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Effects of Short-Term Practice of Fast Deep Breathing Exercise on Parasympathetic Functions in Trans-Femoral and Trans-Tibial-Amputation Patients

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ABSTRACT

Background of the Study: After lower limb amputation, the functioning parasympathetic system is compromised so the regular practice of breathing techniques improves cardiorespiratory functions. To determine the effects of short-term fast-breathing exercises on parasympathetic functions in amputees.

Methodology: The study was conducted at the Armed Forces Institute of Rehabilitation Medicine Rawalpindi, on 61 stable transfemoral and transtibial amputation patients within the duration of six months (January to June 2017), performed fast deep breathing exercises Parasympathetic functions were observed through different variables. Data was analyzed using IBM® SPSS® v 21.

Results: Breathing exercises showed significant effects on HR with a p-value of (0.000), the Valsalva ratio had a p-value of (0.000), and oxygen saturation was improved in both control and experimental groups with p-values of (0.000) and (0.000). Valsalva's BP systolic and diastolic p values were (0.001) (0.012), breathing exercise BP systolic and diastolic values were (0.16) and (0.000), and orthostatic testing BP systolic and diastolic p values were (0.134) and (0.389). Post Borg scale readings showed a significant decrease in exertion level

Conclusion: The study concludes that short-term fast deep breathing exercise improves cardiovagal functioning.

Keywords: *Blood pressure, breathing exercises, fast deep breathing exercises, heart rate, valsalva maneuver, systolic blood pressure, diastolic blood pressure.*

INTRODUCTION

A study conducted in Pakistan had shown the highest incidence of transtibial amputation which was 52.8%, with transfemoral amputation followed closely at 24.4%. Partial foot amputation occurred in 6.5% of cases, Symes in 7.3%, and knee disarticulation in 3.3% of patients. The diversity in amputation levels likely stemmed from the heightened utilization of IEDs and land mines by terrorist1.Breathing is the task we do clearly and with minimal responsiveness. Profound

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relaxation or deep breathing is called diaphragmatic breathing; likewise, it emphasizes the work of the diaphragm, that muscular sheet is inferior to the rib cage. A transient or short-term breathing activity helps to enhance breathing or respiratory rate. This is because the muscles require a greater amount of oxygen; also increases carbon dioxide levels encourage quicker and deeper relaxation. These activities also enhance tidal volume, the volume of air that is displaced between inhalation and exhalation when more force is applied. At the point where relaxation practice is carried out tidal volume increases to permit the entire air to pass to the lungs. Relaxing or breathing activities enhance pulmonary functions, cardiorespiratory fitness, posture, respiratory muscle length, and furthermore respiratory muscle quality. When the body goes into a relaxation position, blood pressure drops, and the immune system works at the top level, which lowers heart rate lowers and breathing rate[2]. Passive heart functioning is affected in transtibial and transfemoral amputation patients so breathing is the most essential function for maintenance of cardiopulmonary health. Studies showed that breathing exercises reduce HR & BP. The parasympathetic sensory system plays an important role among the three divisions of the autonomic nervous system. The autonomic sensory system is very important for evaluating the body's conscious events. It controls rest-digest and feed-breed movements happening at the time of rest, especially after eating, sexual stimulation, tears, urination, etc[3,4]. When an individual expires forcefully in resistance to closed glottis, intrathoracic pressure changes significantly and affects venous return, cardiac output, arterial pressure and heart rate. This maneuver is called Valsalva[14,15]. Valsalva ratio is the ratio between heart rates of phase IV and phase II, and I it is basically a measurement of vagal activity. It increases heart rate in phase II and decreases blood pressure, blood pressure overshoots in phase IV that's temporary bradycardia[5,6]. Transient breathing practice can lower the blood pressure[7]. Deep breathing can increase cardiovagal sensitivity in humans[8]. It was observed in a study that a slow type of breathing decreases blood pressure significantly and little drop-in heart rate. Slow breathing shows significant improvement in autonomic nervous system by increased activation of parasympathetic system[9]. Autonomic control of heart rate and blood pressure can be assessing through Valsalva maneuver. An alteration in heart rate and blood pressure indicates constant changes in sympathetic and parasympathetic activity[10]. Oxygen saturation plays an important role in monitoring patient's health, and it is measured by pulse oximeter that is standard tool during asthma, anesthesia, pre and post-operative recoveries. Oxygen level measurement is essential for infants with respiratory illness, adults and in other serious problems[11, 12].Objectives of the study were 1. To determine the effects of short-term fast deep breathing exercises in patients with trans-femoral and trans-tibial amputation, 2. To determine the effects of short-term fast deep breathing exercise on parasympathetic function.

