Original Article

Acute Effect of Selective Yogic Exercises on Brainstem Auditory Evoked Potentials in Stable Chronic Obstructive Pulmonary Disease Patients

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is presently regarded as a multi-system disorder. A decrease oxygen transport to brain in these patients alters spontaneous brain activity. Yoga plays a vital role in complementary management of the disease. Brainstem auditory evoked potentials (BAEP) reflect neuronal activity along the auditory pathway up to the midbrain. Thus, we aimed to assess the effects of short-term yogic exercises in BAEP in stable COPD patients.

Methods: This one group pretest – posttest observational study enrolled 50 stable patients with COPD. Steps of yogic exercises which included *bhujangasana* (snake pose), *nadisodhana pranayama* (alternate nostril breathing), *swana pranayama* (panting dog breathing) and *ajapa-japa* meditation (constant awareness of breathing) were taught to subjects by yoga instructor and given rest for 15 minutes. Then, BAEP latencies were recorded. After recording subjects performed the 20-25 minutes of yogic exercises as per the instructions, immediately after the completion, BAEP latencies were recorded. Thereafter, subjects were allowed to have rest for 10-15 minutes recording was done again.

Results: Latency of BAEP wave I (1.78 ± 0.50 vs 1.99 ± 0.49 ms, p=0.006) and wave II (2.91 ± 0.32 vs 2.99 ± 0.30 ms, p=0.006) significantly decreased immediately after yoga, compared to baseline in right ear. Similarly, latency of wave II (2.77 ± 0.42 vs 2.92 ± 0.46 ms, p=0.005) and wave V (5.72 ± 0.32 vs 5.91 ± 0.37 ms, p=0.017) significantly decreased immediately after yoga, compared to baseline in left ear. However, latency of wave IV (5.51 ± 0.32 vs 5.34 ± 0.40 ms, p=0.042) increased significantly after the rest of 30 minutes, compared to immediately after yoga in right ear.

Conclusions: Enhancement of neuronal transmission along the auditory pathway up to the midbrain was seen immediately after yogic exercises, which returned back to the baseline after 30 mins of rest.

Keywords: Brainstem auditory evoked potentials, Chronic Obstructive Pulmonary Disease, Yoga

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INTRODUCTION

As per Global Initiative for Chronic Obstructive Lung Disease (GOLD), 17th edition, Chronic Obstructive Pulmonay Disease (COPD) is defined as a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.[1]

Brainstem Auditory Evoked Potentials (BAEP) are the potentials recorded over the scalp in response to an auditory stimulus. They reflect neuronal activity in the auditory pathway.[2] It has been hypothesized that the abnormal BAEP findings in COPD are due to brainstem hypoxia. Yoga training can relieve dyspnea, improve lung function in COPD patients.[3] In patients with COPD, due to progressive decrease in airflow, oxygen transport to the brain decreases, this alters the spontaneous brain activity.

Study has shown that breathing, meditation and posture-based yoga increased overall brain wave activity. Not only lung functions, yoga is also associated with moderate improvements in cognitive function.[4] However, continuous regular adherence to the yoga is a challenge to most of the individual. In this context, we wanted to investigate how neuronal activity in midbrain through the auditory pathway will respond after acute yogic exercises in stable COPD patients.

MATERIALS AND METHODS

This one group pretest - posttest observational study was conducted in Department of Basic and Clinical Physiology at BPKIHS, Dharan, Nepal from December 2017 to December 2018 in a duration of one year. The ethical approval was obtained from the Institutional Review Committee (reference no. 272/074/075). The procedure was fully explained and informed written consent was taken from all the subjects recruited for the study.

The study was conducted on 50 stable COPD patients. The sample size was calculated from the published data using two mean formula.[5] Patients diagnosed with COPD having stable course of disease with no history of hospitalization for COPD related illness during preceding 6 months were included in the study. Patients having hearing loss, neuropathy, diabetes mellitus, hypertension, malignancy, traumatic brain lesion, ototoxic drugs use were excluded from the study. A detailed history and clinical examination were performed using standard proforma of all subjects involved in the study. No subjects were regular yoga practitioners.

