DO PATIENTS WITH CHRONIC NECK PAIN HAVE RELATED DIAPHRAGMATIC DYSFUNCTION?

Samir al Gazzar[1], Ahmad Mahdi Ahmad[2], Khalid Mahmoud Kamel[3], Reda Gomaa Mohamed[4]

Department of physical therapy for internal medicine and geriatrics, faculty of physical therapy, Cairo University.
Department of physical therapy for internal medicine and geriatrics, faculty of physical therapy, Cairo University.
Department of chest diseases, Faculty of medicine, Cairo University
Department of physical therapy for internal medicine and geriatrics, faculty of physical therapy, Cairo University.

Abstract

Background: Recently, an association between chronic neck pain and deterioration in pulmonary functions has been reported. There have been recent suggestions to add respiratory assessment to the routine physiotherapy assessment for chronic neck pain patients. The purpose of this study was to assess Diaphragmatic thickness fraction (DTF) in patients with chronic neck pain and to investigate for a correlation between DTF and neck pain symptoms or daily life disabilities caused by neck pain. **Methods**: Fifty subjects with chronic neck pain were recruited to this study (10 male and 40 female). The mean value of age of the subjects was 41.14±8.11 years; the mean value of BMI was 25.57±2.85,and the mean value of neck pain duration was3.62±5.3 years. The inclusion criteria were middle-aged patients, both males and females, patients with nonspecific chronic neck pain, and patients with craniovertebral angle of less than 50 degrees. The exclusion criteria were patients with neck pain due to disc prolapsed or trauma, patients with cardiopulmonary problems, or smokers. The outcome measures in this study were DTF measured by ultrasonography, Visual Analogue Scale (VAS) for pain, and Arabic version of Neck Disability Index (NDI). **Results:** The mean DTF was 114.8±40 % in patients with chronic neck pain. DTF had no significant correlation either with VAS for neck pain (r=0.04, p=0.781), or NDI (r=o.14, p=0.331). **Conclusions**: DTF is not affected in middle-aged adults with chronic neck pain, and is not correlated with neck pain and/or neck disabilities in daily life.

Keyword: Chronic neck pain, forward head posture, diaphragmatic function.

Introduction

In recent years, the widespread usage of smart phones and laptops has led to higher prevalence of chronic neck pain among middle age population [1].Chronic neck pain (CNP) is a multifactorial disorder accompanied by dysfunctional changes in cervical region, including forward head posture and biomechanical changes in cervical spine [2,3]. Recently, researches have been directed to assessing the need for respiratory assessment in patients with chronic neck pain [4-7]. None of these researches have included measurement of the diaphragmatic thickness fraction (DTF). DTF has been used as a good estimator of diaphragm function [8], as it has shown a tight correlation with trans diaphragmatic pressure [9,10]. Therefore, the main purpose of the present study is to measure DTF in patients with chronic neck pain and to assess if there is an association between chronic neck pain and diaphragmatic dysfunction assessed by using the diaphragmatic thickness fraction. The results of this study may provide new insights for the routine assessment of patients suffering from chronic neck pain.

Methods

Ethical consideration

The Ethics Committee of Scientific Research of the Faculty of Physical Therapy at Cairo University approved this study. Written consents were obtained from subjects before the study.

Subjects

Fifty subjects having chronic neck pain and forward head posture angle were recruited from the Faculty of Physical Therapy Outpatients Clinic and from kasr El-Ainy Hospital. The mean age was 41.14±8.11, the mean value of BMI was 25.57±2.85. Inclusion criteria were patients with nonspecific neck pain, forward head posture measured by a craniovertebral angle of less than 50 degree, both males and females. Exclusion criteria included patients with cervical disc prolapse or spondylolithesis, patients with chest or cardiac problems, patients with neurological disorders affecting respiratory muscle; smokers were also excluded

Measurements

1-Anthropometric characteristics

Body weight and height of patients were measured by weight and height scale. Then,the calculation of body mass index (BMI) for patients was done according to the following equation: BMI = Body weight / height in meters squared [11].

2-Craniovertbral angle (CVA) measurement

CVA) is define as the angle between a horizontal line passingthrough C7 and a line drawn from C7 to the tragus of the ear [12]. Patients with CVA

of less than 50 degrees do have forward head posture [13]. CVA was measured by Photograph capturing, which is a reliable method to assess orward head posture. First, the spinous process of C7 was detected and adhesive markers on tragus of the ear and spinous process of C7. Secondly, the patients were instructed to stand by side and to look in front of them at a target at the level of the eye and both hands by sides. Thirdly, a digital camera (Sony, 8 mega pexel) was installed on the right side of the patients, at the level of 7th spinous process, and at 1.5 meters away. Fourthly, three images were captured from the right side using the digital camera, and were analyzed by Surgimap spine software to calculate the CVA [14] .

