

Rajyoga Meditation: Effects on Visual Evoked Potentials in Migraine Patients

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Abstract

Background

Migraine is a disabling disease characterized by recurrent headaches, affecting the individual, family, and society. Light can precipitate migraine attacks, and most migraine auras are visual, suggesting, in particular, the role of the visual system in the pathophysiology of migraine. The present study assessed the effects of rajyoga meditation on visual evoked potentials (VEPs) in migraine patients.

Materials and Methods

This repeated measures study was conducted in the Department of Physiology, Rajasthan University of Health Sciences, Jaipur (Rajasthan, India) and Jaipuria Hospital, Jaipur (Rajasthan, India) after approval from the institutional ethics committee. The study included 185 migraine patients (Group A) and 51 age-matched controls (Group B), satisfying the inclusion and exclusion criteria. VEPs of A and B groups were recorded and compared using the Mann-Whitney U test. Further, group A patients followed weekly sessions of rajyoga meditation at the Department of Physiology for three months and daily half-hour meditation at home. After three months, VEPs were re-recorded and compared with pre-intervention measurements using the Wilcoxon signed-rank test. The level of significance was considered at 5%.

Results

The P100 latency was significantly delayed ($W = 2954$; $p < 0.001$) and P100 amplitude ($W = 6561$; $p < 0.001$) was significantly lower in migraine patients than in control group. However, no significant differences were found in N75 latency ($W = 3902.5$; $p = 0.06$) and N145 latency ($W = 4008.5$; $p = 0.10$). The intervention of rajyoga meditation in migraine patients showed significant decrease in P100 latency ($W = 11306.5$; $p < 0.001$) and significant increase in P 100 peak amplitude ($W = 3138$; $p < 0.001$)

Conclusion

The present study showed favorable effects of rajyoga meditation on P100 latencies in migraine patients. The migraineurs might consider this non-pharmacologic measure as an adjunct with antimigraine therapy. However, more studies are required to establish the benefits of rajyoga meditation in migraine.

Introduction

Migraine is a common disabling primary headache disorder. Many previous epidemiological studies have documented its high prevalence of personal and socio-economic impacts. ¹ Prevalence of migraine ranges from 2.6–21.7%, with an average of 12% differences between countries and within the same

state.^{2,3} The migraine epidemiology showed the tip of the iceberg due to the under-diagnosis of headaches in India. Although a study conducted in Karnataka and NCT of Delhi (unpublished data) showed that the one-year age-standardized prevalence of migraine was slightly more than 25%.⁴ The migraine rates were reportedly higher in females (70%) than males (30%) and are highest in reproductive years (aged 25 to 55).⁵ In fact, migraine is the top cause of disability-adjusted life years (DALYs) in females. In separate online estimates figured in 2019, headache disorders were the cause in 5.4% of total Years Lived with disability (YLDs) globally, with 88.2% of these attributable to migraine.⁶ Migraine patients also experience many potential psychiatric co-morbidities, including anxiety, depression, and various respiratory problems.⁷

Traditionally, medications are first-line treatments for migraine therapy. However, only a half of migraineurs have clinically meaningful responses to preventive drug treatments; of these, more than 10% discontinue their drug therapy due to adverse events,⁸ and a half report dissatisfaction with their current treatment strategies.⁹ When preventive treatments are ineffective, there are chances that migraineurs may overuse symptomatic relief medications with a consequent worsening of their headache burden. In addition to well-known evidence-based behavioral interventions like electromyographic biofeedback, relaxation training, thermal biofeedback combined with relaxation training, and cognitive behavioral therapy,¹⁰ many patients are using less-well researched non-pharmacological options such as complementary and alternative medicine (CAM) modalities in the treatment of headache.¹¹ Meditation encompasses a family of complex practices, including yoga meditation, mindfulness meditation, mantra meditation, and Tai chi¹² Rajyoga meditation is a form of meditation performed without rituals or mantras. The word 'Rajyoga' originated from 'Raja', meaning king, and 'yoga,' meaning union between Soul (spiritual energy) and Supreme Soul (ocean of spiritual energy).¹³ Rajyoga meditation harmonizes physical, mental, and spiritual power, increasing inner strength to lead a stress-free life. Meditation has various neurophysiological correlates. Various sensory evoked potentials (SEPs), including VEPs, provide a relatively noninvasive way of studying changes in specific sensory pathways during meditation¹⁴. Meditation might modify information processing at the brainstem and thalamic levels by altering cortical functioning and corticofugal controls.¹⁵⁻¹⁷

Until now, no electrophysiological test is reliable for diagnosing migraine; however, studies found that migraineurs had a habituation deficit of visual evoked potentials (VEP) between attacks¹⁸⁻²². The electrophysiological and clinical findings during the interictal period may hold the key to a better understanding migraine pathogenesis. Visual Evoked Potential (VEP) is one such technique regarded as a practical, reliable, noninvasive, widely accepted, and standardized method for evaluating visual pathways. The present study evaluates the effect of Rajyog meditation in migraine patients as assessed by VEPs.