Anthropometric and cardiorespiratory variables were recorded. The sequential steps of selected yogic exercises were taught to the subjects by a yoga instructor. Then, the subjects were allowed to take rest for 15 minutes. BAEP was recorded in three consecutive times; before yoga (baseline), immediately after yoga and after the rest of 30 minutes of yoga. The recording was done from both ears. Baseline BAEP was recorded in Neurophysiology laboratory at BPKIHS. Then, with the electrodes placed on their head, the subjects performed the 20-25 minutes of yogic exercises which included *bhujangasana* (snake pose), *nadisodhana* pranayama (alternate nostril breathing), *swana pranayama* (panting dog breathing) and *ajapa japa* meditation (constant awareness of breathing). Immediately after the completion of the yoga, BAEP was recorded. Duration for the recording of BAEP was 15-20 minutes. Thereafter, the subjects were allowed to have rest for 10-15 minutes. Addition of these two durations (recording time and rest time) reflects the total time after the yogic exercise. So, after 30 minutes, BAEP was recorded again. The room temperature was maintained at 26±2 degree Celsius during recording.

Latencies of BAEP wave I, II, III, IV and V were calculated. Data were normally distributed. Repeated measures ANOVA (post hoc: Bonferroni) test was applied to compare BAEP of the stable COPD patients recorded in three consecutive times: before yoga (baseline value), immediately after yoga and after 30 minutes of yoga. P value less than 0.05 was considered statistically significant.

RESULTS

This study enrolled 50 stable COPD patients (male=38, female=12). The anthropometric and cardiorespiratory variables of the subjects are shown in table 1 and 2 respectively. The comparison between the BAEP latencies in three consecutive times in right and left ear is shown in table 3 and 4 respectively.

A significant decrease in BAEP latencies of waves I and II were found immediately after yogic exercises; however, a significant increase in latency of wave IV was also found after 30 mins of rest in right ear. Wave III, IV and V showed the decreasing trend of latency immediately after yogic exercise (Table 3). A significant decrease in BAEP latencies of waves II and V was found immediately after yogic exercises in left ear. Waves I, III and IV showed the decreasing trend of latency immediately after yogic exercises (Table 4).

Table 1: Anthropometric variables of stable COPD patients.

Anthropometric variables	Mean ± SD
Age (years)	64.52 ± 3.60
Weight (Kg)	65.96 ± 4.58
Height (m)	1.62 ± 0.46
Body mass index (Kg/m^2)	24.52 ± 1.58

Table 2: Cardiorespiratory variables of stable COPD patients.

Cardiorespiratory variables	Mean ± SD
Systolic blood pressure (mmHg)	120.40 ± 6.37
Diastolic blood pressure (mmHg)	77.80 ± 5.06
Heart rate (bpm)	73.84 ± 2.22
Respiratory rate (per minute)	20.72 ± 1.12

Table 3: Comparison of BAEP latencies; before yoga, immediately after yoga and 30 minutes after yoga in stable COPD patients (right ear)

BAEP of right ear	(Mean ± SD)			ANOVA P value	Post hoc (Bonferroni)		
	Before yoga (Baseline)	Immediately after yoga	30 minutes after yoga		P_1 value	P_2 value	P_3 value
Latency Wave I (ms)	1.99 ± 0.49	1.78 ± 0.50	1.86 ± 0.47	**0.005**	**0.006**	0.760	0.091
Latency Wave II (ms)	2.99 ± 0.30	2.91 ± 0.32	3.06 ± 0.42	**0.005**	**0.006**	0.105	0.920
Latency Wave III (ms)	4.34 ± 0.40	4.27 ± 0.40	4.33 ± 0.42	0.580	0.890	1.00	1.00
Latency Wave IV (ms)	5.45 ± 0.38	5.34 ± 0.40	5.51 ± 0.32	**0.044**	0.261	**0.042**	0.801
Latency Wave V (ms)	6.00 ± 0.33	5.90 ± 0.41	6.09 ± 0.39	0.114	0.586	0.108	0.614

P_1 value: Probability value between before yoga and immediately after yoga; P_2 value: Probability value between immediately after yoga and 30 minutes after yoga; P_3 value: Probability value between before yoga and 30 minutes after yoga

Table 4: Comparison of BAEP latencies; before yoga, immediately after yoga and 30 minutes after yoga in stable COPD patients (left ear).

BAEP of left ear	(Mean ± SD)			ANOVA P value	Post hoc (Bonferroni)		
	Before yoga (Baseline)	Immediately after yoga	30 minutes after yoga		P_1 value	P_2 value	P_3 Value
Latency Wave I (ms)	2.12 ± 0.44	2.03± 0.53	1.98 ± 0.41	0.087	0.306	1.00	0.109
Latency Wave II (ms)	2.92 ± 0.46	2.77 ± 0.42	2.84 ± 0.48	**0.007**	**0.005**	0.593	0.238
Latency Wave III (ms)	4.25 ± 0.55	4.15 ± 0.47	4.35 ± 0.35	0.074	0.885	0.072	0.636
Latency Wave IV (ms)	5.44 ± 0.40	5.29 ± 0.32	5.37 ± 0.32	0.071	0.063	0.79	0.748
Latency Wave V (ms)	5.91 ± 0.37	5.72 ± 0.32	5.80 ± 0.37	**0.022**	**0.017**	0.77	0.322

DISCUSSION

It has been demonstrated that breathing, meditation and posture-based yoga increased overall brain wave activity. demonstrated by alteration in EEG wave forms like alpha and beta waves. It is also found to be associated with moderate improvements in cognitive function.[6] It has been included as a component of exercises prescribed for many pulmonary rehabilitation programs. However, continuous regular adherence to the yogic exercise seems to be a challenge to most of the individuals.