Impaired passive heart function is observed in individuals with transtibial and transfemoral amputations, making respiratory function crucial for maintaining cardiopulmonary health. Previous research indicates that engaging in breathing exercises can lead to a reduction in heart rate (HR) and blood pressure (BP). Given the limited existing literature on the subject, the current study was formulated to investigate the effects of short-term, rapid deep breathing exercises on amputees. This research aims to contribute valuable insights into recognizing the positive impacts of deep breathing exercises, particularly for individuals with transtibial and transfemoral amputations. The findings could potentially support the integration of these exercises into the rehabilitation regimen for amputees.

METHODOLOGY

RCT trial was conducted at AFIRM (Armed Forces Institute of Rehabilitation medicine from January 2017-July 2017. Total 61 stable patients with transfemoral and transtibial amputation were included whereas related Diagnosed Heart Diseases, Arrhythmias, Neurological disorders and other Co- Morbidities patients were excluded. Eligible patients were randomly divided into two groups. 61 patients were included in control group and 60 patients in experimental group. Randomization was done through toss and coin method. The patients were briefed about the study

protocol and permission was obtained from them. Consent of ethics committee was obtained. They were also instructed not to practice any techniques other than the given one and other physical exercises during the study duration. Two groups were selected through purposive non probability sampling method. These groups are control group (normal breathing group) and experimental group (fast breathing group). The group members were briefed about the protocol and informed consent was obtained from them. Parasympathetic functions were measured through HR and BP before and after performing orthostatic testing and Valsalva maneuver and breathing exercises were performed during these tests. All the patients were assessed at baseline prior to intervention and after completion of 15 days of protocol. Data was analyzed using SPSS 21 software and expressed in the form of tables, charts and graphs.

RESULTS

Majority of the amputations were transtibial in both groups with frequencies and percentages of 20 (67%) in experimental group, 22(71%) in control group.

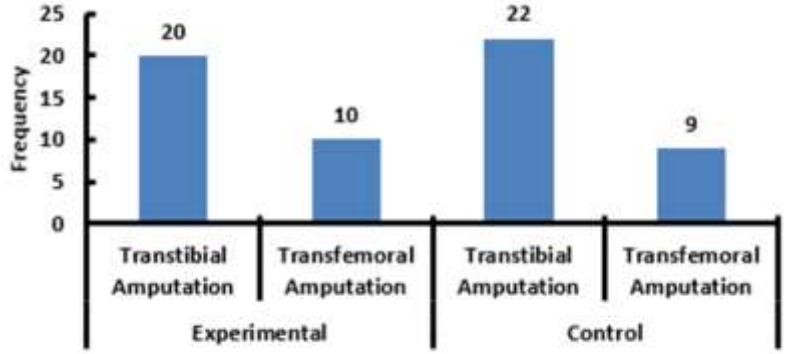

Fig 01: Level of Amputation

Post Borg scale results shows the significant decrease in exertion level in experimental group i.e. from category (1very light exertion) – (0.5 very light exertion).

