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SHORT COMMUNICATION

IMMEDIATE EFFECT OF MUKHA BHASTRIKA (A BELLOWS TYPE PRANAYAMA) ON REACTION TIME IN MENTALLY CHALLENGED ADOLESCENTS

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Abstract : Mentally challenged individuals are known to have slower speed of reaction. As a previous study has shown immediate improvement in reaction time (RT) following *mukha bhastrika,* a bellows type of *pranayama,* we planned to study the effect of this *pranayama* in mentally challenged adolescents. 34 mentally challenged adolescents (15.1±0.806 y) studying in a school for Special Needs were recruited as they have been receiving yoga training once a week for more than 3 years. Exclusion criteria were inability to either perform *mukha bhastrika* or to understand procedure for testing RT. Visual (VRT) and auditory reaction time (ART) was measured using RT apparatus before and after nine rounds *of mukha bhastrika* and a control period of ten minutes of normal activities to rule out any test-retest practice effect. Analysis of non-intervention period values showed that the reliability in terms of reproducibility of the observation for both VRT (r=0.87) and ART (r=0.95) was excellent. *Mukha bhastrika* produced an immediate and significant decrease in both VRT and ART. There was a statistically significant decrease in VRT (P<0.0001) from 296.15 ms±13.49 to 263.59 ms±12.53 and ART (P<0.0001) from 247.88 ms±14.33 to 217.35 ms±11.36 following *mukha bhastrika.* Decrease in RT signifies improved central neuronal processing ability. This may be due to greater arousal and faster rate of information processing, improved concentration and/or ability to ignore or inhibit extraneous stimuli. *Mukha bhastrika* may be altering afferent inputs from abdominal and thoracic regions, in turn modulating activity at ascending reticular activating system and thalamo-cortical levels. It is suggested that yogic breathing techniques like *mukha bhastrika* be used as an effective means of improving neuro-muscular abilities in special children.

Key words : reaction time, mukha bhastrika, mental retardation, central processing

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INTRODUCTION

Yoga has been found to be an effective adjunct therapeutic modality in numerous health conditions and is being widely used all over the world. The diverse applications of yoga in rehabilitation of mentally and physically handicapped as well as visually impaired children have been demonstrated earlier with significant decrease in their abnormal anxiety levels (1).

Mental retardation is one of the conditions in which yoga may have great potential. Though there are some documented reports (2), very few have scientifically studied this effect and hence more studies are required to streamline the use of yoga as an adjunct therapy in such children.

Uma et al (3) have reported that yoga improved IQ in MR children and that the Binet Kamath (BK) test scores for general mental ability improved significantly in the yoga group. They suggested that the breath control obtained through yoga increases psycho-motor coordination. They concluded that yoga improves concentration, attention-span and enhances IQ and memory power by gaining conscious control over the mind.

The neurological benefits of yoga have interested scientists all over the world. It has been reported to be beneficial in both peripheral nerve function as well as central neuronal processing (4, 5, 6). One of the simple and effective methods of studying the central neuronal processing is the RT that is the interval between the onset of a signal (stimulus) and the initiation of a movement response. It is an indirect index of central neuronal processing and is a simple means of determining sensory-motor association, performance and cortical arousal. Decrease in RT indicates an improved sensory-motor performance and an enhanced processing ability of the central nervous system. It is a sensitive and reproducible test that can be measured with a simple apparatus and setup.

It has been found that changes in breathing period produced by voluntary control of inspiration are significantly correlated to changes in RT (7). Some studies on yoga have shown that regular practice of yoga over a period of a few weeks to a few months can significantly decrease VRT and ART (4, 5). Not many have however studied the acute and immediate effects of yoga techniques on RT.

A previous study from our laboratories reported a significant and immediate decrease in RT following the practice of nine rounds of mukha bhastrika, a bellows type of pranayama in normal school children (8). It has been previously reported that mentally challenged individuals show specific motor performance deficits on measures of RT, aiming, dexterity and that their motor performance measures are considerably longer compared to the non retarded (9).

