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ORIGINAL ARTICLE

The comparative clinical effectiveness of withdrawal treatment with greater occipital nerve block at the C2 level with dexamethasone or bupivacaine in medication-overuse headache

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ABSTRACT

Objectives: This study aimed to evaluate the clinical effectiveness of withdrawal treatment combined with greater occipital nerve (GON) block at the C2 level using dexamethasone or bupivacaine in patients with medication-overuse headache (MOH).

Patients and methods: The retrospective study was conducted with 78 patients (17 males, 61 females; mean age: 40.6±12.5 years; range, 25 to 63 years) with MOH who were admitted between October 2022 and April 2024. Patients were divided into three groups: Group A (n=21) received a standard withdrawal protocol with limited use of triptans and nonsteroidal anti-inflammatory drugs, Group B (n=27) received a GON blockade with a single administration of dexamethasone and bupivacaine, and Group C (n=30) received weekly GON blockades with bupivacaine for four weeks. Comprehensive headache diaries were used to collect data on headache severity, medication usage, and headache duration before and after treatment.

Results: Group A showed significant reductions in severe headache intensity, mean Visual Analog Scale (VAS) scores, migraine-related headaches, and medication usage in the third and fourth weeks after treatment. Group B demonstrated significant decreases in severe headaches, mean VAS scores, and headache days by the third month. Group C exhibited significant reductions in headache severity, VAS scores, and headache frequency over four weeks. All groups showed a decrease in headache days per month, with Group C showing the most consistent improvement.

Conclusion: The study concluded that GON blockade, both as a single administration and in repeated weekly doses, was an effective treatment for MOH. The combined approach of withdrawal protocol and GON blockade significantly reduced headache severity, medication usage, and headache frequency, offering a promising treatment strategy for patients with MOH.

Keywords: Bupivacaine, dexamethasone, greater occipital nerve block, medication-overuse headache.

In individuals with primary headache conditions, such as migraine or tension-type headache, frequent use of acute headache medication can lead to an increase in both the frequency and severity of headaches. This creates a harmful cycle of more medication consumption and more frequent attacks. Consequently, the treatment inadvertently becomes the cause of the condition, referred to as medication-overuse headache (MOH).[1]

The third edition of the International Classification of Headache Disorders, 3rd edition (ICHD-3)[2] (beta version) categorizes MOH as a secondary headache; hence, patients should also be diagnosed with the preexisting headache disorder, such as chronic migraine. Additionally, the diagnosis should specify the substance being overused (e.g., "8.2.2. Triptan-overuse headache"). Since most patients use more than one medication, all relevant codes should be applied

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if multiple drugs are overused. If multiple drugs are overused without the overuse of any single drug or drug class alone, the diagnosis should be "8.2.6 Medication-overuse headache attributed to combination of acute medications." Patients who are unaware of the exact amounts of different drugs possibly overused should receive the diagnosis "8.2.7. Medication-overuse headache attributed to unverified overuse of multiple drug classes."

Medication-overuse headache can be characterized by neuronal hyperexcitability and central sensitization as potential mechanisms of pathophysiology, as demonstrated in various human neurophysiological studies. These studies employed techniques such as sensory evoked cortical potentials, cold pressor tests, somatosensory evoked potentials (SEP), and carbon dioxide laser evoked potentials, all of which showed increased stimulation responses and habituation deficits in MOH patients. In the case of SEP, electrical stimulation of the median nerve was applied at the wrist, and the resulting cortical responses were recorded using surface electrodes placed on the scalp over the somatosensory cortex. The studies revealed that MOH patients exhibited increased SEP amplitudes after the first stimulation and demonstrated a lack of habituation upon repeated stimulations. Notably, SEP amplitudes were smaller in patients who overused triptans compared to those who overused nonsteroidal anti-inflammatory drugs (NSAIDs). These findings indicate a state of central sensitization affecting both cephalic and extracephalic regions. Additionally, MOH patients exhibit increases in both somatic and trigeminal pain-induced evoked potentials. Interestingly, MOH patients who overuse analgesics show a reduced latency of somatic pain-induced evoked potentials compared to those who overuse triptans, chronic migraine patients with depression, patients with major depressive disorder, episodic migraine patients, and healthy controls.[3-5]

Given the common features of central sensitization and neuronal hyperexcitability in MOH and conditions treated with greater occipital nerve (GON) block, we propose that GON block may offer a potential treatment option for MOH. The rationale for using GON block in headache treatment lies in the proximity of sensory neurons in the upper cervical spinal cord to the trigeminal nucleus caudalis (TNC) and the convergence of sensory inputs from cervical and trigeminal fibers at the TNC. Animal studies have shown that GON stimulation increases metabolic activity in the TNC and upper cervical dorsal horn, which are also activated by mechanical or electrical stimulation of trigeminally innervated structures. This suggests that sensory input from cervical and trigeminal afferents converges at the TNC level. Furthermore, a rat cranial nociception model demonstrated that dorsal horn neurons at the C2 level responded to dural stimulation. In humans, GON blockade was shown to relieve pain beyond the skin region of the nerve, demonstrating its effectiveness in treating central sensitization.[6] Therefore, given the common mechanisms of central sensitization and neuronal hyperexcitability in MOH and conditions treated with GON block, we envision that GON block may be a promising treatment option for MOH. Thus, this study aimed to evaluate the clinical effectiveness of withdrawal treatment combined with GON block at the C2 level using dexamethasone or bupivacaine in patients with MOH.

PATIENTS AND METHODS

The retrospective study was conducted with 78 patients (17 males, 61 females; mean age: 40.6±12.5 years; range, 25 to 63 years) who were admitted to the Algology Clinic of the Ordu State Hospital between October 2022 and April 2024. These patients attended regular follow-ups, completed comprehensive headache diaries, and were diagnosed with MOH, specifically MOH attributed to a combination of acute medications.[2] In this study, only patients who had been previously diagnosed with chronic migraine according to the ICHD-3 were included. Consequently, the classification into migrainous and nonmigrainous headaches was applied solely to patients with MOH who had a prior diagnosis of migraine. The nonmigrainous headaches group represented patients whose headache episodes during the pretreatment period did not meet the clinical criteria for migraine attacks but were still attributed to medication overuse. These headaches were not classified as tension-type headaches or secondary headaches, as patients with these diagnoses were excluded from the study. Since all patients in the study did not benefit sufficiently from prophylactic treatments for at least three months or discontinued them due to side effects,[7] they represented a special group recommended by the ICHD-3 to be diagnosed with both chronic migraine and MOH.[2] Patients were excluded if they had significant psychiatric disorders (e.g., severe depression or schizophrenia), physical

impairments (e.g., malignancy, concurrent heart disease, or severe comorbid pain), a prior diagnosis of secondary headaches, or if they were pregnant or breastfeeding. Additionally, exclusion criteria encompassed individuals who underwent invasive procedures in the occipital region, those with sensory impairments in the occipital region, individuals with a history of adverse reactions to corticosteroids or lidocaine, and those who overused opioids, benzodiazepines, or barbiturates. Written informed consent was obtained from each patient. The study protocol was approved by the Ordu University Ethics Committee (Date: 6.07.2024, No: 98). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patients were divided into three treatment groups. Group A (n=21) received the standard withdrawal protocol with limited use of triptans and NSAIDs for acute headache relief. Group B (n=27) did not receive the standard withdrawal protocol. Instead, GON blockade was applied only once to manage withdrawal symptoms and reduce headache severity. The block was applied bilaterally. Dexamethasone (2 mg) and 0.125% bupivacaine (4 mL) were administered to Group B only once via occipital nerve block. Group C (n=30) also did not receive the standard withdrawal protocol. Instead, GON blockade was administered once a week for four weeks to manage withdrawal symptoms and reduce headache intensity. The block was applied bilaterally. Group C was administered 0.125% bupivacaine (4 mL) via occipital nerve block weekly for four weeks.

