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The Relationship between Posture and Muscle Stiffness with Blood Flow in Cervicogenic Headache

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Abstract

Purpose: *The aim of this study was to investigate the relationship between head-shoulder posture, and head-neck muscle stiffness, with blood flow in cervicogenic headache (CH).*
Methods: *A total of 37 patients who met the inclusion criteria participated in this study. Head-shoulder posture was assessed with PostureScreen application, suboccipital, upper trapezius (UT) and sternecleidomastoid (SCM) muscle stiffness with the Myoton Pro device, internal carotid (ICA), vertebral artery (VA) blood flow with Doppler US.*
Results: *Head-shoulder posture deviations increased with increasing right and left suboccipital muscle stiffness (p=0.002, p=0.004, p=0.043, p=0.011) and head posture deviations increased with increasing left SCM muscle stiffness (p=0.004). As the UT muscle stiffness increased, VA blood flow (p=0.047, p=0.049) and as the left SCM muscle stiffness increased, ICA-VA blood flow decreased (p=0.009, p=0.002). As head posture deviation increased, ICA-VA blood flow decreased (p=0.002, p=0.011).*
Conclusion: *In conclusion, muscle stiffness and head-shoulder posture deviations negatively affect blood flow in CH.*

Key words: *Blood flow, Cervicogenic Headache, Neck, Stiffness, Posture*

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Introduction

Cervicogenic headache (CH) is a secondary headache type with a unilateral compressive and sometimes throbbing character spreading from the back of the head and neck to the ear and zygomatic region. The pain may be triggered after mechanical maneuvers and may last for weeks, starting from a few days, and may have a serious negative effect on the quality of life (1). Although the prevalence and incidence of CH vary according to societies, its prevalence was reported to be 0.1-4.1% in a recent study considering the accepted diagnostic criteria (2). It constitutes 15-20% of chronic headaches (3).

There is an increasing number of studies investigating the relationship between CH and musculoskeletal disorders. The convergence of the primary afferent inputs of the trigeminal and upper cervical nerves in the spinal trigeminal nucleus and the convergence of the head-face nociceptive sensory inputs from the upper cervical structures in the trigeminal nucleus may cause the pain signal in one region to spread to the other region, increase sensitivity to pain, and cause a pain response to nonpainful stimuli (4,5). Thus, it is thought that nociceptive input from cervical structures may cause headaches or that headache may spread to the cervical region. Current studies investigating the relationship between the cervical musculoskeletal system and CH are rather inadequate.

There are also studies that report the presence of a forward head posture in CH (6,7). The presence of tension and tenderness in the muscles of the neck due to this postural deviation has been reported in several studies (8,9). There are also studies reporting that cervical and thoracic posture deviations and suboccipital, upper trapezius (UT) muscle stiffness are higher in CH compared to healthy individuals (10).

In a study in which vertebral artery (VA) blood flow parameters were evaluated in individuals with CH, changes in VA blood flow were observed with cervical rotation movement. It has been reported that changes in blood flow may be the main pathogenetic mechanism in the development of pain (11). There are several studies investigating changes in head-neck blood flow, mostly in primary headache types. Studies on head-neck blood flow changes in CH are insufficient. Studies investigating changes in posture and neck-shoulder muscle stiffness with head-neck blood flow in CH are limited. No studies have investigated the relationship between postural deviations, muscle stiffness, and head-neck blood flow in CH. In this respect, our study contributes to the literature. The aim of our study was to investigate the relationship between neck-shoulder posture deviations, neck-shoulder muscle stiffness, and head-neck blood flow in individuals with CH.

Material and Methods

The study was approved by the Clinical Research Ethics Committee of SANKO University in accordance with the Declaration of Helsinki (Session No: 2020/04, Decision No: 03). Patients who presented to the Neurology Outpatient Clinic of Sani Konukoğlu Practice and Research Hospital and were diagnosed with CH by a specialist were included in the study. Patients with CH who signed the voluntary consent form. The inclusion criteria were as follows: diagnosed with CHA, an adult between 18 and 65 years of age, and not having received medical treatment (excluding analgesics) or physiotherapy for CHA in the previous months. The exclusion criteria were as follows: history of headache surgery, history of serious heart disease or surgery, history of current or previous malignancy, and diagnosis of epilepsy.

First, the demographic data of individuals such as gender, age, body weight (kg), height (m), body mass index (kg/m2), and disease duration (years) were also recorded. The PostureScreen Mobile® (PSM) application was used for posture evaluation. This is a valid and reliable application developed to evaluate posture (12). Head and shoulder angulation and translation values measured via the application were recorded as lateral posture analyses.

