International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Website: https://ijmpr.in/

Original Article

A Study of Characterstics of Visual Evoked Potential in Patients with Optic Neuritis (Pre-Pulse and Post Pulse) Presenting to A Tertiary Eye Care Institute

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Received: 19-02-2026
Accepted: 25-03-2026
Published: 11-04-2026

ABSTRACT

Introduction
Inflammation of the optic nerve is known as optic neuritis (ON). ON can significantly impact visual function, either temporarily or permanently. The condition is multifactorial in origin, but it is most commonly associated with demyelinating diseases like multiple sclerosis (MS) and neuromyelitis optica spectrum disorder (NMOSD), an autoimmune disorder that primarily affects the optic .Mainly ON is classified in Retrobulbar neuritis (2/3 of cases) with normal optic disc appearance, Papillitis with swollen disc, Perineuritis, which involves the optic nerve sheath while the optic disc may or may not be swollen and Neuroretinitis with optic disc oedema and macular star exudates. Retrobulbar neuritis and papillitis are mainly associated with MS while perineuritis and neuroretinitis are more often associated with infectious or inflammatory pathologies.

Methodology:
Hospital based prospective interventional (analytic) study was conducted at ophthalmology department Jawaharlal Nehru Medical College, Ajmer, Rajasthan during the period of March 2024 to March 2025. Permission was brought from the research review board and ethics committee (No. 2429/Acad-III/MCA/ 2023)of Jawaharlal Nehru Medical College, Ajmer. Rajasthan.

Result
Total of 30 eyes (subjects) were enrolled for the study. Majorities of them were female (60%) andthe majority of patients (40%) were in the 21–35 years age group, followed by 37% in the 36–50 years group. Seventeen percent of patients were between 51–65 years, while the youngest group, those under 20 years of age, accounted for 7%. The mean age of patients was 37.8 ±13.5 years (Male: 35.3 ±14.2 years and Female: 39.6 ± 12.6 years). In residence of the patients, a slight majority of patients (53.4%) were from urban areas, while 46.6% belonged to rural regions. The distribution of patients as per VEP pre pulse latency and amplitude are depicted

Conclusion
This hospital-based interventional study demonstrated that VEP parameters, specifically P100 latency and amplitude, are valuable markers for assessing the severity of optic neuritis and monitoring recovery over time. At baseline, all patients exhibited significantly prolonged P100 latencies (>115 ms) and reduced amplitudes, indicating impaired visual pathway conduction.

Keywords: *Optic Neuritis, Visual Evoked Potential (VEP), P100 Latency, Multiple Sclerosis, Neuromyelitis Optica Spectrum Disorder.*

INTRODUCTION

Inflammation of the optic nerve is known as optic neuritis (ON). ON can significantly impact visual function, either temporarily or permanently. The condition is multifactorial in origin, but it is most commonly associated with demyelinating diseases like multiple sclerosis (MS) and neuromyelitis optica spectrum disorder (NMOSD), an autoimmune disorder that primarily affects the optic .Mainly ON is classified in Retrobulbar neuritis (2/3 of cases) with normal optic disc appearance, Papillitis with swollen disc, Perineuritis, which involves the optic nerve sheath while the optic disc may or may not be swollen and Neuroretinitis with optic disc oedema and macular star exudates. Retrobulbar neuritis and papillitis are mainly associated with MS while perineuritis and neuroretinitis are more often associated with infectious or inflammatory pathologies , , .

The ON isprevalent across worldwide, with an annual incidence reported to range between 0.56 to 5.1 cases per 100,000 population. . The incidence in SouthAsian country like in south Korea nnual incidence was 1.04 per100 000 pediatric individuals and 3.29 per 100 000 adults and japan this is around 1.5 per 10000.In contrast, the prevalence in India is estimated at 7–10 per 10,000 individuals, indicating regional disparities in disease burden and possibly underlying risk factors , .Risk of ON is 2-3 time higher in female and adults , , . Studies shows that the incidence of multiple sclerosis is higher in temperate climates .