During the standard withdrawal protocol (Group A), patients were advised to minimize their overuse of medications as much as possible during the first two weeks. To manage withdrawal symptoms and minimize discomfort, patients were permitted to use acute medications as needed during this initial phase. This period served as a detoxification phase to mitigate rebound headaches. Patients were provided with education and support throughout this phase to help manage withdrawal symptoms, which typically included headaches, nausea, and sleep disturbances. Furthermore, they received extensive education on headache management, with a focus on reducing medication overuse. This education was provided once a week for the first two weeks. Following the initial phase, patients were advised to limit their use of acute medications to no more than two days per week. The purpose of this restriction was to prevent the recurrence of MOH and to encourage the use of alternative, non-pharmacological treatments.[8,9]

For the C2 GON block, the patient was positioned in a prone position with the neck flexed. An ultrasound-guided technique was used with the obliquus capitis inferior (OCI) muscle and the spinous process of C2 as anatomical landmarks. Initially, a 12-18 MHz linear probe was placed transversely over the occipital prominence. The probe was then moved caudally in the sagittal plane to visualize the unicorn of the spinous process of C1. Further progress allowed visualization of the spinous process of C2 in the form of two horns where the probe was stopped. The probe was

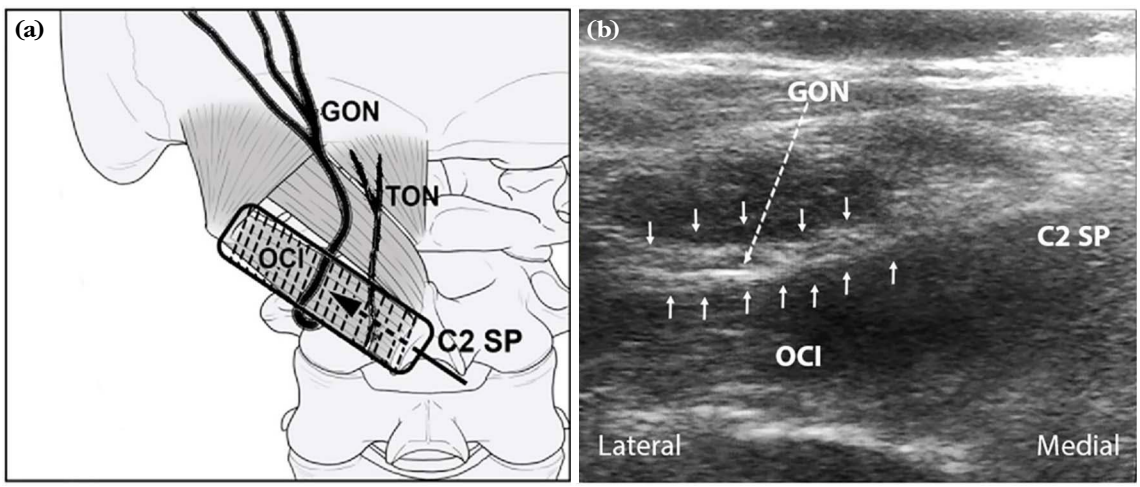

Figure 1. Greater occipital nerve block at the level of C2 with ultrasound guided.

GON: Greater occipital nerve; TON: Third occipital nerve; OCI: Obliquus capitis inferior muscle; C2 SP: Spinal process of C2.

then moved laterally to visualize the OCI and semispinalis capitis muscles. The lateral part of the probe was tilted slightly cephalad to better visualize the long axis of the muscles. Once this adjustment was complete, a boat shape emerged within the lamina of C2, from which the OCI muscle stood out. The flat image between the OCI and semispinalis capitis muscles was determined as the target point. The occipital artery was visualized medially, and the GON was visualized laterally (Figure 1).[6]

All patients included in this study were diagnosed with MOH attributed to the combined overuse of triptans and NSAIDs, as per ICHD-3. This ensured homogeneity within the study population and allowed for a focused analysis of this specific subgroup.

The data collection process involved comprehensive headache diaries, which recorded medication types and quantities, headache frequency, intensity (Visual Analog Scale [VAS] score),[10] and duration. Pretreatment data were derived by averaging the last three months preceding the treatment to establish baseline values. These included severe headache frequency (VAS >4),[10] total headache days, total migraine headaches, total medication use (triptans and NSAIDs in tablet units), and mean headache duration (hours). Posttreatment data were recorded weekly during the first month to assess short-term treatment effects.

Statistical analysis

All statistical analyses were performed using IBM SPSS version 26.0 (IBM Corp., Armonk, NY, USA) or R version 4.0.3 software (R Foundation for Statistical Computing, Vienna, Austria). Means, medians, standard deviations, and ranges were calculated for continuous variables (e.g., age, duration of migraine diagnosis, VAS scores, and headache duration). Frequencies and percentages were calculated for categorical variables (e.g., sex, education level, and type of headaches). Paired t-tests were used to compare the mean values of continuous variables (e.g., VAS scores and headache duration) between the pretreatment and posttreatment phases within each group. Chi-square tests were used to compare categorical variables between groups. One-way analysis of variance (ANOVA) was used to compare mean changes in clinical variables among the three treatment groups (Groups A, B, and C). Post hoc Tukey tests were conducted for pairwise comparisons if the ANOVA showed significant differences. Repeated measures ANOVA was used to analyze changes over time (e.g., weekly posttreatment data) within each group. Multiple linear regression analysis was performed to identify predictors of treatment success, considering sociodemographic and clinical variables. Logistic regression was used to determine factors associated with a significant reduction in MOH frequency (e.g., ≥50% reduction in headache days). A p-value <0.05 was considered statistically significant for all tests. Confidence intervals (CI) were calculated at the 95% level.

RESULTS

There was a significant reduction in severe headache intensity from pretreatment (7.00±1.92) to the first month (8.10±3.27; Z=–1.585, p=0.113), with a notable decrease by the third month (3.24±2.19; Z=–3.736, p<0.001; Table 4). The mean VAS scores significantly decreased from pretreatment (7.90±1.48) to the first month (5.30±1.40; Z=–3.531, p<0.001). By the third month, the VAS scores further decreased (5.48±2.11), showing a statistically significant change (Z=–3.982, p<0.001). Migraine headache intensity significantly decreased (Z=–3.837, p<0.001), while nonmigraine headaches also showed a significant reduction by the first month (Z=–3.608, p<0.001; Table 4). Triptan and NSAID use both significantly decreased by the first month (p<0.001; Table 4).

