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ACUTE EFFECT OF *MUKH BHASTRIKA* (A YOGIC BELLOWS TYPE BREATHING) ON REACTION TIME

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Abstract : Reaction time (RT) is an index of the processing ability of central nervous system and a simple means of determining sensory-motor performance. It has been reported that yoga training improves human performance including central neural processing. Earlier studies from our laboratories have shown that yoga training produces a significant decrease in visual reaction time (VRT) and auditory reaction time (ART). The present work was planned to determine if *mukh bhastrika* (a yogic technique in which breath is actively blasted out in 'whooshes' following a deep inspiration) has any effect on central neural processing by studying its effect on RT. 22 healthy schoolboys who were practising yoga for the past three months were recruited for the present study. VRT and ART were recorded before and after nine rounds of *mukh bhastrika. Mukh bhastrika* produced a significant ($P<0.01$) decrease in VRT as well as ART. A decrease in RT indicates an improved sensory-motor performance and enhanced processing ability of central nervous system. This may be due to greater arousal, faster rate of information processing, improved concentration and/ or an ability to ignore extraneous stimuli. This is of applied value in situations requiring faster reactivity such as sports, machine operation, race driving and specialised surgery. It may also be of value to train mentally retarded children and older sports persons who have prolonged RT.

Key words: *mukh bhastrika* reaction time sensory-motor performance central neural processing

INTRODUCTION

The physiological and psychological benefits of *yoga* have been demonstrated in several studies (1, 2, 3, 4). These studies have shown that regular practice of yoga leads to improvement in physiological functions and human performance. Benefits have been reported in both peripheral nerve function (5) as well as central neuronal processing (1, 6, 7). Reaction time (RT) is an indirect index of the processing ability of central nervous system and a simple means of determining sensory-motor association and performance (8). RT involves central neural mechanisms and its study is of physiological interest. It is a sensitive and reproducible test and its measurement can be done with

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simple apparatus and set up. Determination of RT has important implications in sports physiology (9) and the performance of an athlete is dependent on the duration of RT. It is an index of cortical arousal (6) and a decrease in it indicates an improved sensory-motor performance and an enhanced processing ability of the central nervous system. It has been found that changes in breathing period produced by voluntary control of inspiration are significantly correlated to changes in RT (10). Physical conditioning exercises have been shown to shorten visual reaction time (VRT) as well as auditory reaction time (ART) (11). Previous studies on yoga have shown that regular practice of yoga can significantly decrease VRT and ART (1, 6). It has also been suggested that RT can be used as a simple and objective method to determine the beneficial effects of yoga training (1, 6). In an earlier study done in our laboratories, *mukh bhastrika*, the bellows type breathing was one of the yogic practices performed by the subjects. *Mukh bhastrika* is a yogic technique in which the breath is actively blasted out in multiple 'whooshes' with forced abdominal contractions (12). *Agnisar* and *bhastrika* (yogic techniques that employ similar forceful abdominal contractions) have been shown to produce central neuronal activation (13, 14). As *mukh bhastrika* may have a central activating role, we planned this study to determine the acute effect of *mukh bhastrika* on VRT and ART. The study was conducted on yoga-trained subjects because they could perform *mukh bhastrika* properly and readily volunteered for the study.

METHODS

Twenty two healthy school boys in the age group of 13–16 (14.5 ± 1.25, SEM) years who had received training in yoga for three months and were able to perform *mukh bhastrika* properly, were recruited for this study. They were briefed about the study protocol and informed consent was obtained from them as well as their parents. Recordings were taken in an air-conditioned laboratory (room temperature 27 ± 1°C) two hours after a light breakfast. To avoid the effect of lateralised stimulus, visual and auditory signals were given from the front of the subject who was instructed to use his dominant hand while responding to the signal (1, 15). RT was measured using a circuit that had a DC source, two tap keys, a magnetic time marker and visual/auditory signal source arranged in series. Signals obtained by operating the tap keys were recorded on RM 6000 polygraph (Nihon Kohden Corporation, Japan). Measurements were taken before and after nine rounds of *mukh bhastrika* by asking the subject to open as quickly as he could, a tap key that was connected alternatively to a light or sound source. Stimulus applied by completing the circuit was marked by upward deflection of the signal whereas subject's response by breaking the circuit was marked as a downward deflection. RT was calculated as the time between these two deflections. The signals thus obtained were converted into digital format by analog-digital converter (Mi^2, USA) and analysed with the help of data processing software (Bio Windows, Modular Instruments Inc. USA). With this software the RT was obtained with an accuracy of 1 ms. More than ten trials were recorded and mean of three similar observations was taken as a single value for statistical analysis (1). The data was analysed using Student's paired '*t*' test and P values less than 0.05 were accepted as indicating significant difference between the compared values.