3-Diaphragmatic ultrasonography

This was done by a single ultrasongrapher with more than 3 years of experience in ultrasound. Diaphragm ultrasonography produces both structural and functional assessment of the diaphragmatic muscle. Using the intercostal approach; the right sided diaphragm was examined on its zone of apposition to the rib cage. Ultrasonography .M mode enabled measurement of thediaphragm thickness fraction. The diaphragm thickening fraction was computed as the difference between the peak inspiratorydiaphragm thickness and the end-expiratorydiaphragm thickness divided by end-expiratorydiaphragm thickness [10].

4 - Neck disability index (NDI)

The Arabic version of the original English NDI questionnaire was used [15,16]. NDI consists of 10 items questioning the quality of patient's daily life, covering pain symptoms and disabilities during daily activities. Each item has options to answer from 0 (no disability) to 5 (complete disability), with a total score of 50 [16]. The interpretation of NDI was as follows:scores from 0-4 represent no disabilities, from 5-14 represent mild disabilities, from 14-24 represent moderate disabilities, from 25 to 34 represent severe disabilities, and scores ≥35 represent complete disability [16].

5-Visual analogue scale (VAS)

VAS was used as a valid measure of pain intensity, it is graduated from (0-10) as a zero score represents no pain and score of 10 represents maximum pain. VAS has been frequently used in patients with disorders of cervical spine[17].

Statistical analysis

Descriptive statistics were used to summarize the data. The data were presented as means ± standard deviations. The Spearman correlation co-efficient test was used for statistical analysis. Graphpad prism software was used.Only values of $p < 0.05$ were considered as statistically significant.

Results

In table 1, the anthropometric characteristics of the subjects are presented. The outcome measures of the study are shown in table 2. Statistically, there was no significant correlation between the diaphragmatic thickness fraction (DTF) and either of VAS for pain, neck disability index (NDI), or craniovertebral angle (CVA), as shown in table3.

Table.1 Subjects' characteristics

Characteristics	**Study group (n=50)**
Age(yrs)	41.14±8.11
Weight(kg)	69.62±10.35
Height(cm)	163.18±7.58
BMI(kg/m2)	25.57±2.85
Pain duration (y)	3.62±5.3
CVA(degree)	42.22±5.89
BMI: Body mass index; CVA: Craniovertbral angle; VAS:visual analogue scale. The data are represented as means ±SD	

Table 2. The outcome measures of the study

The outcome measures	**The study group (n=50)**
Diaphragm thickness fraction (DTF)%	114.8±40
Visual Analogue Scale (VAS) for Pain	7.24±1.3
Neck Disability Index (NDI)(%)	20±6
The data are represented as means ±SD	

Table 3.Correlation between diaphragmatic thickening fraction (DTF) and other outcome measures

Outcome	**Diaphragmatic thickening fraction (DTF)**	
	R	**P**
VAS	**0.04**	**0.781**
NDI	**0.14**	**0.331**
CVA	**0.07**	**0.587**

Discussion

The key findings in this study are: (a) the diaphragmatic thickness fraction was within normal in patients with chronic neck pain, with a mean value of 114.8±40 %. (b) There has been no significant association between diaphragm function measured by the diaphragmatic thickness fraction and either of the neck pain measured by VAS or disabilities in daily activities assessed by NDI. (c) The degree of forward head angle did not correlate with diaphragmatic thickness fraction.

The possible explanations for our finding are: (a) It is possible that the diaphragmatic function is not affected by the slight degree of forward head posture seen in our patients as the mean value of CVA for them was 42.22±5.89 degrees; this could be not severe enough to cause related changes in the lumbar spine biomechanics with diaphragm muscle affection.

(b) Moreover, the subjects recruited for this study were middle-aged adults with a mean age of 41.14±8.11 years, in whom diaphragmatic function and/or diaphragmatic thickness fraction (DTF) may be not yet affected. Perhaps, if our patients were older, a more disruption of the cervical spine and related regions of the spine, including lumbar vertebrae, could have been occurred with resultant observed affection of diaphragm function. Evidence does exist that the age of patients has an inversely significant correlation with diaphragmatic thickness fraction (DTF) [18].

Other studies have found that pulmonary functions are deteriorated in subjects with chronic neck pain [4-7], but none of these studies have attributed these deteriorations to a decline in the diaphragm thickness fraction but rather to other causes. Thus, the worsening of pulmonary function measures found in subjects with chronic neck pain in those studies is not necessarily related to concomitant affection of the diaphragm thickness fraction. This explanation is in accordance with the findings of two recent studies [18,19]. The first study by Eryuksel et al. [18] has reported that pulmonary function measurements were not linked to diaphragmatic thickness fraction in chronic obstructive pulmonary disease (COPD) patients. The second study by Cimist et al. [19], has also shown that there was no correlation between the diaphragm thickness fraction and pulmonary function decline in moderate and severe COPD patients.

Based on that, the association between neck pain and diaphragm thickness fraction seems to be independent of [4-7] the association between chronic neck pain and other deteriorated respiratory measurements.