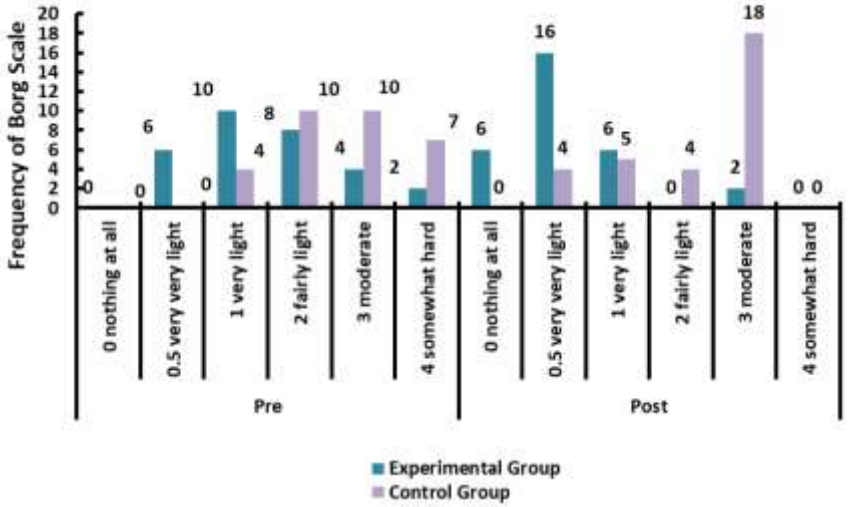

Fig 02: Borg Scale

Using Friedman test HR was non-comparable at baseline, shown by P value of 0.003 in experimental group and 0.000 in control group and post values of p were 0.000 in experimental

group and 0.421 in control group so it is shown that there was a notable statistically observed difference between two groups there was better improvement in heart rate after 15 days of session.

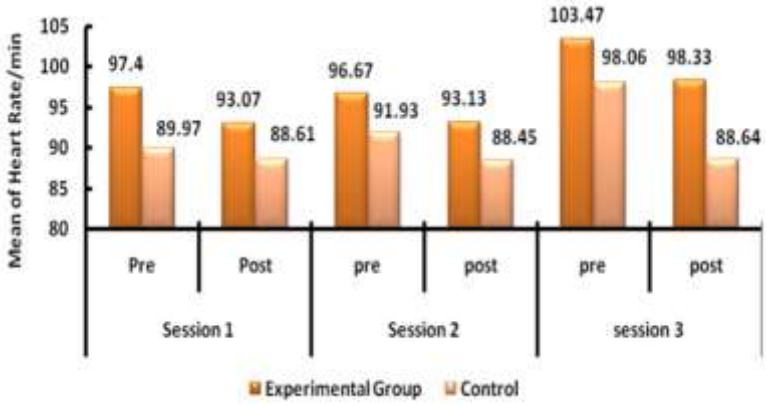

Fig 03: Valsalva Heart Rate

Valsalva ratio improved the heart rate which showing statistically significant with P value (<0.05).

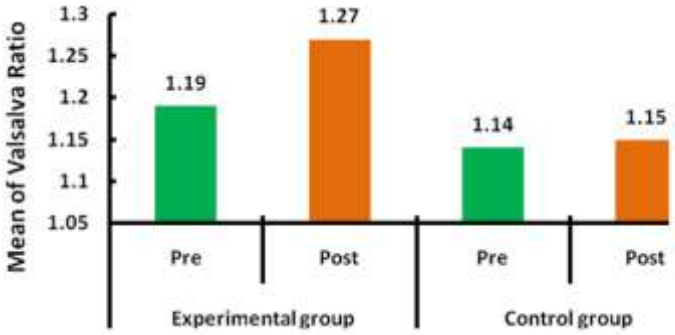

Fig 04: Valsalva Ratio

Using wilcoxon test HR values indicate difference between two groups shown by P value of 0.000 in experimental group and 0.345 as p value is less than 0.05 so it is shown that there was better improvement in heart rate of breathing exercise after 15 days of session (Fig:5). There was no significant improvement in Bp systolic after 15 days of session (Fig:6). There was better improvement in Bp diastolic after 15 days of session (Fig:7).

