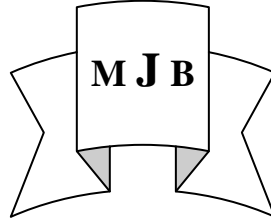


Electrophysiological Changes in Mechanical Neck Pain Patients

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Abstract

Introduction: Neck pain possess a major problem to the society and is a common reason for consultation with physician, rheumatologist, orthopaedic , physiotherapist, etc. The most common cause of mechanical neck pain is degenerative cervical spondylosis which is commonly, mostly asymptomatic condition, occurring as a result of age related degenerative changes in the cervical spine.

Methods: Eighty patients with mechanical neck pain whose pain was more than three months ,were studied. Thirty healthy volunteers, matched in age and gender and did not have neck pain for at least three months before, were enrolled and accepted as a control group. The patient group consisted of 34 males (42.5%) and 46 females (57.5%), mean age of 43.86 ± 1.48 years. The control group consisted of 12 males (40%) and 18 females (60%), mean age was 45.90 ± 1.82 years. All patients underwent electromyography, Nerve conduction study ,Visual Analogue Score and X-Ray examination ,twenty of them underwent Magnetic resonance imaging . Electromyography, Nerve conduction study performed for control group .

Results: Eighty percent of patients had age between 30 to 59 years. In this study females were more common. There was significant ($p < 0.05$) relationship between age and positive electromyography, age and nerve conduction study. There was significant ($p < 0.05$) relationship between cervical roots lesions severity on electromyography and Visual Analogue Score. There was no significant ($p > 0.05$) relationship between X-Ray grading and electromyography roots lesions severity.

Conclusion: Electrophysiological tests should be done for each patient with neck pain even without obvious neurological deficits.

الخلاصة

المقدمة: يشكل ألم الرقبة مشكلة كبرى للمجتمع ، وهو سبب شائع لاستشارة طبيب الأمراض الباطنية ، طبيب المفاصل ، طبيب أمراض العظام ، طبيب العلاج الطبيعي الخ

يشكل مرض سوفان الفقرات العنقية السبب الأكثر شيوعاً لآلام الرقبة الميكانيكية وهو في الغالب لا يصاحبه عرض ويحدث نتيجة التغيرات الانتكاسية المرتبطة بالعمر في العمود الفقري العنقي.

طرق العمل: ثمانون مريضاً يعانون من الآلام الميكانيكية للرقبة والذين كانت مدة الألم لديهم تزيد عن ثلاثة أشهر خضعوا للدراسة . ثلاثون متطوعاً أصحاء مطابقين بالسن والعمر والذين لم يعانون من الألم الرقبة لمدة تزيد عن ثلاثة أشهر تم قبولهم كسيطرة صحية . تكونوا المرضى من ٣٤ ذكر (42.5%) و ٤٦ أنثى (57.5%) وكان معدل أعمارهم 43.86 ± 1.48 سنة . تكونت مجموعة السيطرة من ١٢ ذكر (٤٠%) و ١٨ أنثى (٦٠%) وكان معدل أعمارهم 45.90 ± 1.82 سنة .

خضع جميع المرضى لفحص تخطيط العضلات ، تخطيط الاعصاب ، فحص النقاط البصرية التماثلية والاشعة السينية ، وعشرون من المرضى خضعوا للتصوير بالرنين المغناطيسي .

النتائج: كانت اعمار ثمانون بالمئة من المرضى تتراوح بين ٣٠ سنة و ٥٩ سنة . كانت الاناث الأكثر شيوعاً . كانت هناك علاقة ايجابية بين العمر والنتيجة الموجبة لتخطيط العضلات . كانت هناك علاقة ايجابية بين شدة اصابة جذور الاعصاب العنقية وتخطيط العضلات وكذلك فحص النقاط البصرية التماثلية .

لم تكن هناك علاقة ايجابية بين نتائج فحص الاشعة السينية وشدة اصابة جذور الاعصاب العنقية .

الاستنتاج: كل مريض يعاني من الآلام الميكانيكية للرقبة يجب ان يخضع للفحوصات الكهروفسلجية حتى عند عدم وجود خلل عصبي ملحوظ .

Introduction

The neck, or cervical spine, is formed by seven square-shaped bones (cervical vertebrae), which are stacked one on top of another [1]. Between the vertebrae are discs, which function as shock absorbers, cushioning one bone from another. Applying excessive pressure to the disc causes the inner gelatin-like material to protrude through its outer capsule; this is called a herniated disc [2]. The roots of the brachial plexus are formed by the anterior primary rami of cervical root 5 to thoracic root 1 inclusive, with occasional contributions from cervical root 4 and thoracic root 2 [3]. The most common cause of mechanical neck pain is degenerative cervical spondylosis which is a common, mostly asymptomatic condition, occurring as a result of age-related degenerative changes in the cervical spine [4].

