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Effect of Buteyko Breathing Technique on Haemodynamic Parameters and Functional Capacity in Subjects with Primary Hypertension

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Abstract

The Buteyko Breathing Technique (BBT) has been found to be effective in the treatment of Asthma, Obstructive Airway Disease and other diseases. Its effect on Hypertension has not been studied.

Aim and Objectives: To study the effect of Buteyko Breathing technique for 4 weeks on Hemodynamic parameters and functional capacity in subjects with primary hypertension.

Methodology: Parallel group study design in which 66 subjects from Hypertension OPD of Tertiary Health Care Centre were enrolled after taking their consent and Institutional Ethical approval. The subjects were randomly allocated to Control (N=33) (receiving standard treatment of care) and Experimental (N=33) (receiving Buteyko and standard treatment of care). Standard treatment of care included medication and educational videos on Hypertension, its complications and management. Buteyko Breathing Technique included supervised session of 30 minutes using a video once in a week for 4 weeks. Subjects were informed to perform these exercises at home daily.

Results: The experimental group showed a significant reduction in SBP (p=0.00), DBP (p=0.00), Resting HR (p=0.00) and a significant improvement in Control Pause (p=0.00) and 6MWD (p=0.00). There was a mean reduction in SBP of 8.6 + 6.31 mmHg (95% CI, 10.84- 6.36 mmHg) and in DBP of 4.606 + 4.34 mmHg (95% CI, 6.14-3.06mmHg).

Conclusion: Buteyko Breathing Technique has a positive effect on Haemodynamic parameters and functional capacity in subjects with Essential Hypertension.

Keywords: Hypertension; Buteyko Breathing Technique; slow breathing.

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Introduction

Cardiovascular diseases cause about 18 million deaths of about which 30% deaths are attributed to Cardiovascular diseases & Stroke. Amongst the common risk factor, Hypertension remains the leading cause of premature morbidity and mortality. Hypertension ranks third important risk factor attributing to the burden of cardiovascular diseases. Prevalence of hypertension in India has been reported as 33.8% in urban and 27.6% in rural areas with overall prevalence of 29.8%. According to the latest guidelines, Hypertension in adults is defined as systolic pressure greater than 140 mmHg and / or Diastolic pressure greater than 90 mmHg.[1,2]

Essential hypertension is high blood pressure in which secondary causes such as renovascular diseases, renal failure, Pheochromocytoma, Aldosteronism or other causal factors of secondary hypertension are not present. Factors like obesity, insulin resistance, high alcohol intake, high salt intake, aging, sedentary lifestyle, stress, low calcium intake and low potassium are associated with raised blood pressure.

Essential Hypertension is a chronic disease that requires long term self-management. Lifestyle modification strategies include alterations in eating behaviors like adopting the dietary approaches to stop hypertension (DASH), engaging in physical activity, reducing alcohol consumption, cessation of smoking and weight reduction. Dickinson HO, Mason JM and Nicolson DJ (2006) reported a reduction of 5 mm Hg and 3.7 mm Hg in Systolic BP and Diastolic BP respectively with dietary changes while increased physical activity and exercise reduced Systolic BP and Diastolic BP by 4.6 mm Hg and 2.4 mm Hg respectively. As can be seen both diet and exercises were equally effective and that a change of 5mm Hg was minimal clinically important difference noted for systolic blood pressure.

American Heart Association Guidelines 2017 state that 20% patients with Hypertension followed their treatment plans well enough to improve blood pressure whereas in India (National Indian guidelines of Hypertension, 2019), the levels of control of blood pressure was 20% in urban and 11% in rural areas.

As stated by Rosalba Courtney (2008) "The Buteyko Breathing Method is a unique breathing therapy that uses breath control and breath-holding exercises to treat a wide range of health conditions believed to be connected to hyperventilation and low carbon dioxide." This technique was developed by Dr. Konstantin Pavlovich Buteyko, a Russian physiologist. It aimed to "retrain" the breathing pattern to correct the oxygen and carbon dioxide levels in the bloodstream. According to Buteyko, chronic hidden hyperventilation on account of stressful lifestyle resulted in low carbon dioxide levels in the blood. This depletion of carbon dioxide affects the Krebs cycle, vital chemical reactions requiring carbon compounds and other key homeostatic processes in the cell. In order to retain the carbon dioxide, the body activates a series of defense mechanisms including constriction of airways and blood vessels, giving rise to conditions such as asthma and hypertension.[3]

