ISSN: 2993-6594

Research Article

Open Access Journal of Disease and Global Health

Comparison of Oxcarbazepine and Carbamazepine in the Treatment of Trigeminal Neuralgia: A Systematic Review and Meta-Analysis

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Submitted: 2025, Feb 10; **Accepted:** 2025, Mar 25; **Published:** 2025, Apr 17

Citation: Mendieta, C. D., Da Silva, M. B., Nogueira-Rosa, L. A., de Oliveira Ferreira, D. B. C., Bocanegra-Becerra, J. E., et al. (2025). Comparison of Oxcarbazepine and Carbamazepine in the Treatment of Trigeminal Neuralgia: A Systematic Review and Meta-Analysis. *Ope Acce Jou Dis Glo Heal, 3*(1), 01-08.

Abstract

Oxcarbazepine (OXC) has demonstrated comparable efficacy to Carbamazepine (CBZ) in the treatment of Trigeminal neuralgia (TN), with the added benefit of fewer adverse events (AEs). Whether it can be used as a substitute for carbamazepine is yet to be verified. To address this, we conducted a comprehensive meta-analysis, exploring efficacy and adverse events in detail. We searched PubMed, Embase, Cochrane Library, and Google Scholar for studies comparing CBZ to OXC in patients with TN. The main outcomes were efficacy, AEs, frequency of neurological AEs, skin reactions, and alterations in laboratory parameters. Statistical analysis was performed using Review Manager 5.4.1. And the risk of bias was assessed using RoB-2 and ROBINS-I. We included 838 patients from three observational studies and two randomized clinical trials (RCTs). CBZ was used to treat TN in 445 (53.1%) patients. The CBZ group when compared with the OXC group had no significant difference in efficacy (OR:0.52; 95% Cl:0.13-2.04; p=0.35). Both groups had significant differences noted in AEs, with higher frequency observed in the CBZ group (OR:2.35; 95% Cl:1.51-3.67; p=0.0002). However, the consideration of adverse events may favor clinical decision-making to OXC due to its superiority. Nonetheless, more randomized controlled trials (RCTs) are necessary to confirm this conclusion in the future.

Keywords: Trigeminal Neuralgia, Carbamazepine, Oxcarbazepine, Efficacy, Adverse Events, Side Effects.

Abbreviations

TN = trigeminal neuralgia
OXC = oxcarbazepine
CBZ = carbamazepine
AEs = adverse events

1. Introduction

Trigeminal neuralgia (TN) is a chronic facial pain disorder caused by damage to any or all divisions of the trigeminal nerve, typically affecting one side of the face. It's characterized by sudden, intense electric shock-like pain, often triggered by minor stimuli, which can severely impact the quality of life. TN is the most common craniofacial pain syndrome of neuropathic origin, causing recurrent stabbing or burning pain in the orofacial region. Additionally, it may develop without apparent cause or be a result of another diagnosed disorder [1,2]. The prevalence ranges from 0.03% to 0.3%, more common in females, usually affecting middle-aged and elderly individuals, primarily involving the maxillary and mandibular branches of the trigeminal nerve [3].

Various medications have been employed to manage TN, such as carbamazepine (CBZ) which is considered the gold standard for the initial medical treatment of TN symptoms. However, it's frequently ineffective in providing pain relief and may cause severe side effects causing discontinuation and surgery in appropriate patients [4,5]. In contrast, oxcarbazepine (OXC), the analog of CBZ, has demonstrated an effective treatment with fewer adverse events (AEs) than CBZ, although there is a lack of strong evidence to confirm this [6].

Since the publication of a prior meta-analysis comparing CBZ and OXC, subsequent studies have been published, including observational studies and randomized clinical trials (RCTs) [7]. Further, prior meta-analyses have not specifically investigated the impact on laboratory disorders and skin reactions, Moreover, data availability remains incomplete, published only in abstract form or reviews. Given this controversy, we performed an updated meta-analysis evaluating the efficacy and safety of OXC compared with CBZ in TN therapy. The aim of this analysis is to assess whether OXC might represent a better alternative as the first-line gold standard treatment for TN.

2. Methods

This systematic review and meta-analysis were performed and reported in accordance with the Cochrane Collaboration Handbook for Systematic Review of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [8].

2.1. Inclusion and Exclusion Criteria

Inclusion in this meta-analysis was restricted to studies that meet all the following eligibility criteria: (1) randomized trial or nonrandomized cohorts; (2) comparing CBZ to OXC; and (3) enrolling patients with TN. In addition, studies were included only if they reported any of the outcomes of interest.

