

Cervicogenic Headache in Cervical Radiculopathy Patients: Prevalence and Associated Factors

Prévalence et facteurs associés de la céphalée d'origine cervicale chez les patients atteints de névralgie cervico-brachiale

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ABSTRACT

Background : Cervicogenic headache (CGH) is frequently associated with cervical radiculopathy (CR), but its prevalence and contributing factors in patients undergoing conservative treatment are not well established.

Aim : To assess the prevalence of CGH and identify the factors associated with it among patients with CR undergoing conservative treatment.

Methods: A cross-sectional analytical study was conducted from May 2023 to December 2023 in the Physical Medicine and Rehabilitation (PMR) of Monastir, Tunisia. Patients with CR consulting in PMR and Rheumatology departments were included. The prevalence of CGH was evaluated using the IHS diagnostic criteria, and associated factors were analyzed.

Results: CGH was diagnosed in 53 out of 86 patients (61.6%) with CR. Univariate analysis revealed that limitations in right cervical rotation, impaired cervical spine proprioception, reduced neck flexor and extensor strength, functional impairment, high anxiety levels, and lower scores in the physical and mental health domains of quality of life were associated with CGH. Multivariate analysis identified high anxiety score (OR=1.44; 95% CI 1.04–1.98; p=0.024), limitation of right cervical rotation (OR=0.80; 95% CI 0.70–0.90; p < 0.001), and impaired proprioception during flexion (OR=1.38; 95% CI 1.08–1.76; p=0.009) as independent factors associated with CGH.

Conclusion: CGH seems to be highly prevalent in CR patients undergoing conservative treatment. This study suggests that key factors associated with CGH are proprioception deficit, anxiety, and reduced quality of life. Further large-scale studies are needed to confirm these findings.

Keywords : Cervical neuropathy, Cephalgia, Diagnostic criteria, Epidemiology.

RÉSUMÉ

Contexte: La céphalée d'origine cervicale (COC) est fréquemment associée à la névralgie cervico-brachiale (NCB), mais sa prévalence et ses facteurs contributifs chez les patients au stade du traitement conservateur ne sont pas bien établis.

Objectif: Cette étude visait à évaluer la prévalence de la COC et à identifier ses facteurs associés chez les patients atteints de NCB recevant un traitement conservateur.

Méthodes: Une étude transversale a été menée de mai 2023 à décembre 2023 dans le service de Médecine Physique et de Réadaptation (MPR) de Monastir- Tunisie. Les patients atteints de NCB consultant dans les services de MPR et de Rhumatologie ont été inclus. La prévalence de la COC a été évaluée en utilisant les critères diagnostiques de l'IHS, et les facteurs associés ont été analysés.

Résultats: La COC a été diagnostiquée chez 53 des 86 patients (61,6 %). L'analyse univariée a révélé que la limitation de la rotation cervicale droite, l'altération de la proprioception cervicale, la diminution de la force des fléchisseurs et des extenseurs du cou, l'altération fonctionnelle, le niveau élevé d'anxiété et l'altération de la qualité de vie physique et mentale étaient associés à la COC. L'analyse multivariée a identifié le score d'anxiété élevé (OR=1.44; 95% IC 1.04–1.98; p=0.024), la limitation de la rotation cervicale droite (OR=0.80; 95% IC 0.70–0.90; p < 0.001) et l'altération de la proprioception en flexion (OR=1.38; 95% CI 1.08–1.76; p=0.009) comme des facteurs associés à la COC.

Conclusion: La COC est fréquente chez les patients atteints de NCB. Les principaux facteurs associés sont l'altération de la proprioception cervicale et de la qualité de vie et l'anxiété élevée.

Mots clés: Neuropathie cervicale, Céphalée cervicogénique, Critères diagnostiques, Épidémiologie.

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INTRODUCTION

Cervicogenic headache (CGH) is a unilateral secondary headache triggered by neck movements or sustained postures, often radiating to the occipital or frontal regions (1,2). It results from dysfunction or pathology in cervical structures—vertebrae, intervertebral discs, ligaments, or muscles—and is frequently observed in patients with cervical radiculopathy (CR) (1,2). Because its symptoms overlap with those of tension-type headache and migraine, CGH can be difficult to distinguish clinically (3,4).