The suboccipital, UT, and sternocleidomastoid (SCM) muscle stiffness of the patients was evaluated bilaterally with a myotonometer (Myoton AS, Tallinn, Estonia). Myotonometers are valid and reliable methods for assessing stiffness (13). In muscle stiffness evaluations, suboccipital was evaluated in the prone position, UT in the sitting position, and SCM in the supine position. The measurement was repeated 3 times for the right-left sides. The average of the measurements was taken and recorded in N/m units (14,15).

A Siemens Acuson S2000 (Siemens, Erlangen, Germany) device was used to evaluate the patients' internal carotid artery (ICA)-VA blood flow. Measurements were recorded for the right and left sides (16). The average of the right-left sides of blood flow was taken. While the ICA and VA blood flow evaluations were carried out by a radiologist with 20 years of experience, all other evaluations were performed face-to-face by the same physiotherapist under the same conditions.

Statistical Analysis

All analyses were conducted using SPSS software version 25. The normality and homogeneity of the data were evaluated with the Shapiro Wilk test. Mean and standard deviation were given for continuous variables determined by measurement, and frequency and percentage were given for qualitative variables in descriptive statistics. Since the data were not normally distributed, the correlation between the data was analyzed using the Spearman test.

Results

The study was completed with a total of 37 individuals, 28 females and 9 males, who fulfilled the inclusion criteria. In descriptive statistics; mean age of the study participants was 32.30±9.171, and the mean BMI was 22.29±5.64. Also, the mean presence of headache was 2.97±1.83 years (Table 1).

Table 1. Demographics and presence of headache

	X ± SD
Age (years)	32.30±9.171
BMI (kg/m^2)	22.29±5.64
Presence of headache (years)	2.97±1.83
Gender	n (%)
Famale	28(75.67%)
Male	9(24.32%)

X:Mean; SD:Standard deviation; BMI:Body mass index; n:number of patients; %:percentage

When the relationship between muscle stiffness and posture was analyzed, a moderate correlation was found between right suboccipital muscle stiffness and head translation, shoulder angulation, and translation (p=0.002, p=0.005, p=0.004), between left suboccipital muscle stiffness and head translation and shoulder angulation (p=0.043, p=0.011) and between left SCM muscle stiffness and head angulation (p=0.004). The relationship between muscle stiffness and posture is shown in Table 2.

Table 2. Relationship between muscle stiffness and posture

	Head translation		Head angulation		Shoulder translation		Shoulder angulation	
	r	p	r	p	r	p	r	p
R suboccipital	**0.483***	0.002	0.254	0.129	**0.448***	0.005	**0.456 ***	0.004
L suboccipital	**0.334***	0.043	0.236	0.160	0.321	0.053	**0.413***	0.011
R UT	0.231	0.169	0.110	0.518	0.087	0.609	0.206	0.221
L UT	0.261	0.119	0.051	0.762	0.092	0.586	0.019	0.909
R SCM	0.171	0.311	0.312	0.060	0.185	0.274	0.047	0.783
L SCM	0.034	0.842	0.**460***	0.004	0.027	0.876	0.041	0.811

Spearman Test, r* correlation coefficient; p <0.05; R:right; L:left; UT:upper trapez; SCM:sternocleidomastoideus

When the relationship between posture and blood flow was analyzed, a negative moderate correlation was found between head translation and ICA PS and between ED and VS PS (p=0.002, p=0.022, p=0.011). The relationship between posture and blood flow is shown in Table 3.

Table 3. Relationship between posture and blood flow

	ICA PS		ICA ED		VA PS		VA ED	
	r	p	r	p	r	p	r	p
Head translation	-0.181	0.284	-0.222	0.186	0.009	0.957	0.127	0.453
Head angulation	**-0.490***	0.002	**-0.377***	0.022	**-0.412***	0.011	-0.276	0.098
Shoulder translation	-0.156	0.356	-0.271	0.105	-0.036	0.832	0.103	0.543
Shoulder angulation	-0.097	0.570	-0.322	0.052	-0.189	0.264	-0.051	0.763

Spearman Test, r*:correlation coefficient; p <0.05; ICA:internal carotid artery; VA: vertebral artery; Ps:peak sistoloc; ED:end diastolic

When the relationship between muscle stiffness and blood flow was analyzed, a negative low-level correlation was found between right and left UT muscle stiffness and VA ED (p=0.047, p=0.049), and a negative moderate-level correlation was found between left SCM and ICA PS and VA ED (p=0.009, p=0.002). The relationship between muscle stiffness and blood flow is shown in Table 4.