We excluded editorials, letters, commentaries, opinion pieces, conference abstracts, literature reviews, and articles without the comparison between these drugs in TN treatment.

2.2. Search Strategy and Study Selection

We systematically searched PubMed, Embase, Cochrane Library, and Google Scholar from inception to December 2023 with the following MESH terms, keywords, and Boolean operators: ("Trigeminal neuralgia" OR TN) AND ("carbamazepine" OR CBZ) AND ("oxcarbazepine" OR OXC).

The references from all included studies, previous systematic reviews, and meta-analyses were also searched manually for any additional studies. Two authors (C.D.M. and M.B.D) independently extracted the data following predefined search criteria and quality assessment. The prospective meta-analysis protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) under protocol CRD42024488536.

2.3. Data Extraction

We extracted the data in a standardized collection form. Data fields included authors, year of publication, study design, number of patients in every drug group, number of patients according to sex, mean age, mean dose, and time of follow-up.

2.4. Quality Assessment

We evaluated the quality assessment in randomized studies using version 2 of the Cochrane Risk of Bias assessment tool (RoB 2). Non-randomized studies were assessed with Risk of Bias in Non-randomized Studies of interventions tool (ROBINS-I). Two independent authors completed the risk of bias assessment (C.D.M. and M.B.D). Disagreements were resolved through a consensus after discussing reasons for the discrepancy. Funnel-plot visual analyses were employed to examine the possibility of publication bias. We also performed sensitivity analysis removing each study from the outcome assessment, this method allows us to assess the stability of the results by determining if any single study significantly impacts the overall findings.

2.5. Statistical Analysis

Odds ratios (OR) with 95% confidence intervals were used to compare treatment effects for categorical endpoints. We assessed heterogeneity with I2 statistics and Cochrane Q test; p-values <0.10 and $I2 > 25\%$ were considered significant for heterogeneity. DerSimonian and Laird random-effects models were used for all endpoints. Review Manager 5.4.1 (Cochrane Collaboration) and R statistical software, version 4.2.3 (R Foundation for Statistical Computing) were used for statistical analysis.

3. RESULTS

3.1. Study Selection and Characteristics

As detailed in Figure 1, the initial search yielded 675 results. After the removal of duplicate records and ineligible studies, 22 remained and were fully reviewed based on inclusion criteria. Of these, a total of 5 studies were included, comprising 838 patients from 2 RCTs, and 3 observational studies [4-9].

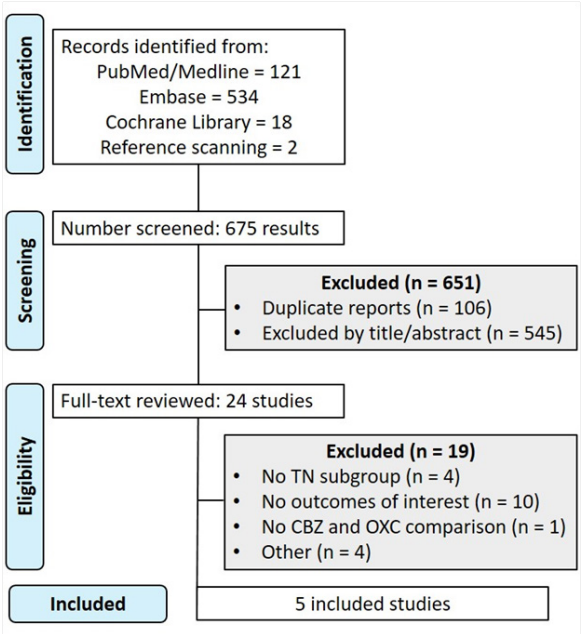


Figure 1: PRISMA flow Diagram of Study Screening and Selection

A total of 458 (55%) patients received CBZ and 380 (45%) received OXC. Study characteristics are reported in Table 1. Significant between-study variability existed as to the duration of follow-up periods, TN, efficacy, and AE definitions.

3.2. Overall Efficacy

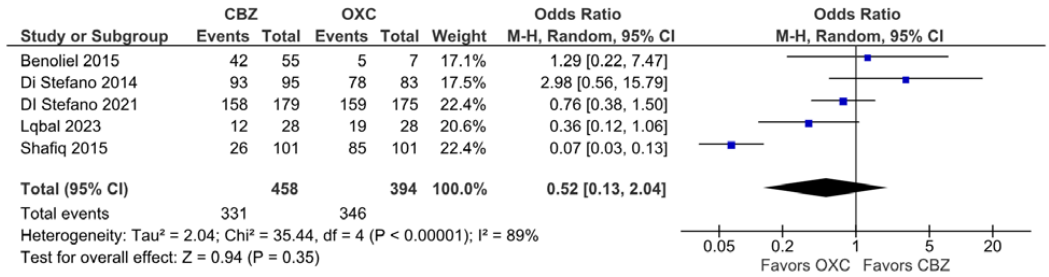
All the included studies reported the overall efficacy [8-12]. There was significant heterogeneity across studies. The final result of the analysis displayed that there was no significant difference in the overall efficacy (OR = 0.52; 95% CI (0.13 - 2.04); p = 0.35; Figure 2).