Headache duration decreased to 26.54±16.44 days by the first month (Z=–1.493, p=0.135) and to 32.33±27.38 days by the third month (Z=–1.835, p=0.066). The number of headache days per month decreased significantly to 18.43±4.96 by the first month (Z=–4.018, p<0.001) and to 10.10±3.95 by the third month (Z=–3.099, p=0.002; Table 4).

Severe headaches showed a decreasing trend as the weeks progressed, with significant reductions observed in the second, third, and fourth weeks compared to the first week (p<0.05). However, no statistically significant differences were found in average VAS scores between the weeks (p>0.05; Table 5).

Migraine headaches decreased significantly in the second, third, and fourth weeks compared to the first week (p<0.05), while nonmigraine headaches showed even greater reductions across the same weeks (p<0.05). However, no significant changes were observed in triptan or NSAID use or in headache duration over the weeks (p>0.05).

TABLE 1
Demographic data distribution among groups

	Group A (n=21)				Group B (n=27)				Group C (n=30)				Total (n=78)		
Variables	n	%	Mean±SD	Min-Max	n	%	Mean±SD	Min-Max	n	%	Mean±SD	Min-Max	n	%	*p*
Age (year)			40.4±9.5	27-61			42.0±11.5	28-63			44.9±10.1	25-60			
Sex															0.597
Female	15	71.43			21	77.78			25	83.33			61	78.21	
Male	6	28.57			6	22.22			5	16.67			17	21.79	
Education level															0.635
Primary school	7	33.33			8	29.63			5	16.67					
Secondary school	6	28.57			4	14.81			6	20.00					
High school	4	19.05			7	25.93			10	33.33					
University	4	19.05			8	29.63			9	30.00					
History of MOH															0.754
No	9	42.86			11	40.74			10	33.33			30	38.46	
Yes	12	57.14			16	59.26			20	66.67			48	61.54	
Primary headache															0.564
Episodic migraine	3	14.29			2	7.41			5	16.67			10	12.82	
Chronic migraine	18	85.71			25	92.59			25	83.33			68	87.18	
Years since migraine diagnosis			18.00±6.80	9-30			16.56±6.80	5-26			17.00±7.93	5-30			0.801

SD: Standard deviation; MOH: Medication-overuse headache.

TABLE 2
Analysis of pretreatment measurements of groups A, B, and C
(one-month average data of the three-month period before treatment)

	Group A (n=21)		Group B (n=27)		Group C (n=30)		
Variables	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	*p*†
Severe headache (VAS >4) (total number of attacks)	7.00±1.92	4.00-10.00	6.67±1.86	3.00-12.00	6.90±2.19	4.00-12.00	0.843
Average VAS score	7.90±1.48	6.00-10.00	7.78±1.67	4.00-10.00	7.53±1.50	4.00-10.00	0.657
Migrainous headache (total number of attacks)	7.00±1.92	4.00-10.00	6.15±1.59	3.00-9.00	6.47±1.78	4.00-10.00	0.289
Non-migrainous headache (total number of attacks)	8.90±4.97	0.00-15.00	8.37±4.12	0.00-15.00	7.73±4.34	0.00-15.00	0.478
Triptan *usage	6.52±2.68	0.00-12.00	6.96±2.85	0.00-12.00	7.00±3.60	0.00-12.00	0.843
NSAID *usage	13.86±5.78	0.00-20.00	13.26±4.81	0.00-20.00	13.63±4.58	5.00-24.00	0.779
Average duration of headache (h)	45.71±25.91	12.00-72.00	36.67±21.41	12.00-72.00	37.37±21.60	12.00-72.00	0.514
Number of days with headache	21.90±2.88	18.00-25.00	21.52±2.72	15.00-27.00	20.97±2.83	15.00-25.00	0.563

SD: Standard deviation; VAS: Visual Analog Scale; † Kruskal Wallis test; * Number of tablets taken.

The number of headache days per month also showed a decreasing trend, with significant reductions observed in the second, third, and fourth weeks compared to the first week ($p<0.05$). The means for the third and fourth weeks were closely aligned (Table 5).

In Group B, the severity of severe headaches did not change significantly in the first month compared to pretreatment ($p>0.05$), but a significant reduction was observed by the third month ($p<0.001$; Table 6). The mean VAS scores showed significant decreases in both the first and third months compared to pretreatment ($p<0.01$), indicating consistent reductions in headache intensity over the treatment period (Table 6). No significant change was observed in severe headache intensity at the first month ($p>0.05$). However, by the third month, a significant reduction was noted ($p<0.01$; Table 6). Significant decreases were observed in VAS scores in both the first and third months compared to pretreatment ($p<0.01$; Table 6). The decrease in migraine headaches was not statistically significant in the first month ($p>0.05$), but by the third month, a significant reduction was observed ($p<0.01$; Table 6). Significant reductions were observed in nonmigraine headaches from pretreatment to the first month ($p<0.05$), with further significant decreases by the third month ($p<0.01$; Table 6). Both triptan and NSAID use significantly decreased in the first month ($p<0.01$), with a continued reduction by the third month, though the reduction was more pronounced in the first month (Table 6). The headache duration decreased significantly by the first month ($p<0.01$), with a less pronounced change by the third month ($p>0.05$; Table 6). Significant reductions were observed in the number of headache days in the first month ($p<0.01$), with further reductions by the third month ($p<0.01$; Table 6).

In Group C, significant reductions were observed in severe headaches in the second, third, and fourth weeks compared to the first week ($p<0.05$; Table 7). Significant reductions were observed in VAS scores in the third week ($p<0.05$), while the decreases in the second and fourth weeks were not statistically significant ($p>0.05$; Table 7). Significant reductions were observed in migraine headaches in the second, third, and fourth weeks compared to the first week ($p<0.05$; Table 7). Statistically significant decreases were observed in nonmigraine headaches in all weeks compared to the first week ($p<0.05$; Table 7). Triptan use decreased over the weeks, with a significant reduction in the fourth week compared to the first week ($p<0.05$; Table 7). A significant decrease was observed in NSAID use in the third week compared to the first week ($p<0.05$), with no significant changes in the second and fourth weeks ($p>0.05$; Table 7). Significant decreases were observed in headache duration in the third and fourth weeks compared to the first week ($p<0.05$), with the fourth week showing a higher average than the third week (Table 7). Significant reductions were observed in the number of days with headache in the second, third, and fourth weeks compared to the first week ($p<0.05$; Table 7).