To improve diagnostic accuracy, the Headache Classification Committee of the International Headache Society (IHS) developed specific criteria emphasizing the causal relationship between cervical abnormalities and headache (2).

The underlying pathophysiology involves the convergence of afferents from the upper cervical spinal roots (C1–C3) and the trigeminal nerve within the trigeminocervical nucleus, explaining referred pain to occipital, frontal, or temporal regions (5,6).

Lower cervical structures can also contribute, as shown by the improvement of CGH after cervical traction or nerve root block in patients with CR (7–10).

The reported prevalence of CGH in the general population ranges from 0.17% to 4.1%, with female predominance (11,12). Among patients with CR and/or cervical myelopathy, the incidence ranges from 30% to 33.7% (13,14). CR itself, most often degenerative in origin, is caused by compression and inflammation of cervical nerve roots, producing neuropathic pain in the upper limb corresponding to the affected root (15,16). Its annual incidence ranges from 83 to 210 cases per 100,000 individuals, peaking between 50 and 59 years (16).

The association between CGH and CR remains insufficiently explored. Because the predominant complaint in CR is radicular pain, associated headaches are often underestimated or misattributed to primary headache disorders (10). Yet CGH and radicular pain frequently coexist, suggesting common pathophysiological pathways. Studying this association could enhance diagnostic precision and inform rehabilitation strategies. Most available studies have focused on patients with advanced CR referred for surgery (13,14,28). However, no data are available on those managed conservatively, who may better represent the general population. Expanding epidemiological knowledge in this group may clarify the mechanisms and clinical correlates of CGH.

Therefore, the aim of our study was to determine the prevalence of CGH in patients with CR at the conservative treatment stage and to identify associated factors.

METHODS

This cross-sectional study was conducted between May first, 2023, and December 31, 2023, at the Physical Medicine and Rehabilitation Department (PMR) of Monastir- Tunisia. Adherence to the STROBE guidelines was ensured throughout the study (17).

Patients were recruited from PMR and Rheumatology departments during the study period. Our study included patients diagnosed with CR persisting for more than 3 months and aged between 18 and 65 years. CR was confirmed by a senior physiatrist using clinical and MRI findings. CGH was diagnosed according to the International Headache Society (ICHD-3) criteria (2) after exclusion of primary headache disorders.

Patients were excluded if they had uncommon causes of CR (infectious or tumoral), cervical myelopathy, or inflammatory and degenerative rheumatic diseases of the thoracolumbar spine or lower limbs that could alter balance or functional capacity. Those with neurological disorders such as multiple sclerosis, Parkinson's disease, or diabetic neuropathy were also excluded. Additional exclusion criteria included a history of cervical surgery or major trauma, vestibular dizziness interfering with balance or proprioception assessments, and uncorrected visual impairment.

Clinical and functional assessments were conducted by an examiner blinded to participants' headache status. Data analysis was performed by an independent investigator unaware of group allocation.

Sample size calculation

The required sample size was calculated using the formula $n = Z^2 \times p \times (1-p) / d^2$, assuming an expected prevalence of 21.4% (8), a 95% confidence level ($Z=1.96$), and an absolute precision of $\pm 9\%$ ($d=0.09$). The estimated sample size was 80 participants.

Outcome measure

Main outcomes included CGH prevalence, frequency, and intensity. The diagnosis of CGH was established based on the criteria of the Headache Classification Committee of the International Headache Society (IHS) (2). In addition, all patients were required to have restricted cervical range of motion (particularly in flexion and rotation) and symptomatic upper cervical joint dysfunction (18). The prevalence of CGH was expressed as a percentage by multiplying the ratio by 100. CGH Frequency was defined as the number of days per week that the patient experienced headaches, based on the week preceding the interview. CGH intensity was measured using a visual analog scale (VAS), rated from zero to 100, where zero indicates no pain and 100 represents the maximum imaginable pain.