Author, Year	Sample size		Female, n		Age (years), median (ranges), or mean ± SD		Dose (mg), median (ranges), or mean ± SD		Study design	Follow-up (months)
	CBZ	OXC	CBZ	OXC	CBZ	OXC	CBZ	OXC		
Di Stefano, 2014	95	83	N/A	N/A	N/A	N/A	600 (200 - 1200)	1200 (600 - 1800)	Retro	87.7
Di Stefano, 2021	179	175	118	111	65 (29 - 89)	65 (29 - 89)	800 (200 - 1200)	900 (300 - 1800)	Retro	12 +
Benoliel, 2016	55	7	30	5	N/A	N/A	550 ± 250	900 ± 550	Pros	2.8 - 8.7
Shafiq, 2015	101	101	N/A	N/A	N/A	N/A	200 -1800	200 -1200	RCT	8
Iqbal, 2023	28	28	12	14	47.5 ± 10.1	48.7 ± 10.3	200 -1800	200 -1200	RCT	10

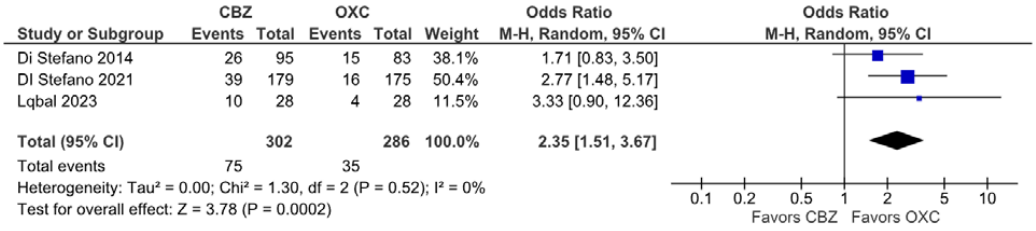
Definitions	Di Stefano, 2014	Di Stefano, 2021	Benoliel, 2016	Shafiq, 2015	Iqbal, 2023
TN	Patients with paroxysmal attacks of intense, sharp, superficial or stabbing pain, affecting one or more divisions of the trigeminal nerve	Classical, secondary and idiopathic TN according to ICHD 2018	Classical TN according to IHS 2013	Patients with sudden, unilateral, severe brief, stabbing pain, affecting one or more divisions of fifth cranial nerve	Classical, seconday and idiopathic TN according to ICHD
Efficacy	Number of responders	Number of responders	≥ 50% reduction in severity from baseline	Relief of pain score	Complete treatment response
AEs	AEs followed by treatment discontinuation	AEs followed by treatment discontinuation	N/A	N/A	AEs in general
Neurological AEs	Somnolence, unbalance, and dizziness	Somnolence, unbalance, and dizziness	N/A	N/A	N/A
SD; Standard Deviation, N/A; Not Available.					

Table 1: The Characteristics of Included Studies

A (Overall Efficacy)



B (Overall Rate of Adverse Events)



C (Neurological Adverse Events)

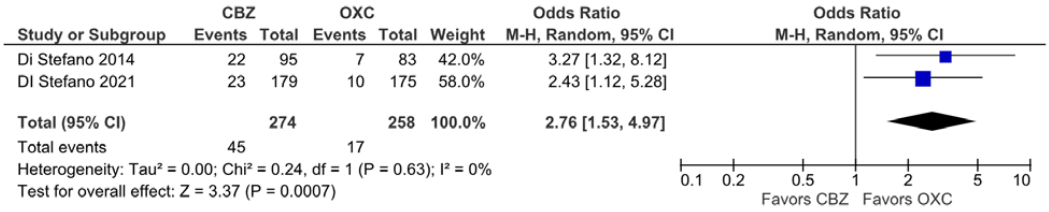


Figure 2: A. Efficacy was not Significantly Different Between CBZ and OXC. B. AEs were Significantly Different Between CBZ and OXC. C. Neurological AEs were Significantly Different Between CBZ and OXC.

