Yoga in Children with Epilepsy: A Randomized Controlled Trial

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Context: Majority of epilepsy begins in childhood. Twenty to thirty percent of patients may not respond to antiepileptic drugs. Yoga as a complementary therapy has been found to be beneficial in adults, but has not yet been studied in children with epilepsy. Aim: To study the effect of yoga on seizure and electroencephalogram (EEG) outcome in children with epilepsy. Setting and Design: A randomized controlled trial was conducted in the pediatric neurology outpatient department of a tertiary care teaching hospital. Materials and Methods: Twenty children aged 8–12 years with an unequivocal diagnosis of epilepsy on regular antiepileptic drugs were enrolled. Yoga therapy was provided to 10 children (study group) and 10 children formed the control group. Yoga therapy was given as 10 sessions of 1 h each. We compared seizure frequency and EEG at baseline, 3, and 6 months. Statistical analysis was carried out using standard statistical tests. A P value of <0.05 was considered significant. Results: No children had seizures at the end of 3 and 6 months in the study group. In the control group, at 3 and 6 months, four and three children, respectively, had seizures. Eight children each in both the groups had an abnormal EEG at enrollment. At the end of 6 months, one EEG in the study group and seven in the control group were abnormal (P = 0.020). Conclusion: Yoga as an additional therapy in children with epilepsy leads to seizure freedom and significant improvement in EEG at 6 months.

Keywords: Children, electroencephalogram, epilepsy, seizures, yoga
of a tertiary care teaching hospital. The approval from the ethics committee was obtained before starting the study. Twenty children were enrolled for the study after obtaining written informed consent from the guardians.

The inclusion criteria included children with an established diagnosis of epilepsy based on the International League Against Epilepsy (ILAE) definition, aged 8–12 years, and taking AEDs regularly. Children with more than 10 seizures in 3 months, seizures lasting >10 min, absence seizures, progressive illness, and any disability preventing active cooperation in the study, were excluded.

The subjects were selected by consecutive sampling. Randomization was carried out using computerized randomization tables. The patients were divided into two groups. Yoga therapy as an intervention was given to 10 children who formed the study group. Ten children who did not receive yoga therapy acted as the control group. All children were on treatment with appropriate AEDs in appropriate doses. A detailed history of seizures and background information was recorded. Patients maintained a seizure diary, which was used for assessing seizure outcome.

**Intervention**

A standard 10-h yoga protocol was specially designed by yoga experts and yoga teachers. The yoga sessions to be conducted were validated by doctors who are qualified experts in the field of yoga to ensure the safety of children. The 10-h yoga protocol consisted of eight sessions of 1 h each conducted once a week over 8 weeks (2 months) followed by two booster sessions at the end of 4th and 5th month, respectively.

Yoga sessions included a few selected primary asanas (in all four positions), breathing techniques, *sadhana mudra, pranayama* (mainly *bhramari* and alternate nostril breathing), body balance and neuromuscular coordinating exercises, *suryanamaskar*, games of body–mind coordination, relaxation through chanting, prayers, and *shavasana* (specially designed *yoganidra* with positive suggestions).

The aforementioned yoga practices were taught to each child and at least one parent. The sessions were conducted in a separate room in the most comfortable environment in the presence of parents. The sessions were designed considering the limitations and capacity of the child. The children were supervised and checked for the correct way of doing it and instructed to practice on their own on a regular basis at least four times a week at home. The performance of children was recorded regularly at each visit.

EEG was recorded using a 24-channel video EEG machine during awake state and in natural sleep. EEG was classified as normal or abnormal. Seizure frequency in the preceding 3 months as well as seizure freedom were assessed using seizure diary. Seizure outcome and EEGs were assessed at enrollment (baseline), 3, and 6 months.

At the end of the study, the two groups were compared. The following outcomes were analyzed: (1) seizure frequency and/or number of children who were seizure free, (2) number of children with abnormal EEG, (3) change in dosage of anticonvulsant, and (4) adverse side effects.

