J. Phys. Ther. Sci. 32: 439–443, 2020

The Journal of Physical Therapy Science

Original Article

Evaluation of cervical spine muscles thickness in patients with cervical vertigo and healthy controls through ultrasonography

Ronak Zargar Talebi, PT, PhD Candidate[1)*], Asghar Rezasoltani, PT, PhD[1)], Minoo Khalkhalizavieh, PT, PhD[1)], Farideh Dehghan Manshadi, PT, PhD[1)], Alireza Akbarzadeh Baghban, Statistics PhD[1)]

[1)] *Department of Physical Therapy, School of Rehabilitation, Shahid Beheshti University of Medical Sciences: Tehran 161679, Iran*

Abstract. [Purpose] Cervical vertigo as a common complaint is associated with some musculoskeletal disorders. However, to date, ultrasonographical parameters of cervical muscles in patients with cervical vertigo have not been investigated. This study was conducted to investigate size of cervical muscles in patients with cervical vertigo compared to healthy controls. [Participants and Methods] Thicknesses of cervical flexor and extensor muscles were evaluated through ultrasonography and results were compared between the patients and healthy controls by Independent Samples t-test or Mann-Whitney U nonparametric test. [Results] Results showed that, thickness of Longus Colli muscle was significantly different between the patients and healthy controls. [Conclusion] According to findings of the study, size of Longus Colli muscle is likely to be associated with etiology of cervical vertigo.

Key words : Cervical vertigo, Muscle ultrasonography, Muscle thickness

(This article was submitted Feb. 11, 2020, and was accepted Apr. 14, 2020)

INTRODUCTION

Vertigo is the third most common complaint among all outpatients[1)]. Occurrence of disorder in cervical region is one of peripheral causes of the vertigo[2–4)], which is reffered to as cervical vertigo[3, 5, 6)]. Musculoskeletal disorders are among the causes of cervical vertigo[7)]. Cervical afferents play an important role in postural control[8)]. The functional role of the cervical afferents is mainly dependent on the short and deep intervetebral muscle, specifically the sub-occipital muscles[9)]. The cervical muscle afferents provide information to the central nervous system (CNS) about the orientation of the head in the space and the orientation of the head and neck relative to the trunk and there are specific connections between the cervical receptors, vestibular, and visual control systems and CNS[1)].

Therefore, evaluation of muscular disorder in cervical region seems to be necessary for assessment and treatment of cervical vertigo[4)].

In recent years, various methods have been used to evaluate spinal muscles, including surface and needle electromyography, Magnetic Resonance Imaging (MRI), and Ultrasound (US)[6, 7, 10–13)]. The MRI evaluations of patients with chronic tension-type headache and whiplash injury revealed that, thickness of sub-occipital muscle decreased compared to healthy controls[7, 10, 11)]. In a study conducted to compare muscle thickness using three methods of MRI, US, and Computed Tomography (CT), all three methods showed similar results[14)]. Thus, it has been concluded that, the use of US is more cost-effective, more accessible and is a better choice as a noninvasive method[14)]. US is an appropriate method for evaluating anatomical characteristics of the muscles such as size, thickness and Cross-Sectional Area (CSA)[13, 15–17)]. However, to the best of our knowledge, US has not been applied in patients with cervical vertigo[18)]. Therefore, the main purpose of this study was

*Corresponding author. Ronak Zargar Talebi (E-mail: r.zargarpt@gmail.com)

investigating thickness of cervical flexor and extensor muscles in the patients with cervical vertigo compared to healthy matched subjects.

PARTICIPANTS AND METHODS

Patients diagnosed with cervical vertigo by a specialized physician and healthy matched subjects were selected to include in this study[19, 20]. Inclusion criteria for all the participants were having the age between 18 and 45 years old and Body Mass Index (BMI) between 18 and 30, and for the patients, they included insidious incidence of vertigo, duration of vertigo between some minutes to some hours, intensity of vertigo ranging from 1 to 5 based on Visual Analogue Scale (VAS), frequency of vertigo between 1 and 5 times a day, cervical pain (rest pain or pain at palpation) for more than 3 months with an intensity ranging from 1 to 5 based on VAS, and temporal relationship between the vertigo incidence and cervical pain. Patients were excluded if they had a history of any recent surgery, were pregnant, or had pain in other areas of the body, any systemic disease, psychological disorders, fractures, inner ear disorder, vestibular disorder, or inability to perform the study procedure. Peoples with high levels of muscular activity like sports or labors were also excluded. Healthy subjects were matched to the patients based on age, gender, and BMI. The study procedure was explained to the subjects and an informed consent was taken from all the participants.