3.3. Overall Rate of Adverse Events

Three studies reported adverse events [10,11,13]. No significant heterogeneity was found among the involved studies. The final result of the analysis displayed that the overall rate of occurrence of adverse events of OXC was significantly less than that of CBZ. (OR = 2.35; 95% CI (1.51 - 3.67); p = 0.0002; Figure 2).

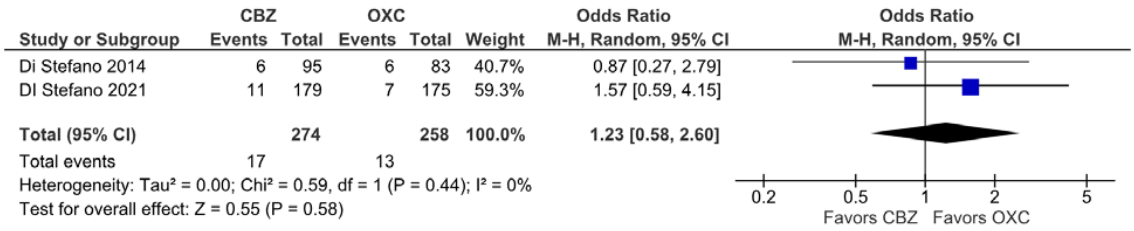
3.4. Neurological Adverse Events

Two studies reported neurological adverse events[10,11]. No significant heterogeneity was found among the involved studies. OXC demonstrated superiority over CBZ with a significantly lower occurrence of neurological adverse events, specifically in terms of dizziness, unbalance, and somnolence. (OR = 2.76; 95% CI (1.53–4.97); p = 0.0007; Figure 2).

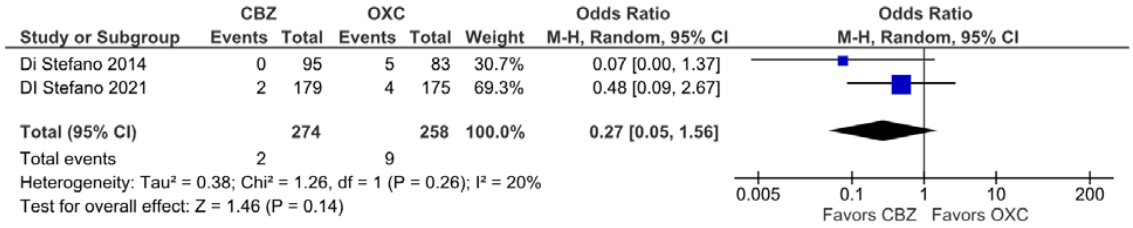
3.5. Laboratory Disorders

Two studies reported laboratory disorders [10,11]. No significant heterogeneity was found among the involved. OXC has not demonstrated significant superiority over CBZ with the occurrence of blood count disorders, elevation of liver transaminases, or occurrence of hyponatremia. (OR = 1.23; 95% CI (0.58 - 2.60); p = 0.58; Figure 3).

A (Laboratory disorders)



B (Hyponatremia)



C (Skin reactions)

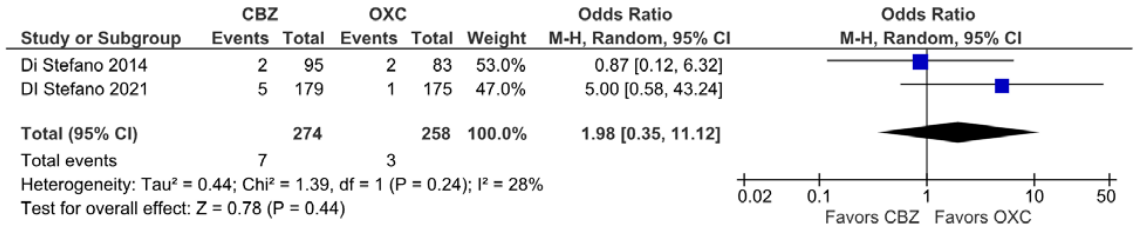


Figure 3: A. Laboratory Disorders were not Significantly Different Between CBZ and OXC. B. Hyponatremia was not Significantly Different Between CBZ and OXC. C. Skin Reactions were not Significantly Different Between CBZ and OXC.

3.6. Skin Reactions

Two studies reported skin reactions [10,11]. There was significant heterogeneity across studies. The final result of the analysis displayed that there was no significant difference in the occurrence of skin reactions (OR = 1.98; 95% CI (0.35–11.12); p = 0.44; Figure 3).

3.7. Sensitivity Analyses

We performed a leave-one-out sensitivity analysis for the main outcomes. There was no significant difference in the outcome of overall efficacy. Otherwise, the interpretation of the leave-one-out sensitivity analyses was consistent with the pooled analysis of all studies (Figure 6).