TABLE 3
Analysis of changes in Group A in the first week after treatment compared to the second, third, and fourth weeks

Variables		Group A (n=21) Mean±SD	Min-Max	Z	*p*[a]
Severe headache (VAS >4) (total number of attacks)	1. Week	2,52±1,33	0,00-4,00	−0,439[b]	0,660
	2. Week	2,62±1,07	1,00-4,00		
	1. Week	2,52±1,33	0,00-4,00	−2,090[c]	**0,037***
	3. Week	1,48±1,44	0,00-4,00		
	1. Week	2,52±1,33	0,00-4,00	−2,607[c]	**0,009***
	4. Week	1,48±1,21	0,00-3,00		
Average VAS score	1. Week	6.05±1.88	3.00-8.00	−0.908[c]	0.364
	2. Week	5.86±1.39	4.00-8.00		
	1. Week	6.05±1.88	3.00-8.00	−2.147[c]	**0.032***
	3. Week	4.67±2.20	2.00-8.00		
	1. Week	6.05±1.88	3.00-8.00	−2.860[c]	**0.004***
	4. Week	4.62±1.80	2.00-7.00		
Migrainous headache (total number of attacks)	1. Week	1,76±1,41	0,00-4,00	−1.557[b]	0.119
	2. Week	2.29±0.90	1.00-4.00		
	1. Week	1.76±1.41	0.00-4.00	−0.858[c]	0.391
	3. Week	1.57±1.63	0.00-5.00		
	1. Week	1.76±1.41	0.00-4.00	−2.202[c]	**0.028***
	4. Week	0.95±1.24	0.00-3.00		
Non-migrainous headache (total number of attacks)	1. Week	2.33±2.37	0.00-7.00	−1.364[c]	0.172
	2. Week	1.81±1.17	0.00-4.00		
	1. Week	2.33±2.37	0.00-7.00	−1.301[c]	0.193
	3. Week	1.76±1.00	0.00-4.00		
	1. Week	2.33±2.37	0.00-7.00	−1.970[c]	**0.049***
	4. Week	1.33±1.02	0.00-4.00		
Triptan *usage	1. Week	0.90±0.77	0.00-2.00	−1.000[c]	0.317
	2. Week	0.76±0.54	0.00-2.00		
	1. Week	0.90±0.77	0.00-2.00	−1.000[c]	0.317
	3. Week	0.71±0.78	0.00-2.00		
	1. Week	0.90±0.77	0.00-2.00	−2.443[c]	**0.015***
	4. Week	0.33±0.66	0.00-2.00		
NSAID *usage	1. Week	0.81±0.81	0.00-2.00	−1.540[b]	0.124
	2. Week	1.10±0.62	0.00-2.00		
	1. Week	0.81±0.81	0.00-2.00	−1.867[c]	0.062
	3. Week	0.37±0.50	0.00-1.00		
	1. Week	0.81±0.81	0.00-2.00	−1.532[c]	0.125
	4. Week	0.43±0.60	0.00-2.00		
Average duration of headache (h)	1. Week	26.86±19.66	4.00-72.00	−0.914[c]	0.360
	2. Week	28.48±22.26	12.00-78.00		
	1. Week	26.86±19.66	4.00-72.00	−0.749[c]	0.454
	3. Week	26.71±20.27	6.00-72.00		
	1. Week	26.86±19.66	4.00-72.00	−1.835[c]	0.066
	4. Week	24.10±27.29	4.00-120.00		
Number of days with headache	1. Week	5.71±1.55	2.00-7.00	−2.095[c]	**0.036***
	2. Week	5.05±1.28	2.00-7.00		
	1. Week	5.71±1.55	2.00-7.00	−2.848[c]	**0.004***
	3. Week	4.10±1.67	2.00-6.00		
	1. Week	5.71±1.55	2.00-7.00	−3.099[c]	**0.002***
	4. Week	3.57±1.89	2.00-7.00		

SD: Standard deviation; VAS: Visual Analog Scale.

TABLE 4
Comparison of Group A data before treatment, at one month, and at three months of treatment

Variables		Group A (n=21) Mean±SD	Min-Max	Z	*p*[a]
Severe headache (VAS >4) (total number of attacks)	Pretreatment	7.00±1.92	4.00-10.00	–1.585[b]	0.113
	Month 1	8.10±3.27	1.00-14.00		
	Pretreatment	7.00±1.92	4.00-10.00	–3.736[c]	**0.001***
	Month 3	3.24±2.19	0.00-6.00		
Average VAS score	Pretreatment	7.90±1.48	6.00-10.00	–3.531[b]	**0.001***
	Month 1	5.30±1.40	3.50-7.75		
	Pretreatment	7.90±1.48	6.00-10.00	–3.982[c]	**0.001***
	Month 3	5.48±2.11	2.00-8.00		
Migrainous headache (total number of attacks)	Pretreatment	7.00±1.92	4.00-10.00	–0.431[c]	0.666
	Month 1	6.57±3.59	1.00-14.00		
	Pretreatment	7.00±1.92	4.00-10.00	–3.837[c]	**0.001***
	Month 3	3.14±2.10	0.00-6.00		
Non-migrainous headache (total number of attacks)	Pretreatment	8.90±4.97	0.00-15.00	–0.934[c]	0.350
	Month 1	7.24±4.30	0.00-17.00		
	Pretreatment	8.90±4.97	0.00-15.00	–3.608[c]	**0.001***
	Month 3	3.00±1.55	0.00-6.00		
Triptan *usage	Pretreatment	6.52±2.68	0.00-12.00	–3.597[c]	**0.001***
	Month 1	2.71±1.95	0.00-6.00		
	Pretreatment	6.52±2.68	0.00-12.00	–3.266[c]	**0.001***
	Month 3	3.05±2.29	0.00-6.00		
NSAID *usage	Pretreatment	13.86±5.78	0.00-20.00	–3.916[c]	**0.001***
	Month 1	2.67±1.35	0.00-5.00		
	Pretreatment	13.86±5.78	0.00-20.00	–3.873[c]	**0.001***
	Month 3	4.19±2.29	0.00-12.00		
Average duration of headache (h)	Pretreatment	45.71±25.91	12.00-72.00	–2.487[b]	**0.013***
	Month 1	26.54±16.44	8.00-60.00		
	Pretreatment	45.71±25.91	12.00-72.00	–1.493[c]	0.135
	Month 3	32.33±27.38	4.00-72.00		
Number of days with headache	Pretreatment	21.90±2.88	18.00-25.00	–2.303[c]	**0.021***
	Month 1	18.43±4.96	10.00-25.00		
	Pretreatment	21.90±2.88	18.00-25.00	–4.018[c]	**0.001***
	Month 3	10.10±3.95	4.00-18.00		

SD: Standard deviation; VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Wilcoxon Signed Ranks test; b: Based on positive ranks; c: Based on negative ranks; * p<0.05 * Number of tablets taken.

In Group C, no significant changes were observed in severe headaches in the first month compared to pretreatment (p>0.05), but a significant decrease was observed by the third month (p<0.01; Table 8). Significant reductions in VAS scores were observed in both the first and third months compared to pretreatment (p<0.01; Table 8). No significant change was observed in

TABLE 5
Analysis of the changes in Group B in the second, third, and fourth weeks according to the data of the first week after treatment