There are numerous studies which have reported positive outcomes of Buteyko breathing in the management of Asthma, Anxiety disorders and Obstructive airway disease. A case series (2019) on Buteyko breathing method in subjects with COPD reported a mean reduction in systolic blood pressure by 4.16 ± 3.76mm of Hg and diastolic blood pressure by 5 ± 3.16mm of Hg and pulse rate by 2.5 ± 1.04/ minute following 2 weeks of intervention.4 Hence, this study aimed to evaluate the effect of Buteyko breathing technique on hemodynamic parameters and functional capacity in subjects with Hypertension.

Methodology

Outcome Measures Measured Pre and Post 4 weeks of Intervention:

1. Systolic (SBP) and Diastolic (DBP) blood pressure in mm Hg
2. 6 Minute Walk distance in Meters
3. Resting HR
4. Control Pause: Time in seconds required to hold a breath after an ordinary exhalation until the first urge to breath.

Control Group: Standard Treatment of Care

Standard Treatment of Care included medical management with antihypertensive medications and

patient education using a video. Patient education video included the following

a) Hypertension: what is hypertension, prevalence, complications, importance of medication and compliance to medications.

b) Lifestyle modification guidelines:

   i) Dietary Approaches to stop Hypertension (DASH):

   ii) Physical Activity: Walking at moderate intensity 20–25 min/day or 90-150 min/ week

   iii) Rest and relaxation.

   iv) Reducing alcohol consumption to 2 standard drinks per day.

Experimental Group: Standard treatment of care + Buteyko technique

In addition to Standard Treatment of Care, the subjects were given Buteyko Breathing. The subjects were seated in a chair with proper back support and were asked to adapt a good posture with relaxed shoulders and lower back.

Control Pause: Subjects were instructed to inhale a small breath from the nose and exhale through the mouth with pursed lips. At the end of normal exhalation, the subjects were made to hold the "out" breath by closing their nostrils with their dominant hand till the first urge to breathe in was felt.[9]

Slow breathing: Subjects were instructed to breathe **in and out** air gently by nose and continue slow nasal breathing at slow pace, best comfortable for him / her.

One set included 1 Control Pause and Slow breathing for 3min. Five sets followed by a rest period of 2 minutes and another 5 sets were performed in a single session.

Results

Data was analyzed using SPSS 16 software. Parametric t tests (paired and unpaired) were used for data passing normality and nonparametric tests (Wilcoxon Sign Rank and Mann Whitney U) were used. Ancova analysis was done for those variables that showed differences between groups at baseline. Effect size was calculated using Cohen's d. Statistical significance was set at 0.05.

Table 1: Baseline comparison between both groups

	Data	Control	Experimental	P
SBP (mmHg)	Mean	126.2 + 2.11	125.5+ 9.09	0.234
	Median	130.0	128.00	
	95%CI	118.9-133.9	122.2-128.6	
	SE	3.667	1.582	
DBP (mm Hg)	Mean	83.33 +1.08	82.909 + 8.03	0.637
	Median	82.00	82.00	
	95%CI	79.47- 87.18	80.06 - +85.75	
	SE	1.89	1.398	
Resting HR (Beats/min)	Mean	76.42 1.005	82.66 9.79	0.013
	Median	76.00	82.00	
	95%CI	72.86-79.98	79.19 – 86.14	
	SE	1.745	1.705	
CP (seconds)	Mean	26.87 6.57	22.06 + 6.80	0.002
	Median	25.00	21.00	
	95%CI	24.54 – 29.20	19.64- 24.47	
	SE	1.14	1.185	
6MWD	Mean	418.4 + 4.25	418.2 + 492.5	0.745
	Median	410.0	430.0	
	95%CI	399.7 – 429.9	401.0- 436.0	
	SE	7.399	8.574	

@ Mann Whitney test

unpaired t test

The above Table shows that there was a significant difference in Control pause (p=0.002) and Resting HR (p=0.013) between the groups at baseline.