Demographic characteristics of the subjects were recorded. Imaging was performed on studied cervical flexors including Sternocleidomastoid (SCM), Longus Colli (LColi), and Longus Capitis (LCap), and extensors including Rectus Capitis posterior major (RCap) and Oblique Capitis superior (OCap) muscles bilaterally. The participants were seated on a low wheel less stool with a straight back and supported feet. They were asked to keep their upper arms in resting position by their sides, the participant's hand was positioned on his/her thigh, their knees and hips at 90 degrees of flexion, and maintained their head and neck in the neutral position. Participant's position was checked during ultrasonography, as any change in position could change the muscle thickness. Ultrasound images were obtained using a rehabilitation ultrasound imaging (RUSI) device (Ultrasonic scanner, HS 2100, Honda Electronic Co., Japan) with a 7 cm linear probe in the B-mode (7.5 MHz). To obtain images of the RCap and OCap muscles, the examiner placed the probe transversely on the C2 spinous process[20–23]. Next, the examiner moved the probe laterally to identify the lamina of the C2 and vertically to identify the C1 lamina[18–20, 24]. To identify the RCap muscle, the examiner moved the probe upward or downward[19, 20]. For visualization of the OCap muscle, the examiner moved the probe further laterally at the same level as used for measuring the RCap (Fig. 1A)[19, 20]. To visualize the LCap (Fig. 1B) and LColi (Fig. 1C) muscle, the probe was placed transversely at the C6 level[19–22]. The reason for using this level was the fact that it has no overlap between the LColi and the LCap muscles[19–22]. In order to obtain the images of the SCM muscle at this level, the examiner placed the probe transversely on the SCM muscle between its origin and insertion (Fig. 1D)[19, 20]. To obtain each image, the probe was removed and repositioned at the same level[19, 20]. We did not include the facial outline to measure the thickness of the muscles and placed the cursor on the inside edge of the superior fascia at the thickest portion of the muscle, drawing a vertical line to the inside edge of the inferior fascia[19, 20]. Imaging of each muscle was performed three times, and mean thickness for each muscle was recorded[20]. Muscles imaging was done randomly. In all measures, thickness of the muscle was normalized to the participant's weight. Since, settings of the system influence on clarity of the images, all parameters such as Compression, Gamma, Brightness, Gain, and focus were fixed in all the shots[25].