Variables		Group B (n=27) Mean±SD	Min-Max	Z	*p*[a]
Severe headache (VAS >4) (total number of attacks)	1. Week	2.33±1.07	0.00-4.00	−3.345[b]	**0.001***
	2. Week	1.59±1.05	0.00-4.00		
	1. Week	2.33±1.07	0.00-4.00	−3.458[b]	**0.001***
	3. Week	1.15±0.99	0.00-4.00		
	1. Week	2.33±1.07	0.00-4.00	−3.459[b]	**0.001***
	4. Week	1.19±0.96	0.00-4.00		
Average VAS score	1. Week	5.63±1.31	4.00-8.00	−0.027[b]	0.978
	2. Week	5.67±1.54	3.00-8.00		
	1. Week	5.63±1.31	4.00-8.00	−0.251[b]	0.802
	3. Week	5.30±2.52	0.00-8.00		
	1. Week	5.63±1.31	4.00-8.00	−0.063[b]	0.949
	4. Week	5.48±2.39	0.00-8.00		
Migrainous headache (total number of attacks)	1. Week	2.11±1.19	0.00-4.00	−2.167[b]	**0.030***
	2. Week	1.56±0.97	0.00-3.00		
	1. Week	2.11±1.19	0.00-4.00	−3.137[b]	**0.002***
	3. Week	1.15±0.99	0.00-4.00		
	1. Week	2.11±1.19	0.00-4.00	−3.145[b]	**0.002***
	4. Week	1.11±0.97	0.00-4.00		
Non-migrainous headache (total number of attacks)	1. Week	3.07±1.75	0.00-7.00	−3.261[b]	**0.001***
	2. Week	1.70±0.99	0.00-4.00		
	1. Week	3.07±1.75	0.00-7.00	−3.573[b]	**0.001***
	3. Week	1.07±1.24	0.00-4.00		
	1. Week	3.07±1.75	0.00-7.00	−3.736[b]	**0.001***
	4. Week	1.00±1.21	0.00-4.00		
Triptane *usage	1. Week	0.85±0.72	0.00-2.00	−1.155[c]	0.248
	2. Week	1.00±0.73	0.00-2.00		
	1. Week	0.85±0.72	0.00-2.00	−0.608[c]	0.543
	3. Week	1.00±0.96	0.00-4.00		
	1. Week	0.85±0.72	0.00-2.00	−0.392[c]	0.695
	4. Week	0.96±0.98	0.00-4.00		
NSAID *usage	1. Week	0.89±0.85	0.00-2.00	0.001[d]	1.000
	2. Week	0.89±0.64	0.00-2.00		
	1. Week	0.89±0.85	0.00-2.00	−0.290[b]	0.772
	3. Week	0.81±0.83	0.00-3.00		
	1. Week	0.89±0.85	0.00-2.00	−0.173[b]	0.862
	4. Week	0.85±0.82	0.00-3.00		
Average duration of headache (h)	1. Week	25.59±21.31	6.00-72.00	−1.108[b]	0.268
	2. Week	21.33±13.46	3.00-48.00		
	1. Week	25.59±21.31	6.00-72.00	−1.482[b]	0.138
	3. Week	17.44±18.44	0.00-72.00		
	1. Week	25.59±21.31	6.00-72.00	−1.859[b]	0.063
	4. Week	16.15±17.44	0.00-72.00		
Number of days with headache	1. Week	5.00±1.44	2.00-7.00	−2.520[b]	**0.012***
	2. Week	4.33±1.39	2.00-7.00		
	1. Week	5.00±1.44	2.00-7.00	−4.009[b]	**0.001***
	3. Week	2.63±1.92	0.00-7.00		
	1. Week	5.00±1.44	2.00-7.00	−4.055[b]	**0.001***
	4. Week	2.52±1.81	0.00-7.00		

SD: Standard deviation; VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Wilcoxon Signed Ranks test; b: Based on negative ranks; c: Based on positive ranks; d: The sum of negative ranks equals the sum of positive ranks; * p<0,05 * Number of tablets taken.

TABLE 6
Comparison of Group B data before treatment, the first month of treatment, and the third month of treatment

Variables		Group B (n=27) Mean±SD	Min-Max	Z	p^a
Severe headache (VAS> 4) (total number of attacks)	Pretreatment	6.67±1.86	3.00-12.00	–0.541[b]	0.589
	Month 1	6.26±3.12	0.00-14.00		
	Pretreatment	6.67±1.86	3.00-12.00	–4.299[b]	**0.001***
	Month 3	3.11±2.26	0.00-6.00		
Average VAS score	Pretreatment	7.78±1.67	4.00-10.00	–3.623[b]	**0.001***
	Month 1	5.52±1.49	2.00-7.00		
	Pretreatment	7.78±1.67	4.00-10.00	–3.568[b]	**0.001***
	Month 3	5.37±2.17	2.00-8.00		
Migrainous headache (total number of attacks)	Pretreatment	6.15±1.59	3.00-9.00	–0.392[b]	0.695
	Month 1	5.93±3.11	0.00-14.00		
	Pretreatment	6.15±1.59	3.00-9.00	–3.632[b]	**0.001***
	Month 3	3.93±4.11	0.00-22.00		
Non-migrainous headache (total number of attacks)	Pretreatment	8.37±4.12	0.00-15.00	–1.482[b]	0.138
	Month 1	6.85±3.48	0.00-16.00		
	Pretreatment	8.37±4.12	0.00-15.00	–4.132[b]	**0.001***
	Month 3	3.04±1.48	0.00-6.00		
Triptan *usage	Pretreatment	6.96±2.85	0.00-12.00	–3.417[b]	**0.001***
	Month 1	3.81±2.62	0.00-10.00		
	Pretreatment	6.96±2.85	0.00-12.00	–3.963[b]	**0.001***
	Month 3	2.96±2.33	0.00-6.00		
NSAID *usage	Pretreatment	13.26±4.81	0.00-20.00	–4.452[b]	**0.001***
	Month 1	3.44±1.65	0.00-6.00		
	Pretreatment	13.26±4.81	0.00-20.00	–4.480[b]	**0.001***
	Month 3	4.19±2.04	0.00-12.00		
Average duration of headache (h)	Pretreatment	36.67±21.41	12.00-72.00	–4.542[b]	**0.001***
	Month 1	20.13±14.06	3.25-60.00		
	Pre-treatment	36.67±21.41	12.00-72.00	–0.744[b]	0.457
	Month 3	32.19±27.82	4.00-72.00		
Number of days with headache	Pre-treatment	21.52±2.72	15.00-27.00	–4.162[b]	**0.001***
	Pretreatment	14.48±5.12	6.00-26.00		
	Pre-treatment	21.52±2.72	15.00-27.00	–4.549[b]	**0.001***
	Month 3	9.89±3.92	4.00-18.00		

SD: Standard deviation; VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Wilcoxon Signed Ranks test; b: Based on positive ranks; * p<0.05.

migraine headaches in the first month (p>0.05), but a significant decrease was observed by the third month (p<0.01; Table 8). Significant decreases were observed in nonmigraine headaches in the first month (p<0.05), and further reductions were observed by the third month (p<0.01; Table 8). Triptan and NSAID use significantly decreased in both the first month (p<0.01) and the third

TABLE 7
Analysis of changes in Group C in the second, third, and fourth weeks according to the data of the first week after treatment