**Statistical analysis**

Data were entered using Microsoft (MS) Excel, India and analyzed by Statistical Package for Social Sciences (SPSS) software, IBM, India. Unpaired *t*-test, Mann–Whitney *U* test, and Fisher’s exact test were used for comparison between the two groups. A *P* value of less than 0.05 was taken as statistically significant.

**Results**

Of the 20 children enrolled in the study from December 2015 to October 2017, 10 received yoga therapy, whereas 10 acted as controls [Figure 1]. No dropouts were reported from the study.

The demographic characteristics of both the groups are summarized in Table 1.

No statistically significant differences were observed between the two groups in terms of demographic data related to age, gender, age of onset of epilepsy, duration of epilepsy at enrollment, and duration of AEDs, thus making the two groups comparable.

**Seizure outcome**

All children were on appropriate AEDs in appropriate doses. However, at baseline, three children in the study group and four in the control group had history of seizures in the preceding 3 months. When the effect of yoga as an intervention on seizures was analyzed, we found that no children had seizures at the end of 3 and 6 months in the yoga group. In the control group, at 3 and 6 months, four and three children, respectively, had seizures. This difference was not statistically significant [Table 2]. However, none of the other patients had seizure episodes during this period.

**EEG changes**

Eight children each in both the groups had an abnormal EEG at the beginning of the study. At 3 months, only two children in the study group and six children in the control group had an abnormal EEG, the difference was not statistically significant (*P* = 0.170). In the yoga group, at the end of 6 months after starting yoga, only one EEG was abnormal. In the control group, seven EEGs were abnormal at 6 months. This difference was statistically significant (*P* = 0.020) [Table 3].
Anticonvulsant doses
The dose of anticonvulsant remained the same in five patients from each group. The dose could be reduced in four from the yoga group and three from the control group. The dose was increased in one child from the yoga group and two from the control group.

Adverse effects
No adverse effects of yoga therapy were observed in any patient.

DISCUSSION
Yoga is an ancient traditional Indian physio-philosophical, cultural art of living and science of healing. Yoga has been used as an adjuvant or complementary treatment for a number of neurological and non-neurological disorders in adults and children. To the best of our knowledge, this is the first randomized controlled trial studying the effect of yoga in children with epilepsy.
Effect of yoga on seizure control

The results of this study showed that yoga as an additional therapy in children with epilepsy was associated with seizure freedom when compared to the control group. These findings are similar to all other studies in literature. Although all children in the yoga group were seizure free, the difference was not statistically significant. This may be due to the fact that the patients in both the groups were taking AEDs. Appropriate AEDs in correct doses lead to seizure control in 60%–70% of patients and a reduction in frequency of seizures may be seen in others.

Cochrane reviews assessing the use of yoga in epilepsy in 2012, 2015, and 2017 have included only two randomized controlled trials.[1,11,12] Both these studies were carried out in adults with refractory epilepsy, one by Panjwani et al.[13] and the other by Lundgren et al.[4] The evidence indicates possible beneficial effects of yoga; however, the beneficial outcomes are limited and of low quality. Panjwani et al.[13] studied 10 patients with idiopathic epilepsy on meditation protocol and 22 patients with idiopathic epilepsy without a meditation protocol (controls). They observed 62% and 86% reduction in seizure frequency at 3 and 6 months of meditation therapy, respectively, compared to the control group.[13]

Lundgren et al.[4] conducted a randomized controlled trial comparing acceptance and commitment therapy and yoga for drug refractory epilepsy involving 18 patients with EEG-diagnosed epilepsy. Yoga showed therapeutic effects of decreasing seizure index. The authors concluded that yoga in people with epilepsy is an inexpensive, noninvasive, enjoyable, and potentially cross-cultural supplementation for epilepsy control.[4]