Table 2: Pre and Post Comparison between groups

		Control Group		P	Experimental Group		p
		Pre	Post		Pre	Post	
SBP (mmHg)	Mean	126.4 ± 21.1	127.3 ± 9.78	0.36@	125.5 ± 9.09	116.9 ± 8.53	0.000#
	Median	130.0	128.0		128.0	118.0	
	95%CI	118.9-133.9	123.8-130.8		122-128.8	113.9-119.9	
	SE	3.677	1.702		1.582	1.485	
DBP (mmHg)	Mean	83.33 ± 10.8	80.36 ± 9.00	0.053@	82.90 ± 8.03	78.30 ± 6.32	0.000#
	Median	82.00	80.00		82.00	80.00	
	95%CI	79.47-87.18	77.17-83.55		80.06-85.75	76.05-80.54	
	SE	1.890	1.567		1.398	1.101	
Resting HR (beats/ minute)	Mean	76.42 ± 10.05	77.69 ± 9.85	0.290#	82.66 ± 9.79	74.84 ± 8.43	0.000#
	Median	76.00	78.00		82.00	73.00	
	95%CI	72.86-79.98	74.20-81.19		79.19 – 86.14	71.85-77.83	
	SE	1.749	1.715		1.705	1.467	
CP (seconds)	Mean	26.87 ± 6.57	27.36 ± 6.94	0.208@	22.06 ± 6.80	31.81 ± 8.38	0.000#
	Median	25.00	25.00		21.00	30.00	
	95%CI	24.54-29.20	24.90-29.83		19.64 – 24.47	28.84-34.79	
	SE	1.143	1.209		1.187	1.459	
6 MWD (meters)	Mean	414.8 ± 42.50	432.2 ± 44.5	0.000#	418.5 ± 49.25	435.1 ± 48.6	0.000@
	Median	410.0	430.0		430.0	440	
	95%CI	399.0-429.9	416.6-448.2		401.0-436.0	417.9-452.3	
	SE	7.399	7.74		8.57	8.46	

@ Wilcoxin Rank test

paired t test

The above table shows that there was a significant difference in the Experimental Group ($p<0.05$) as compared to the Control group.

Table 3: Comparison of the differences in both groups

Data		Control Group	Experimental Group	p
SBP (mmHg)	Mean	0.909 ± 20.4	-8.60 ± 6.31	0.00@
	Median	-2.00	-6.00	
	95%CI	-6.33 to 8.15	-10.8 to -6.36	
	SE	3.55	1.099	
DBP (mmHg)	Mean	-2.96 ± 8.26	-4.606 ± 4.34	0.003@
	Median	-2.00	-4.00	
	95%CI	-5.89 to -0.0397	-6.146 to -3.06	
	SE	1.43	0.756	

Data		Control Group	Experimental Group	p
Resting HR (beats/ minute)	Mean	1.27 ± 6.797	-7.818 ± 5.021	0.000#
	Median	1.00	-7.00	
	95%CI	-1.137 to 3.683	-9.598 to -6.037	
	SE	1.182	0.874	
CP (seconds)	Mean	0.484 ± 2.501	9.757 ± 5.67	0.000@
	Median	1.00	8.00	
	95%CI	-0.402 to 1.37	7.745 to 11.76	
	SE	0.435	0.987	
6MWD (meters)	Mean	17.57 ± 16.58	16.60 ± 15.12	0.000@
	Median	20.00	20.00	
	95%CI	11.69 to 23.45	11.241 to 21.970	
	SE	2.887	2.633	

Table 4: ANCOVA analysis of Resting HR and CP

	Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Resting HR (beats/min)	Corrected Model	3639.199[a]	2	1819.599	61.044	0.000
	Intercept	282.086	1	282.086	9.463	0.003
	HR_PRE	3505.320	1	3505.320	117.597	0.000
	Groups	843.023	1	843.023	28.282	0.000
CP (seconds)	Corrected Model	2899.564[a]	2	1449.782	74.719	0.000
	Intercept	183.167	1	183.167	9.440	0.003
	CP_PRE	2572.155	1	2572.155	132.565	0.000
	Groups	1184.027	1	1184.027	61.023	0.000

The above table shows that the there was an overall statistically significant difference in post-intervention Resting HR and CP (post) between the different interventions (group) once their means had been adjusted for pre-intervention Resting HR and CP.

