Original Article

CPAP Therapy Effects on Neck and Shoulder Muscles in OSA Patients

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Obstructive sleep apnea [OSA] is very prevalent worldwide and causes several major cardiovascular diseases. There are limited studies on a correlation of OSA and musculoskeletal system. This study aimed to evaluate the effects of continuous positive airway pressure [CPAP] on musculoskeletal system focused on cervical alignment and pressure pain threshold of neck and shoulders in OSA patients. This study was an experimental study and conducted at Sleep Clinic, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand. The study period was between September and December 2017. The inclusion criteria were adult patients (aged between 20 and 60 years), newly diagnosed as OSA, and able to use CPAP therapy. Both cervical range of motion and pressure pain threshold of neck and shoulder muscles were measured at baseline and one month after CPAP therapy. There were 15 OSA patients with CPAP therapy eligible for the study. The means [SD] age and body mass index of all patients were 39.13 (11.81) years and 32.20 (8.57) kg/m^2. The average (SD) AHI was 23.06 (15.06) events/hour with average CPAP use of 6.5 hours. Regarding the cervical range of motion, there was no statistical difference between pre- and post-CPAP therapy in all six directions of the cervical range of motion. For pressure pain threshold in ten muscles of neck and shoulders were significantly lower after CPAP therapy. In conclusion, CPAP therapy significantly reduced pressure pain threshold in neck and shoulder muscles in a shortterm period.

Keywords: Obstructive sleep apnea, Range of motion, Pressure pain threshold

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Obstructive sleep apnea [OSA] is very prevalent worldwide and causes several major cardiovascular diseases. In North America, OSA may be found up to 30% of men and 15% of women in general population[1,2], while the prevalence of OSA may be as high as 75.9% in snorers[3]. Additionally, OSA is associated with five major cardiovascular diseases including hypertension, coronary artery disease, atrial fibrillation, stroke, and heart failure[4]. Two meta-analysis studies showed that a continuous positive airway pressure [CPAP] is beneficial in sleepiness improvement by 2.0 unit, reduction of diurnal systolic blood pressure by 2.4 unit, and reduction of diurnal diastolic blood pressure by 1.3 unit[5]. Furthermore, significant improvement in sleep quality, quality of life, cognitive function and depression were also found in CPAP therapy[6].

There are limited studies on a correlation of OSA and musculoskeletal system. A report from the US found that OSA is very common and may be associated with pain in patients with fibromyalgia[7]. Most patients with fibromyalgia had a moderate degree of OSA (average apnea-hypopnea index or AHI of 22 events/hour). On the other hand, occipital-cervical

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misalignment may cause OSA[8]. Currently, there is no previous study on the effects of CPAP on musculoskeletal system focused on cervical alignment and pain threshold of neck and shoulders in OSA patients. Therefore this study aimed to evaluate the effects of CPAP on musculoskeletal system focused on cervical alignment and pressure pain threshold of neck and shoulders in OSA patients.

Materials and Methods

The present study was an experimental study and conducted at Sleep Clinic, Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand. The study period was between September and December 2017. The inclusion criteria were adult patients (aged between 20 and 60 years), newly diagnosed as OSA, and able to use CPAP therapy. Those patients with a history of cervical spondylosis, severe neck or upper back pain, or unable to communicate. The diagnosis of OSA was made by the presence of AHI over or equal to five events/hour by polysomnography. The study protocol was approved by the Khon Kaen University Ethics Committee for Human Research (HE601222).

Baseline characteristics including age, sex, body mass index, neck circumference, and Epworth Sleepiness Scale of all eligible patients were evaluated at the baseline. Both cervical range of motion and pressure pain threshold of neck and shoulder muscles were measured at baseline and one month after CPAP therapy.

The cervical range of motion was measured by using a cervical range of motion measurement device (CROM Deluxe, Performance Attainment Associates, St. Paul, Minnesota, USA). The procedures were followed a previously published article in the following six directions: cervical flexion, cervical extension, cervical rotation to the left, cervical rotation to the right, cervical lateral flexion to the left, and cervical lateral flexion to the right[9]. All directions were measured three times with an interval of two minutes. The averages of all three measurements were reported in degree unit.

The pressure pain threshold was measured by using a digital electronic algometer (FPX25, Wagner Instruments, Greenwich, USA). The measurements were performed on both sides of five neck and shoulder muscles including upper trapezius, levator scapulae, sub-occipital, infraspinatus, and deltoid. The landmarks for all muscles were followed a previous article[10]. All muscles were measured three times with an interval of two minutes. The averages of all three measurements were reported in kg/m^2.

Statistical analyses. Data were calculated by descriptive statistics and presented as mean (SD) or number (percentage) for numerical and categorical variables. The baseline and post CPAP therapy of a cervical range of motion values and pressure pain threshold were tested for normality by Shapiro test. If values are normally distributed, paired t-test is used to declare significant differences. If values are not normally distributed, sign rank test is used instead. All statistical analyses were calculated by the Statistical Package for Social Sciences; SPSS version 19 (Chicago, Illinois, USA).

Results

There were 15 OSA patients with CPAP therapy eligible for the study. The means (SD) age and body mass index of all patients were 39.13 (11.81) years and 32.20 (8.57) kg/m^2 as shown in Table 1. The male: female ratio was 2:3. The average (SD) AHI was 23.06 (15.06) events/hour with average CPAP use of 6.5 hours.

Regarding the cervical range of motion, there was no statistical difference between pre- and post-CPAP therapy in all six directions (Table 2). The post-CPAP ranges of motions were slightly lower than pre-CPAP treatment such as cervical flexion was lower from 43.87 to 43.11.