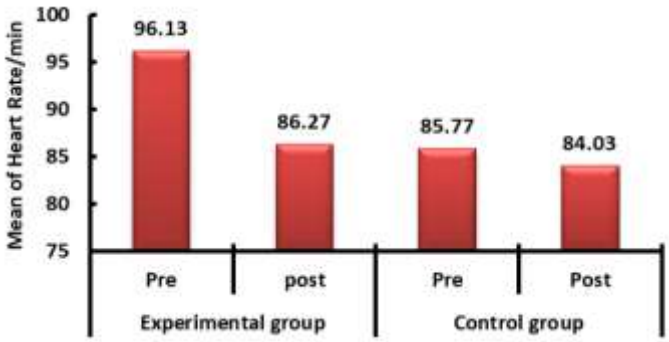

Fig 05: Breathing Exercises Heart Rate

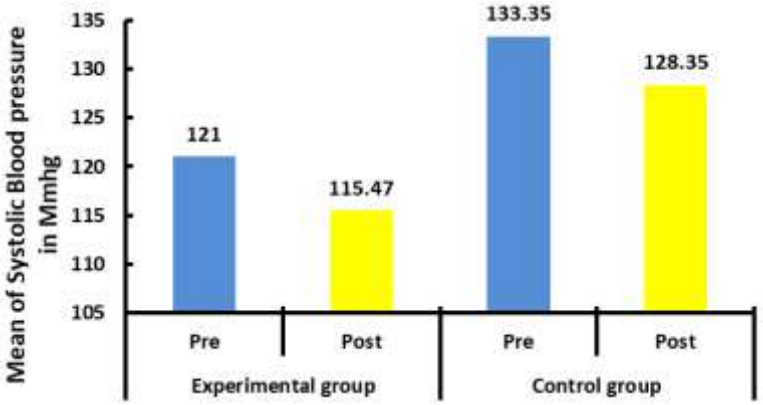

Fig 06: Breathing exercises Systolic BP

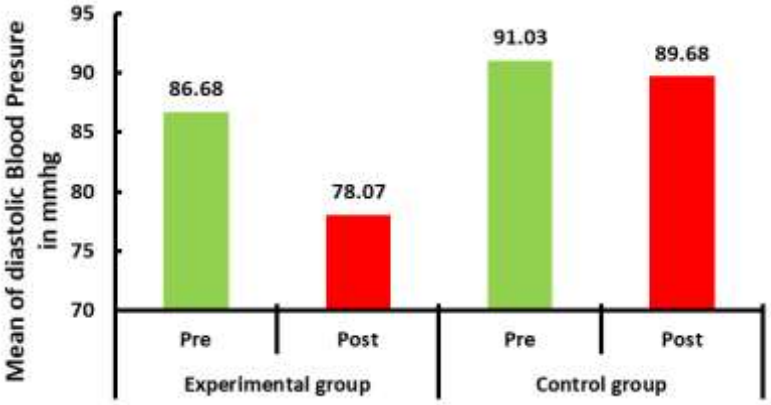

Fig 07: Breathing exercises Diastolic BP

Oxygen saturation can be improved through short-term fast deep breathing exercise and also from normal breathing exercise (Fig:8).

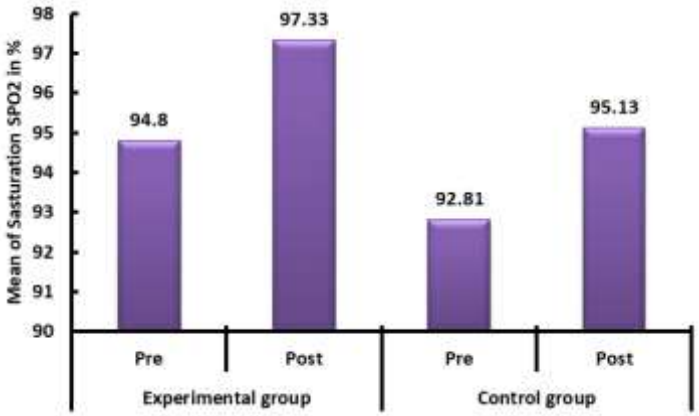

Fig 08: Breathing Exercises SPO2

Using wilcoxon test in HR values no significant change was found between both groups with p values of 0.132 in experimental group and 0.475 in control group (Fig:9).