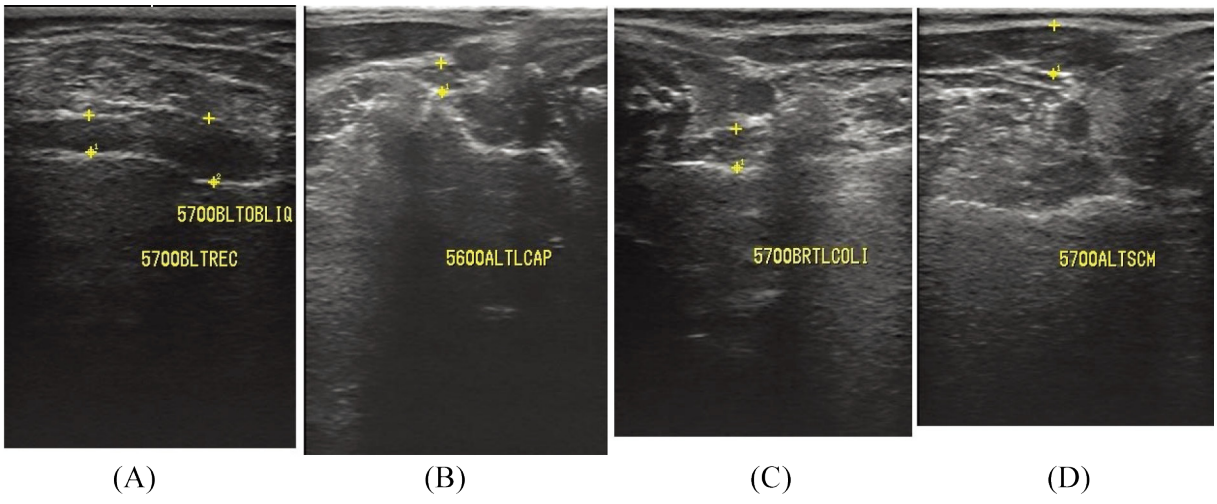

Fig. 1. Ultrasonographic images of the rectus capitis posterior (A), oblique capitis superior (A), longus capitis (B), longus colli (C) and sternocleidomastoid (D) muscles (REC, rectus capitis posterior; OBLIQE, oblique capitis superior, LCAP, longus capitis; LCOLI, longus colli; SCM, sternocleidomastoid).

It should be mentioned that prior to the main study, the reliability of RUSI for measuring the thickness of the aforementioned muscles was evaluated and the results showed that RUSI is a reliable method (Intraclass Correlation Coefficient >0.8 for all muscles).

All data analyses were performed using SPSS software (version 16). Descriptive statistics of studied variables were calculated. Independent Samples t-test was used to compare demographic variables between the patients and healthy subjects. To evaluate distribution of quantitative variables of the study with normal theoretical distribution curve, Shapiro-Wilk test was used. Mean thickness of right and left sides for each evaluated muscle was used for further analysis. To compare muscles thickness between the patients and healthy subjects, Independent Samples t-test or nonparametric Mann-Whitney U test were performed. Statistical significance level was set at 0.05 for all tests.

RESULTS

Forty-four men and women including 22 patients with cervical vertigo and 22 healthy matched individuals were selected to include in the study. Table 1 presents demographic characteristics of all the participants and clinical measures of the patients. The mean (SD) of the evaluated muscles thickness in the patients and healthy control subjects are described in Table 2. Results of the Shapiro-Wilk test revealed that, thickness of SCM, LCap, and OCap had not normal distribution. Results of Independent Samples t-tests showed a significant difference for LColli normalized thickness (p=0.002, CI=(−0.05, −0.01), Cohen's d=0.89) and a non-significant difference for RCap normalized thickness (p=0.18, CI=(−0.009, 0.04), Cohen's d=0.40). Results of Mann-Whitney U test showed a non-significant difference for normalized thickness of SCM (p=0.38), LCap (p=1) and OCap (0.46).

DISCUSSION

This study was the first study evaluated US characteristics of cervical muscles in the patients with cervical vertigo. Results of this study showed that, thickness of extensor muscles was not significantly different between the patients with cervical vertigo and healthy participants. This finding is consistent with results of the research by Goodarzi, et al. who compared muscle thickness between people with and without forward head posture[26]. Bokaee, et al. investigated cervical muscle thickness in people with and without forward head posture, and they showed only a significant difference in SCM thickness[20], however, in our study, a significant difference was only observed in LColi muscle so that, the LColi thickness was higher in the patients with cervical vertigo than healthy subjects. This finding is inconsistent with results of the study by Javanshir et al[22]. This contradiction between the results may be due to different patient population as Javanshir et al. investigated bilateral LColi muscles in patients with chronic neck pain compared to healthy subjects using US[22]. LColi as a deep neck flexor muscle stabilizes cervical spine together with other deep muscles during the movements. As the cervical instability may cause abnormal afferent signals to the CNS and consequently vertigo feeling, higher thickness of LColi may

Table 1. Participants' demographic and clinical variables' mean (SD)

Variable	Total sample (n=44)	Healthy controls (n=22, 50%)	Cervical vertigo patients (n=22, 50%)	p value
Demographic				
Age (years)	38.50 (5.01)	38.05 (4.82)	38.95 (5.26)	0.55
Gender, n female	30 (68%)	15 (68%)	15 (68%)	1
Height (m)	1.65 (0.08)	1.66 (0.08)	1.64 (0.07)	0.45
Weight (kg)	68.05 (10.50)	67.50 (11.79)	68.59 (9.28)	0.73
BMI (kg/m^2)	24.81 (2.37)	24.30 (2.81)	25.33 (1.75)	0.15
Clinical measures				
Pain intensity (0–10)	-	-	3.14 (0.8)	-
Vertigo frequency (0–5)	-	-	2.59 (0.9)	-
Vertigo intensity (0–5)	-	-	4 (1.23)	-

SD: Standard Deviation; BMI: Body Mass Index.

