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Original Article

Effect of Relaxation on the Autonomic Functions in Cervical Spondylosis.

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ABSTRACT

Background: The Autonomic Nervous System is a control system that regulates bodily functions. Through its sympathetic & para-sympathetic divisions it exerts a rapid & effective control over internal tasks such as arterial blood pressure, cardiac regulation, body temperature, respiratory rate etc. Cervical spondylosis is a degenerative joint disorder affecting the intervertebral joint 7 the interposing discs. Researchers have suggested the implications of the sympathetic elements on the cervical spinal nerves in the mechanism of referred pain & tissue changes in the shoulder & arm. Relaxation is any activity that helps an individual to attain a state of increased calmness & reduce pain levels, anxiety & stress. Thus, the aim of this study was to analyze the effects of relaxation on the autonomic functions in cervical spondylosis patients.

Methodology: 70 individuals (age group – 30-60 years) participating in the study were divided into 35 normal subjects as Control Group & 35 patients suffering from Cervical Spondylosis. The subjects of both groups were assessed for pain, anxiety & depression & autonomic functions (orthostatic blood pressure, response to cold pressor, sympathetic skin response). The data was collected & analyzed by Students' t test.

Results: Comparison between control & patient group showed highly significant in scores for pain, anxiety & autonomic functions tested. Also, when compared pre & post relaxation therapy the results within the patient population was highly significant. When post relaxation compared to control group, latency showed statistically non-significant results.

Conclusion: Autonomic dysfunction was observed in cervical spondylosis patients. Relaxation therapy achieves symptomatic relief & has a favorable effect on latent autonomic dysfunction. Hence, it should be incorporated in the management of chronic pain in cervical spondylosis.

KEYWORDS: Autonomic functions, Cervical spondylosis, Orthostatic blood pressure, Pain, Relaxation, Sympathetic skin response.

INTRODUCTION

Cervical Spondylosis is defined as "spinal canal & neural foraminal narrowing in cervical spine secondary to multifactorial degenerative changes"[1]. This is the most common degenerative disorder of the spine, affecting 95% of patients by the age of 65 years[2, 3, 4, 5]. The degeneration of the intervertebral disc stems from osteophyte development of the amphiarthrodial joint. The non-inflammatory disc degeneration is one of the defining characteristics of spondylosis. It is characterized by a loss of disc height, end plate sclerosis & formation of osteophytes, spurs & ridges, hypertrophy of facet joints & ligaments[6].

In cervical spine, the single outstanding feature of innervation is the combined contribution of peripheral spinal nerves & autonomic nervous system[7]. Sympathetic symptoms of cervical spondylosis, such as vertigo, headache, heartthrob, hypomnesia, tinnitus, nausea and vomiting & gastroenterologic discomfort are common clinical manifestations. Patients have diverse subjective symptoms but less objective signs, which bring great difficulties in disease diagnosis & treatment[8]. It has been demonstrated that sympathetic nerve fibers are abundant in cervical posterior longitudinal ligament that are related to the symptoms produced[7, 9].

CLINICAL PRESENTATION

Patients present with 3 types of symptoms[1, 10, 11, 12]

1. Neck pain: Acute or Chronic with/without an identifiable precipitating event.

2. Radiculopathy: implies a problem with spinal nerve root. Caused by herniated nucleus pulposus or osteophyte stenosis of spinal canal or foramina resulting in weakness, atrophy, paresthesias, hyperalgesia.

3. Myelopathy: implies a problem with the spinal cord. It is the presence of long tract signs, which are a result of inhibition of the spinal afferent/efferent nerve tracts. Symptoms include neck & shoulder pain, sensory changes (tingling, numbness, painful paresthesias) & motor changes (progressive spasticity, decrease dexterity, gait)

Relaxation: techniques are any method or procedure that helps an individual to attain a state of increased calmness & reduce levels of pain, anxiety, and stress. It consists of a variety of strategies that are integrated to decrease physical tension, lower blood pressure & slow heart & respiratory rates within the affected individual[13]. They are a powerful tool & essential ingredient for physiotherapy interventions. The sympathetic & parasympathetic branches of the autonomous nervous system are continually active to maintain bodily functions at their basal rates. Any increase in the degree of stimulation thereby exaggerates the system tone & increases pain, radiculopathy etc in cervical spondylosis patients.

