Original Article

Immediate Effects of Diaphragmatic Breathing Versus Pursed Lip Breathing on Blood Pressure, Pulse Rate and Oxygen Saturation of Patients with Hypertension

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ABSTRACT

Objective: To compare the immediate effects of diaphragmatic breathing and pursed lip breathing exercise on blood pressure, pulse rate and oxygen saturation in hypertensive people.
Study Design: Randomized Clinical Trial
Place and Duration of Study: This study was conducted at the Community Dwelling Areas of Lahore Study was completed in 6 months from December, 2020 to June, 2021.
Materials and Methods: One group was given diaphragmatic breathing exercise (DBE) and other was instructed pursed lip breathing exercise (PLBE). Pre and Post treatment values of blood pressure(BP), pulse(PR) and oxygen saturation(PSO2) were recorded.
Results: In across the group comparison both groups showed significant changes after treatment with $p<0.05$.
Conclusion: Diaphragmatic breathing and pursed lip breathing are equally effective in decreasing BP, HB and surging PSO2.
Key Words: blood pressure, breathing exercise, diaphragmatic breathing exercise, heartbeat, hypertension, oxygen saturation, pulse rate

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INTRODUCTION

WHO states "In hypertension (HTN) blood vessels have continuously spiked pressure that puts vessels under stress". High blood pressure (BP) is ≥ 140/90 mm Hg. More than **1 in 5 adults** have HTN around the globe. HTN is the main cause for stroke and many cardiac conditions [(1)]. In developing countries much of the population with HTN is not aware of their pathology. Many of them have little or no access to treatment that can control HTN or prevent deaths and complications due to HTN[(1)].

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Pharmaceutical treatment for controlling blood pressure is much expensive and people in poor income countries cannot afford these medicines [(2)]. Moreover, these medicines can have different sideffects on kindney, liver and other systems of body. According to National Health survey of Pakistan, every third person over the age of 40 years becomes increasingly vulnrable to different health conditions due to increased blood pressure. Furthermore, only 50% of people with HTN ever got a diagnosis and only half of these diagnosed cases ever got a treatment [(3)].

All the above mentioned problems can be overcome by breathing exercises. It is both involountary as well as volountary process [(4)].

Breathing Exercise (BE): Consciously, breathing can be used to have an impact on sympathetic nervous system (SNS) so that heart rate (HR), circulation, BP and other body functions can be regulated[(2, 5)].

Breathing exercises are categorized under therapeutic interventions in which purposepful modification is achieved in a specific breathing pattern [(6)].

Role of Pursed Lip Breathing Exercise (PLBE): This generates remarkable changes in pressure gradient for oxygen that leads to more oxygen in alveoli. This leads to improved oxygen saturation of body. Oxygen

saturation (PSO2) is presence of oxygenated haemoglobin in blood [7-9] .

Deep breathing exercises increase baroreflex senstivity and vagal tone that lead to decrease in BP and pulse rate (PR)[10].

Role of Diaphragmatic breathing Exercise (DBE): It causes improvements in sympathetic and parasympathetic nervous system(PNS). It shows improvements in cardiopulmonary baroceptor stretch reflex hence decreasing peripheral vascular resistance[10]. DBE improves HR variability that shows the changes in SNS and PNS [11]. During inhalation negative intrathoracic pressure is generated that acts as a vaccum for blood thereby DBE improves venous return to heart and that increases the stroke volume and then which in return triggers the arterial stretchreceptors. These arterial stretchreceptors triggers PNS and decreases the SNS. These stimulations cause BP and PR to drop due to decrease in peripheral resistance[12-13].

There are plethora of studies on DBE, nostril breathing, paced breathing and other types of breathings and on their effects on BP, PR and PSO2 in other patient populations and on healthy individuals as well, but in the patients with HTN no comparison has been made between breathing techniques yet, stating which one is effective. Secondly, already present studies had shown long term effects mostly, not the immediate effects of breathing exercises on BP, PR and PSO2 of patients with hypertension. In under developing countries where poverty has been shooting with every passing hour in a way that people cannot afford costly medicines, there is a need to look for other therapeutically effective techniques like DBE and PLBE. These techniques are inexpensive, easy to perform and contain no known harmful effect. Hence, this study undertook this task of finding out what are the immediate possible effects of DBE and PLBE on the BP, PR and SO2 and secondly which technique is more effective.

MATERIALS AND METHODS

Study design was randomized clinical trial with non probability convenient sampling. Data was collected from community dwelling areas. Data was collected within 6 months. Total sample was 46 with 23 in each group.

Inclusion: Patients with hypertension (stage 1 and stage 2) with BP ≥ 140/90mmHg, 40 to 60 years of age people, both genders, patients who had taken no antihypertensive medicines or who had taken antihypertensive medicines more than 6 hours ago were considered.

