Transient Effect of Slow Pace Breathing Exercise on Blood Pressure, Heart Rate and Pulmonary Function Tests

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ABSTRACT

The study was done to evaluate the transient effect of slow pace breathing exercise *Vastrika pranayama,* respiratory rate 6/ min; 4 sec inhalation, 6 sec exhalation] for 5 minutes on heart rate, blood pressure, FVC, FEV_1, PEFR and $FEF_{25-75\%}$ in volunteers in February-March 2015 in the Department of Physiology. In healthy, non-smoker sedentary volunteers (n=25, age=18-25 years) heart rate and blood pressure were recorded by using a sphygmomanometer following 5 minutes rest. After 5 minutes of slow pace breathing exercise, the blood pressure and heart rate were recorded again using the same instrument. In another group (n=12, age=18-25 years) pulmonary function tests were performed before and after the same exercise for the same duration using a spirometer (Spiro Excel Medicaid). Data were statistically analysed using MS Excel programme.It was noted that aforesaid slow pace breathing exercise causeda decrease in systolic and diastolic blood pressure as well as mean blood pressure (85.97 mmHg Vs 82.48 mmHg) along with heart rate significantly (p-value<0.05, 73.32 beats/min Vs 67.72 beats/min). The same manoeuvre for same duration produced significant decrease in FVC (3.44L vs 3.11L), FEV_1 (3.06L vs 2.75L) and $FEF_{25-75\%}$ (4.90L/s vs 4.27L/s). PEFR also decreased but insignificantly (8.63L/s Vs 8.38L/s). Volunteers felt calm, sleepy and very light indicating parasympathetic dominance. Slow pace breathing, thus, caused an activation of parasympathetic system and can be practiced to keep autonomic nervous system in balance, for mental relaxation and reduction of stress in daily life.

Keywords: Blood pressure, Pulmonary function test, Slow pace breathing exercise

INTRODUCTION

Manipulation of breath movement, popularly known as *Pranayama* exerts profound physiologic effects on cardio-pulmonary and mental functions.[1] Regular practice of *yoga* and *pranayama* (breathing exercises) is one of the ways to combat mental stress in our daily life.[2] Slow deep pranayamic breathing is reported as one of the most practical relaxation techniques.[3,4] It is a part of yogic techniques followed in ancient India. *Pranayama* is defined as a manipulation of breath movement. Most of the studies report the effect of different *pranayamas*, yogic postures, meditations and so on collectively and the effects of regular practices of all these for a period of time (for few weeks).[2,5] In the present study, the transient effect of a slow pace breathing exercise, *Vastrika Pranayama* in slow pace for 5 minutes duration, on blood pressure, heart rate, FVC, FEV_1, PEFR and $FEF_{25-75\%}$ has been represented in untrained sedentary volunteers.

MATERIALS AND METHODS

The study was done in February-March 2015 in the Department of Physiology, Nepal Medical College. Healthy, non smoker sedentary volunteers (n=37, age=18-25 years) took part in the study.

The aims and objectives were explained and verbal consent was taken. Heart rate and blood pressure was recorded using a sphygmomanometer following 5 minutes rest.[6, 7] The breathing techniques were demonstrated to them. First, one has to sit comfortably in an easy and steady posture *(Sukhashana*) on a fairly soft seat on the fl oor as keeping the head, neck, and trunk erect and in a straight line, with eyes closed. One should keep the body still during the breathing practice. The back muscle should not remain very stiff and one should try to keep the other muscle loose as well. Then the subject is directed to inhale through both the nostrils slowly, up to the maximum for about 4 seconds. The breathing must not be abdominal. The subject was instructed to exhale slowly as well, up to the maximum through both the nostrils for about 6 seconds. These steps complete one cycle of *Vastrika slow pace pranayama* (respiratory rate 6/ min).[8] During the practice the subject was asked not to think much about the inhalation and exhalation time; rather he/she was requested to imagine the open blue sky. The *pranayama* was conducted in a cool, well ventilated room (18-20^{o}C) . After 5 minutes of this breathing exercise, the blood pressure and heart rate were recorded again in the aforesaid manner using the same instrument in a group of volunteers (n=25, age18-25 years).

In another group (n=12, age18-25 years) pulmonary function tests were performed before and after the same exercise for same the duration using a spirometer (Spiro Excel Medicaid) following the guidelines of American Thoracic Society.[9] Data were statistically analysed using MS Excel programme. After the breathing exercise when volunteers were asked about their feeling, some answered that they were feeling calm, some felt sleepy, some felt very light and calm.

RESULTS

Results are presented in Table 1 and Table 2. After slow *Vastrika Pranayamic* breathing (respiratory rate 6/ min) for 5 minutes, significant decrease in systolic blood pressure (117.44 mmHg Vs 112.88 mmHg), diastolic blood pressure (70.48 mmHg Vs 67.52 mmHg) and mean blood pressure (85.97 mmHg Vs 82.48 mmHg) along with heart rate (73.32 beats/min Vs 67.72 beats/min) was noted.