Discussion

Chacko N. Joseph et. al. in a study titled "Slow breathing improves arterial baroreflex sensitivity and reduces blood pressure in Essential hypertension" studied the effect of slow breathing on Blood pressure, RR interval and end tidal CO_2 in 20 hypertensive subjects and 26 controls in sitting position during spontaneous breathing and controlled breathing (at rate of 6 breaths/min and faster at 15 breaths/min). Baroreflex sensitivity was measured by autoregressive spectral analysis and alpha angle method. The study reported that slow breathing decreased systolic and diastolic pressure in Hypertensive subjects from 149.7 + 3.7 to 141.1 + 4mmHg and 82.7 + to 77.8 + 3.7mmHg respectively. It also increased baroreflex sensitivity (from 5.8 + 0.7 to 10.3 + 2.0m/s mmHg). It thus reported that hypertensive subjects tend to hyperventilate and that correction of hyperventilation could improve cardiovascular function.

Since, Buteyko breathing technique also incorporates slow breathing, this could probably explain the possible mechanism in lowering the BP and HR.

There have been a lot of studies conducted on Pranayam, Yoga which include slow breathing on blood pressure in primary Hypertension. But no such

study was conducted to study the effect of Buteyko breathing technique, which also contains slow breathing as an important entity of the treatment on the hypertensive subjects.

Buteyko Breathing Technique is a unique Breathing technique that uses breathing control (relaxation and slow breathing) and breath hold (control pause) exercises to retrain breathing in order to maintain carbon dioxide levels in the body.

Buteyko practioners believe that the mechanism of action of buteyko is its influence on the effect of Nitric Oxide (NO). Though O_2 and CO_2 are essential respiratory gases and are not directly linked to blood pressure, nitric oxide plays an important role in regulating blood pressure. NO which is unavailable in the atmosphere, is produced only in the paranasal sinuses. Nitric oxide is involved in number of physiological responses including Bronchodilation, Vasodilation, tissue permeability, immune response, oxygen transport,neurotransmission,memory and learning. Low levels of NO causes blood vessels to contract and raise blood pressure while higher levels of NO dilates blood vessels and lowers blood pressure.

Buteyko technique focuses on nasal breathing to have an effect on NO levels, as a large percentage of body's NO levels are made in paranasal sinuses. Buteyko breathing techniques maintain a steady high supply of NO as the breath holds (control pause) interspersed with slow breathing incorporated in technique influences on NO levels which produces widespread vasodilation, reducing the peripheral resistance and thus lower the blood pressure and heart rate.

Breath holding technique is shared by yoga and Buteyko few studies have been done on the therapeutic effects of breath holding. During a long breath hold such as the Maximum pause,one can see oxygen saturation dropping and then often reaching maximumsaturation of 100% when the first breath is taken. The face flushes,tight diaphragms relax, and people feel their breathing becomes free. One effect of long breath holds is that they enable the body to reverse carbon doxide gas exchange so that the body reabsorbs carbon dioxide. **(Hong, Rahn Kang, Song & Kang, 1963)**

Joulia F et. al. in the study "Breath hold training of humans reduce oxidative stress and blood acidosis after static and dynamic apnea" reported that repeated use of extended breath hold increases the body's production of endogenous antioxidants and raises the anaerobic threshold thus increasing capacity to exercise at higher levels of exertion, an effect similar to altitude or hypoxic training.

The research in Buteyko Technique has tested its effectiveness in treatment of Asthma, Chronic Obstructive Airway disease, Coronary Artery Bypass Grafting which showed improvement in physical, psychological health and quality of life. The study showed a significant reduction in Hemodynamic parameters and improvement in functional capacity in subjects receiving 4 weeks of Buteyko breathing technique.

Conclusion

Buteyko breathing technique has a positive effect on hemodynamic parameters and functional capacity in subjects with Essential hypertension.

Buteyko breathing technique uses a combination of breath holding post exhalation and slow breathing which in turn improves the autonomic regulation of BP and hence effective in subjects with hypertension.

Abbreviations

CP: Control Pause

HR: Heart Rate

SBP: Systolic blood pressure

DBP: Diastolic blood pressure

6MWD: Six Minute Walk Distance

%PV of 6MWD: % predicted value of six minute walk distance

NO: Nitric Oxide

Ethical Clearance: Sought from Ethics Committee for Academic Research Projects (ECARP)

Source of Funding: Self Funded

Conflict of Interest: None

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