Exclusion: Patients with lung conditions and cardiovascular issues e.g. exacerbation of COPD, Asthma, lung surgies, MI, thoracic surgies, cardiovascular related surgies; patients with speech issues and pateints who were critically ill e.g. with mental illness, psychosocial issus, cancer, infectious diseases, and comatose patients were excluded.

Patients were asked for their consent first and they were made fully aware about techniques. It was single blinded study with blinding of assessor.

Participants were allocated to the groups through randomization using coin toss method. Physiotherapist guided the one group of patients to do PLBE by inhaling through the nose [14] for two counts, keeping mouth closed. Then the subjects were asked to pursue their lips, and breathe out slowly through pursed- lips while counting to four. Other group of patients was asked with back and head supported to perform DBE by placing one hand on abdomin and other on chest for sensory feedback. Then they were asked to breathe in slowly and deeply through the nose as if filling their abdomins with air while keeping the shoulder and upper chest relaxed during the proceedure. Then the patients were instructed to slowly let all the air out through the mouth as if letting the air out of their abdomins [12].

Both interventions were applied for 3 to 4 repeatitions and then rest was given for one minute, a total of 5 sets were given. Pre interventional BP, PR and PSO2 were taken for both groups on the same day. Post intervention BP, PR and PSO2 were taken after 5 minutes[15] of completion of intervention for both groups. Average was taken of two consecutive readings of blood pressure pre and post intervention in both groups. Data was analyzed using IBM SPSS Statistic 21. Aneriod Sphygmomanometer for measuring BP was used. Pulse oximeter for measuring PSO2 and PR was used.

RESULTS

Table 1 shows clinical and descriptive statistics for DBE and PLBE group. It shows mean age 53.2 (5.6) years, mean hypertension history 7.7 (4.7) years, pretreatment Systolic BP (SBP) mean 147.6 (7.3) mm Hg, pretreatment Diastolic BP (DBP) mean 93.2 (6.14) mmHg, pretreatment oxygen saturation means 97.3 (0.9) % and pretreatment pulse rate 84.5 (8.5) beats per minute for DBE. It shows mean age 52.2 (6.3) years, mean hypertension history 6.5 (5.4) years, pretreatment SBP mean 148.0 (7.2) mm Hg, pretreatment DBP mean 94.8 (5.3) mmHg, pretreatment oxygen saturation means 97.1 (0.9) % and pretreatment pulse rate 85.3 (12.8) beats per minute for pursed lip breathing group.

DBE group had 43.48% females and 56.52% males whereas PLBE group had 43.48% males and 56.52% females.

This study has used Shapiro-Wilk normality test as sample size was smaller than 50. All variables have p value less than 0.05 that shows this data is non-parametric. So for comparing two groups, this study used Mann Whitney U test. For pre and post treatment comparison with in the groups, Wilcoxin Rank Test was used. Table 2 shows that there was no significant

changes in systolic, DBP, PSO2 and PR after treatment between both groups with p= 0.40 for SBP; p= 0.51 for DBP; p=0.14 for PSO2; & p= 0.91 for PR. Table 3 shows for DBE group, number of negatives is more in case of average BP values and PR values and number of positive is more in case of PSO2 values. Table 4 shows for PLBE group, number of negatives is more in case of average BP values and heart beat values and number of positives is more in case of PSO2 values.

Table No.1: Descriptive and Clinical Demographics of Diaphragmatic group & Pursed Lip Breathing

Variables in Diaphragmatic Breathing Exercise Group	Minimum Value		Maximum Value		Mean (S.D)	
	DBE	PLBE	DBE	PLBE	DBE	PLBE
Age/years	41	40	60	60	53.2 (5.6)	52.2 (6.3)
History of HTN/ years	2	1	20	20	7.7 (4.8)	6.5 (5.4)
Pre Treatment SBP mmHg	140	140	160	162	147.6 (7.3)	148.0 (7.2)
Pre Treatment DBP/ mmHg	88	90	110	110	93.2 (6.1)	94.8 (5.3)
Pre Treatment PSO2 %	96%	95%	99%	99%	97.3 (0.9)	97.1 (0.9)
Pre Treatment PR bpm	70	70	100	116	84.5 (8.5)	85.3 (12.8)

Table No.2: Post treatment comparison of both groups using Mann Whitney

Factors	Intervention	P-Value
Post SBP	DBE	0.40
	PLBE	
Post DBP	DBE	0.51
	PLBE	
Post PSO2	DBE	0.14
	PLBE	
Post PR	DBE	0.91
	PLBE	

Table No.3: With in group changes in Diaphragmatic Breathing group using Wilcoxin test

Variables	Ranks	No.	Mean Ranks
post treatment - Pre treatment average SBP	Negatives	18	9.5
	Positives	0	0.0
	Ties	5	
post treatment average - pre treatment average DBP	Negatives	7	4.0
	Positives	0	0.0
	ties	16	
post treatment - pre treatment PSO2	Negatives	1	7.5
	Positives	15	8.6
	ties	7	
post treatment - pre treatment PR	Negatives	23	12.0
	Positives	0	0.0
	ties	0	