Materials And Methods

This repeated-measure study was conducted in the Department of Physiology, RUHS College of Medical Sciences (RUHS-CMS) and associated RDBP Jaipuria Hospital, Jaipur (Rajasthan, India) to evaluate the effect of Rajyog meditation on VEPs parameters of migraine patients. A total of 185 migraine patients (Group A) and 51 normal healthy controls (Group B) satisfying the inclusion and exclusion criteria were included in the study after approval from the Institutional Ethics committee (Table 1.) The diagnosis of migraine was confirmed at the time of patient recruitment based on criteria laid down by the International Headache Society (IHS) in 2018. All the participants in group A were allowed to continue taking their prophylactic and abortive medications as usual and were asked not to change dosages for the trial duration.

Table 1
Inclusion and exclusion criterion for selection of participants in the study.

Inclusion Criteria	Exclusion criteria
1. Migraine patients with or without aura (diagnosed as per IHS 2018)	1. History of practicing meditation or yoga
2. Age \geq 18 years	2. Subjects suffered from a significant systemic illness or psychiatric condition.
3. Gender: Male or Female	3. Plan of pregnancy or pregnant or breastfeeding.
4. Duration of migraine \geq 1 year	4. New prophylactic migraine medicine started within the past four weeks.
5. Frequency of migraine- 4 to 14 days per month	5. Unwilling to maintain stable migraine medication dosages
6. Willing to attend weekly sessions and perform daily Rajyog meditation for 30 to 45 minutes.	6. Failure to complete baseline headache log records.

Rajyoga Intervention:

Group A patients underwent weekly sessions of Rajyoga meditation under a trained instructor from Brahma Kumaris center in a dim light room within the department of physiology for three consecutive months. Also, the patients were advised to practice Rajyoga Meditation for half an hour daily at their home, preferably in the morning for three months.

Rajyoga Meditation training was given as per the standard technique of Rajyoga Education and Research Foundation of the medical wing of Brahma Kumaris World Spiritual University, Mount Abu, India. The three sessions were included in the following training:

- Session 1: Self-realization and self-confidence, and self-improvement by positive and genuine thinking resulting in high self-esteem
- Session 2: Charging the self (mind and intellect) by Supreme power
- Session 3: Positive and purposeful attitude, self-awareness, and self-empowerment.

In addition, patients were given a standard video recording of the Rajyog Meditation training and practice to encourage them to practice the same without fail. Compliance was monitored through weekly phone calls and by daily logs of home practice.

A detailed clinical history of all subjects and a thorough physical examination were performed. All participants were assessed using clinical neurological examination, including fundoscopy, measurement of visual acuity, external ocular movements.

Data acquisition

The clinical data were collected, and participants underwent visual examination, including fundoscopy, visual acuity, and assessment of external ocular movements. Patients were instructed to come without applying oil to the scalp, shampoo their hair, and dry it. VEPs were recorded with a PC-based, two-channel RMS EMG EP mark II machine and Ag/AgCl disc electrodes. A VEP monitor displaying a checkerboard is used to give the pattern reversal stimulus. A montage consisting of one channel was used for the VEP recording. The subject was asked to sit comfortably in front of the checkerboard pattern at an eye screen distance of 100cm. An amplification that ranged between 20,000 and 1,00,000 was used to record the VEPs. The electrode impedance was kept below 5K Ω . The recordings were performed in a dark and sound-attenuated room. Binocular stimulation was given to both the eyes separately with black and white checks that changed the phase.

VEP analysis

VEPs consists of a series of waveforms of opposite polarity, a negative waveform (N), and a positive waveform (P), followed by the approximate latency. The latencies of the waves N₇₀, P₁₀₀, and N₁₅₅ (in milliseconds) and the peak to peak amplitudes of the waves N₇₀-P₁₀₀ and P₁₀₀-N₁₅₅ (in microvolts) were measured.²³ Initially, VEPs of both groups (Group A and Group B) were recorded. Subsequently, Group A participants underwent Rajyog intervention for three months, and VEP recording was repeated to evaluate intervention effectiveness.

Statistical Analysis

The descriptive statistics for quantitative data were expressed as the median and interquartile range (IQR), and qualitative data were expressed as proportions. After appropriate assumption checks, the control and intervention groups were compared using the non-parametric Mann-Whitney U test. The mean difference between pre and post-intervention groups were tested using the Wilcoxon signed-rank test, and the independence of attributes was tested using the chi-squared test. Statistical significance was considered at 5% level of significance ($\alpha = 0.05$). The R 4.1.2 statistical package was used for statistical analysis.