In a non-randomized study by Deepak et al.[14] 11 adults with drug-resistant epilepsies practiced a meditation protocol, whereas 9 similar patients acted as control group. The meditation group showed a significant reduction in seizure frequency compared to the control group.[14] Rajesh et al.[3] in another prospective non-randomized clinical trial included patients with drug-resistant epilepsy who adhered to a twice-daily yoga meditation protocol. A total of 19 of 20 patients reported a decreased frequency of seizures within 3 months, and 6 of those 19 showed significant reduction (>50% reduction) in seizure frequency.[3]

Various mechanisms have been proposed to explain the beneficial effects of yoga in epilepsy. Yoga may have an effect on the probability of seizure occurrence because of the effect it has on brain wave activity and arousal level.[15,16] Brown and Gerbarg[17] suggested that yoga training stimulates the vagus nerve, and stimulation of the vagus nerve has been shown to decrease the seizure frequency by 28%–38%.[18,19]

Effect of yoga on EEG

Yoga is a common relaxation technique that is set to induce relaxation and cause stress reduction. This influences the EEG and autonomic nervous system, thus controlling the seizures. The reduction in stress, increased parasympathetic nervous system activity, and increased brain GABA levels associated with yoga-based interventions are said to be beneficial.[7-9] Yoga not only reduces the stress associated with epilepsy but also modifies brain rhythm, and thereby helps in controlling seizure frequency.

Effect of yoga on EEG in normal adults was studied by Stancák et al.[18] Satyanarayana et al.[20] Corby et al.[21] and Banquet.[22] The effect of yoga on EEG was first recorded by Anand et al.[23] in 1961. Prominent alpha
band activity on EEG and cardiac rhythm modulation were observed after adjunct yoga therapy in patients with refractory epilepsy.[14]

Detailed analysis of EEG rhythm patterns and their changes in adults with epilepsy after yoga therapy were studied by Panjwani et al.[13] and Deepak et al.[14] Panjwani et al.[13] reported that after yoga therapy, the power spectral analysis of the EEG of the subjects showed a shift in frequency from 0–8 to 8–20 Hz. Deepak et al.[16] in a study of 11 adults with drug-resistant epilepsy, concluded that continued meditation practice resulted in EEG changes that were statistically significant and substantially helped in improving the clinicoelectrographic picture.

In this study, EEGs were classified as normal and abnormal and the number of children with abnormal EEGs in the two groups were compared. Eight children each in both the groups had an abnormal EEG at the beginning of the study. At 3 months, only two children in the study group and six children in the control group had an abnormal EEG, the difference was not statistically significant (P = 0.170). At 6 months, in the yoga group, only one EEG was abnormal, whereas seven EEGs were abnormal in the control group. This difference was statistically significant (*P = 0.020). This study observed that children on yoga therapy showed significant improvement in EEG with normalization of EEG in the yoga group at 6 months of therapy.

In children, doses of AEDs are increased with gain in weight or are tapered after 2 years of seizure-free period, hence findings related to dose changes may not be of significance. No adverse effects of yoga were reported as found in other studies.[9]

The limitation in this study was the small number of participants. Blinding in such a study was not possible. Further research through large multicentric trials is recommended to evaluate various effects of yoga in children with epilepsy.