Visual Evoked Potential (VEP) is an important electrophysiological test used to assess the functional integrity of the visual pathway in patients with optic neuritis . It measures the brain's electrical response to visual stimuli, typically using a checkerboard pattern while the patient maintains fixation. In optic neuritis, delayed latency of the P100 wave the prominent positive component generated from the striate cortex and preceded by the N75 wave indicates demyelination and slowed nerve conduction . Prolongation of P100 latency reflects the degree of demyelination, while reduced amplitude is associated with axonal damage. Although VEP is not always required for diagnosis, it serves as a valuable supportive tool, especially in cases where clinical findings are ambiguous or MRI results are inconclusive. VEP abnormalities may persist for several years even after clinical recovery, highlighting its sensitivity in detecting subclinical dysfunction. Furthermore, treatment with intravenous methylprednisolone followed by oral corticosteroids leads to faster and more sustained visual recovery in patients with optic neuritis .

Despite the utility of VEP in diagnosing and monitoring optic neuritis, there is limited data available in the regional context, especially regarding the comparative characteristics of VEP responses before and after visual stimulation. So this study was planned to evaluate the characteristics of visual evoked potential in patients with optic neuritis (pre pulse and post pulse) presenting to a tertiary eye care institute.

METHODOLOGY:

Hospital based prospective interventional (analytic) study was conducted at ophthalmology department Jawaharlal Nehru Medical College, Ajmer, Rajasthan during the period of March 2024 to March 2025. Permission was brought from the research review board and ethics committee (No. 2429/Acad-III/MCA/ 2023)of Jawaharlal Nehru Medical College, Ajmer. Rajasthan.

Clinically diagnosed patients with optic neuritisabove the age of 14year were included for the study.Patients with ischemic optic neuropathy, compressive optic neuropathy due to tumors, history of significant ocular trauma, or pre-existing ocular diseases affecting the optic nerve (such as glaucoma, retinal diseases, or prior ischemic optic neuropathy) were excluded from the study. Additionally, patients with high refractive errors greater than ±6 diopters, which could interfere with VEP accuracy, were also excluded.

In sample size calculation, a sample of 30 cases was adequate for the pilot study at 95 % confidence interval and power of 80% to verify expected assumed difference of $1.8 \pm 4.71 \mu V$for mean amplitude before and after one month of pulse therapy (post pulse).

Convenient sampling was done for selection of the patients and the pretested questionnaire was used to assess demographic, personal and clinical profile of the patients.

After the enrollment of the patients, complete history of patient including any known drug allergy, chronic medical history and Family history were taken complete Clinical and Ocular examination was done including, Visualacuity(Snellen), anteriorsegmentexamination (slit lamp), fundusexamination(indirectophthalmoscopies), IOPmeasurements, colourvision(IshiharaChart), contrastsensitivity and RAPD(pupillaryreaction)withswinginglightreflextest, including visual evoked potential (VEP), and magnetic resonance imaging (MRI) of the brain and orbits with contrast to identify demyelinating lesions and rule out other etiologies.

Measurement of VEP was conducted by stimulating the visual field using a patterned stimulus. A checkerboard pattern was used for stimulation, and the patient was instructed to maintain fixation during the VEP recording. The VEP response was recorded using three electrodes placed in the occipital region, with mid-frontal electrodes serving as references. Electrode placement followed the International 10–20 system, with reference electrodes on the forehead, the ground electrode on the

vertex (Cz), and active electrodes placed on the mid-occipital (Oz), left (O1), and right (O2) regions. Electrodes were applied by a single experienced medical professional. Recordings were performed in a quiet, dark room. All VEP recordings were interpreted by one neuro-electrophysiology consultant.Following diagnosis, all patients was received pulse corticosteroid therapy, consisting of intravenous methylprednisolone 1 gram daily for three consecutive days. This was followed by an oral prednisone taper starting at 1 mg/kg/day for 11 days, with gradual dose reduction over the subsequent four days. Throughout the treatment period, patients were closely monitored for side effects and treatment tolerance. Supportive care and education regarding symptom monitoring and recurrence was provided.

All patients enrolled in the study was followed up immediate (day 1), at 3 months and at 6months after initiation of therapy to evaluate visual recovery and assess for recurrence or progression.

VEP may be repeated to assess conduction improvements. A comprehensive ophthalmologic and neurological evaluation was conducted, especially for those with persistent or recurrent symptoms. Finally, at the 6 month follow-up, the long-term visual outcome was assessed, including any permanent visual impairment, recurrence of optic neuritis, or conversion to a chronic demyelinating condition such as multiple sclerosis.