Electrophysiological methods studies provide information on the course of the nerve disease that can be hyper acute (one week), acute (a few weeks), sub-acute (a few weeks to a few months) or chronic (months to years) [5]. X-Ray imaging plays an important role in evaluating patients with chronic neck pain. Magnetic resonance imaging of the cervical spine is the investigation of choice if more serious pathology is suspected [6].

This study aims to:

- 1- Identify the physio-clinical manifestation of mechanical neck pain.
- 2- Elucidate the electrophysiological changes in patients with mechanical neck pain.

3- Demonstrate the disproportion between radiological findings and the electrophysiological studies.

Materials and Methods

A cross sectional study of eighty patients with mechanical neck pain whose pain was more than three months were studied at Neurophysiology departments in Merjan teaching hospital in Al-Hilla city. The study was conducted in the period from October 2012 to May 2013. Thirty apparent healthy volunteers (age , gender matched and without neck pain for more than three months) were accepted as a control group. The patient group consisted of 34 males (42.5%) and 46 females (57.5%), their ages ranged from 28 to 70 years, with a mean age of 43.86 ± 1.48 years:

- 7.5% of patients were less than 30 years, 45% of patients were 30-44 years, 35% of patients were 45-59 years, 12.5% of patients were ≥ 60 years.

The control group consisted of 12 males (40%) and 18 females (60%), mean age was 45.90 ± 1.82 years. According to age :30-39 years was 17% of control group , age group 40-49 years was 26% and age group 50-60 years was 57%. The patients underwent the following tests:

1-Electromyography:

Electromyography is most commonly used to investigate weakness and helps distinguish myopathic from neurogenic causes. Fine needles (gauge 20-25mm and length 30-45mm) were inserted into muscle fibers and then the patient was asked to contract these muscles [7].

2-Nerve conduction study: Nerve conduction study test of the median and ulnar nerve was done for 160 arms of

patients group and 60 arms of control group in the electrophysiological department in Merjan teaching hospital according to the electrodiagnostic protocol recommended by American Association of Electrodiagnostic Medicine (AAEM) [8].

3- Visual Analogue Scale: The severity of neck pain was examined by Visual Analogue Scale (VAS) which is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured [9].

4-X-Ray.

5-Magnetic resonance imaging: Magnetic resonance imaging done for twenty of patients with progressive, unresolving neck pain and/or neurological deficits.

The control group underwent electromyography and Nerve conduction study test only.

Exclusions Criteria:

Patients with hyperthyroidism, hypothyroidism, high ESR level, neck trauma, diabetes mellitus, hypertension, rheumatoid arthritis or any inflammatory tissue disorders, neck and upper limbs surgery, patients with pace maker. Alcohol or other drugs abuse, history of previous median and/or ulnar nerves and brachial plexus injury or mechanical problems in the neck like a cyst, tumor compressing the vertebrae or the cervical roots, congenital anomalies (e.g. scoliosis, spina bifida) and infections (systemic or neck infection).

Statistical analysis:

Analysis of variants independent Chi-Square test was used to determine the significance level of difference in our parameters. The difference was considered significant when the probability (P) was less than 0.05 ($P < 0.05$) and non-significant when the probability was more than 0.05 ($P > 0.001$) [10].

Results

In this study there was significant ($p < 0.05$) relationship between age and mechanical neck pain.

Ninety percent of the patients had positive electromyography and 10% had negative electromyography results. Distribution of sex according to positive electromyography was:

-57% of positive patients were female.

-43% of positive patients were male

There was significant ($p < 0.05$) relationship between age and positive electromyography.

cervical roots lesions segments were:

-5.5% of patients had C4-C5 cervical roots lesion segment.

-50% of patients had C5-C6 roots lesion segment.

-11.5% of patients had C6-C7 root lesion segment.

-33% of patients had C4,C5,C6,C7 roots lesion segment.

So the highest result in patients who suffering from neck pain was C5-C6 roots lesion segment.

The results showed that 31.25% of the patients had mild roots lesions, 43.75% had moderate lesion and 15% had severe roots lesions.

The sensitivity of electromyography test was 90%, the specificity of the test was 10% while that the sensitivity of the NCS test is (20%), the specificity is (80%).

Nerve conduction study distribution was:

Eighty percent of patients and control group showed negative nerve conduction study and 20% showed positive results. All positive results revealed Carpal Tunnel Syndrome findings.

Distribution of patients with neck pain according to pain radiation was:

-65% of patients had bilateral neck pain.

-13% of patients had unilateral left pain.

-10% of patients had unilateral right .
 -12% of patients had non radiated neck pain .
 There was significant (p <0.05) relationship between the duration and

severity of cervical roots lesion on electromyography.
 There was significant relationship (p <0.05) between cervical roots lesions severity on electromyography and Visual Analogue Score. (Table 1) .