Secondary outcomes focused on socio-demographic and clinical factors. Socio-demographic data collected included age, gender, medical history (such as hypertension and diabetes), employment status (employed, unemployed, or retired), occupation type (low or high physical demand), and socio-economic status (categorized as low if salary is below the guaranteed minimum monthly wage, medium if salary is between the minimum wage and three times the minimum wage, and high if above three times the minimum wage).

Clinical outcomes included the duration of CR (months), the affected side (right, left, or bilateral), and the

intensity of radicular pain measured using a 100-VAS. Additional measures comprised body mass index (BMI) in kg/m² and cervical range of motion (ROM), assessed with an inclinometer (CROM; Performance Attainment Associates, St Paul, MN) across flexion, extension, rotation, and lateral bending (19). Cervical proprioception was evaluated using the same CROM device in a seated position (20). Patients were instructed to hold their head in a neutral reference position, close their eyes, move their head, and then attempt to return to the original position. The repositioning error in degrees was recorded for both flexion and extension movements, with the average error from three trials reported (20). Cervical muscle strength was assessed using a handheld isometric dynamometer (MicroFET2; Hoggan Health Industries) (21), measuring the strength of cervical flexors (dynamometer is placed on the forehead) and extensors (dynamometer placed at the back of the head), reported in Newtons. Grip strength was evaluated using a Jamar hydraulic dynamometer, with results reported in kilograms (22). Both hands were tested, with three trials for each, and the average value recorded. Functional disability was assessed using the validated Neck Disability Index (NDI), which covers ten activity domains, each scored from 0 (no disability) to 5 (total disability). The total score categorizes disability as none (0–8), mild (10–29), moderate (30–49), severe (50–68), or complete (>68) (23). Psychological status of participants was assessed using the Arabic version of the Hospital Anxiety and Depression Scale (HAD) (24), which evaluates anxiety and depression using 14 questions. Scores of 0–7 indicated no case, 8–10 indicated a doubtful case, and scores of 11 or higher signaled a definite case for either anxiety or depression (24). Quality of life was assessed using the WHOQOL-BREF questionnaire, which measures physical, psychological, social, and environmental domains, each expressed as a percentage (25). Kinesiophobia was measured using the Tampa Scale for Kinesiophobia (TSK; 17 items, scores 17–68), with values >37 indicating kinesiophobia (26). Balance was evaluated with the Brief BesTest (27), covering six domains—biomechanical constraints, limits of stability, anticipatory and reactive postural adjustments, sensory orientation, and gait stability. The test includes eight items scored 0–3, for a total of 24 points; higher scores reflect better balance, and administration takes under 10 minutes (27).

Statistical Analyses

The collected data were entered and analyzed using IBM SPSS statistical software (Statistical Package for the Social Sciences), version 23. The Kolmogorov-Smirnov (KS) test was employed to assess the normality of quantitative variables. Quantitative variables with a normal distribution were described using means and standard deviations (SD), while variables with asymmetric distributions were described using medians and interquartile ranges (IQR) [Q1–Q2]. Qualitative variables were expressed as frequencies and percentages. For the comparison of two percentages, chi-squared test and Fisher's exact test were utilized. Student's t-test and Mann-Whitney U test were

used for comparing quantitative variables. Binary logistic regression was performed to identify factors associated with CGH. Variables with a p-value less than 0.20 in univariate analysis were included in the multivariate model. The significance level was set at 5%.

Ethical Considerations

Written consent was obtained and signed by all participating patients. Approval from the ethics committee of the Faculty of Medicine of XXXX was secured under the number: IORG 0009738 N 122/OMB 0990-0279.

RESULTS

Our study included 86 patients who fulfilled the inclusion criteria from a total of 96 individuals seeking consultation for CR (Figure 1). Out of the 86 patients, 53 (61.6%) were diagnosed with CGH.