Mukha bhastrika is a yogic technique in which the breath is actively blasted out in multiple 'whooshes' with forced abdominal contractions. After taking up Vajra Asana, a straight back sitting position, a deep inhalation is performed with awareness of the sequential expansion of the lungs. The mouth is then puckered up into Kaki Mudra, the crow beak gesture and the breath is blasted out in multiple, forceful expulsions

while simultaneously bringing the head down to the ground. Then, with a deep inhalation, the head is raised slowly and the subject comes back to the sting position. This constitutes one round of mukha bhastrika that is one of the practices being taught on a regular basis in all pranayama classes in the Gitananda tradition. This is also one of the techniques taught in regular yoga training imparted for special children in Pondicherry as part of the outreach programmes of ICYER and Yoganjali Natyalayam, Pondicherry, India.

Keeping all of this in mind, this study was planned to investigate the acute effects of mukha bhastrika on VRT and ART in mentally challenged children. Since the study was done on mentally challenged subjects and as we wanted to rule out potential practice effects on the readings, we included a non-intervention period and performed test-retest analysis to ensure reliability and reproducibility of the readings.

MATERIALS AND METHODS

Thirty four children (21 male, 13 female) with MR studying in SADAY School for Special Needs, Pondicherry, were recruited for this study by accidental sampling method as they have been receiving yoga training once a week for 2-3 years. Their mean age was 15.1±0.806 and mean IQ was 54.88±2.51. two of the children belonged to the severe mental retardation category (IQ 20-34), 10 to the moderate mental retardation category (IQ 35-49), 19 to the mild mental retardation category (IQ 50-69) and 3 were in the borderline intellectual functioning category (IQ 70-84) according to the International Classification of Diseases-10.

Exclusion criteria were the inability to either perform mukha bhastrika or to understand the procedure for testing RT. Of the 63 students studying in the school, only 34 of those children who could perform mukha bhastrika in the proper manner, as well as understand the procedure of testing RT were recruited for this study. Informed consent for the study was obtained from the head of the institution on behalf of the special children and ethical clearance obtained from that institution as well as ICYER.

RT apparatus manufactured by Anand Agencies, Pune, was used for the study. The instrument has a built in 4 digit chronoscope with a display accuracy of 1 ms. It features four stimuli, two response keys and a ready signal. Switches for selecting right or left response key for any stimulus is provided. In the present study simple ART was recorded for auditory beep sound stimulus and simple VRT for red light stimulus. The subjects were instructed to release the response key as soon as they perceived the stimulus. The signals were given from the front of the subjects to avoid the effect of lateralised stimulus and they used their dominant hand while responding to the signal (10). All subjects were given adequate exposure to the equipment on 2 different occasions to familiarize them with the procedure of RT measurement.

RT measurements were done before and after a non-intervention period of 10 minutes where the subjects continued their normal activities between the recordings. Test-retest study was done on these values to assess reliability and reproducibility of the observations and to rule out any changes

that could be resulting from 'practice effect'. RT was then recorded before and after the practice of nine rounds of mukha bhastrika. To avoid any extraneous influences due to the recording on different days, one half of the subjects performed non-intervention period recordings on day-1, while the other half did the mukha bhastrika recordings. This was then reversed on day-2. More than 8-10 trials were recorded and the average of the lowest three similar observations was taken as a single value for statistical analysis (10).

Data are expressed as mean±SEM. All statistical analysis was carried out using SPSS 13.0. The reliability and reproducibility of the observations of VRT and ART in the non-intervention period were assessed by using Test-Retest study using correlation analysis. The distribution of both VRT and ART was assessed by using Kolmogrov Smirnov (KS) test. The immediate effect of mukha bhastrika on RT was assessed by using Students t (paired) test. Correlation Analysis (Karl Pearson Coefficient of Correlation) was carried out to assess the test retest reliability of the observations in the non-intervention period to rule out 'practice effect". All statistical analysis was carried out at 5% level of significance and a P value <0.05 was taken to indicate significant differences between groups of data.

RESULTS

The results are given in Table I. Mean VRT score at baseline was 296.15±13.49 ms and there was no significant difference between male and female subjects though mean score of male subjects (301.5±18.42 ms) was marginally higher than that of the female (287.46±19.62 ms) subjects. The mean ART score at baseline was 247.88±14.33 ms and there was no significant difference between male and female subjects though mean score of the female subjects (250.54±26.67 ms) was marginally higher than that of the male (246.2±16.85 ms) subjects.