Table No.4: With in group changes in Pursed lip breathing group using Wilcoxin Test

Variables	Ranks	No.	Mean Ranks
post treatment - Pre treatment average SBP	Negatives	13	7.0
	Positives	0	0.0
	Ties	10	
post treatment average - pre treatment average DBP	Negatives	18	10.1
	Positives	3	16.5
	ties	2	
post treatment - pre treatment PSO2	Negatives	0	0.0
	Positives	13	7.0
	ties	10	
post treatment - pre treatment PR	Negatives	23	12.0
	Positives	0	0.0
	ties	0	

Table 5 shows that within the group, SBP, DBP, PSO2 and PR in pre and post treatment differ with significant changes in both groups (For DBE: p<0.001 for SBP; p=0.01 for DBP; p<0.01 for PSO2 & p<0.001 for PR; For PLBE: p<0.001 for SBP; p=0.02 for DBP; p<0.001 for PSO2 & p<0.001 for PR).

Table No.5: P values for DBE and for PLBE using Wilcoxin Test

Variables	p-value	p-value
	Diaphragmatic Exercise	Pursed Lip Breathing Exercise
SBP	<0.001	<0.001
DBP	0.01	0.02
PSO2	<0.01	<0.001
PR	<0.001	<0.001

DISCUSSION

Current study found that pursed lip breathing and diaphragmatic breathing are equally effective in decreasing blood pressure, pulse rate and in improving saturations of patients with HTN. This study results about curbing the raised blood pressure levels after administration of pursed lip breathing (p<0.05) is in agreement with the significant results (p <0.05) of declining blood pressure following PLBE about young healthy college going students. But this investigation found none of the techniques more effective in decreasing blood pressure, pulse rate and surging oxygen saturation with p>0.05 while using Mann Whitney test.

However, a research found that PLBE group was more effective in diminishing BP and spiking saturations with p<0.05, whereas, diaphragmatic breathing was more effective in reducing pulses with p<0.05.

Another [16] about effectiveness of DBE on HR, BP and PSO2 in elder patients with hypertension concluded that DBE is statistically and clinically effective in decreasing systolic blood pressure (r= 0.46), diastolic blood pressure(r=0.39), pulse rate (r=0.39) and in improving oxygen saturation levels (r=0.56) all with p values<0.05.

Above mentioned findings are similar to this investigation's findings about effectiveness of DBE in improving systolic blood pressure levels, diastolic blood pressure levels, pulse rates and PSO2 all with p values<0.05.

Yan Zou et.al conducted a Meta-Analysis of 6 studies in 2017 and included studies from 1966 to 2016 about the Voluntary Slow Breathing Exercises for maintaining blood pressures and heart rates in patient with cardiovascular problems and they reached the conclusion that voluntary and slow breathing exercises decrease SBP, DBP and heart rates statistically all with p<0.05; and this decreases the chances of myocardial event in such patients [17].

However, current study shows decrease in SBP, DBP and pulse rate both in PLBE & DBE with negatives =18, mean rank = 9.5 for SBP, negatives = 7, mean rank = 4 for DBP & negatives = 23, mean rank = 12 for PR in DBE; with negatives= 13, mean rank= 7 for SBP, negatives = 18, mean ranks= 10.08 for DBP, negatives= 23, mean ranks= 12 for PR for PLBE. Hence current investigation showed more negatives than positives while subtracting pretreatment values from post treatment values in cases of BP and PR in both groups. This point out that current study is in agreement with results from study by Yan Zou et.al.

Randomized control trial about effect of deep breathing exercise on PSO2 of patients with surgery of abdomen by Mostafa et.al showed significant difference between experimental and control groups of study with p<0.05 using t-test. This finding from literature that is again in agreement with findings of current study about PSO2 in blood that showed PSO2 changed significantly with p<0.05 after administration of forms of deep breathing exercise (PLBE & DBE)[18] .

A study about DBE impact on BP and PR in people with prehypertension showed that significant changes were there in decreasing blood pressure with p<0.05, this finding is similar to the finding of this study that represented p< 0.05 in case of SBP and DBP.

Additionally, there was no significant change was found in PR following the DBE with p>0.05. However, present study found significant changes in PR with p<0.05 after DBE.

CONCLUSION

Diaphragmatic breathing and pursed lip breathing are equally effective in decreasing BP, HB and surging PSO2.

Recommendations

- This study suggests future researchers to increase the size of data.
- Additionally, it is also recommended to recruit other diseased populations as well.
- Future investigators should add more age groups to get clearer picture.
- Comparative studies of breathing exercises with antihypertensive drugs can also be adopted in order to study the effectiveness of both interventions.
- Furthermore, respiratory rates, frequencies and durations of these breathing exercises can also be altered in order to draw conclusions about BP, PR and PSO2 based on these factors

Author's Contribution:

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