International Journal of Recent Trends in Science And Technology, ISSN 2277-2812 E-ISSN 2249-8109, Volume 3, Issue 1, 2012 pp 05-08

# Effect of Combined Slow & Fast Pranayamic Breathing Exercises on Autonomic Nervous System

S. B. Jore[1*], T. B. Bhutada[2], U.S. Patil[3], S. V. Patil[4], P. B. Gaikwad[5]

[1]Assistant Professor, Dept. of physiology, B. V. D.U. M. C. & H. Sangli (MS) INDIA.

[2]Associate Professor, Dept. of physiology, G.M.C., Miraj(MS) INDIA.

[3]Professor, Dept. of physiology, B. V. D.U. M. C. & H., Sangli (MS) INDIA.

[4]Lecturer, Dept. of physiology, B. V. D.U. D. C. & H., Sangli (MS) INDIA.

[5]Tutor, Dept. of Physiology, Medical Sciences and Research Institute, Mayani.

[*]Corresponding Addresses:

smita17j82@gmail.com, ajayshinde791@gmail.com

***Research Article***

***Abstract:*-Background**- Pranayama is well known breathing exercise which is known to be improving cardiac autonomic status. This effect mainly depends on type & duration of Pranayama for which it is carried out.

**Objectives** - This study was undertaken to access the effects of both fast & slow type pranayama done for short duration on autonomic parameters.

**Materials & Methods** - The study was conducted on 60 healthy M.B.B.S. students. Pranayama practice was carried out daily for 12 weeks which included slow as well as fast breathing exercises. Autonomic nervous system parameters reading were taken before & after pranayama practice. The autonomic status was studied with non-invasive cardiovascular autonomic function tests which included Resting Heart Rate, Basal Blood Pressure, and HRV with deep breathing i.e. E: I Ratio, Cold Pressor Test.

**Results -** There was statistically significant decrease in heart rate, systolic blood pressure, rise of blood pressure after CPT, increase in E: I Ratio after 12th week of Pranayama practice. Also there was decrease in diastolic BP, but this change was not statistically significant.

**Conclusion -** Thus results of study showed a significantly improved vagal tone and reduced sympathetic activity after pranayama training. Thus the regular practice of pranayama has beneficial effect on body as it reduces harmful effect of sympathetic nervous system on cardiovascular system. This can be applied in day today life to reduce incidence of stress related disorders mainly hypertension, stroke, peptic ulcer.

***Key words:*** Pranayama, Heart Rate (HR), Autonomic parameters, Cold Pressor Test (CPT), E: I Ratio.

## Introduction:-

Yoga is a philosophy and discipline applied to the development of mind, body & spirit. Through practices of holding a variety of body positions or asana and centering of mind in meditative way the yoga practitioner increases awareness, flexibility of body and calmness of spirit. Pranayama is 4th component of Ashtanga Yoga described by Maharshi Patanjali. [1]

Pranayama consists of various ways of inhaling, exhaling & retention of prana. It was devised by ancient Yogic masters to create synergy between the self energizing life force and individual mind – body – spirit by regulation of prana. [2]

Regular practice of Pranayama is also known to improve cardio-respiratory autonomic status. [3, 4]

Many scientists have done studies on pranayama and claimed that pranayama increases longetivity. J.R. Bharshankar & his colleagues in 2003 found decrease in systolic & diastolic blood pressure after 5 years Pranayama practice in individuals above 40 years. [5] G.K.Pal & Velkumary studied effect of slow as well as fast breathing exercise on autonomic nervous system. They observed that slow breathing exercise improves autonomic functions with dominance of parasympathetic activity and fast breathing exercise does not affect it.[3] Kalwale p. & his colleagues Noted that short term pranayama training produces no significant change in blood pressure, heart rate but long term pranayama has reducing effect on it. [6]

We carried this study to see the effect of short duration pranayama training which includes both fast & slow breathing exercises on shift of balance of autonomic nervous system in young subjects.