Table 1 Distribution of Visual Analogue Score in neck pain patients according to electromyography Roots Lesion Severity.

| VisualAnalogue Score | Electromyography Roots Lesion Severity | | | Total |
|----------------------|--|------------|---------|-------------|
| | Mild % | Moderate % | Sever % | |
| Mild % | 8% | 4 % | 0 % | 12% |
| Moderate% | 14% | 36 % | 3 % | 53 % |
| Sever% | 9.25% | 3.75 % | 12 % | 25 % |
| | 31.25% | 43.75% | 15 % | 90 % |

There was significant (p<0.05) relationship between age and X-Ray grading (Table 2).

Table 2 Distribution of X-Ray grading in neck pain patients according to age.

| Age in years | X-Ray Grading percentage | | | | Total |
|--------------|--------------------------|-------|-------|-------|-------|
| | G0 % | G1 % | G2 % | G3 % | |
| <30 | 2.5% | 5% | 0% | 0% | 7.5% |
| 30-44 | 10% | 17.5% | 12.5% | 5% | 45% |
| 45-59 | 2.5% | 15% | 10% | 7.5% | 35% |
| ≥60 | 5% | 2.5% | 5% | 0% | 12.5% |
| Total | 20% | 40% | 27.5% | 12.5% | 100% |

There was no significant (p>0.05) relationship between X-Ray grading

findings and electromyography roots lesions severity (Table 3).

Table 3 Distribution of electromyography cervical roots lesion severity according to X-Ray grading.

| X-Ray Grading | Severity of Cervical Roots Lesions | | | Total |
|---------------|------------------------------------|------------|---------|--------------|
| | Mild % | Moderate % | Sever % | |
| G0 | 5% | 6.25 % | 8.75% | 20% |
| G1 | 6.25 % | 22.5% | 6.25 % | 35 % |
| G2 | 7.5% | 15% | 0% | 22.5% |
| G3 | 12.5% | 0% | 0% | 12.5% |
| Total | 31.25% | 43.75 % | 15% | 90% |

In this study a comparison between electromyography cervical roots lesion and that on magnetic resonance imaging we found that 50% of patients had C5-C6 roots lesion in both tests while other roots lesion segments were of different percentage.

Discussion

The age of patients agrees with [11-16]they cited that cervical spondylosis is a common progressive degenerative disorder of the human spine often caused by the natural aging process , but [17]disagreed with this result, his result revealed the weak correlation ($p > 0.01$) of neck pain with age. In this study , 90% of patients were positive for electromyography findings. The results revealed that electromyography was specific test in diagnosis cervical spondylosis and determine its severity in neck pain patients .This findings agree with [15,19,20,21]. This result did not agree with [5] who demonstrated that in Radiculopathy ; EMG and NCSs have little prognostic value in radiculopathy when compared to clinical and psychosocial factors. Females are more prevalent in having positive electromyography results than males. This agrees with [21] who found that a more prominent muscle fatigue resistance occurs in females compared

with males and mobilization of different muscle activation strategies during eccentric exercise. In the current study there was significant ($p < 0.05$) relationship between age and positive electromyography findings for patients and control group .This indicates that there were spondylotic changes in the cervical spine which had their effects on cervical roots and were demonstrated by electromyography results in symptomatic or non-symptomatic individuals. Soelectromyography examination can detect myopathic changes in muscle and signs of denervation [23]. According to this study, majority of patients revealed C5-C6 roots involvement. This result agree with [24-26]they demonstrated that radiculopathy (nerve root compression) due to cervical spondylosis usually occurs at the C5 to C7. [27] found that the most common evidence of degeneration is found at C5-C6 followed by C6-C7 and C4-C5. This result not agree with [28-30]they demonstrated that the increase in joint motion causes an acceleration of osteophyte growth, and this is most pronounced at C5-C6 and C6-C7. Most of patients in this study had moderate cervical roots lesions on electromyography. This means that

most of patients seek medical advice after the disease had been progress to moderate or severe ,or the pain became in tolerable when the cervical roots lesion severity progressed to moderate or severe.