The same manoeuvre for same duration produced significant decrease in FVC (3.44L vs 3.11L), FEV_1 (3.06L vs 2.75L) and $FEF_{25-75\%}$ (4.90L/s vs 4.27L/s). PEFR also decreased but insignificantly (8.63L/s Vs 8.38L/s

Table 1: Comparison of cardiovascular parameters before and after exercise (n=25)

Parameters	Before exercise Mean ±SD	After exercise Mean± SD	p value	Remarks
SBP (mmHg)	117.44±11.24	112.88±10.37	< 0.05	Significant
DBP(mmHg)	70.48±11.8	67.52±11.42	< 0.05	Significant
MBP(mmHg)	85.97±10.96	82.48±10.35	< 0.05	Significant
HR (beats/min)	73.32±8.03	67.72±8.42	< 0.05	Significant

Table 2: Comparison of pulmonary function parameters before and after exercise (n=12)

Parameters	Before exercise Mean ±SD	After exercise Mean± SD	p value	Remarks
FVC (L)	3.44±0.85	3.11±0.96	< 0.05	Significant
FEV1 (L)	3.06±0.69	2.75±0.79	< 0.05	Significant
PEFR (L/sec)	8.63±4.01	8.38±3.54	> 0.05	Insignificant
FEF25-75% (L/ sec)	4.90±1.15	4.27±1.09	< 0.05	Significant

DISCUSSION

Regulated slow breathing exercise [*Pranayama*] increases the frequency and duration of inhibitory neural impulses by activating stretch receptors of lungs during above tidal volume inhalation as in Hering-Breuer reflex.[10] Respiratory centre and cardiac centre have inverse relationship. Stimulation of respiratory centre may be the cause of reduction of heart rate and peripheral resistance.

Previous reports also expressed after being released from hyperinfl ation it exhibits inhibitory responses- decrease systemic vascular resistance and heart rate.[11,12] Recent studies also suggest that repeated practice of slow deep *pranayamic* breathing exercise may strengthen cardio-respiratory coupling and can evoke short-term plasticity effectively in normal humans.[13]

Inhibitory current synchronizes rhythmic cellular activity between the cardiopulmonary centre and the central nervous system.[14] Inhibitory current regulates synchronization of neural elements, which typically is within the hypothalamus and the brainstem, and is likely responsible for inducing the parasympathetic response during breathing exercises.[15]

Diastolic blood pressure depends upon peripheral resistance and lung inflation has been known to decrease systemic vascular resistance.[16] This response is initiated by pulmonary stretch receptors, which bring about withdrawal of sympathetic tone in the skeletal muscle blood vessels, leading to widespread vasodilatation, thus causing a decrease in peripheral resistance and decreasing the diastolic as well as the mean blood pressure in our study.[17]

During prolonged voluntary expiration intra-thoracic pressure increases and blood from the lungs is squeezed into the heart leading to an increase in stroke volume; baroreceptors in carotid sinus experience more pressure and discharge more. The increased baroreceptor discharge inhibits the tonic discharge of the vasoconstrictor nerves and excites the vagus innervations of the heart producing vasodilatation, a drop in blood pressure and bradycardia.

Vagal cardiac and pulmonary mechanisms are linked and improvement in one vagal limb might spill over into the other. It has been suggested that chronic biofeedback-induced increase in baroreceptor gain, reflect neuroplasticity.[18] Baroreceptor sensitivity can be enhanced significantly by slow breathing. This seems to occur through a relative increase in vagal activity, denoted by reduction in the heart rate, systolic, diastolic and mean blood pressure observed during slow deep breathing.[19]

Decreased FVC, FEV_1, $FEF_{25-75\%}$ and PEFR following slow pace breathing exercise indicated the effect of parasympathetic stimulation on bronchial smooth muscle. Decrement of $FEF_{25-75\%}$ indicated decreased calibre of terminal bronchioles made up of only smooth muscles which were constricted by parasympathetic stimulation. Significant increase in FVC after 2 minutes of deep breathing exercise was observed by Shiba Kumar *et al* but in the present case after 5 minutes deep breathing exercise less value of FVC was recorded indicating parasympathetic stimulation.[20]

Most of the volunteers felt calmness of mind, a sense of well being, and some felt sleepy, thus supporting parasympathetic stimulation. This may be the effect of increased melatonin production after a regimen of slow breathing *pranayamic* exercises.[21] Slow pranayamic breathing was also reported to elicit alpha waves, indicating a parasympathetic dominance and may be the cause of the sleepy feeling.[22]

Slow pace breathingexercise (*Bhastrika Pranayama*, Respiratory rate 6/min) thus caused an activation of parasympathetic system and can be practiced to keep autonomic nervous system in balance, for mental relaxation and reduction of stress in daily life.

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