StatisticalAnalysis:Data was collected, compile and clean in Microsoft Excel. Statistical analyses were done using computer software (SPSS Vs 26 and primer). The qualitative data were expressed in proportion and percentages and the quantitative data expressed as mean and standard deviations. The difference in proportion was analyzed by using chi square test and the difference in means were analyzed by using student T Test

RESULT

Total of 30 eyes (subjects) were enrolled for the study. Majorities of them were female (60%) andthe majority of patients (40%) were in the 21–35 years age group, followed by 37% in the 36–50 years group. Seventeen percent of patients were between 51–65 years, while the youngest group, those under 20 years of age, accounted for 7%. The mean age of patients was 37.8 ±13.5 years (Male: 35.3 ±14.2 years and Female: 39.6 ± 12.6 years). In residence of the patients, a slight majority of patients (53.4%) were from urban areas, while 46.6% belonged to rural regions. The distribution of patients as per VEP pre pulse latency and amplitude are depicted in table 1.

Table 1. Distribution of patients as per VEP pre pulse latency and pre pulse amplitude.

P100 latency	**N**	**%**	**P100 amplitude**	**N**	**%**
<90 ms (decreased)	0	0%	<5 µV (decreased)	4	13.33%
90-115 ms (normal)	0	0%	5-10 µV (normal)	26	86.6%
>115 ms (elevated)	30	100%	>10 µV (elevated)	0	0%

Before treatment, VEP amplitudes were low. More than half of the eyes (50 %) fell below 7 µV and the mean amplitude was 7.17 ± 1.82 µV, reflecting the marked conduction block typical of acute optic neuritis.Immediateafter high dose steroid therapy there was a clear right shift in the distribution. No eyes remained below 5 µV, and the mean rose to 8.9 ± 1.74 µV and the difference between pre and post amplitude was statistically significant ($t = 8.64$, $p < 0.001$).(Table 2).

By 3 months the recovery curve had shifted further upward. Low amplitude classes (< 6 µV) disappeared entirely and the mean amplitude became 9.61 ± 1.62. Improvement compared with the immediate post pulse value remained statistically significant ($t = 4.61$, $p < 0.001$).(Table 2).

At 6 months the distribution stabilised at the higher end and the meanamplitudes rose to 9.81±1.64. Although the increment from the 1 month level was small, it was still significant ($t = -3.73$, $p < 0.001$), (Table 2).

Table 2. VEP Pre and post amplitude (µV) findings in patients with optic neuritis

VEP amplitude	Pre Pulse (P1)		Immediate post pulse(P2)		At 3 month (P3)		At 6 month (P4)	
	N	%	N	%	N	%	N	%
<5	4	13.33%	0	0%	0	0%	0	0%
5.1-6	5	16.67%	5	16.67%	0	0%	0	0%
6.1-7	6	20.00%	10	33.33%	2	6.67%	0	0%
7.1-8	4	13.33%	10	33.33%	4	13.33%	4	13.33%
8.1-9	5	16.67%	4	13.33%	7	23.33%	8	26.67%
9.1-10	6	20.00%	1	3.3%	9	30.00%	10	33.33%
>10	0	0%	0	0%	8	26.67%	8	26.67%
Mean ± SD	7.17 ± 1.82 µV		8.9 ± 1.74 µV		9.61 ± 1.62.		9.81±1.64	
Level of significance (pair t test)	P1 Vs P2 : T value: 8.64 P value: <0.001(S)							

	P2 vs P3: T value: 4.61 P value: <0.001(S) P3 vs P4: T value: -3.73 P value: <0.001(S)

Initially at before pulse, a significant proportion of patients (30%) had delayed latencies in the 130.1–135 ms range, followed by 26.6% with mean latency of125.5 ± 6.17 ms. After pulse therapy, there was a significant improvement, with latency reducing to 118.6 ± 6.31 ms. This change was statistically significant (P1 vs P2: t = 27.31, p< 0.001).At the 3-month follow-up, the majority (40%) continued to show latency in the 120.1–125 ms range, with 20% each in the 105–110 ms and 115.1–120 ms ranges overall the improvement remained statistically significant when compared to immediate post-treatment VEP (P2 vs P3: t = 13.6, p< 0.001), (Table 3).

By the 6-month follow-up, latency improvement was maintained. A combined 33.34% of patients were now in the lower latency ranges of 105–115 ms.However, latency remained relatively stable between 1 month and 6 months (117.6 ± 6.29 ms), with no statistically significant difference (P3 vs P4: t = -1.68, p = 0.103). (Table 3).