Table 2. The normalized thickness mean (SD) of the evaluated muscles in the healthy controls and the cervical vertigo patients

	LColi normalized thickness	RCap normalized thickness	SCM normalized thickness	LCap normalized thickness	OCap normalized thickness
Healthy controls (mm)	0.22 (0.03)	0.24 (0.04)	0.24 (0.03)	0.13 (0.01)	0.32 (0.05)
Cervical vertigo patients (mm)	0.25 (0.03)	0.22 (0.05)	0.23 (0.01)	0.14 (0.03)	0.29 (0.05)

SD: Standard Deviation; LColi: Longus Coli; RCap: Rectus Capitis posterior major; SCM: Sternocleidomastoid; OCap: Oblique Capitis superior; LCap: Lungus Capitis.

be a compensatory mechanism in the patients with cervical vertigo[27]. Due to the small number of the literature in the field of RUSI, clinical interpretation of the findings is difficult and more studies are required to confirm results of our study, but so far, it can be suggested that the clinicians take into account the findings of this study in the evaluation of patients with cervical vertigo and incorporated the cervical stabilization exercises in the treatment planning for the cervical vertigo.

There were some limitations in this study. Firstly, sample size was small, and it is noteworthy that, investigated variables may show normal distribution and more significant results in larger sample size. Secondly, people with a limited range of age were included in the study. Older adults with cervical vertigo may have different characteristics, which need to be investigated. Thirdly, intensity of pain and vertigo was mild to moderate in evaluated patients. Thus, different results may be revealed in patients with more severe symptoms. Fourth, the muscles thickness was not normalized to the participant's gender. As the muscles mass may be different in the two gender types, investigating the muscles thickness in the males and females separately may resulted in different findings.

Conflict of interest

There was no conflict of interest to report.

ACKNOWLEDGMENT

This project is part of Ph.D. thesis for Ronak Zargar and was supported by a grant from the Musculoskeletal Rehabilitation Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