3.8. Quality Assessment

RoB 2 and ROBINS-I tools were used for quality assessment. All RCTs were considered for some concerns of risk of bias, two observational studies with a moderate risk of bias, and one study with a low risk of bias (Figure 4). In funnel plot analysis, the dots representing overall efficacy were positioned both on and outside the slant, suggesting a risk of bias possibly due to the study design of the included literature studies. Conversely, the overall rate of AEs showed a symmetrical distribution according to weight and converged toward the pooled effect as the weight increased (Figure 5).

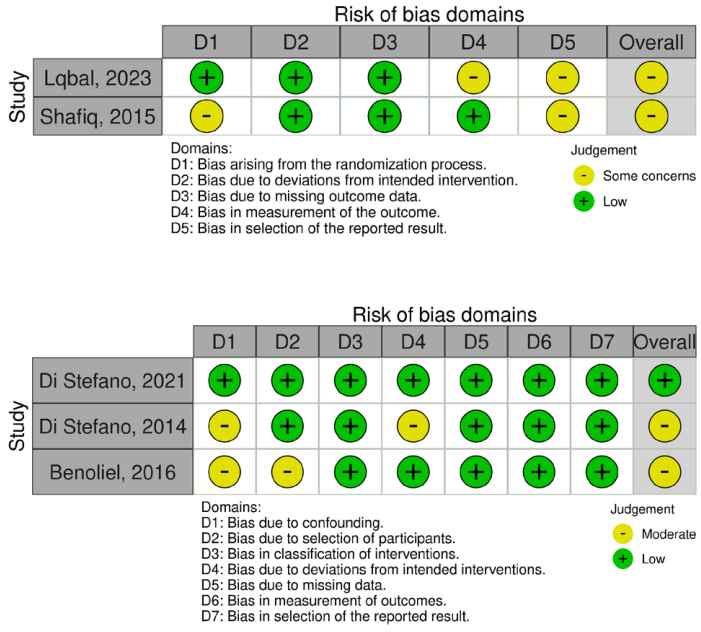


Figure 4: Risk of Bias Summary of the Included Studies

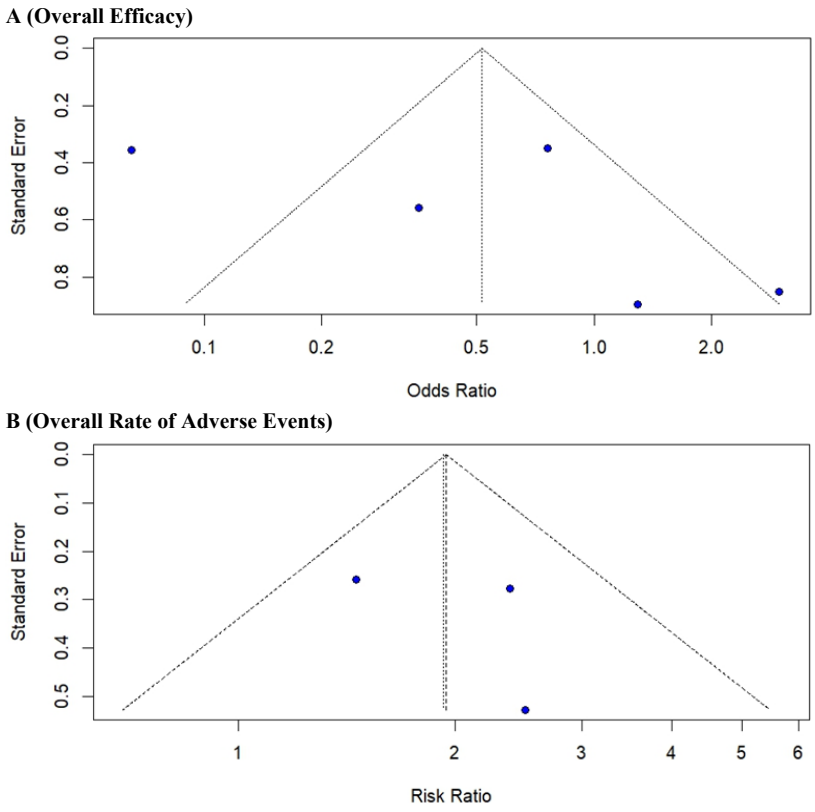


Figure 5: Funnel Plot for Testing the Publication Bias.