Table 3. VEP Pre Latency (ms)and post latency findings in patients with optic neuritis

	Pre Pulse (P1)		Immediate post pulse (P2)		At 3 month (P3)		At 6 month (P4)	
	N	%	N	%	N	%	N	%
105-110	0	0%	4	13.33%	6	20.00%	5	16.67%
110.1-115	0	0%	6	20.00%	4	13.33%	5	16.67%
115.1-120	8	26.6%	5	16.67%	6	20.00%	6	20.00%
120.1-125	5	16.6%	11	36.67%	12	40.00%	11	36.67%
125.1-130	8	26.6%	4	13.33%	2	6.67%	3	10.00%
130.1-135	9	30.00%	0	0.00%	0	0.00%	0	0.00%
Mean ± SD	125.5±**6.17**		118.6±**6.31**		117.5±**6.39**		117.3±**6.29**	
Level of significance (pair t test)	P1 Vs P2 : T value: 27.31 P value: <0.001(S) P2 vs P3: T value: 13.6 P value: <0.001(S) P3 vs P4: T value: -1.68 P value: 0.103(NS)							

The Visual acuity of the patients at baseline was marked low as most of patients (83.3 %) could see no better than counting fingers (<6/60 to finger-count). Significant improvement was observed at immediately after the pulse at three-month. And At 6 months (table 4).

Table 10. comparison of pre and post pulse visual acuity findings in patients with optic neuritis

	Pre Pulse		**Immediate post pulse**		**At 3 month**		**At 6 month**	
	N	%	N	%	N	%	N	%
6/6.	0	0%	0	0%	0	0%	1	3.33%
6/9	0	0%	0	0%	2	6.67%	4	13.33%
6/12.	0	0%	2	6.67%	9	30.00%	8	26.67%
6/18.	0	0%	2	6.67%	3	10.00%	5	16.67%
6/24.	0	0%	5	16.67%	9	30.00%	7	23.33%
6/36.	0	0%	2	6.67%	1	3.33%	3	10.00%
6/60.	1	3.33%	10	33.33%	6	20.00%	0	0%
<6/60 to FC	25	83.33%	9	30.00%	0	0%	0	0%
MHCF	3	10.00%	0	0%	0	0%	0	0%
Only PL	1	3.33%	0	0%	0	0%	0	0%

DISCUSSION

Total of 30 participants who fulfilled the predefined inclusion and exclusion criteria were enrolled for the study during the period from March 2024 to March 2025. In the present study, the mean age of the study population was 37.8 ±13.5 years and the majority of patients with optic neuritis were between 21–35 years of age,indicating a higher prevalence among young to middle-aged adults. Similarly the Optic Neuritis Treatment Trial (ONTT)found that the mean age of presentation was around 32 years (Beck et al.,) . The result of our study is also supported by the study of Braithwaite T et al conducted a trend analysis in UK, documented that the median age of ON patients was 32.6 with the range of 18 to 54 year. Similarly, the study of Costello F et al also noted the similar mean age of 39 year in patients.Therefore, recognizing the typical age profile in optic neuritis can help guide clinical suspicion and timely neurophysiological evaluation.

In the present study, a female predominance was observed among patients with optic neuritis, with 60% females and 40% males. This finding aligns with established literature Pérez-Cambrodí RJ et al. reported that the being female poses 2 time

high risk as compare to male patients of optic neuritis or multiple sclerosis. Similarly the study of Costello F et al also noted the male dominance in their study (62% vs 41%).This female predominance is could be due to the its relation with the autoimmune nature of the condition, as many cases of optic neuritis are associated with demyelinating diseases such as multiple sclerosis (MS), which are themselves more prevalent in females. Hormonal and immunological differences between sexes are believed to contribute to this disparity.