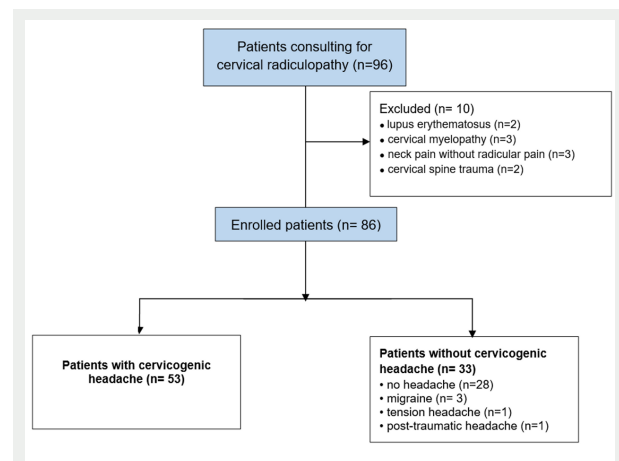


Figure 1. Study flow chart

Among sociodemographic factors, radicular pain VAS scores are significantly lower in patients with CGH compared to those without CGH ($p=0.001$) (Table 1).

The univariate analysis of clinical parameters showed that a limitation of right cervical rotation, impaired cervical spine proprioception, reduced strength of cervical spine flexors and extensors, high NDI and HAD-anxiety scores, and a reduction in the physical and mental health domains of quality of life were significantly associated with CGH (Table 2).

The multivariate analysis showed that factors independently associated with CGH were an impaired HAD-anxiety score, limitation of right rotation, and impaired proprioception during flexion (Table 3).

Table 1. Sociodemographic factors associated with cervicogenic headache

Variable	Cervicogenic Headache (n=53)	No Cervicogenic Headache (n=33)	P value
Age (years, mean $\pm$ SD)	46.3 $\pm$ 10.7	46.8 $\pm$ 9.1	0.828
BMI (mean $\pm$ SD)	28.6 $\pm$ 5.3	28.8 $\pm$ 3.7	0.857
Occupation (n)			
Manual labor	29	19	0.819
Shift work	23	13	
Socio-economic status (n)			
Low	12	4	
Medium	32	19	0.411
High	8	9	
Side of CR (n)			
Right	25	15	
Left	21	14	
Bilateral	4	7	0.965
Median CR duration (Q1-Q3)	35 [IQR: 17; 72]	24 [IQR: 7-42]	0.082
VAS radiculopathy (mean $\pm$ SD)	58.1 $\pm$ 16.2	74.8 $\pm$ 9.7	0.001*
Dizziness n (%)	38 (63.3)	22 (36.7)	0.726

*p<0.05; SD: standard deviation; CR: cervicobrachial radiculopathy; IQR: interquartile range

Table 2. Clinical factors associated with cervicogenic headache

Variable	Cervicogenic Headache (n=53)	No Cervicogenic Headache (n=33)	P value
Cervical ROM (°)			
Flexion	40.1 $\pm$ 10.6	36.6 $\pm$ 10.4	0.210
Extension	29 $\pm$ 13.9	28.6 $\pm$ 10.7	0.729
Right Rotation	27.8 $\pm$ 7.7	38.8 $\pm$ 9.4	0.000*
Left Rotation	28.8 $\pm$ 9.3	33.7 $\pm$ 10.7	0.074
Right Lateral Flexion	23.7 $\pm$ 8.8	25.5 $\pm$ 9.6	0.381
Left Lateral Flexion	26 $\pm$ 9.2	22.3 $\pm$ 7.7	0.070
Proprioception (°)			
Flexion error angle	11.3 $\pm$ 6.3	7.6 $\pm$ 3.3	0.000*
Extension error angle	10.2 $\pm$ 3.5	6.7 $\pm$ 3.4	0.000*
Flexor Strength (Newton)	15.13 $\pm$ 6.67	19.33 $\pm$ 6.2	0.005*
Extensor Strength (Newton)	17.3 $\pm$ 6.3	23.6 $\pm$ 6.7	0.000*
Grip Strength (kg)			
Right	16.2 $\pm$ 7.5	17.7 $\pm$ 9.3	0.523
Left	10.2 $\pm$ 3.5	16.5 $\pm$ 7.6	0.616
Brief BesTest	15.1 $\pm$ 3.4	14.9 $\pm$ 3.9	0.584
NDI	52.3 $\pm$ 10.3	38.9 $\pm$ 16.4	0.000*
HAD	20.6 $\pm$ 5	18.2 $\pm$ 4.5	0.030*
HAD-anxiety	11.1 $\pm$ 2.9	8.8 $\pm$ 2.5	0.000*
HAD-depression	9.5 $\pm$ 2.8	9.4 $\pm$ 2.6	0.886
WHOQOL-bref			
Physical Health	38.4 $\pm$ 10	45.7 $\pm$ 12.1	0.010*
Mental Health	46.1 $\pm$ 12.8	53.1 $\pm$ 11.7	0.008*
Social Relationships	50.3 $\pm$ 15.8	48.2 $\pm$ 11.3	0.596
Environment	46.1 $\pm$ 12	42.9 $\pm$ 11.3	0.297
TSK	47.1 $\pm$ 12	42.9 $\pm$ 10.4	0.739