Test-Retest analysis of the non-intervention period values showed that the reliability in terms of reproducibility of the observations was excellent for both VRT (r =0.87) and ART (r=0.95). On the other hand, Mukha bhastrika produced an immediate and significant decrease in VRT and ART. There was a statistically significant (P<0.0001) decrease in VRT from 296.15±13.49 ms to 263.59±12.53 ms. There was also a statistically significant (p < 0.0001) decrease in ART from 247.88±14.33 ms to 217.35±11.36 ms following mukha bhastrika. There was an overall reduction of 33 ms and 30.5 ms (10.99% and 12.31% reduction) in mean scores of VRT and ART respectively after mukha bhastrika.

TABLE I : Visual reaction time (VRT) and auditory reaction time (ART) of mentally challenged adolescents before (B) and immediately after (A) performance of nine rounds of mukha bhastrika.

	B	*A*	*% Change*	*P Value*
VRT (ms)	296.15±13.49	263.59±12.53	– 10.99%	<0.0001
ART (ms)	247.88±14.33	217.35±11.36	– 12.31%	<0.0001

Values are mean±SEM for 34 subjects.

DISCUSSION

In our subjects, ART values were significantly shorter than VRT and this is in agreement with previous reports (4, 5, 10). All pre and post values obtained in the present study showed slower RT than expected values for a normal population. A literature review by Kosinski gives normal values of ART as 140-160 ms and VRT as 180-200 ms (11). In the present study the mean value of ART and VRT before mukha bhastrika was 247.88±14.33 ms and 296.15±13.49 ms respectively. This difference between the expected normal values and the values in our study can be explained by the well documented delay in the processing speed in children with MR (9).

Performance of nine rounds of mukha bhastrika produced an immediate and statistically significant decrease in both VRT and ART. The faster reactivity seen post mukha bhastrika, both in the present study as well as in our earlier study (8) may be due to a generalized alteration in information processing at the primary thalamo-cortical level that occurs during pranayama as postulated by Telles et al (6). According to the traditional wisdom of yoga, pranayama is the key to bringing about psychosomatic integration and harmony. A calm mind will be able to process information much better than an agitated one. A previous study from our laboratory has also reported a reduction in RT following three weeks of training in slow and fast pranayamas (10).

Decrease in RT signifies an improvement in central neuronal processing ability of the special children. This may be due to (i) greater arousal and faster rate of information processing (ii) improved concentration and/or (iii) ability to ignore or inhibit extraneous stimuli.

Studies done in the erstwhile Czechoslovakia have demonstrated EEC changes around somato-sensory and parietal areas of the cerebral cortex suggesting an affective arousal following agnisara, nauli and bhastrika (12). It was suggested that these practices bring about such changes through strong stimulation of somatic and splanchnic receptors. As mukha bhastrika utilizes similar forceful abdominal contractions, it may be shortening RT through similar mechanisms.

It has been reported that moderate muscular tension shortened pre-contraction RT (13) and that isometric contraction allows the brain to work faster (14). It is possible that the vigorous abdomino-thoracic muscular contractions in mukha bhastrika influenced the RT in a manner similar to isometric muscular exercise. However the post mukha bhastrika shortening of RT shows that this effect differs, as unlike muscular exercise it is carried over into the post mukha bhastrika period too.

The level of intelligence has been correlated with RT and it has been found that serious MR produces slower and more variable RT (15). In our study we have focused primarily on the mild and moderately retarded subjects with a mean IQ of 54.88±2.51. Uma et al (3) reported significant improvement of BK scores in the group having a moderate degree of MR signifying an improved IQ after yoga training. They also suggested that yoga techniques help MR children in improving their locomotor skills as well as their psycho-motor coordination.

Improved concentration and attention-span may result in improved IQ and memory power too.

RT has been found to be faster when the stimulus occurred during expiration as compared to inspiration (16). As mukha bhastrika involves multiple forceful expirations done rapidly and consecutively, this may be having a prolonged and residual neuro-muscular effect that is also influencing the RT. Mukha bhastrika may be altering afferent inputs from abdominal and thoracic regions, in turn modulating activity at ascending reticular activating system and thalamo-cortical levels. This is quite plausible as kapalbhathi, a yogic technique with similar bellows type breathing has been reported to increase mental activity and induce a calm and alert state (17).

In conclusions on the basis of the present study, we suggest that yogic breathing techniques like *mukha bhastrika* may be used as an effective means of training to improve neuromuscular abilities in special children. Further studies are required to understand the underlying mechanisms involved in bringing about such an immediate benefit.

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