The aim of this study was thus, to study the effect of relaxation on the autonomic functions in cervical spondylosis.

MATERIALS AND METHODS

An institutional ethics committee approval was obtained prior to commencement of the study. All subjects were explained about the study procedure and a written informed consent was obtained. The study consisted of 2 groups – control (n=35) & cervical spondylosis patients (n=35) between the age group of 30-60 years. The control group consisted of normal subjects. The patients included in the study were selected from the Out patient department of a public sector tertiary care hospital. No alterations in the drug dosage were made throughout the study.

Inclusion criteria

- All patients included had a history & clinical features suggestive of cervical spondylosis of mid/lower cervical region.
- Duration of cervical spondylosis more than 3 months with/without pain radiation to upper extremity with/without parasthesias.

Exclusion criteria

- Any history of trauma & infection confirmed by cervical spine roentgenograms
- Acute pain or duration less than 3 months
- Any patient with associated diabetes mellitus, hypertension or any medical or surgical conditions.

The patient group was assessed for pain using the Visual Analogue scale and anxiety & depression by the Hamilton scale prior to autonomic function tests both pre & post relaxation therapy.

- Visual Analogue Scale (VAS): consists of a 10 cm scale with “no pain” & “extremely painful” marked on the left & right side of the scale respectively. The patient was told to rate their pain by marking on this scale.
- Hamilton Anxiety Scale (HAS)[14]: is a series of semi-structured questions related to symptoms of anxiety. The interviewer then rates the individuals on a 5point scale for each of the 14 items. 7 items of the scale specifically address psychic anxiety while the remaining 7 tackle somatic anxiety. For the 14 items the score ranges between 0 – 4. (0 – no anxiety, 1 – mild anxiety, 2 – moderate, 3 – severe & 4 – grossly disabling anxiety) The total anxiety score ranges from 0 – 56.

Autonomic function tests studied in both the groups were

1. Orthostatic Hypotension test (blood pressure response to standing): was performed by measuring blood pressure with a sphygmomanometer while the subject was in supine position & then while in standing. The postural fall in BP was recorded.

2. Cold Pressor test (blood pressure response to temperature change): skin temperature was measured with a Viscon Digital readout unit with probes secured to the palm of the affected side in patients & to the palm of the right hand in controls with the help of adhesive tapes. Baseline temperature & BP were recorded. Then, the subjects were made to immerse the hand up to wrist in cold water maintained at a temperature of 10^0 Celsius for 1 minute. The skin temperature & BP were recorded immediately after hand removal & at intervals of 30 seconds till the parameters returned to baseline.

SYMPATHETIC SKIN RESPONSE (SSR)[15, 16]

It is a change in skin potential following arousal stimulation, first described by Tarchanoff (1890). SSR is a polysynaptic reflex that is activated by a variety of afferent inputs. The spinal efferent pathway involves pre- and postganglionic sympathetic sudomotor fibers and ultimately activation of sweat glands by the sympathetic outflow. The reflex is coordinated in the posterior hypothalamus, upper brain-stem reticular formation and spinal cord.

Technical requirements

At normal ambient temperature, the test was performed in a relaxed supine position, in a dimly lit room to reduce the exogenous stimuli.

Recording

- The electrodes used were surface disc electrodes of 1 cm diameter.
- Cathode: placed over 2nd palmar interspace 2-3 cm proximal to 2nd web space proximal to anode.
- Anode: placed over 2nd dorsal interspace 2-3 cm proximal to 2nd web space.
- Ground electrode: placed at the wrist on the upper extremity tested.
- Stimulating electrode: was placed on the contralateral Median nerve 2-3 cm proximal to wrist crease on the volar surface between Flexor carpi radialis longus & palmaris longus tendons. This was done to eliminate shock artifact occurring if same limb was stimulated.

Stimulation

- Carried out with constant current stimulus – 0.2 ms, supra maximal, and 10-30 mA.
- Recording time – 5-10 s with a computerized EMG Medlac-Saphire machine
- Duration: 100 ms
- Amplification sensitivity: 2 mV

10 SSR were recorded from the affected upper extremity in the patient group & right upper extremity in the control group. The amplitude (from baseline to highest peak) & latency (from stimulus artifact to the onset of response) of each attempt was measured.