*p<0.05; SD: standard deviation; NDI: Neck Disability Index; WHOQOL-bref: World Health Organization Quality of Life; HAD: Hospital Anxiety and Depression Scale; TSK: Tampa Scale for Kinesiophobia

Table 3. Factors associated with cervicogenic headache according to multivariate analysis

Variable	Adjusted OR	95% CI (OR)	P-value (Binary logistic regression)
HAD-anxiety	1.44	1.04-1.98	0.024
Right rotation (°)	0.80	0.70-0.90	0.000
Flexion error angle (°)	1.38	1.08-1.76	0.009

OR: Odd Ratio; HAD: Hospital Anxiety and Depression

Our cross-sectional study involved 86 patients suffering from CR and revealed 53(61.6%) cases of CGH. Binary logistic regression identified the following factors associated with CGH: (i) high HAD-anxiety score, (ii) limitation of right rotation, (iii) and impaired proprioception during cervical spine flexion.

Prevalence

Within the scope of our literature review, Persson and Carlsson (28) reported a 54.3% prevalence of CGH in 81 CR patients, lower than the 61.6% observed in our study. This difference may reflect their use of the 1988 IHS criteria, which omit two clinical signs included in the 2018 edition, and their focus on patients referred for neurosurgery with symptoms >6 months, unlike our conservatively treated cohort. Thus, our findings likely provide a more accurate estimate of CGH prevalence in the general CR population. On the other hand, two other authors, Pang, Liu, and Peng (13) and Yang et al. (14), investigated heterogeneous populations presenting with both CR and cervical spondylotic myelopathy, reporting respectively an incidence of 30% (50/166) and a prevalence of 33.7% (221/656). Besides the heterogeneity of their populations, it is important to note that the patients in these studies were also referred to surgical treatment after conservative management had failed. Therefore, the patient profiles in these studies are not representative of the typical form of CR.

A Swedish study reported a 58.5% prevalence of chronic headaches among patients with CR, without differentiating CGH from other headache types (10). Neck pain occurs in both primary and secondary headaches, limiting its diagnostic specificity for CGH (29). The IHS criteria are challenging to apply in practice, as establishing a temporal link between headaches and cervical pathology is difficult. Degenerative cervical changes often develop insidiously and subclinically, reducing the diagnostic value of criteria C1 and C2 (30). Thus, CGH diagnosis relies on careful clinical examination, with cervical stiffness and a positive cervical provocation test being the most specific indicators. (31).

Cervical Function and Proprioception

In our study, cervical spine stiffness, particularly in right rotation, was associated with CGH. Limited cervical range of motion is a hallmark of CGH and part of its diagnostic criteria. Previous studies have similarly reported restrictions in one or more cervical movements (8,32). Shimohata et al. (8) found cervical stiffness to be a risk

factor for CGH, with rotations most affected. Another study reported at least a 10° reduction in rotation in CGH patients compared to those with migraines or chronic non-specific headaches (33), likely related to C1-C2 dysfunction. Biomechanically, the upper cervical spine primarily governs rotation and is involved early in CGH pathophysiology. Stiffness of the upper trapezius, levator scapulae, and sternocleidomastoid muscles may further contribute to restricted movement (34).