**Conclusion**

A reduction in seizure frequency resulting in seizure freedom was observed in the yoga group. EEG became normal in a significant number of children who received yoga as an intervention. No adverse effects of yoga therapy were reported.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Panebianco M, Sridharan K, Ramaratnam S. Yoga for epilepsy. Cochrane Database Syst Rev 2017;10:CD001524.
2. Elger CE, Schmidt D. Modern management of Epilepsy, a practical approach. Epilepsy Behav 2008;12:501-39.
3. Rajesh B, Jayachandran D, Mohandas G, Radhakrishnan K. A pilot study of a yoga meditation protocol for patients with medically refractory epilepsy. J Altern Complement Med 2006;12:367-71.
4. Lundgren T, Dahl J, Yardi N, Melin L. Acceptance and commitment therapy and yoga for drug-refractory epilepsy: A randomized controlled trial. Epilepsy Behav 2008;13:102-8.
5. Saxena VS, Nadkarni VV. Nonpharmacological treatment of epilepsy. Ann Indian Acad Neurol 2011;14:148-52.
6. Mishra SK, Singh P, Bunch SJ, Zhang R. The therapeutic value of yoga in neurological disorders. Ann Indian Acad Neurol 2012;15:247-54.
7. Streeter CC, Gerbarg PL, Saper RB, Ciraulo DA, Brown RP. Effects of yoga on the autonomic nervous system, gamma-aminobutyric-acid, and allostatic in epilepsy, depression, and post-traumatic stress disorder. Med Hypotheses 2012;78:571-9.
8. Sathyaprabha TN, Satishchandra P, Pradhan C, Sinha S, Kaveri B, Thennarasu K, et al. Modulation of cardiac autonomic balance with adjuvant yoga therapy in patients with refractory epilepsy. Epilepsy Behav 2008;12:245-52.
9. Panjwani U, Gupta HL, Singh SH, Selvamurthy W, Rai UC. Effect of sahaja yoga practice on stress management in patients of epilepsy. Indian J Physiol Pharmacol 1995;39:111-6.
10. Birdee GS, Yeh GY, Wayne PM, Phillips RS, Davis RB, Gardiner P. Clinical applications of yoga for the pediatric population: A systematic review. Acad Pediatr 2009;9:212-20. e1-9.
11. Ramaratnam S, Sridharan K. Yoga for epilepsy. Cochrane Database Syst Rev 2012;3:CD001524.
12. Panebianco M, Sridharan K, Ramaratnam S. Yoga for epilepsy. Cochrane Database Syst Rev 2015;5:CD001524.
13. Panjwani U, Selvamurthy W, Singh SH, Gupta HL, Thakur L, Rai UC. Effect of sahaja yoga practice on seizure control and EEG changes in patients of epilepsy. Indian J Med Res 1996;103:165-72.
14. Deepak KK, Manchanda SK, Maheshwari MC. Meditation improves clinicoelectroencephalographic measures in drug-resistant epileptics. Biofeedback Self Regul 1994;19:25-40.
15. Stancák A Jr, Kuna M, Snirvasan, Dostálek C, Vishnudevanda S, Kapalabhati–yogic cleansing exercise. II. EEG topography analysis. Homeost Health Dis 1991;33:182-9.
16. Yardi N. Yoga for control of epilepsy. Seizure 2001;10:7-12.
17. Brown RP, Gerbarg PL. Sudarshan kriya yogic breathing in the treatment of stress, anxiety, and depression: Part I-neurophysiologic model. J Altern Complement Med 2005;11:189-201.

18. Handforth A, DeGiorgio CM, Schachter SC, Uthman BM, Naritoku DK, Tecoma ES, et al. Vagus nerve stimulation therapy for partial-onset seizures: A randomized active-control trial. Neurology 1998;51:48-55.

19. Ben-Menachem E, Manon-Espaillat R, Ristanovic R, Wilder BJ, Stefan H, Mirza W, et al. Vagus nerve stimulation for the treatment of partial seizures: 1. A controlled study of effect of seizures. First International Vagus Nerve Stimulation Study Group. Epilepsia 1994;35:616-26.

20. Satyanarayana M, Rajeswari KR, Rani NJ, Krishna CS, Rao PV. Effect of santhi kriya on certain psychophysiological parameters: A preliminary study. Indian J Physiol Pharmacol 1992;36:88-92.

21. Corby JC, Roth WT, Zarcone VP, Kopel BS. Psychophysiological correlates of the practice of Tantric Yoga meditation. Arch Gen Psychiatry 1978;35:571-7.

22. Banquet JP. Spectral analysis of the EEG in meditation. Electroencephalogr Clin Neurophysiol 1973;35:143-51.

23. Anand BK, Chinna GS, Singh B. Some aspects of electroencephalographic studies in Yogis. Electroencephalography and Clinical Neurophysiology 1961;13:452-6.