Variables		Group C (n=30) Mean±SD	Min-Max	Z	*p*[a]
Severe headache (VAS >4) (total number of attacks)	1. Week	2.70±1.09	0.00-5.00	−3.424[b]	**0.001***
	2. Week	1.73±1.08	0.00-4.00		
	1. Week	2.70±1.09	0.00-5.00	−4.512[b]	**0.001***
	3. Week	0.73±0.83	0.00-2.00		
	1. Week	2.70±1.09	0.00-5.00	−4.469[b]	**0.001***
	4. Week	0.83±0.79	0.00-2.00		
Average VAS score	1. Week	5.57±1.19	4.00-8.00	−0.969[b]	0.332
	2. Week	5.27±1.93	0.00-8.00		
	1. Week	5.57±1.19	4.00-8.00	−2.928[b]	**0.003***
	3. Week	3.50±3.42	0.00-8.00		
	1. Week	5.57±1.19	4.00-8.00	−1.933[b]	0.053
	4. Week	4.17±3.27	0.00-8.00		
Migrainous headache (total number of attacks)	1. Week	2.70±1.09	0.00-5.00	−3.530[b]	**0.001***
	2. Week	1.70±1.02	0.00-4.00		
	1. Week	2.70±1.09	0.00-5.00	−4.512[b]	**0.001***
	3. Week	0.73±0.83	0.00-2.00		
	1. Week	2.70±1.09	0.00-5.00	−4.669[b]	**0.001***
	4. Week	0.53±0.68	0.00-2.00		
Non-migrainous headache (total number of attacks)	1. Week	2.90±1.58	0.00-6.00	−3.677[b]	**0.001***
	2. Week	1.40±1.30	0.00-5.00		
	1. Week	2.90±1.58	0.00-6.00	−4.367[b]	**0.001***
	3. Week	0.53±1.01	0.00-4.00		
	1. Week	2.90±1.58	0.00-6.00	−4.434[b]	**0.001***
	4. Week	0.53±0.97	0.00-4.00		
Triptane *usage	1. Week	0.80±0.66	0.00-2.00	−1.164[c]	0.244
	2. Week	1.00±0.83	0.00-3.00		
	1. Week	0.80±0.66	0.00-2.00	−1.641[b]	0.101
	3. Week	0.53±0.73	0.00-2.00		
	1. Week	0.80±0.66	0.00-2.00	−2.134[b]	**0.033***
	4. Week	0.47±0.63	0.00-2.00		
NSAID *usage	1. Week	0.73±0.78	0.00-2.00	−1.225[c]	0.221
	2. Week	0.93±0.74	0.00-3.00		
	1. Week	0.73±0.78	0.00-2.00	−2.725[b]	**0.006***
	3. Week	0.27±0.45	0.00-1.00		
	1. Week	0.73±0.78	0.00-2.00	−1.896[b]	0.058
	4. Week	0.37±0.67	0.00-2.00		
Average duration of headache (h)	1. Week	20.43±14.49	6.00-72.00	−0.498[b]	0.618
	2. Week	19.13±12.78	0.00-48.00		
	1. Week	20.43±14.49	6.00-72.00	−3.853[b]	**0.001***
	3. Week	6.60±11.03	0.00-48.00		
	1. Week	20.43±14.49	6.00-72.00	−3.104[b]	**0.002***
	4. Week	9.67±15.63	0.00-72.00		
Number of days with headache	1. Week	4.93±1.51	2.00-7.00	−2.827[b]	**0.005***
	2. Week	4.00±2.57	0.00-14.00		
	1. Week	4.93±1.51	2.00-7.00	−4.653[b]	**0.001***
	3. Week	1.40±1.50	0.00-5.00		
	1. Week	4.93±1.51	2.00-7.00	−4.267[b]	**0.001***
	4. Week	1.63±1.88	0.00-7.00		

SD: Standard deviation; VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Wilcoxon Signed Ranks test; b. Based on negative ranks; c. Based on positive ranks; * p<0.05.

TABLE 8
Comparison of Group C data before treatment, first month of treatment, and third month of treatment

Variables		Group C (n=30) Mean±SD	Min-Max	Z	p^a
Severe headache (VAS >4) (total number of attacks)	Pretreatment	6.90±2.19	4.00-12.00	–1.596[b]	0.110
	Month 1	6.00±2.29	0.00-10.00		
	Pretreatment	6.90±2.19	4.00-12.00	–4.653[b]	0.001*
	Month 3	2.17±2.26	0.00-6.00		
Average VAS score	Pretreatment	7.53±1.50	4.00-10.00	–4.103[b]	0.001*
	Month 1	4.63±1.59	1.00-7.50		
	Pretreatment	7.53±1.50	4.00-10.00	–4.048[b]	0.001*
	Month 3	4.33±3.10	0.00-8.00		
Migrainous headache (total number of attacks)	Pretreatment	6.47±1.78	4.00-10.00	–4.755[b]	0.001*
	Month 1	5.67±2.22	0.00-10.00		
	Pretreatment	6.47±1.78	4.00-10.00	–2.471[b]	0.013*
	Month 3	1.83±2.00	0.00-6.00		
Non-migrainous headache (total number of attacks)	Pretreatment	7.73±4.34	0.00-15.00	–4.497[b]	0.001*
	Month 1	5.37±3.30	0.00-16.00		
	Pretreatment	7.73±4.34	0.00-15.00	–3.898[b]	0.001*
	Month 3	1.37±1.69	0.00-5.00		
Triptan *usage	Pretreatment	7.00±3.60	0.00-12.00	–4.413[b]	0.001*
	Month 1	2.80±1.86	0.00-6.00		
	Pretreatment	7.00±3.60	0.00-12.00	–4.710[b]	0.001*
	Month 3	1.60±2.16	0.00-6.00		
NSAID *usage	Pretreatment	13.63±4.58	5.00-24.00	–4.788[b]	0.001*
	Month 1	2.30±1.73	0.00-7.00		
	Pretreatment	13.63±4.58	5.00-24.00	–3.877[b]	0.001*
	Month 3	2.03±2.71	0.00-12.00		
Average duration of headache (h)	Pretreatment	37.37±21.60	12.00-72.00	–3.216[b]	0.001*
	Month 1	13.96±9.50	2.00-51.00		
	Pretreatment	37.37±21.60	12.00-72.00	–4.687[b]	0.001*
	Month 3	16.83±25.30	0.00-72.00		
Number of days with headache	Pretreatment	20.97±2.83	15.00-25.00	–4.788[b]	0.001*
	Month 1	11.97±4.23	5.00-21.00		
	Pretreatment	20.97±2.83	15.00-25.00	-	-
	Month 3	4.83±5.64	0.00-18.00		

SD: Standard deviation; VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Wilcoxon Signed Ranks test; b: Based on positive ranks; * p<0.05.

month (p<0.01; Table 8). Significant reductions were observed in headache durations in the first month (p<0.01), with continued decrease by the third month (p<0.01; Table 8). Number of headache days significantly decreased in both the first month (p<0.01) and the third month (p<0.01), showing substantial reduction over time (Table 8).

In the comparison of Groups A, B, and C, several significant differences were observed during the treatment process (Tables 8-10). In the first month, Group A exhibited a significantly higher mean number of severe headache attacks (VAS >4) compared to both Group B (p=0.020) and Group C (p=0.012). The mean duration of headaches in hours differed significantly between groups. Group A had a higher mean duration compared to Group C (p=0.004). Group A had significantly more days with headaches compared to both Group B (p=0.016) and Group C (p<0.001), indicating more frequent headache episodes. Group B had significantly higher NSAID use compared to Group C (p=0.008).

In the third month, Group B had significantly more migrainous headache attacks compared to Group C, which had fewer attacks (p=0.026). Group C experienced significantly fewer nonmigrainous headache attacks compared to both Group B (p=0.002) and Group A (p<0.001). Group C showed significantly lower NSAID use compared to both Group A (p=0.001) and Group B (p<0.001). Group C had significantly fewer days with headache compared to both Group A (p=0.001) and Group B (p<0.001; Figure 2).