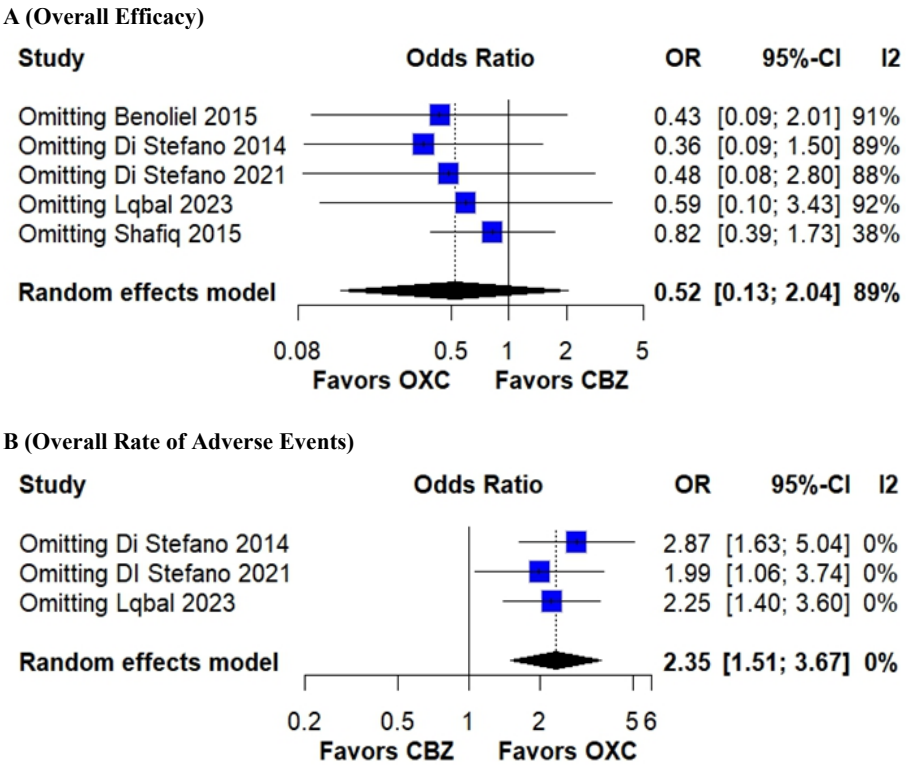


Figure 6: Leave-One-Out Sensitivity Analysis

4. Discussion

This meta-analysis aimed to compare CBZ and OXC in the treatment of TN. The main findings of this study are as follows. (1) there was no significant difference in the overall efficacy of CBZ and OXC, (2) the overall rate of AEs was significantly higher in the CBZ group compared with the OXC, (3) there was a higher frequency of neurological AEs in the CBZ group. (4) the frequency of laboratory disorders was higher in the CBZ group, and (5) there was a higher frequency of skin reactions in the CBZ subgroup.

It is well-established that CBZ is the first-line therapy for TN and presently days is the only drug approved by the Food and Drug Administration (FDA) for TN treatment. However, its use is often discontinued due to frequent tolerability issues [7,14-16]. On the other hand, OXC has been investigated for the treatment of neuropathic pain, demonstrating a different mode of action with the absence of drug interactions and the requirement of lower concentration for sodium current blockade, which suggests it might be more efficient than CBZ with fewer side effects [17]. Considering both as first-line treatments for international guidelines but with a stronger recommendation for CBZ as gold standard treatment [18].

A previous meta-analysis of three clinical trials found that OXC and CBZ were comparable in efficacy, with a reduction in pain days of 96% in the OXC group compared with 86% in the CBZ group, and an improvement in the number of attacks per day of 83% for CBZ and 80% for OXC5. Similarly, recent studies by Besi and Piperas reported equally effective pain relief without significant differences between groups [19,20]. Our study also found no significant change in efficacy, noting that while definitions of efficacy differ across studies, these variations are not deemed relevant to the overall conclusions.

In contrast, OXC was better tolerated, with a higher frequency of AEs in the CBZ groups, especially neurological ones such as vertigo, fatigue, dizziness, somnolence, and ataxia [7]. In addition, in another study, OXC demonstrated a less negative impact on memory and induced less fatigue, while CBZ groups showed at least triple the odds of experiencing more severe Aes [20]. Indeed, we also observed positive results in the switch from CBZ discontinuation to OXC, without incurring major side effects [21,22]. Additionally, our study emphasizes the lower incidence of neurological AEs in the OXC group.

Three RCTs comparing CBZ to placebo presented a frequency of neurological AEs, liver dysfunction, and blood cell disorders. Killian's study identified that 17 (47%) patients experienced vertiginous symptoms, with 10 reporting concomitant drowsiness [23]. Campbell's study noted that CBZ induced giddiness in 30% of patients initially, dropping to 23% in the second period, with unsteadiness and drowsiness affecting 15% separately24. Nicol's study reported 10 (37%) cases of drowsiness and 7 (26%) instances of staggering gait among patients25. Furthermore, CBZ was associated with significant laboratory abnormalities across these studies, including decreased white blood cell count and abnormal liver function tests early in the treatment [23-25].