Relaxation therapy

Progressive muscle relaxation is a technique for learning to monitor & control the state of muscular tension[17]. All patients underwent therapy for 30 minutes daily for a period of 15 days. Each patient was made to lie down in a comfortable supine position in a dimly lit, quiet room with eyes closed. Commands were given in a slow, monotonous tone. They were asked to concentrate on every part of the body sequentially beginning from toes & coming up towards the head. Patients were taught to feel the presence of tension in each body part & then commands were given to slowly relax that part[18].

After 15 days, both the groups were re-tested for all outcome measures & were once again rated. The results were then statistically analyzed using Student's t test & compared for significance.

RESULTS

All statistical analyses were carried out with SPSS software & a *p value* < 0.05 was considered as statistically significant.

Table 1: Comparison of changes in Orthostatic Hypotension Pre-Relaxation.

	Mean Score Pre-Relaxation	
Group	**Change in Systolic Blood Pressure**	**Change in Diastoloic Blood Pressure**
Patient	12.16 + 3.73	4.24 + 1.89
Control	3.6 + 1.90	2.40 + 1.50
t value	10.54	4.03
p value	p < 0.001	p < 0.001

Inference: The scores were higher in the patient group showing statistically high significance.

Table 2: Comparison of change in Cold Pressor test Pre-Relaxation

	Mean Score Pre-Relaxation		
Group	**Change in Systolic Blood Pressure**	**Change in Diastoloic Blood Pressure**	**Change in Temperature**
Patient	19 + 3.547	16.64 + 3.45	6.85 + 0.80
Control	13.62 + 4.3	13.05 + 2.48	4.50 + 0.72
t value	5.29	4.44	11.76
p value	p < 0.001	p < 0.001	p < 0.001

Inference: The change in temperature observed was highly significant in the patient group

Table 3: Changes in Sympathetic skin response Pre-Relaxation

	Mean Score Pre-Relaxation	
Group	**Latency**	**Amplitude**
Patient	1.483 + 0.183	2.006 + 0.56
Control	1.453 + 0.332	2.83 + 0.453
t value	7.4	6.78
p value	p < 0.001	p < 0.001

Inference: This shows statistically high significant difference in the scores. The latency was higher & the amplitude was lower in the patient group.

Table 4: Changes in VAS score for pain

Period	Mean Change in Pain
Pre-Relaxation	6.971 + 2.10
Post-Relaxation	3.692 + 1.931
Change	2.153 + 0.688
t value	11.27
p value	$p < 0.001$

Inference: A highly significant reduction in the pain was observed following relaxation therapy.

Table 5: Changes in Hamilton Anxiety score in patient group.

	Mean Score	
Period	**Anxiety**	**Depression**
Pre-Relaxation	5.057 + 3.386	5.514 + 3.616
Post-Relaxation	4.384 + 2.987	5.3844.093
Change	1.846 + 1.068	2.00 + 0.816
t value	6.23	8.83
p value	$p < 0.001$	$p < 0.001$

Inference: Anxiety & depression scores showed statistically high significant difference post relaxation therapy.

Table 6: Comparison of changes in Orthostatic Hypotension post relaxation.

	Mean Score Post-Relaxation	
Group	Change in Systolic Blood Pressure	Change in Diastoloic Blood Pressure
Patient	12.61 +1.60	10.25 + 1.30
Control	3.6 + 1.90	2.40 + 1.50
t value	16.41	4.03
p value	$p < 0.001$	$p < 0.001$

Inference: The scores were higher in the patient group showing statistically high significance.

Table 7: Comparison of change in Cold Pressor test Post-Relaxation

	Mean score Post-Relaxation		
Group	**Change in Systolic Blood Pressure**	**Change in Diastoloic Blood Pressure**	**Change in Temperature**
Patient	20.61 + 2.21	17.14 + 3.40	6.28 + 0.36
Control	13.62 + 4.3	13.05 + 2.48	4.50 + 0.72
t value	7.35	4.78	11.33
p value	$p < 0.001$	$p < 0.001$	$p < 0.001$

Inference: The change in temperature observed was highly significant in the patient group

Table 8: Changes in Sympathetic skin response Post-Relaxation

	Mean score Post-Relaxation	
Group	**Latency**	**Amplitude**
Patient	1.436 + 0.112	19.36 + 0.46
Control	1.453 + 0.332	2.83 + 0.453
t value	0.26	5.67
p value	$p > 0.05$	$p < 0.001$

Inference: The scores show non-significant difference in latency but statistically significant difference in the amplitude between the two groups.