In addition, our study has not found an association between diaphragmatic thickness fraction (DTF) and either of the level of chronic neck pain symptoms measured by VAS or the quality of life during daily

activities measured by NDI. An evidence does exist that diaphragmatic thickness fraction (DTF) has no relation with symptoms of patients in chest diseases [18,19]. Eryuksel et al. [18], have shown that quality of life scores and COPD Assessment Test scores were not linked to percent diaphragm thickness. Climist et al. [19], have also reported that the level of COPD symptoms, as assessed by modified Medical Research Council (mMRC) dyspnea scale and COPD Assessment Test, was not related to the diaphragm thickness fraction (DFT).

In conclusion

Diaphragmatic thickness fraction (DTF) measurement by diaphragmatic ultrasonography in patients with chronic neck pain and FHP has proved normal DTF in these patients. There was no a correlation between DTF and either of chronic neck pain symptoms assessed by VAS, or with the quality of daily life activities measured by NDI. Accordingly, DTF assessment in patients with chronic neck pain is not helpful in identifying respiratory problems that may be caused by the neck pain itself and/or the related forward head posture.

References

1. Ruivo RM, Carita AI, Pezarat-Correia P. The effects of training and detraining after an 8 month resistance and stretching training program on forward head and protracted shoulder postures in adolescents: randomised controlled study. Man Ther 2016; 21:76–8.
2. Falla D, Farina D: Neuromuscular adaptation in experimental and clinical neck pain. J Electromyogr Kinesiol; 2008 18:255–61.
3. Silva AG, Punt TD, Sharples P, et al Head posture and neck pain of chronic nontraumatic origin: a comparison between patients and pain-free persons. Arch Phys Med Rehabil;2009: 90:669–74.
4. Kapreli E, Vourazanis E, Billis E, Oldham JA, Strimpakos N.. Respiratory dysfunction in chronic neck pain patients. A pilot study. Cephalalgia 2009; 29:701-10.
5. Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J. Respiratory weakness in patients with chronic neck pain. Man Ther 2013; 18:248-53.
6. Dimitriadis Z, Kapreli E, Strimpakos N, Oldham J. Pulmonary Function of Patients with Chronic Neck Pain: A Spirometry Study. Resp Care 2014; 59:543-49.
7. Wirth B, Amstalden M, Perk M, Boutellier U, Humphreys BK. Respiratory dysfunction in patients with chronic neck pain - influence of thoracic spine and chest mobility. Man Ther 2014; 19:440-44.
8. American Thoracic Society, European Respiratory Society ATS/ERS Statement on respiratory muscle testing. Am J Respir Crit Care Med. 2002;166:518–624.

9. Vivier E, MekontsoDessap A, Dimassi S, et al. Diaphragm ultrasonography to estimate the work of breathing during non-invasive ventilation. Intensive Care Med. 2012;38:796–803.
10. Dres M, Demoule A. Diaphragm dysfunction during weaning from mechanical ventilation: an underestimated phenomenon with clinical implications. Critical Care2018; **22**:73.
11. Housh TJ, Cramer JT, Joseph PW, Beck TW, Johnson GO. Laboratory Manual for Exercise Physiology, Exercise Testing, and Physical Fitness. New York : Routledge, Tylor & Francis Group; 2017. p. 322.
12. Mani S, Sharma S, Omar B, Ahmad K, Muniandy Y. Singh DKA. Quantitative measurements of forward head posture in a clinical settings: a technical feasibility study. Eur. J.Physiother 2017; 19:119-23.
13. Fayssoil A , Behin A,Ogna A, Mompoint D, Amthor H, Clair B, et al. Diaphragm: Pathophysiology and Ultrasound Imaging in Neuromuscular Disorders. J Neuromuscul Dis 2018; 5:1-10.
14. Youssef. Photogrammetric quantification of forward head posture is side dependent in healthy participants and patients with mechanical neck pain. International Journal of Physiology 2016;.3(3): 326-331.
15. Shaheen AA, Omar MT, Vernon H. Cross-cultural Adaptation, Reliability, and Validity of the Arabic Version of Neck Disability Index in Patients With Neck Pain. SPINE 2013; 38 :609-15.
16. Vernon H, Mior S. The Neck Disability Index: a study of reliability and validity. J Manipulative Physiol Ther 1991; 14:409-15.
17. MacDowall A, Skeppholm M, Robinson Y, Olerud C. Validation of the visual analog scale in the cervical spine. J Neurosurg Spine. 2018 Mar;28(3):227-235.
18. Eryuksel E, Cimsit C, Bekir M, Cimsit C, Karakurt S.Is diaphragmatic thickness fraction valuable in identifying high-risk chronic obstructive pulmonary disease patients? Eur. Respir. J.2017 50: PA3625
19. Cimsit C, BEKIR M, Karakurt S, Eryukselui E. trasound assessment of diaphragm thickness in COPD. Marmara Medical Journal 2016; 29: 8-13