Skins reactions are common AEs for these types of aromatic antiepileptic drugs according to Mani's review, at the same time it emphasizes a minor difference between them, with higher frequency for CBZ [26].

Nonetheless, it is important to highlight that OXC had demonstrated an elevated incidence of hyponatremia, with increased odds of causing a profound serum sodium-lowering effect [27]. Accordingly, Besi's study showed that 23% of the OXC group reported low sodium levels, while Gomez's study obtained a hyponatremia incidence of 30%, indicating a strong association compared with CBZ [18,21].

This meta-analysis has some potential limitations. First, the retrospective, observational studies inclusion and risk of bias as discussed previously introduces potential confounding factors and biases that may affect the accuracy and reliability of the findings. Second, this meta-analysis only included 5 studies. The sample sizes were not large enough in this study. Third, the dose of CBZ and OXC administration was different, which may have affected the accuracy of the final results. Fourth, the efficacy outcome was not reported in all studies in the same way. Moreover, we performed a funnel plot and a sensitivity analysis to address these issues, which largely showed similar findings to the pooled data.

5. Conclusion

In conclusion, our research did not demonstrate OXC to be superior to CBZ in reducing pain in TN patients. However, the notably lower incidence of adverse events with OXC suggests it could be a promising alternative as the new first-line treatment for TN. Nonetheless, the results should be interpreted with caution due to substantial heterogeneity and limited evidence. Further double-blind RCTs and real-world observational studies are necessary to strengthen our findings and provide more robust evidence.

Author Contributions

All authors contributed to preparing the manuscript for publication as shown below. C.D.M participated in all aspects. M.B.D.- data analysis, re-validation of data. L.A.N.- revised manuscript drafs substantively. D.B.C.O.- revised manuscript drafts substantively. J.E.B.B.- revised manuscript drafts substantively. N.M.F.- Conception, data acquisition, interpretation of data, data analysis, and substantive revision of manuscript drafts.

Competing Interests

The authors declare no competing interests.

Data Availability

All data generated or analyzed during this study are included in this published article.

References

1. Khan, M., Nishi, S. E., Hassan, S. N., Islam, M. A., & Gan, S. H. (2017). Trigeminal neuralgia, glossopharyngeal neuralgia,