## Materials and Methods:-

An interventional study was carried out on healthy 1st year M.B.B.S. students in Dept. of Physiology, G. M. C. Miraj. Students were evaluated as per standard proforma, which included a questionnaire. The students with, past or present history suggestive of cardiovascular or respiratory illness or any other systemic illness, any family history of asthma or allergic diseases, were not included in the study. Only nonsmoker students were enrolled. Subjects performing any type of Yoga or Pranayama and other physical exercise like resistance training, sports and athletic were excluded from the study. The experimental protocol was explained to students and written informed consent was obtained from them.

In the beginning itself the institutional ethical committee approval was obtained for the study.

**Autonomic parameters** - Readings of autonomic parameters were taken just before & immediately after pranayama practice in between 11.00 am to 4.00 pm. Before taking readings of autonomic parameters two hours fasting was assured, 10 minutes rest given to relax the subject.

**1.Heart rate** was measured by measuring R-R interval in ECG lead II.

**2. Blood pressure** was taken with help of mercury sphygmomanometer.

**3.** For taking readings of **HRV with deep breathing i.e. E: I ratio**, subject was asked to take a deep breath at 6 cycles/ minute after quiet breathing for 2 minutes. Continuous lead II ECG was taken for 1 minute. Beginning of each inspiration & expiration marked on ECG with pencil. In each respiratory cycle the longest R-R interval during expiration & the shortest during inspiration were selected. Mean value of R-R interval was calculated.

E/I ratio = mean value of longest R-R interval / mean value of shortest R-R interval. [7]

**4. Cold pressor test** was carried out by asking subject to immerse right hand in ice cold water ($4^0$C) for 1 minute. Blood pressure was recorded with help of automated digital sphygmomanometer before & immediately after completion of test. Normally there is rise of systolic blood pressure of 15-20 mm of Hg & diastolic of 10-15 mm of Hg after cold pressor test. [8]

After recording the above parameters, students were trained by yoga instructor. They Performed the Pranayama practice daily in the morning for one hour (5.10 pm-6.15 pm), Six days in a week for 12 weeks under expert's supervision. The Pranayama practice consisted of prayer with both fast & slow breating exercises like Nadishuddhi, Anulom-vilom, Suryabhedan, Kapalbhati, Bhastrika, Omkar recitation, each done for a period of 45 mins. Students paired t-test was applied to analyze data.

### Observation Table:-

Comparison of Mean ± SD Values of autonomic parameters before and after 12th week of pranayama practice

| Parameters | Before pranayama Mean ± SD | After $12^{th}$ week of pranayama Mean ± SD | 't' Value | 'P' Value |
|---|---|---|---|---|
| Heart rate (beats / minute ) | 77.53 ± 4.98 | 75.01 ± 5.01 | 8.3 | P < 0.001** |
| Systolic Blood pressure ( mm of Hg ) | 119.6 ± 6.94 | 116.6 ± 6.65 | 10.4 | P < 0.001** |
| Diastolic Blood pressure ( mm of Hg ) | 77.9 ± 5.98 | 77.35 ± 5.48 | 1.67 | P> 0.05 NS |
| E : I ratio | 1.31 ± 0.12 | 1.52 ± 0.11 | 11.88 | P < 0.001** |
| Rise of SBP after Cold pressor test ( mm of Hg ) | 22.72 ± 3.34 | 20.63 ± 3.12 | 9.6 | P < 0.001** |
| Rise of DBP after Cold pressor test ( mm of Hg ) | 11.78 ± 1.73 | 10.87 ± 1.38 | 4.36 | P < 0.001** |

## Results:-

The observed values of autonomic parameters before and after 12 weeks of Pranayama practice are given in observation table.

As shown in Table, there was statistically significant difference in mean values of Heart rate,

systolic blood pressure, HRV after deep breathing, BP rise after cold pressor test ($p<0.001$) before & after pranayama training. While there was decrease in diastolic blood pressure after pranayama training but it is not statistically significant ($P>0.05$).

## Discussion:-

Nowadays one has to face lot of stress due to competitive attitude in working places, educational places. Any kind of stress, physical or mental, if continued for prolonged period, results in sympathetic dominance which has hazardous effects on health. This leads to emergence of stress related disorders like hypertension, stroke, coronary heart disease, peptic ulcer. These stress related disorders have great impact on quality & longativiity of life.