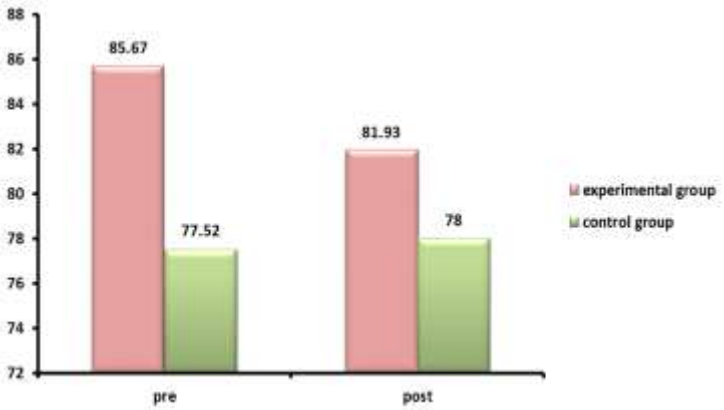

Fig 08: Orthostatic testing 5 min lying HR

DISCUSSION

Deep breathing exercises and relaxation exercises will help to increase vital capacity, decrease anxiety and prevent bronchopneumonia which in turn increases parasympathetic activity after amputation. Oxygen Saturation also remarkably improves via breathing exercises following amputations according to findings of several studies. Patient satisfaction with the treatment protocol depends on the level of amputation as there was the highest degree of satisfaction in patients with transtibial amputation as compared to the patients with transfemoral amputation. This was observed in this study during data collection. Regularly practicing breathing exercises have shown better improvement in the study demonstrated that regular practice of slow breathing exercises can help improve cardiovascular and respiratory functions and improve the effects of stress following amputation. It was observed that this practice reduced sympathetic tone in both healthy volunteers and amputees. Hence, these exercises also improve volume of air that is called tidal volume to allow more air to lungs which improves overall health status including pulmonary functions, cardio respiratory fitness, and respiratory muscle length and breathing muscles strength[13,14]. Findings of our study coincides with findings of previous studies which showed that deep breathing work reduces heart rate and blood pressure. Previous study supports the fact that Transtibial amputations are very common and the reliability and validity of the TT Amputations after monitoring activities such as potential use of rehabilitation and physical therapy when performed post-operatively[15], this clearly coincide with the findings of our study that majority of our population also undergoes through transtibial amputations. According to a study change in heart rate during Valsalva maneuver provides a safe method for assessment of cardiac function[16, 17]. And another study states that the when intrathoracic pressure increases it produces change in preload and after load. Venous return reduces and in result peripheral resistance increases, this produces positive effects on cardiac contractility. As the presence of diminished venous return ultimately shows beneficial effects in reducing heart rate in people undergoing amputation[18,19] these findings directly correlate with the findings of our study that venous return reduces and peripheral resistance increases which as well clinically shows positive effects on heart rate after performing Valsalva maneuver. In general, individuals with trans-tibial amputation, whether unilateral or bilateral, tend to have better coping abilities compared to those who undergo above-knee amputation. As a result, rehabilitation for this group presents challenges, necessitating optimization of their underlying medical condition and close medical supervision to prevent cardiovascular complications. So, the study implies that incorporating breathing exercises into the rehabilitation regimen of these patients could provide added benefits to their overall well-being and exponentially improves Oxygen saturation along[20]. Findings directly coincide with the findings of our study that short-term deep breathing exercises shows significant improvement in the oxygen saturation.

CONCLUSION

Now we have come to the conclusion that short-term fast deep breathing exercise shows positive benefits on parasympathetic functions in amputation patients. Individuals that perform these short-term exercises can improve their overall health but further researches are required to confirm the outcomes of the study.

RECOMMENDATIONS

On the basis of experience of this study we recommend to: Further researches should be done because there are no studies regarding autonomic functioning in amputation patients. To conduct a research on amputation patients one must has to keep several points in mind that, courteous and gentle words towards them as regard and care mean a lot to them. The time duration should have to be long enough to cover almost everything regarding all aspects of the study.

AUTHORS' CONTRIBUTION:
The following authors have made substantial contributions to the manuscript as under:
Conception or Design: Faryal Naveed
Acquisition, Analysis or Interpretation of Data: Iqbal Tariq, Madiha Ashfaq & Sana Bashir
Manuscript Writing & Approval: Sana Bashir, Hina Shafi, Marwa Asim
All authors acknowledge their accountability for all facets of the research, ensuring that any concerns regarding the accuracy or integrity of the work are duly investigated and resolved.

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