly allocated equally (n=33) into group: A (expiratory muscle training group) and group B (inspiratory muscle training group) through envelope method. The protocol approval was taken from Riphah Research Ethical Committee and Informed consent from each subject was taken.

All subjects were examined at day zero and data were taken through semi-structured questionnaire. Heart rate and blood pressure were taken through cardiac monitor, Forced Vital Capacity (FVC), Forced Expiratory Volume in one Second (FEV₁), Peak Expiratory Flow Rate (PEF), and ration between FEV₁ and FVC (FEV₁/FVC) were measured by digital spirometer. And estimated peak VO₂ was measured through 6 minute walk test.¹⁶ These were measured at day zero and at the end of two weeks of respiratory training.

Inspiratory muscle training group received therapy for 15 minutes, approximately 16 breaths/minute (with forced inspiration and normal expiration) two times a day for overall 2 weeks. Same as expiratory muscle training group received therapy for 15 minutes, approximately 16 breaths/minute (with forced expiration and normal inspiration) two times a day for overall 2 weeks.

Statistical Analysis: Data were analyzed through SPSS version 21. Independent t-test was applied on heart rate, mean and SD were compared at baseline and after the therapy of 2 weeks.

RESULTS

Total 66 patients were included in the study consisting of 24 females (36.65%) and 42 males (63.64%). Mean age was 46.83±8.68 years. We found that 28.80% and 25.80% were taking calcium channel blockers and beta blockers, respectively as monotherapy treatment for hypertension.

Table 1. Independent T-test for Heart Rate.

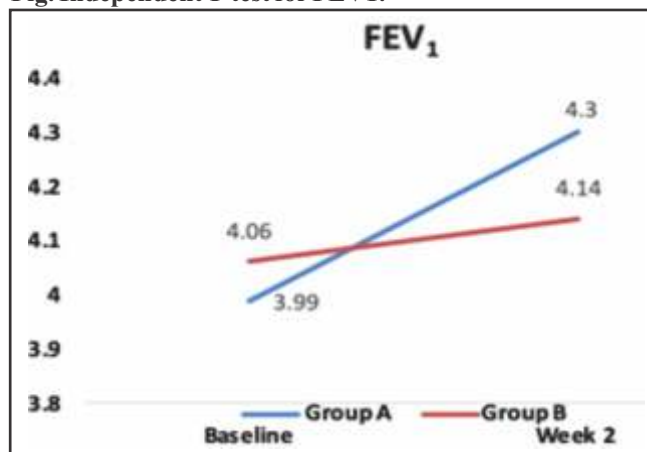
| Variable | Group A Mean±SD | Group B Mean±SD | P-value |
|----------|--------------------|--------------------|---------|
| Baseline | 145.45±5.58 | 143.33±6.0 | 0.93 |
| Week 2 | 144.01±6.07 | 139.36±5.54 | 0.002 |

Table 2. Independent T-test for Systolic blood pressure.

| Variable | Group A Mean±SD | Group B Mean±SD | P-value |
|----------|--------------------|--------------------|---------|
| Baseline | 74.82±7.67 | 77.49±6.74 | 0.14 |
| Week 2 | 74.06±7.31 | 70.79±6.04 | 0.03 |

Reduction in mean heart rate in particular Group B was noted from 77.49±6.74 to 70.79±6.04 (P<0.05) (Table 1). Systolic blood pressure decreased from 143.33±6.0 to 139.36±5.54 (P<0.05) in inspiratory muscle training group (Table 2). Mean diastolic blood pressure was 92.48mmHg and 95.93mmHg on baseline assessment in Group A and Group B, respectively. After the respiratory training, diastolic blood pressure dropped in Group B up to 86.88mm Hg while in Group A it dropped up to 89.67mm Hg. Results were not statically significant (P>0.05).

Fig. Independent T-test for FEV₁.



The FEV₁ increased in Expiratory Muscle Training group after the 2 week exercise program (p<0.05)

(Figure). There was significant improvement in FVC in expiratory training group from 4.56 ± 0.30 to 4.92 ± 0.21 ($p=0.02$). Expiratory muscle training for 2 weeks showed improvement in peak expiratory flow rate from 4.63 ± 0.45 to 4.91 ± 0.37 ($p=0.02$). After the 2 weeks of intervention, FEV1/FVC was significantly raised in expiratory muscle training group from 0.87 ± 0.04 to 0.89 ± 0.07 ($p=0.03$) while in inspiratory muscle training FEV1/FVC was slightly raised (0.85 ± 0.043 to 0.86 ± 0.051) The estimated peak VO₂ did not changed significantly in both the groups. Estimated peak VO₂ in expiratory muscle training group was slightly raised from 26.53 ± 3.46 to 27.15 ± 3.48 only. And in inspiratory muscle training group from 25.46 ± 2.63 to 25.74 ± 2.61 .

DISCUSSION

To our knowledge this is the first randomized control trial to investigate inspiratory and expiratory muscle training on blood pressure among hypertensive subjects. In this study, it was demonstrated that inspiratory muscle training was effective in lowering blood pressure and heart rate among hypertensive subjects. There was significant reduction in systolic (-3.97 mmHg) and diastolic blood pressure (-9.05 mmHg) in the inspiratory muscle training group and also reduction in heart rate (-6.7 beats/min) that was not shown by expiratory muscle training group subjects.

The same results were reported by a study to investigate the effect of inspiratory muscle training that inspiratory muscle training reduces the blood pressure, heart rate and sympathetic activity.¹⁷ Cardiovascular modulation is related with that respiratory modulation.¹⁸ This respiratory and cardiovascular interaction affects the blood pressure because of two physiological responses first as the increase in baroreflex sensitivity¹⁹ and secondly due to reduction in sympathetic tone.^{12,14}

There is positive correlation between the sympathetic tone and blood pressure so reduction in the sympathetic tone leads to reduction in blood pressure and heart rate.¹⁴

The literature supported the same physiological phenomena about sympathetic tone and baroreflex sensitivity that device guided slow breathing exercises also reduces the sympathetic nerve

activity and increases the baroreflex sensitivity that causes drop in blood pressure as in inspiratory muscle training.^{12,20}

In our study, the inspiratory muscle training had not much influence on pulmonary function testing, as shown by another study.²¹ The expiratory muscle training group showed more improvement in aspect of pulmonary function testing in our study as the FEV1, PEF and FVC all are substantially related to forced expiration. But previously, no influence was found in improving pulmonary function testing on healthy and COPD subjects.^{17,22}

Our study showed 2 weeks respiratory muscle training had no influence on estimated peak VO₂ in both inspiratory and expiratory muscle training groups. Same results were reported in a randomized control trial.¹⁷ Likewise in a study on COPD patients, the levels on VO₂ remained unchanged after the therapy of inspiratory muscle training.²³

CONCLUSION

The study concludes that inspiratory muscle training was positively affective in lowering systolic blood pressure, diastolic blood pressure and heart rate. Expiratory muscle training was effective in improving pulmonary functions but not much effective in lowering blood pressure and heart rate. So inspiratory muscle training could be added as adjunctive non pharmacological therapy in lowering systolic, diastolic blood pressure and heart rate.

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