These results indicate that Group A experienced more severe headache attacks and longer headache durations in the early phase of treatment. However, Group C showed superior long-term outcomes, with fewer headache attacks, reduced NSAID use, and fewer headache days by the third month.

DISCUSSION

This study evaluated the effectiveness of three treatment methods in MOH patients over a

TABLE 9
Analysis of the difference between Groups A, B, and C at different periods of the treatment process

	Group A (n=21)		Group B (n=27)		Group C (n=30)		
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	*p*[a]
Severe headache (VAS >4) at first months (total number of attacks)	8.10±3.27	1.00-14.00	6.26±3.12	0.00-14.00	6.00±2.29	0.00-10.00	**0.023***
Average VAS scores at first month	5.30±1.40	3.50-7.75	5.52±1.49	2.00-7.00	4.63±1.59	1.00-7.50	0.052
Migrainous headache at first month (total number of attacks)	6.57±3.59	1.00-14.00	5.93±3.11	0.00-14.00	5.67±2.22	0.00-10.00	0.796
Non-migrainous headache at first month (total number of attacks)	7.24±4.30	0.00-17.00	6.85±3.48	0.00-16.00	5.37±3.30	0.00-16.00	0.062
Triptan *usage at first month	2.71±1.95	0.00-6.00	3.81±2.62	0.00-10.00	2.80±1.86	0.00-6.00	0.186
NSAID *usage at first month	2.67±1.35	0.00-5.00	3.44±1.65	0.00-6.00	2.30±1.73	0.00-7.00	**0.019***
Average duration of headache at first month (h)	26.54±16.44	8.00-60.00	20.13±14.06	3.25-60.00	13.96±9.50	2.00-51.00	**0.009***
Number of days with headache at first month	18.43±4.96	10.00-25.00	14.48±5.12	6.00-26.00	11.97±.23	5.00-21.00	**0.001***
Severe headache (VAS >4) at third months (total number of attacks)	3.24±2.19	0.00-6.00	3.11±2.26	0.00-6.00	2.17±2.26	0.00-6.00	0.132
Average VAS scores at third month	5.48±2.11	2.00-8.00	5.37±2.17	2.00-8.00	4.33±3.10	0.00-8.00	0.385
Migrainous headache at third month (total number of attacks)	3.14±2.10	0.00-6.00	3.93±4.11	0.00-22.00	1.83±2.00	0.00-6.00	**0.012***
Non-migrainous headache at third month (total number of attacks)	3.00±1.55	0.00-6.00	3.04±1.48	0.00-6.00	1.37±1.69	0.00-5.00	**0.001***
Triptan *usage at third month	3.05±2.29	0.00-6.00	2.96±2.33	0.00-6.00	1.60±2.16	0.00-6.00	**0.009***
NSAIS *usage at third month	4.19±2.29	0.00-12.00	4.19±2.04	0.00-12.00	2.03±2.71	0.00-12.00	**0.001***
Average duration of headache at third month (h)	32.33±27.38	4.00-72.00	32.19±27.82	4.00-72.00	16.83±25.30	0.00-72.00	**0.001***
Number of days with headache at third month	10.10±3.95	4.00-18.00	9.89±3.92	4.00-18.00	4.83±5.64	0.00-18.00	**0.001***

SD: Standard deviation; VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Kruskal Wallis test; * p<0.05 * Number of tablets taken.

TABLE 10
Pairwise comparison of treatment durations between groups

Variables	Group A U	Group B p^*	Group A U	Group C p^*	Group B U	Group C p^a
Severe headache (VAS >4) at first months (total number of attacks)	172.00	**0.020***	185.00	**0.012***	384.00	0.735
Average VAS scores at first month	241.50	0.380	229.00	0.099	265.00	**0.025***
Migrainous headache at first month (total number of attacks)	253.00	0.523	286.50	0.583	394.50	0.866
Non-migrainous headache at first month (total number of attacks)	264.50	0.691	214.50	0.053	278.50	**0.042***
Triptan *usage at first month	205.00	0.099	302.50	0.808	312.50	0.135
NSAID *usage at first month	202.50	0.086	252.50	0.220	241.00	**0.008***
Average duration of headache at first month (h)	208.50	0.118	164.00	**0.004***	291.00	0.068
Number of days with headache at first month	168.50	**0.016***	111.50	**0.001***	292.00	0.070
Severe headache (VAS >4) at third months (total number of attacks)	273.50	0.831	225.00	0.078	304.50	0.101
Average VAS scores at third month	274.50	0.847	254.50	0.238	334.50	0.251
Migrainous headache at third month (total number of attacks)	266.00	0.711	201.50	**0.026***	234.50	**0.006***
Non-migrainous headache at third month (total number of attacks)	281.00	0.957	155.50	**0.002***	193.00	**0.001***
Triptan *usage at third month	274.00	0.837	184.00	**0.009***	248.50	**0.010***
NSAID *usage at third month	283.00	0.991	153.00	**0.001***	190.00	**0.001***
Average duration of headache at third month (h)	278.00	0.907	154.00	**0.002***	202.50	**0.001***
Number of days with headache at third month	277.00	0.891	138.50	**0.001***	182.00	**0.001***

VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug; a: Mann-Whitney U test; * p<0.05 * Number of tablets taken.

three-month period: the withdrawal protocol, GON blockade with dexamethasone (dGON), and repetitive GON blockade (rGON). The results showed significant improvements in all three treatment groups. Group A (withdrawal protocol) demonstrated a 53% reduction in headache frequency, Group B (dGON) a 54% reduction, and Group C (rGON) a 63% reduction. There were also notable decreases in medication overuse, with triptan use decreasing by 63% in Group A, 70% in Group B, and 74% in Group C. The use of NSAIDs also decreased by 50% in Group A, 60% in Group B, and 52% in Group C. Additionally, all groups exhibited reductions in headache frequency, duration, and severity, although the improvements were less pronounced in the rGON group compared to the others.

The withdrawal protocol used in this study was based on established guidelines and previous studies, which recommended specific strategies for effectively managing headaches and reducing medication overuse in MOH patients.[9,10] Despite the dropout of nine patients due to noncompliance after one month, the treatment protocol demonstrated its effectiveness in managing headaches and reducing medication overuse, as supported by the literature.[11-13]

In contrast, some studies suggested that adding steroids to GON blockade for chronic migraine did not provide additional benefits.[14,15] However, oral or intravenous steroid treatment is commonly used for MOH.[16,17] In our study, the addition of 2 mg of dexamethasone to GON blockade at the C2 level showed partial effectiveness after one month, with the effect becoming more pronounced by the third month. The outcomes in the dGON group were comparable to those observed with the withdrawal protocol alone, which is consistent with findings from existing studies on steroid-aided GON blockade in MOH treatment.[18]

Repeated GON blockade was reported as an effective treatment for chronic migraine,[16,17] but there was limited data on its use for MOH. In our