and myofascial pain dysfunction syndrome: an update. *Pain Research and Management, 2017*(1), 7438326.
2. Maarbjerg, S., Sørensen, M. T., Gozalov, A., Bendtsen, L., & Olesen, J. (2015). Field-testing of the ICHD-3 beta diagnostic criteria for classical trigeminal neuralgia. *Cephalalgia, 35*(4), 291-300.
3. De Toledo, I. P., Réus, J. C., Fernandes, M., Porporatti, A. L., Peres, M. A., Takaschima, A., ... & Canto, G. D. L. (2016). Prevalence of trigeminal neuralgia: A systematic review. *The Journal of the American Dental Association, 147*(7), 570-576.
4. Chong, M. S., Bahra, A., & Zakrzewska, J. M. (2023). Guidelines for the management of trigeminal neuralgia. *Cleveland Clinic journal of medicine, 90*(6), 355-362.
5. Panczykowski, D. M., Jani, R. H., Hughes, M. A., & Sekula Jr, R. F. (2020). Development and evaluation of a preoperative trigeminal neuralgia scoring system to predict long-term outcome following microvascular decompression. *Neurosurgery, 87*(1), 71-79.
6. Lambru, G., Zakrzewska, J., & Matharu, M. (2021). Trigeminal neuralgia: a practical guide. *Practical neurology, 21*(5), 392-402.
7. Beydoun, A. (2002). Clinical use of tricyclic anticonvulsants in painful neuropathies and bipolar disorders. *Epilepsy & Behavior, 3*(3), S18-S22.
8. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj,* 372.
9. Benoliel, R., Zini, A., Khan, J., Almoznino, G., Sharav, Y., & Haviv, Y. (2016). Trigeminal neuralgia (part II): factors affecting early pharmacotherapeutic outcome. *Cephalalgia, 36*(8), 747-759.
10. Di Stefano, G., La Cesa, S., Truini, A., & Cruccu, G. (2014). Natural history and outcome of 200 outpatients with classical trigeminal neuralgia treated with carbamazepine or oxcarbazepine in a tertiary centre for neuropathic pain. *The journal of headache and pain, 15*, 1-5.
11. Di Stefano, G., De Stefano, G., Leone, C., Di Lionardo, A., Di Pietro, G., Sgro, E., ... & Truini, A. (2021). Real-world effectiveness and tolerability of carbamazepine and oxcarbazepine in 354 patients with trigeminal neuralgia. *European journal of pain, 25*(5), 1064-1071.
12. Shafiq, H., Badar, M. A., Qayyum, Z., & Saeed, M. (2015). effectiveness of carbamazepine versus oxcarbazepine in the management of Trigeminal Neuralgia. *Journal of Khyber College of Dentistry, 6*(1), 32-35.
13. Iqbal, S., Rashid, W., ul Ain, Q., Atiq, T., Noor, R., & Irfan, F. (2022). Efficacy of Carbamazepine and Oxcarbazepine for Treating Trigeminal Neuralgia. *BMC Journal of Medical Sciences, 3*(2), 55-59.
14. Bendtsen, L., Zakrzewska, J. M., Abbott, J. A., Braschinsky, M., Di Stefano, G., Donnet, A., ... & Cruccu, G. (2019). European Academy of Neurology guideline on trigeminal neuralgia. *European journal of neurology, 26*(6), 831-849.
15. Gronseth, G., Cruccu, G., Alksne, J., Argoff, C., Brainin, M., Burchiel, K., ... & Zakrzewska, J. M. (2008). Practice Parameter: The diagnostic evaluation and treatment of trigeminal neuralgia (an evidence-based review) Report of the Quality Standards Subcommittee of the American Academy of Neurology and the European Federation of Neurological Societies. *Neurology, 71*(15), 1183-1190.
16. Royal College of Surgeons of England. Guidelines for the management of trigeminal neuralgia 2021.
17. Schmidt, D., & Elger, C. E. (2004). What is the evidence that oxcarbazepine and carbamazepine are distinctly different antiepileptic drugs?. *Epilepsy & behavior, 5*(5), 627-635.
18. Gambeta, E., Chichorro, J. G., & Zamponi, G. W. (2020). Trigeminal neuralgia: An overview from pathophysiology to pharmacological treatments. *Molecular pain, 16,* 1744806920901890.
19. Besi, E., Boniface, D. R., Cregg, R., & Zakrzewska, J. M. (2015). Comparison of tolerability and adverse symptoms in oxcarbazepine and carbamazepine in the treatment of trigeminal neuralgia and neuralgiform headaches using the Liverpool Adverse Events Profile (AEP). *The journal of headache and pain, 16,* 1-7.
20. Tentolouris-Piperas, V., Lee, G., Reading, J., O'Keeffe, A. G., Zakrzewska, J. M., & Cregg, R. (2018). Adverse effects of anti-epileptics in trigeminal neuralgiform pain. *Acta Neurologica Scandinavica, 137*(6), 566-574.
21. Gomez-Arguelles, J. M., Dorado, R., Sepulveda, J. M., Herrera, A., Arrojo, F. G., Aragon, E., ... & Anciones, B. (2008). Oxcarbazepine monotherapy in carbamazepine-unresponsive trigeminal neuralgia. *Journal of Clinical Neuroscience, 15*(5), 516-519.
22. Campos, M. S. D. A., Ayres, L. R., Morelo, M. R. S., Marques, F. A., & Pereira, L. R. L. (2016). Efficacy and tolerability of antiepileptic drugs in patients with focal epilepsy: systematic review and network meta-analyses. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 36*(12), 1255-1271.
23. Killian, J. M., & Fromm, G. H. (1968). Carbamazepine in the treatment of neuralgia: use and side effects. *Archives of neurology, 19*(2), 129-136.
24. Campbell, F. G., Graham, J. G., & Zilkha, K. J. (1966). Clinical trial of carbazepine (tegretol) in trigeminal neuralgia. *Journal of neurology, neurosurgery, and psychiatry, 29*(3), 265.
25. NICOL, C. F. (1969). A four year double-blind study of Tegretol (r) in facial pain. *Headache: The Journal of Head and Face Pain, 9*(1), 54-57.
26. Mani, R., Monteleone, C., Schalock, P. C., Truong, T., Zhang, X. B., & Wagner, M. L. (2019). Rashes and other hypersensitivity reactions associated with antiepileptic drugs: a review of current literature. *Seizure, 71,* 270-278.
27. Van Amelsvoort, T. H., Bakshi, R., Devaux, C. B., & Schwabe, S. (1994). Hyponatremia associated with carbamazepine and oxcarbazepine therapy: a review. *Epilepsia, 35*(1), 181-188.