However, Persson and Carlsson (28) did not find a significant difference in cervical spine stiffness between patients with and without headaches. We reiterate the previously mentioned differences between our study and that of Persson and Carlsson (28), particularly regarding the nature of the study population.

In our study, patients with CGH showed greater impairment of cervical proprioception than those without CGH. Proprioceptive deficits have been linked to reduced cervical mobility and muscle strength, disrupting sensory inputs connected to the trigeminal nucleus (35), and have been associated with CGH in chronic neck pain (36). Dumas et al. (37) did not find this relationship, likely because their cohort primarily included post-traumatic rather than degenerative cases, suggesting that CGH pathophysiology may vary by etiology. Proprioceptive impairment may be more pronounced in post-traumatic CGH (32). Additionally, 45% of our CGH patients had confirmed anxiety, consistent with Jin et al. (38), who reported at least moderate anxiety in all CGH patients, supporting the role of psychological stress as a sensitizing factor for headaches (39,40).

Psychological and quality of life impact

As we observed in our CR population, quality of life is also impaired in CGH cases within the general population. This impairment predominantly affects both physical and mental domains, regardless of the measurement scale used (41,42). The link between CGH and quality of life impairment underscores the dysfunction in central pain management mechanisms, particularly central sensitization (41). Moreover, CGH is marked by neuro-musculoskeletal deficiencies, such as reduced cervical range of motion and muscle strength, which can limit physical function and daily activities, further diminishing quality of life (43,44).

Our results align with those from several studies that reported weakness in the flexors and extensors of the cervical spine in patients with CGH compared to healthy controls (34,45). Additionally, the endurance of the cervical spine flexors in patients with CGH is significantly reduced compared to healthy subjects (45). This impairment in motor performance of cervical spine muscles, particularly the flexors, is common among patients suffering from degenerative cervical conditions, especially those with CGH. Indeed, strengthening programs for these muscles has shown improvement in the intensity and frequency of CGH episodes (46). The study of deep cervical flexors and cranio-cervical flexors (longus colli and rectus capitis) through specific activation also demonstrated weakness and decreased activation

in patients with CGH compared to healthy subjects (47). This same significant difference in strength of the flexors and extensors of the cervical spine has also been noted between patients with CGH and those suffering from other types of headaches (migraine, tension headaches) (34). The observation of decreased muscle cross-sectional area of the deep flexors (cranio-cervical), particularly the semispinalis capitis on the same side as the CGH, could explain their weakness (48).

The semispinalis capitis, specifically atrophied in CGH, is innervated wholly or partially by the dorsal rami of the upper cervical roots, unlike longus colli or trapezius (49), supporting the involvement of upper cervical segments in CGH pathophysiology. Weak deep neck flexors and stiff upper trapezius are common in headaches (34). Muscle imbalance in the upper trunk, described as 'upper crossed syndrome' (34), leads to elevated, protracted shoulders, scapular winging, and forward head posture. This posture increases strain on the cervico-cranial junction and C4–C5, linking cervico-scapular weakness and stiffness to headache development.

Radicular pain was found to be more significant in patients with CGH compared to the control group (10,28). This contrasts with our findings and may be explained by the fact that the patients in these studies were recruited from a neurosurgery department, had an older age profile, and included 49(18%) patients who had undergone surgery for cervical radiculopathy with recurrence during the study period (10).

Strengths and Limitations

The strength of the present study is the fact that it focused on a CR population at a non-complicated stage, seeking conservative treatment, and applied the recent 2018 diagnostic criteria for CGH (ICHD-3). However, the limitations are the small sample size and the low number of male patients which may limit the generalizability of the findings to the broader CR population.

CONCLUSION

This study reveals a notably high prevalence of CGH (61.6%) among patients with CR. Cervical stiffness, proprioceptive impairment, anxiety, and muscle weakness were identified as key factors associated with CGH, highlighting the importance of a comprehensive approach to managing this condition. Future studies with larger CR populations are needed to confirm our findings.

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