DISCUSSION

The degenerative changes in the cervical spine begin with intervertebral disc desiccation, loss of elasticity in nucleus pulposus and aging process. Disc height is initially lost in the ventral portion, which results in a decrease of cervical lordosis. These early changes lead to the main pathophysiological process - reduction in sagittal spinal canal diameter, transfer of axial load to the facet joints, hypertrophy, osteophyte formation, reduction in canal diameter etc producing symptoms[19, 20]. A recent study described the possible sympathetic symptoms of cervical spondylosis to include "vertigo, headache, tinnitus, nausea and vomiting, heartthrob, hypomnesia, and gastroenterologic discomfort" as a result of "stimulation or compression of the sympathetic nervous system" due to degenerative changes in the cervical spine[21].

The ventral compartment of the cervical spine incorporates the vertebral bodies, anterior and posterior longitudinal ligaments, intervertebral disc, uncovertebral joints and dura mater. Three discrete sources of innervation to these structures have been identified: direct branches from the sympathetic trunk, branches of the sympathetic rami communicate and the perivascular nerve plexuses associated with the vertebral arteries. The sympathetic nerves within these networks extend over two or three vertebral segments forming a dense plexus[22]. Wang et al. in their study found that the sympathetic nerve fibers distributed in the cervical PLL maybe a significant factor causing sympathetic symptom of cervical spondylosis[23]. Pal GK et al. in their study proved that Short-term practice of relaxation therapy could improve autonomic balance and promote cardiovascular health of medical students. Sympathovagal balance is directly linked to BP status in these individuals[24]. Also, in recent years, there has been a tendency to accept psychosomatic factors as an important component of chronic pain in cervical spondylosis leading to active use of relaxation methods for treatment. Thus, this study was performed to evaluate the effect of relaxation on ANS functions in cervical spondylosis patients.

The findings obtained from tables 1,2&3, indicate that autonomic dysfunction exist in patients of cervical spondylosis when compared to the control group consisting of age appropriate normal individuals. All the ANS tests show statistically significant results. The rise in BP was higher inpatient group owing to sympathetic over activity in cervical spondylosis.

Pain is a protective mechanism of the body to the process of tissue damage. This nociceptive mechanism is triggered by an abnormal state where pain receptors are depolarized. The latency in SSR was found to increase while the amplitude was found to decrease in the patient group pre-relaxation as depicted in table 3. This could be due to the fact that SSR depends on the intact conduction through post-ganglionic unmyelinated fibers, which are frequently affected in cervical spondylosis[25]. Tables 4 & 5, showed significant decrease in pain, anxiety & depression post relaxation therapy. Chronic pain leads to changes within CNS which is manifested in the form of stress leading to increased pain perception. Sympathetic over activity is decreased to a great extent due to relaxation techniques. These techniques are also used to reduce mental pressure & hence help in stress management. Similarly, tables 6 & 7, show significant changes in BP post relaxation due to reduction in sympathetic overactivity Table 8 shows that relaxation therapy led to a significant reduction in the latency & amplitude in SSR.

Cervical spondylosis is a complex pathology. The management requires an extensive knowledge of the anatomy, biomechanics & integrated treatment approaches. Relaxation should be added as an adjunct to therapy as it helps in reduction of ANS related symptoms while reducing stress, pain & anxiety amongst patients.

CONCLUSION

A difference having statistically high significance in SSR, Orthostatic Blood pressure & Cold pressor test between control & patient groups showed that autonomic dysfunction was present in cervical spondylosis patients.

A statistically high significance was observed between pre & post relaxation therapy among the patient population leading to a conclusion that relaxation therapy is beneficial in reducing pain & anxiety.

Relaxation therapy not only achieves symptomatic relief but also has a favorable effect on latent autonomic dysfunction in cervical spondylosis patients.

This study emphasizes the need for incorporating relaxation techniques as an integral part of management of cervical spondylosis.

CONFLICT OF INTEREST: None declared.

REFERENCES

1. Mullin J, Sheid D, BEnzel E. Overview of cervical spondylosis pathophysiology & biomechanics. World spinal column journal. 2011; 2(3): 89-97.