REFERENCES

1) Chawla N, Olshaker JS: Diagnosis and management of dizziness and vertigo. Med Clin North Am, 2006, 90: 291–304. [Medline] [CrossRef]
2) Brandt T: Cervical vertigo—reality or fiction? Audiol Neurotol, 1996, 1: 187–196. [Medline] [CrossRef]
3) Brandt T, Bronstein AM: Cervical vertigo. J Neurol Neurosurg Psychiatry, 2001, 71: 8–12. [Medline] [CrossRef]
4) Végh I, Harmat K, Gerlinger I: [Cervical vertigo - reality or fiction?]. Orv Hetil, 2019, 160: 967–972 (in Hungarian and English abstract). [Medline]
5) Bracher ES, Almeida CI, Almeida RR, et al.: A combined approach for the treatment of cervical vertigo. J Manipulative Physiol Ther, 2000, 23: 96–100. [Medline] [CrossRef]
6) Norré ME, Forrez G, Stevens A, et al.: Cervical vertigo diagnosed by posturography? Preliminary report. Acta Otorhinolaryngol Belg, 1987, 41: 574–581. [Medline]
7) Fernández-de-Las-Peñas C, Bueno A, Ferrando J, et al.: Magnetic resonance imaging study of the morphometry of cervical extensor muscles in chronic tension-type headache. Cephalalgia, 2007, 27: 355–362. [Medline] [CrossRef]
8) Treleaven J: Sensorimotor disturbances in neck disorders affecting postural stability, head and eye movement control. Man Ther, 2008, 13: 2–11. [Medline] [CrossRef]
9) Liu JX, Thornell LE, Pedrosa-Domellöf F: Muscle spindles in the deep muscles of the human neck: a morphological and immunocytochemical study. J Histochem Cytochem, 2003, 51: 175–186. [Medline] [CrossRef]
10) Elliott J, Jull G, Noteboom JT, et al.: MRI study of the cross-sectional area for the cervical extensor musculature in patients with persistent whiplash associated disorders (WAD). Man Ther, 2008, 13: 258–265. [Medline] [CrossRef]
11) Elliott JM, O'Leary S, Sterling M, et al.: Magnetic resonance imaging findings of fatty infiltrate in the cervical flexors in chronic whiplash. Spine, 2010, 35: 948–954. [Medline] [CrossRef]
12) Øverås CK, Myhrvold BL, Røsok G, et al.: Musculoskeletal diagnostic ultrasound imaging for thickness measurement of four principal muscles of the cervical spine—a reliability and agreement study. Chiropr Man Therap, 2017, 25: 2. [Medline] [CrossRef]
13) Whittaker JL, Teyhen DS, Elliott JM, et al.: Rehabilitative ultrasound imaging: understanding the technology and its applications. J Orthop Sports Phys Ther, 2007, 37: 434–449. [Medline] [CrossRef]
14) Dupont AC, Sauerbrei EE, Fenton PV, et al.: Real-time sonography to estimate muscle thickness: comparison with MRI and CT. J Clin Ultrasound, 2001, 29: 230–236. [Medline] [CrossRef]
15) O'Sullivan C, Meaney J, Boyle G, et al.: The validity of Rehabilitative Ultrasound Imaging for measurement of trapezius muscle thickness. Man Ther, 2009, 14: 572–578. [Medline] [CrossRef]
16) Teyhen DS: Rehabilitative ultrasound imaging for assessment and treatment of musculoskeletal conditions. Man Ther, 2011, 16: 44–45. [Medline] [CrossRef]
17) Maurits NM, Bollen AE, Windhausen A, et al.: Muscle ultrasound analysis: normal values and differentiation between myopathies and neuropathies. Ultrasound Med Biol, 2003, 29: 215–225. [Medline] [CrossRef]
18) Javanshir K, Amiri M, Mohseni-Bandpei MA, et al.: Ultrasonography of the cervical muscles: a critical review of the literature. J Manipulative Physiol Ther, 2010, 33: 630–637. [Medline] [CrossRef]
19) Bokaee F, Rezasoltani A, Manshadi FD, et al.: Comparison of isometric force of the craniocervical flexor and extensor muscles between women with and without forward head posture. Cranio, 2016, 34: 286–290. [Medline] [CrossRef]
20) Bokaee F, Rezasoltani A, Manshadi FD, et al.: Comparison of cervical muscle thickness between asymptomatic women with and without forward head posture. Braz J Phys Ther, 2017, 21: 206–211. [Medline] [CrossRef]
21) Javanshir K, Mohseni-Bandpei MA, Rezasoltani A, et al.: Ultrasonography of longus colli muscle: a reliability study on healthy subjects and patients with chronic neck pain. J Bodyw Mov Ther, 2011, 15: 50–56. [Medline] [CrossRef]

22) Javanshir K, Rezasoltani A, Mohseni-Bandpei MA, et al.: Ultrasound assessment of bilateral longus colli muscles in subjects with chronic bilateral neck pain. Am J Phys Med Rehabil, 2011, 90: 293–301. [Medline] [CrossRef]
23) Pillen S, Tak RO, Zwarts MJ, et al.: Skeletal muscle ultrasound: correlation between fibrous tissue and echo intensity. Ultrasound Med Biol, 2009, 35: 443–446. [Medline] [CrossRef]
24) Goodpaster BH, Carlson CL, Visser M, et al.: Attenuation of skeletal muscle and strength in the elderly: the Health ABC Study. J Appl Physiol 1985, 2001, 90: 2157–2165. [Medline] [CrossRef]
25) Pillen S, van Keimpema M, Nievelstein RA, et al.: Skeletal muscle ultrasonography: visual versus quantitative evaluation. Ultrasound Med Biol, 2006, 32: 1315–1321. [Medline] [CrossRef]
26) Goodarzi F, Karimi N, Rahnama L, et al.: Differences in cervical extensor muscles thickness on subjects with normal head posture and forward head posture: an ultrasonography study. J Rehabil Sci Res, 2015, 2: 23–26.
27) Treleaven J, Jull G, Sterling M: Dizziness and unsteadiness following whiplash injury: characteristic features and relationship with cervical joint position error. J Rehabil Med, 2003, 35: 36–43. [Medline] [CrossRef]