Regular practice of Pranayama is known to provide state of psychosomatic relaxation which gradually diminishes sympathetic dominance resulting in better balance of autonomic nervous system. [9]

In our study there was statistically significant decline in heart rate, systolic blood pressure, rise of blood pressure after CPT & increase in E:I ratio.

Heart rate is controlled by background vagal activity which has inhibitory influence over it. [10] In our study there was reduced resting heart rate which might be due to improved vagal tone.

In this study, there was statistically significant decline in systolic blood pressure but no change in diastolic blood pressure. Decrease in systolic blood pressure may be due to the reduced sympathetic vasoconstrictor tone. [10, 11] Many studies on Pranayama found decrease in systolic & diastolic blood pressure. [12] Our study was for short duration which might be the reason for no alteration in diastolic blood pressure.

Autonomic reactivity test refer to cardiovascular responses to stimuli. [13] We took HRV with deep breathing (parasympathetic function test) & cold pressor test (sympathetic function test) to access autonomic nervous system.

HRV with deep breathing is simply respiratory sinus arrhythmia (RSA) magnified by deep breathing. RSA is predominantly modified by respiratory gating of parasympathetic efferent activity to heart. [14] Thus HRV with deep breathing is a measure of cardiovagal function. [15] Increase in HRV suggests increased parasympathetic discharge to heart.

In CPT stimulation of cold receptor triggers sympathetic activation leading to marked vasoconstriction. This leads to marked increase in heart rate, blood pressure due to catecholamine release. [16] Decease in rise of blood pressure after CPT suggests reduced sympathetic discharge after pranayama.

Thus practice of Pranayama for short duration leads to increase in parasympathetic activity & decrease in sympathetic activity & also leads to mental relaxation.

Exact mechanism behind shift of autonomic balance towards parasympathetic side after Pranayama practice is not known. Possible mechanism behind it could be as follows

- While doing breathing exercises practitioner tries to keep attention on it. This removes his attention from stress & worries & provides state of mental relaxation. In relaxed state of mind parasympathetic activity overrides sympathetic activity.
- When one breaths both the nostril does not take part in breathing equally. One nostril predominates over other & follows definite cycle. In pranayamic breathing, right nostril dominance corresponds to activation of 'Pingala' subtle energy channel i.e. sympathetic activation & left nostril to 'Ida' subtle energy channel i.e. parasympathetic activation. Alternate nostril breathing leads to proper balance between 'Pingala' & 'Ida' i.e. parasympathetic & sympathetic activity & gain spiritual upliftment. [17]

  There could be mechanical receptors in the nasal mucosa which get activated with airflow into nostril. These signals are unilaterally transmitted to the hypothalamus.[18] Hypothalamus is the highest centre for autonomic nervous system regulation which brings balance in parasympathetic & sympathetic nervous system.
- Normally Rostral ventrolateral medulla (RVLM) or vasomotor centre usually gives excitatory input to sympathetic system controlling vasculature. Sympathetic impulses inturn inhibit effect of vagal parasympathetic stimulation by releasing Neuropeptide Y. [10]

  When practitioner tries to inhale above tidal volume or during antara kumbhaka

slow adapting receptors of lung sends inhibitory impulses to vasomotor center. Inhibition of vasomotor center or rostral ventrolateral medulla by lung inflation during Pranayama produces decreased sympathetic tone in vasculature with overriding parasympathetic (vagal) activity.

Although we got results, there are limitations for our study like

1. Our study group was small. Such study on large group should be carried out.
2. Instruments to measure GSR, computorised ECG for frequency domain HRV were not available in our institute. So we could not take these parameters in our study.
3.

## Conclusion:-

From above discussion we can conclude that regular practice of both slow & fast combined Pranayama practice leads to shift of autonomic nervous system balance towards parasympathetic side by decreasing sympathetic tone. Also it improves cardiorespiratoratory autonomic status.

Since this method is easy to apply with no side effects & leads to deep physical & mental relaxation, it could be a suitable intervention during cardiac rehabilitation to shift the autonomic balance towards an increase of vagal activity & to decrease cardiac mortality also to prevent or treat stress related illnesses.

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