Results

In this repeated measure study, 185 migraine patients (median age = 36 years; IQR = 15 years) and 51 healthy controls (median age = 35 years; IQR = 14 years) were enrolled. Both groups were matched with respect to age ($W = 4374.5$; $p = 0.43$) and gender ($\chi^2 = 0.14$; $df = 1$; $p = 0.71$). The P100 latency was significantly delayed ($W = 2954$; $p < 0.001$) and P100 amplitude ($W = 6561$; $p < 0.001$) was significantly lower in migraine patients than in control group. However, no significant differences were found in N75 latency ($W = 3902.5$; $p = 0.06$) and N145 latency ($W = 4008.5$; $p = 0.10$) (Table 2).

Table 2

shows descriptive statistics and the difference of means between controls (N = 51) and migraine patients with no intervention (N = 185) using the Mann-Whitney U Test.

Variable	Groups	Median	IQR	W	<i>p</i>
N70 Latency	Control	64.62	9.38	3902.5	0.059
	Pre-intervention	67.32	11.47		
P100 Latency	Control	102.62	10.395	2954	< .001
	Pre-intervention	111.9	17		
N155 Latency	Control	148.01	20.185	4008.5	0.101
	Pre-intervention	149.66	19.27		
P100 Peak Amplitude	Control	5.9	0.87	6561	< .001
	Pre-intervention	5.44	1.13		
Age	Control	35	14	4374.5	0.427
	Pre-intervention	36	15		

The intervention of rajyoga meditation in migraine patients showed significant decrease in P100 latency ($W = 11306.5$; $p < 0.001$) and significant increase in P 100 peak amplitude ($W = 3138$; $p < 0.001$) (Table 3; Figs. 1 and 2).

Table 3
shows descriptive statistics and the difference of means between pre-intervention and post-intervention (N = 185) using the Wilcoxon signed-rank test.

Variables	Groups	Median	IQR	W	<i>p</i>
N70 Latency	Pre-intervention	67.32	11.47	10385	0.015
	Post-intervention	65.8	9.34		
P100 Latency	Pre-intervention	111.9	17	11306.5	< .001
	Post-intervention	102.38	10.89		
N155 Latency	Pre-intervention	149.66	19.27	9362	0.239
	Post-intervention	149.85	20.37		
P100 Peak Amplitude	Pre-intervention	5.44	1.13	3138	< .001
	Post-intervention	5.94	0.64		

Discussion

Migraine is a neurological disorder manifested with periodic symptoms, most notably a throbbing headache on one side of the head. The periodicity reflects functional and morphological changes in the brain that fluctuate over time. Further, the intensity of headaches relates to lights, sounds, and smells. In migrainous brain, temporal processing of external stimuli and sequential recruitment of neuronal networks are often dysfunctional. Researchers assessed visual evoked potentials (VEPs) that can reveal altered patterns of the brain's electrophysiological activity and aid in understanding migraine pathophysiology. The non-pharmacologic measures such as meditation, yogic exercises, and deep breathing can be adjuncts to routine antimigraine therapy.

The present study compared P100 latencies and amplitude in visual evoked potentials of healthy controls and migraineurs. Researchers found delayed P100 latency and decrease P100 amplitude in migraine patients compared to controls. In addition, the study evaluated the effect of Rajyoga meditation on migraine patients and found early P100 latencies and higher P100 amplitude after training. Similarly, Kennard et al. found delayed P100 latency and higher P100 amplitude in migraine patients.²⁴ Winter et al. found a decrease in P100 (ms) after practicing Rajyoga meditation in migraine patients²⁵. However, in a study, Polich et al. obtained visual evoked potentials from 20 migraine patients and compared them with age-matched controls. They showed no substantial differences in N75, P100, and N145 (latencies and amplitudes), elicited using full- and half-field reversing checkerboard stimulus presentations.²⁶ Mariani et al. compared twenty migraine patients with healthy controls and found significantly longer P100 latency in migraine patients.²⁷

The present study showed a decrease in P100 amplitude in migraine patients compared to controls. However, many neurophysiological studies found higher P100 amplitude in migraineurs. The higher P100

amplitudes in visual evoked potentials resulted from a decrease in habituation between attacks.^{28–29} This implies that cortical information processing gets modified in most migraine patients between attacks, which can be considered an endophenotypic biomarker of the disorder. The underlying neural mechanisms might involve lower preactivation levels of sensory cortices due to thalamocortical dysrhythmia and low serotonergic tone, but these mechanisms are still under research.^{30–33} Theoretically, one explanation was seen in the ceiling theory^{34–35}, based on the assumption that for evoked potentials, after reaching a ceiling point, cortical reactivity is reduced, which initiates a habituation response. Also, a lower preactivation level in migraine patients would cause a delayed or missing habituation because the ceiling would be reached later than healthy people. In this context, migraine patients' higher amplitudes of evoked potentials were due to the missing or reduced habituation. However, some researchers could not reproduce these findings^{36–42}, attributed to various methodological issues, including the absence of blinding³³ or differences in migraine phenotypes⁴³.