RESULTS

The results are expressed as Mean ± SEM. Before *mukh bhastrika,* VRT was 244.57 ± 5.86 ms and the ART was 198.82 ± 5.86 ms. Immediately after performing nine rounds of *mukh bhastrika*, VRT and ART decreased to 228.15 ± 5.84 ms and 179.58 ± 6.35 ms respectively, the decrease being statistically significant ($P<0.01$).

DISCUSSION

The present study was conducted on male subjects to avoid any possible effect of menstrual phase on RT as reported by earlier workers (8). In our subjects, pre-*mukh bhastrika* ART was significantly shorter than VRT and this is in agreement with previous reports (1, 6, 8). After *mukh bhastrika* also ART was significantly shorter than VRT. Although Madanmohan et al (1) and Malathi et al (6) have reported that yoga training produces a significant reduction in VRT and ART, to the best of our knowledge there is no report on the immediate effect of *pranayam* on RT. *Kapalabhati*, a yogic breathing practice utilizing abdominal maneuvers and bellows type breathing that is similar to *mukh bhastrika*, has been reported to increase mental activity (16) and induce a calm and alert state (17). This type of 'ready' state can explain the *mukh bhastrika*-induced shortening of RT in our subjects. *Hatha yogic* practices like *agnisar, nauli* and *bhastrika* have been shown to induce EEG changes around the somatosensory and parietal areas of the cerebral cortex suggesting an affective arousal (13, 14). As these practices utilize forceful abdominal contractions similar to *mukh bhastrika* and bring about EEG changes through strong stimulation of somatic and splanchnic receptors (13, 14), we suggest that *mukh bhastrika* results in shortening of RT through similar mechanisms. The faster reactivity of our subjects after *mukh bhastrika* can also be explained on the basis of generalized alteration in information processing at the primary thalamo-cortical level that has been reported during concentrated mental exercise of *pranayam* breathing (7).

Mukh bhastrika involves active and rapid expiratory efforts and it is interesting to note that hyperventilation has been found to selectively depress motor cortical inhibition in humans (18). This release of motor cortical inhibition may be one of the mechanisms by which *mukh bhastrika* results in shortening of RT. However an important difference between yogic bellows-type breathing like *mukh bhastrika* or *kapalabhati* and hyperventilation is that prolonged hyperventilation produces abnormal EEG changes whereas there are no abnormal EEG changes even after 10 minutes of *kapalabhati* (16). The present study shows that *mukh bhastrika* produces an immediate reduction in RT. A decrease in RT indicates an improved sensory-motor performance, which can be explained on the basis of enhanced processing ability of central nervous system. *Mukh bhastrika* may be improving this processing ability by i) greater arousal and faster rate of information processing ii) improved concentration power and/or iii) ability to ignore or inhibit extraneous stimuli. Greater arousal and faster information processing can be explained on the basis of *mukh bhastrika*-induced alterations in afferent inputs from abdominal and thoracic regions, which in turn can modulate the activity at ascending reticular activating system and thalamocortical levels.

This shortening of RT is of applied value in situations requiring faster reactivity such as sports, machine operation, race driving

and specialised surgery. RT has been reported to be altered in trainable mentally retarded children (19). On the basis of the present study, we suggest that yogic techniques like *mukh bhastrika* may be used as an effective means of training to improve the RT in such children. It has also been reported that older soccer players perform poorly on measures of conceptual thinking, RT, and concentration (20). We suggest that yogic techniques like *mukh bhastrika* may be used as an effective means of training such players.

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