Brainstem auditory evoked potential (BAEP) typically includes five different waves: Wave I, II, III, IV and V, which are generated from peripheral portion of 8th cranial nerve, cochlear nuclei, superior olivery nucleus, lateral leminiscus and inferior colliculus, respectively. We found a decrease in latencies in wave I, II and V. It signifies the enhancement of the neuronal transmission from the starting of the auditory pathway up to the midbrain (inferior colliculus). Thus, this study indicates that there was an increase in the neuronal transmission velocity along the auditory pathway immediately after 20-25 minutes of yoga. Our findings also show that this change in the neuronal transmission returned back to the baseline level after 30-minutes of rest.

Studies have shown a significant decrease in shortness of breath, improvement in quality of life and increase in vital capacity among elderly patients with COPD after they complete yoga programs of 6 weeks or more. Differences in preyoga and postyoga scores in the subjects showed statistically significant improvements in St. George respiratory questionnaire, vital capacity, maximal inspiratory pressure and maximal expiratory pressure. The programs included postures and controlled breathing.[4,7]

Though we have not compared the BAEP of COPD patients with normal subjects, several studies have shown that wave latencies and inter-peak latencies of BAEP are prolonged in COPD patients.[8,10] It has been shown that this prolongation is due to the progressive chronic hypoxemia in COPD patients that leads to the development of tissue hypoxia and decreases the cerebral perfusion.[9,10]

In contrast to most of the studies, we made a combination of yogic exercises consisting of posture, breathing control and meditation with a duration of 20-25 minutes. These yogic exercises were found to be beneficial for COPD patients in various ways. In most of the studies, researchers have studied the effect of only pranayama on pulmonary functions of COPD patients.

Meditation has been described as training in awareness, perception, and cognition. Kumar S et al. had studied effects of chanting Om on BAEP and their results showed a significant increase in the latency of wave V indicating that auditory information transmission was delayed at the inferior colliculus located in the tectum (midbrain).[5] Telles and Naveen KV studied the effect of Brahmakumari Rajyoga meditation on middle latency auditory evoked potentials and found that there was a decrease in the peak latency of the Na wave. This indicated that the meditation reduces neuronal conduction time at the midbrain-thalamic level.[11] Singh N and Telles reviewed the neurophysiological effects of meditation based on evoked and event-related potential.[12] Studies included in the review have evaluated short latency BAEP, they have shown the changes in Qigong meditation[13], but not in transcendental meditation[14] and Sahaj yoga[15]. But on assessment with mid latency BAEP, changes were seen in all type of meditations (i.e. Qigong, Sahaja yoga meditation and Om meditation). This suggests that meditation modifies neural generators at the level of specific thalamic nuclei, thalamic radiation, and primary sensory cortices irrespective of the meditation techniques.[16]

Saoji, Raghavendra and Manjunath reviewed the effect of yogic breath regulation and found that most yogic breathing techniques influence the neurocognitive abilities positively. They have assessed the neurocognitive effect of breath regulation (pranayama) by studying variables like EEG, mid latency BAEP, P300, reaction times, spatial and verbal task performance, digit letter substitution task (DLST), six letter cancellation test (SLCT) and purdue pegboard task.[17]

All these mentioned researches were done on healthy volunteers who practiced yoga or who have completed yoga programs of 6 weeks or more. However, we have studied on stable COPD patients who performed only 20-25 minutes of yogic exercise and assessed their BAEP. Therefore, these findings of above-mentioned research are not comparable with our subjects. We could not find the studies regarding the changes in BAEP of COPD patients after yoga.

We have chosen single bout of 20-25 minutes of yoga. It would have been better to study the effect of yoga on BAEP in COPD patients after the training for weeks to months. Mid and long latency BAEP also could have been assessed.

CONCLUSIONS

Neuronal transmission velocity increases along the auditory pathway up to the midbrain immediately after 20-25 minutes of single session of yoga. However, after 30 minutes of rest, this transient change in neuronal transmission returned back to the baseline level in stable COPD patients.

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