Table 4. Relationship between muscle stiffness and blood flow

	ICA PS		ICA ED		VS PS		VA ED	
	r	p	r	p	r	p	r	p
R suboccipital	0.089	0.600	0.115	0.499	0.196	0.245	0.035	0.839
L suboccipital	0.087	0.611	0.093	0.584	0.181	0.283	0.093	0.585
R UT	-0.004	0.982	-0.076	0.656	-0.188	0.266	**-0.329***	0.047
L UT	-0.062	0.714	-0.047	0.781	-0.127	0.455	**-0.326***	0.049
R SCM	-0.083	0.627	-0.215	0.201	-0.004	0.982	-0.322	0.052
L SCM	-0.**423***	0.009	-0.318	0.055	-0.240	0.153	**-0.502***	0.002

Spearman Test, r* correlation coefficient; p <0.05; R: right; L:left; UT:upper trapez; SCM:sternocleidomastoideus; ICA:internal carotid artery; VS:vertebral artery; PS:peak sistoloc; ED:end diastolic

Discussion

This study investigated the relationship between head-shoulder posture and neck-shoulder muscle stiffness with head-neck blood flow in CH. It was observed that head translation, shoulder translation, and angulation increased with increasing suboccipital muscle stiffness. In addition, it was observed that posture affects negatively blood flow. Also, VA blood flow decreased as UT and SCM muscle stiffness increased, and ICA-VA blood flow decreased as head translation increased.

Farmer et al. compared the cervical lordosis of patients with CH with the control group by radyographic methods. It is reported that cervical lordosis is higher in individuals with CH compared to the healthy group. However, the results of the study cannot provide information about whether this deviation in cervical posture causes CH (17). Yoon evaluated the neck tilt angle and T1 slope angle in a study to contribute to the diagnostic criteria and clinical evaluation in CH. They found a significant difference in posture in CH compared to healthy individuals (10). Moustafa et al. investigated 3D spinal alignment in CH and found that there was much more thoracolumbar deviation compared to healthy individuals (18). Studies in the literature have generally shown that postural deviations may be associated with CH. This study similarly analyzed postural deviations but reported that head and shoulder posture may be related to muscle stiffness and blood flow.

The mechanical properties of the cervical muscles were investigated in CH. No significant difference was found in the elasticity of the suboccipital and UT muscles compared with healthy subjects, but a significant difference was found in cervical muscle stiffness (11). Lin et al. reported increased stiffness in superficial neck extensor muscles in cervicogenic headache. They concluded that increased muscle stiffness, especially on the side of the headache, may be significant for the diagnosis of CH. A systematic review showed that manual therapy approaches to reduce the tension of the muscles in the neck region may be effective in the treatment of CH (19). All these studies reported that muscle stiffness is a symptom to be considered in individuals with CH. In parallel with the literature, our study reported that posture deviations may be associated with neck muscle stiffness. In addition, the results that increased cervical muscle stiffness may adversely affect head and neck blood flow contribute to the literature.

Kaur et al. study with a large population showed that factors that would cause compression of the VBA may be associated with CH (20). Research suggests that low blood flow velocity and high resistance in the transverse cervical artery may be closely related to the underlying pathogenesis of cervical and upper back stiffness (21). Abdullaiev R Ya et al. compared the VA blood flow of patients with CHA and healthy individuals and reported that blood flow decreased, especially in head rotation (11).

In the literature, head-neck blood flow relationships related to headache have generally been examined. Another study showed that VA blood flow increased after acupuncture application in individuals with tension-type headache (22). Similarly, there are studies showing that blood flow may be affected by headache after various interventions. Based on the literature, we examined the factors that may be associated with VA and ICA blood flow in a cervicogenic headache in our study. We reported that VA-ICA blood flow may be significantly related to posture and neck stiffness. In the literature, most of the studies on postural deviations, muscle stiffness, and head and neck blood flow have been conducted in relation to the diagnosis of CH. The relationship between these symptoms in CH has not been studied. Our study is one that will contribute to the literature in this aspect.

The main limitation of our study is that we were able to reach a limited number of individuals diagnosed with CH since our study was conducted in a single center. We recommend that the relationship between neck-shoulder postural deviations, muscle stiffness, and blood flow in individuals with CH be examined in larger population studies. We also think that examining the relationship between not only neck-shoulder posture but also postural deviations of the entire spine and muscle stiffness will bring a different perspective to the literature. Our study contains results that may give clinicians insight into the treatment approaches of individuals with CH.

Conclusion

This study showed that neck-shoulder postural deviations and suboccipital and UT muscle stiffness with VA and ICA blood flow may be related in individuals with CH. Postural deviations, muscle stiffness, and blood flow should be taken into account during the evaluations made in patients with CH. Additionally, posture correction and muscle relaxation methods can be added to treatment programs to increase blood flow.

Conflict of interest: No potential conflict of interest was reported by the author(s)

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