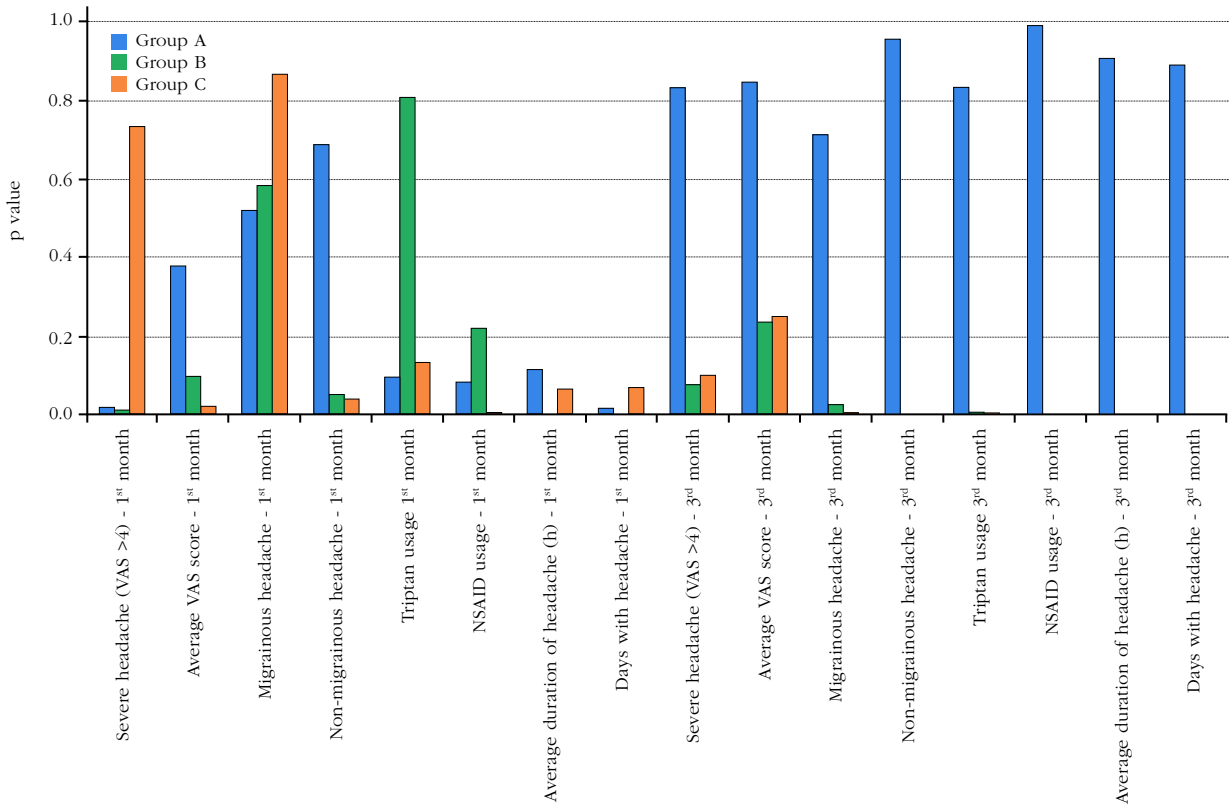

Figure 2. Pairwise comparison of treatment durations between groups.

VAS: Visual Analog Scale; NSAID: Nonsteroidal anti-inflammatory drug.

TABLE 11
Adverse effect

	Withdrawal protocol	GON block with dexamethasone	Repetitive GON block
	n	n	n
Noncompliance with treatment	9	0	0
Temporary dizziness	0	5	7
Headache on the day of the procedure	0	4	6
Systemic side effects of corticosteroids	0	0	0
Alopecia in the application area	0	0	0

GON: Greater occipital nerve.

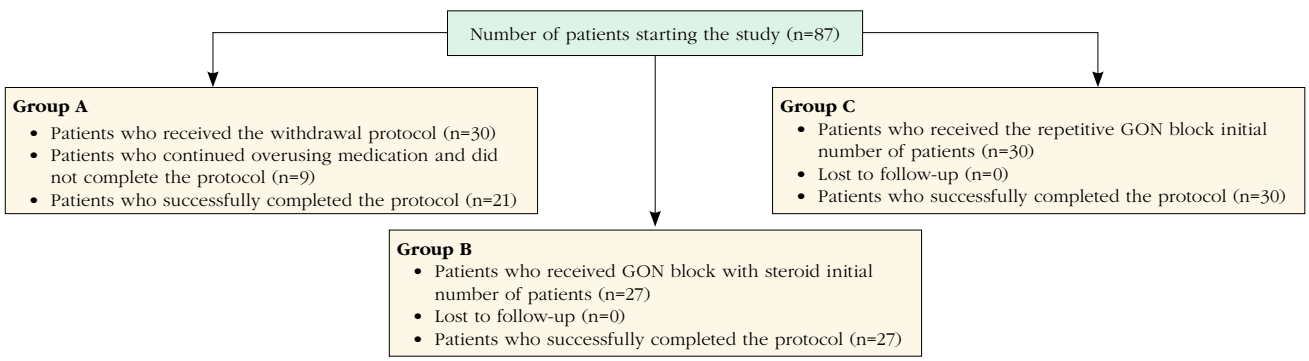

Figure 3. Follow-up diagram.

GON: Greater occipital nerve.

study, rGON provided faster pain relief and more significant medication control compared to other treatments, with its efficacy increasing over the three-month period. This aligns with the general understanding of GON blockade effectiveness in chronic migraine treatment. However, variability in outcomes was reported in the literature regarding the effectiveness of GON blockade in MOH patients, likely due to comorbid psychiatric conditions and the mixed nature of primary headaches in MOH.[18-21] The present study also suggested that the repeated application of GON blockade may be a promising option for MOH, although more research is needed.

Furthermore, some studies proposed that using a larger volume of solution at the C2 level of blockade could be more beneficial than distal GON blockade.[6,22,23] In our study, all patients had chronic migraine as the primary headache disorder, which is known to respond better to GON blockade than other headache types.[16,19] Additionally, the absence of opioid use in our study might have simplified the management of MOH, as opioid use has been associated with poorer outcomes in MOH patients.[24]

In terms of safety, no severe side effects were observed in our study (Table 11). The use of nonparticulate steroids, such as dexamethasone, in GON blockade was considered safe, particularly at the C2 level, due to its proximity to arterial structures and the lower risk of severe side effects.[25] Alopecia, a potential side effect of GON blockade observed in previous studies, was not observed in our study, likely due to the deeper C2-level blockade, which does not target the hairy areas of the scalp.[15,26]

Despite the positive results, the withdrawal protocol posed challenges in implementation. Nine patients who continued to overuse medication were excluded from the study (Figure 3). Withdrawal treatment in MOH is known to be difficult due to the lack of clear boundaries, the frequent presence of psychiatric comorbidities, and the tendency for patients to relapse into medication overuse.[27] Effective training and patient follow-up are crucial for success, particularly in settings with high patient volumes, such as in developing countries.[28]

This study had several limitations. First, the sample size was relatively small, which could limit the generalizability of the findings. Additionally, the long-term effects of the treatments were not assessed, and the durability of the improvements remains uncertain. Noncompliance and the presence of psychiatric symptoms also posed challenges in evaluating the full effectiveness of the treatments. Furthermore, the study was conducted in a specific geographic region, and it is unclear whether the same results would be observed in different populations.

In conclusion, future studies should aim to address these limitations by including larger patient populations, longer follow-up periods, and diverse geographic settings. These efforts will help validate the findings and assess the long-term sustainability of the treatment benefits.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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