In the present study, a significant improvement in the mean P100 amplitude was observed following pulse corticosteroid therapy. These findings suggest that visual evoked potential (VEP) amplitude is a sensitive marker for early and sustained electrophysiological improvement in patients with optic neuritis. Findings of our study is significantly higher than the study of Dahanayake et al. where the VEP amplitude decrease in ONTT plus group while somewhat improvement with ONTT group but the improvement in P 100 amplitude was not significant as we observed in our study.Similar patterns have been reported in earlier studies. Klistorner et al. (2008) observed that VEP amplitude increases significantly following corticosteroid therapy, correlating with clinical visual recovery. Additionally, Trip et al. (2005) demonstrated that amplitude improvement in the early post-inflammatory phase is associated with remyelination and axonal preservation. The gradual increase in amplitude over six months in our study reinforces the concept that early therapeutic intervention promotes neuro-functional recovery and supports the use of serial VEP recordings in monitoring treatment response and disease progression in optic neuritis.

The present study demonstrated a sustained improvement in VEP P100 latency following pulse corticosteroid therapy, with the most significant reduction occurring within the first three months and stabilization thereafter up to six months. This trend suggests both early functional recovery and possible re-myelination. No other literature has found comparing before and after the pulse therapy response in term of, although some other study compared the VEP before and after the other steroid therapy.Morrow SA et al conducted an RCT, with IV methylprednisolone and oral prednisone. They observed that latency in the IV group significantly decreased from 181.9 (53.6) milliseconds to 119.0 (16.5) milliseconds. The P100 latency in the group receiving oral administration decreased from a mean (SD) of 200.5 (67.2) milliseconds to 133.8 (31.5) milliseconds. However, the difference between both group was not statistically significantly among the groups (P = .07). In contrast, Trauzettel-Klosinski et al. (2002) , in their comparative study of oral methylprednisolone versus thiamine, found that while methylprednisolone led to a faster reduction in VEP latency during the early phase ($p = 0.015$ at 4 weeks), this benefit did not persist beyond 12 weeks. Their follow-up demonstrated heterogeneous courses of latency over time, suggesting that long-term improvement was not uniform across patients. Unlike their findings, our study shows that latency improvement was not only rapid in the acute phase but also remained stable up to six months, indicating a sustained therapeutic effect of intravenous pulse therapy.When comparing the present study with those of Morrow SAet al , a similar trend in VEP latency improvement following high-dose intravenous methylprednisolone therapy is evident. In their study, patients received 1 gram of IV methylprednisolone daily for 3–5 days, and a significant reduction in P100 latency was observed from a markedly delayed average of 200 ms to 116.33 ms at six months. This substantial improvement closely mirrors the trend seen in our study, where latency reduced from 125.5 ± 6.17 ms at baseline to 117.6 ± 6.29 ms at six months. Although baseline latency values differed due to variation in study populations or disease severity at presentation, both studies demonstrate that early initiation of high-dose intravenous corticosteroids leads to meaningful electrophysiological recovery within a 6-month period.

In the present study, a majority of patients with optic neuritis presented with severe visual impairment, these findings are consistent with the results of the Optic Neuritis Treatment Trial (ONTT), which reported that most patients with optic neuritis experience substantial visual recovery within 6 months of onset, especially when with high-dose corticosteroids (Beck et al., 1992) . Similarly, Sharma et al. (2004) observed that over 70% of treated patients recovered to 6/18 or better within 6 months. Our study supports these observations and emphasizes that pulse methylprednisolone therapy not only accelerates recovery but also contributes to long-term improvement in visual acuity. The correlation between improved visual acuity and VEP amplitude recovery further underscores the utility of combining clinical and electrophysiological parameters for comprehensive monitoring of optic neuritis outcomes.These findings are in line with the results of Tsumura R et al. , who conducted a study in Hiroshima and reported significant improvement in visual acuity after corticosteroid therapy in optic neuritis patients. Their study concluded that early administration of steroids was associated with better visual outcomes and faster resolution of optic nerve inflammation, echoing our observation of improved acuity post-treatment.

CONCLUSION

This hospital-based interventional study demonstrated that VEP parameters, specifically P100 latency and amplitude, are valuable markers for assessing the severity of optic neuritis and monitoring recovery over time. At baseline, all patients exhibited significantly prolonged P100 latencies (>115 ms) and reduced amplitudes, indicating impaired visual pathway conduction.

Following pulse steroid therapy, there was a significant improvement in both VEP latency and amplitude, with sustained gains observed over a 6-month follow-up period. These electrophysiological improvements were paralleled by a marked enhancement in visual acuity, indicating both functional and structural recovery. Overall, the study highlights the effectiveness of pulse therapy and the clinical utility of VEP in diagnosing, quantifying, and tracking optic neuritis.
Conflict of interest: No any

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