For pressure pain threshold in ten muscles were significantly lower after CPAP therapy (Table 3). For example, the pressure pain threshold in left upper trapezius was lower from 2.02 to 1.51 after CPAP therapy (p-value = 0.027).

Discussion

The present study showed that pressure pain

Table 1. Baseline characteristics of patients with obstructive sleep apnea before continuous positive airway pressure therapy

Variables	Values
Age, years	39.13 (11.81)
Male sex, n (%)	6 (33.33)
Weight, kg	87.87 (23.60)
Height, cm	165.37 (9.91)
Body mass index, kg/m^2	32.20 (8.57)
Neck circumference, cm	40.00 (5.54)
Epworth Sleepiness Scale	9.73 (3.86)
Apnea-hypopnea index, events/hour	23.06 (15.06)

Data presented as mean (SD) unless indicated otherwise

Table 2. The cervical ranges of motion in six directions of patients with obstructive sleep apnea at baseline and one month after continuous positive airway pressure (CPAP) therapy

Directions	Baseline	One month after CPAP therapy	*p*-value
Cervical flexion	43.87±8.27	43.11±9.10	0.697
Cervical extension	52.31±14.79	48.98±8.12	0.314
Cervical rotation to the left	51.29±8.46	51.20±10.23	0.974
Cervical rotation to the right	53.11±10.19	52.27±12.69	0.680
Cervical lateral flexion to the left	33.24±7.44	31.73±6.47	0.387
Cervical lateral flexion to the right	34.27±6.71	32.93±6.25	0.457

Data presented as mean (SD)

Table 3. The pressure pain threshold of five muscles in patients with obstructive sleep apnea at baseline and one month after continuous positive airway pressure (CPAP) therapy

Muscle and side	Baseline	One month after CPAP therapy	*p*-value
Lt upper trapezius	2.02±1.20	1.51±0.71	0.027
Rt upper trapezius	2.22±1.38	1.66±1.04	0.020
Lt levator scapulae	2.47±1.55	1.89±1.09	0.035
Rt levator scapulae	2.62±1.77	1.97±1.24	0.026
Lt sub-occipital muscle	1.82±0.96	1.25±0.57	0.008
Rt sub-occipital muscle	1.89±0.93	1.34±0.73	0.001
Lt middle part of deltoid	2.10±1.16	1.45±0.87	0.009
Rt middle part of deltoid	2.11±1.27	1.64±0.90	0.024
Lt infraspinatus	2.57±1.54	1.85±1.01	0.008
Rt infraspinatus	2.36±1.39	1.84±1.13	0.028

Data presented as mean (SD)
Lt = left; Rt = right

threshold of all five muscles reduced after one month of CPAP therapy significantly (Table 3). Baseline pressure pain thresholds of OSA patients in this study are quite comparable with those with myofascial pain or a migraine (2.22 vs. 2.12 vs. 2.91 kg/cm^2)[11,12]. These data may imply that OSA patients are not normal in terms of pain threshold at neck or shoulders.

CPAP therapy has shown several benefits on sleep quality, blood pressure and neuropsychological conditions as mentioned earlier in the introduction part[5,6]. OSA patients may have muscle tension from hypoxemia causing pain or muscle tension as in fibromyalgia or temporomandibular joint disorder[7,13]. This study added information on CPAP therapy and musculoskeletal conditions. Not surprisingly, CPAP therapy did not change any directions of cervical ranges of motion (Table 2). Even though the values were slightly lower after one month CPAP therapy, no statistical significance was declared. There are several factors associated with cervical ranges of motions including age, cervical spine condition, cervical muscle, or cervical alignment. However, factors associated with a cervical range of motion may need a longer duration of CPAP therapy to affect these factors.

The reason why CPAP therapy reduces pressure pain threshold is not clear. Two possible explanations are purposed here. One, OSA patients may have muscle tension leading to less sensitive to pain due to repeat apneic events during the night. As a result, the pressure pain threshold may be higher than normal subjects as shown by the baseline pressure pain threshold are comparable with other two pain disorders[11,12]. After clearing of the apneic events, the patients became more sensitive to pressure and pain.

This concept is confirmed by a study on pain and OSA[14]. OSA patients tend to have hypoalgesia from low desaturation (p-value = 0.0440) and high insulin growth factor binding protein-1 (IGFBP-1; p-value = 0.0013). The second possible reason is that OSA patients may not be familiar with CPAP therapy in the first month of treatment. The restlessness during sleep with CPAP therapy may cause muscle tension and lead to lower pressure pain threshold. Further studies to evaluate pressure pain threshold at a longer duration of CPAP therapy are required to prove this theory.

There are some limitations in the present study. This study was a pilot study resulting in a small sample size of OSA patients with CPAP therapy. Further studies with larger sample size and comparison with non-CPAP users are needed. No biological marker was measured during the study such as an IGFBP-1 level. Finally, long-term effects of CPAP therapy on the musculoskeletal system should be studied.

In conclusion, CPAP therapy significantly reduced pressure pain threshold in neck and shoulders in a short-term period.

What is already known on this topic?

The effects of CPAP on the musculoskeletal system on cervical alignment and pain threshold of neck and shoulders in OSA patients are limited.

What this study adds?

CPAP therapy for one month did not change the cervical range of motion but significantly lower pressure pain threshold of neck and shoulder muscles.

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Potential conflict of interest

The authors declare no conflict of interest.

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