2. Asgari S: Cervical Spondylotic Myelopathy, in Palmer JD (ed): Neurosurgery ’96: Manuel of Neurosurgery. New York, Churchill Livingstone, 1996 pp;750-754

3. Crandall PH, Batzdorf U: Cervical Spondylotic Myelopathy. J Neurosurg. 1966; 25:57-66

4. Morishita Y, Falakassa J, Naito M, Hymanson HJ, Taghavi C, Wang JC. The Kinematic Relationships of the Upper Cervical Spine Spine. 2009; 34, 2642–2645

5. Garfin SR: Cervical Degenerative Disorders: Etiology, Presentation, and imaging Studies. Instr Course Lect. 2000; 49:335-338

6. Ronthal, M.: The coincidence of cervical spondylosis and multiple sclerosis. Clinical Neurology and Neurosurgery. 2006; 108(3): 275-277.

7. Johnson GM. The sensory & sympathetic nerve supply within the cervical spine: review of recent observations. Man Ther. 2004; 9: 71-76.

8. Gu Q, Jiang D, Wang X, Chen D, Yuan W. Chronic compression of the posterior longitudinal ligament of the cervical spine is associated with abnormal discharge of middle cervical ganglion. Int J Clin Exp Med. 2014; 7(11): 4316-4321.

9. Yamada H, Honda T, Yaginuma H, Kikuchi S, Sugiura Y. comparison of sensory & sympathetic innervation of the dura mater & posterior longitudinal ligament in the cervical spine after removal of the stellate ganglion. J Comp Neurol. 2001; 434: 86-100.

10. Connell MD, Wiesel SW. Natural history & pathogenesis of cervical disc disease. Orthop Clin North Am. 1992; 23: 369-380.

11. Harrop J, Hanna A, Silva M, Sharan A. Neurological Manifestations of Cervical Spondylosis: An Overview of Signs, Symptoms, and Pathophysiology. Neurosurgery. 2007; 60:S1-14–S1-20
12. Morishita Y, Falakassa J, Naito M, Hymanson HJ, Taghavi C, Wang JC. The Kinematic Relationships of the Upper Cervical Spine. Spine 2009; 34, 2642–2645
13. Smith, Jonathan C."Ch. 3: The Psychology of Relaxation". In Lehrer, Paul M.; Woolfolk, Robert L.; Sime, Wesley E. Principles and Practice of Stress Management (3rd ed.). 2007; pg no. 38-47
14. Hamilton M. The assessment of anxiety states by rating. British journal of medical psychology, 1959. 32:50-55
15. Claus D, Schondorf R. Sympathetic skin response. Chap.7.1, Recommendations for the practice of clinical neurophysiology: Guidelines of the international federation of clinical physiology (EEG Suppl 52). Editors: Deuschl G & Eisen A. published by Elsevier science BV. 1999. Pg no. 277-282
16. Vetrugno R, Liguori R, Cortelli, Montagna P. Sympathetic skin response. Clinical Autonomic Research. 2003. 13(4):256-270.
17. Jacobson E. Progressive relaxation. Chicago: University of Chicago press. 1938
18. Dahong Z, Dighe J, Basmajian J. EMG biofeedback & chinese Chi kung relaxation effects in patients with low back pain. Physiotherapy, 1983; 35(1): 13-7
19. Benzel EC: Biomechanics of Spine Stabilization. Rolling Meadows, American Association of Neurological Surgeons Publications, 2001 pg no.45-60
20. Emery SE: Cervical Spondylotic Myelopathy: Diagnosis and Treatment. J Am Acad Orthop Surg 2001; 9:376-388
21. Hong L and Kawaguchi Y. Anterior Cervical Discectomy and Fusion to Treat Cervical Spondylosis With Sympathetic Symptoms. J Spinal Disord Tech. 2011; 24: 11-14.
22. Groen GJ, Baljet B, Drukker J. Nerve and nerve plexuses of the human vertebral column. American Journal of Anatomy 1990; 188:282–96
23. Wang XW, Gu T, Yuan W. Treatment & mechanism of cervical spondylosis with sympathetic symptoms. Chinese journal of surgery. 2008; 46(18): 1424-1427.
24. Pal GK, Ganesh V, Karthik S, Nanda N, Pal P. The effects of short term relaxation therapy on indices of heart rate variability & blood pressure in young adults. American journal of health promotion. 2014; 29(1): 23-28.
25. Knezevic W, Bajada S. Peripheral autonomic surface potential – a quantitative technique for recording sympathetic conduction in man. Journal of neurological science. 1985; 75: 252-256.

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