The study showed substantially reduced N70 and P100 latencies after performing Rajyoga meditation. The shifting autonomic balance in favor of parasympathetic instead of sympathetic might explain the above phenomenon. However, it requires further studies on Rajyoga meditation. In addition, there was a significant increase in post-intervention P100 amplitude. Similarly, results obtained by light flashes before, during, and after Qigong meditation showed an increase in VEP amplitudes (N80, P115, N150, P200, N280) in advanced practitioners not in novices and beginners. However, a significant decrease in the VEP amplitudes was obtained within the same study group of Qigong practitioners of other schools⁴⁴. Contrary, Schöne et al. (2018)⁴⁵ observed that modulations in much higher latency waveforms (500–6,800 ms) resulted in reduced VEP amplitudes acquired during multiple object tracking paradigms in the group that performed training in mindful breath awareness, compared to an active control group, trained in muscular relaxation. The results were attributable to an increased ability to ignore irrelevant stimuli with lower attentional effort after meditation training⁴⁵. The results of evoked potentials (EP) are highly dependent on the onset, the number of repetitions, and the type (e.g., auditory or visual) of stimuli and rely on signal averaging around an event. Most results suggest that meditation affects the processes underlying the generation of endogenous EP; it is still tricky to thoroughly compare these studies because of distinct EP components evaluated, stimuli diversity, and most importantly, the mental state of the participants.

Conclusion

The present study showed favorable effects of rajyoga meditation on P100 latencies in migraine patients. The migraineurs might consider this non-pharmacologic measure as an adjunct with antimigraine therapy. However, more studies are required to establish the benefits of rajyoga meditation in migraine.

Limitations of the study: VEPs recorded in close vicinity to or within an attack may show normal findings, as VEPs are sensitive to the recording period. Ideally, VEPs recording should be conducted in the interictal

period. The study had not considered the interaction of habituation with various groups. In addition, chronic migraineurs might show no VEP habituation.

Declarations

- **Source of financial support in the form of grants:** NA
- **Registration number in case of Clinical Trials:** NA
- **Contribution of Authors:** Equal contribution was made by all the authors in their respective domains.
- **Competing Interest** – There is no competing interest among authors
- **Research Quality and Ethics Statement-** The present study was in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000. The ethical approval was obtained from the Office of RUHS-CMS Ethics Committee via letter-number RUHS-CMS/ETHICSCOMM./2016-06 dated 30 Jul 2016

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Figures

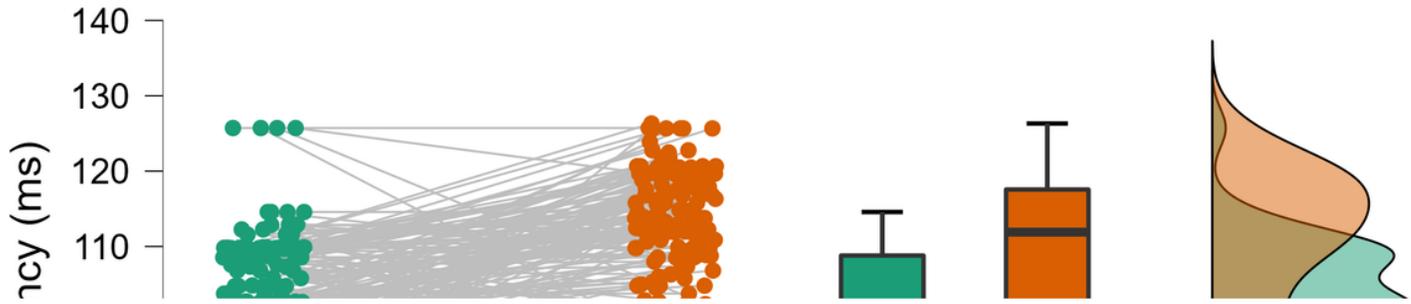


Figure 1

Raincloud plot showed a decrease in P100 latency after three months of intervention with rajyoga meditation

Figure 2

Raincloud plot showed an increase in P100 amplitude after three months of intervention with rajyoga meditation.