The results of NCS agreed with [31,32] they demonstrated that nerve conduction studies may still miss disorders that only affect nerve roots or plexus. [33] studied the nerve conduction studies of the median and ulnar nerves of healthy individuals, their ages were between 20 and 60 years, all of them had normal nerve conduction studies results. In this study we found that most of patients were having bilateral neck pain and in unilateral pain ,the left side is more common. The result of pain radiation agreed with [34-37] they proposed that chronic neck pain associated with spondylosis is typically bilateral, whereas neck pain associated with radiculopathy is more often unilateral. Pain radiation varies depending on the involved nerve root [25] cited that cervical spondylosis pain can be perceived locally, or it may radiate to the occiput, shoulder, scapula, or arm . In this study there was significant ($p < 0.05$) relationship between the duration and severity of cervical roots lesion. This could be either the spondylosis became more sever with the time or could be complicated into radiculopathy. This also means that electromyography is a sensitive test in diagnosis the progression or the complication of cervical spondylosis. There was significant ($p < 0.05$) relation between Visual Analogue Scale and electromyography roots lesion severity. This result agree with [18] he demonstrated that electrophysiological tests achieved a universally accepted role in the evaluation of radiculopathies patients. Needle electromyography is the best

established of these procedures [20] demonstrated that electromyography is a valuable diagnostic modality in radiculopathies patients. [37] found that the diagnostic accuracy for neuropathies or radiculopathies might be improved when the results of needle electromyography are combined with clinical findings. In this study there was significant relation between age and X-Ray grads of cervical spine on the anterior-posterior and lateral views. This result agrees [40] demonstrated that a neck X-Ray revealed that greater than 90% of senior men and women aged 65 years and older present with signs of cervical spondylosis. We found that there was no significant ($p > 0.05$) relationship between X-Ray grading and cervical roots lesion severity. This result goes with [41] they demonstrated that X-Ray changes of cervical spine not correlate with severity of neck pain in reverse to that of hip joint. [15] demonstrated that there was little correlation between the presence of cervical spondylosis or degenerative disk disease and the severity or duration of symptoms. In this study a comparisom between electromyography cervical roots lesion and that on magnetic resonance imaging we found that 50% of patients had C5-C6 roots lesion in both tests while other roots lesion segments were of different percentage. This similarity in the highest result between the two tests could be due to that most patients had C5-C6 roots lesion while differences in the percentage of other cervical roots lesion segments could be due to differences between the two tests.

Conclusions and Recommendations

1-Electromyography could be valuable test in diagnosis and determining the severity of pain due to cervical spondylosis or its complications and should be done for each patient with

neck pain even with normal X-Ray findings.

2- X-Ray film can reveal degenerative changes and grading of cervical spondylosis, but these changes not always correlate with the disease severity or symptoms of the patients .

3- Electrophysiological tests should be done for each patient with neck pain even with even without obvious neurological deficits.

References

- 1-Kroeling,P;Gross, A & Houghton, P.(2005). Cervical Overview Group. Electrotherapy for neck disorders. Cochrane Database Syst Rev;(32):4284- 4251.
- 2-Verhagen, A; Scholten-Peeters, G; Wingaarden, S; de Bie, R&Bierma-Zeinstra, S.(2007). Conservative treatments for whiplash. Cochrane Database Syst Rev.:(2):3328-3338.
- 3-Rae ,R.(2010).Principles of practical rheumatology .In :Rae ,R. Cervical spine . 6 thed.Churchill Livingstone ;(6):33-47.
- 4-Butler,J; Oner,F; Poynton, A& O'Byrne,J. (2012). Degenerative Cervical Spondylosis: Natural History, Pathogenesis, and Current Management Strategies. Advances in Orthopedics; (16):1-3.
- 5-Chichkova, R &Katzin, L. (2010). EMG and Nerve Conduction Studies in Clinical Practice Electrodiagnostic studies are helpful in evaluating weakness, muscle wasting, and sensory symptoms. More specific questions may allow more detailed and directed conclusions.Practical Neurology ;(12):32-28.
- 6-Daffner,R.(2010). Radiologic Evaluation of Chronic Neck Pain. Am Fam Physician. ;82(8):959-964.
- 7-Schoeck ,A; Mellion ,M; Gilchrist, J& Christian, F. (2007). Safety of nerve conduction studies in patients with implanted cardiac devices. Muscle Nerve.:(35):521–524.
- 8- Aluclu, M. ; Turhanoglu, A. & Aluclu, M. (2006) . The Frequency Of Carpal Tunnel Syndrome In Patients With Rheumatoid Arthritis . The Internet Journal of Neurology. ;5 (2):124-134.
- 9- Hawker,G; Mian,S; Kendzerska , T& French ,M.(2011). Measures of Adult Pain. Arthritis Care & Research;(63) S11, : S240 –S252.
- 10- Daniel, W. W. (2009). Biostatistic: A foundation for analysis in the health sciences. 7th ed. John Winey. Philadilphia.: pa. 55.
- 11- Chiu ,T & Leung ,A . (2006). Neck pain in Hong Kong: A telephone survey on ,prevalence, consequences, and risk groups. Spine; (31):E540-E544.
- 12-Abbed,K& Coumans, J.(2007). Cervical Radiculopathy: Pathophysiology, Presentation, And Clinical Evaluation.Neurosurgery (60):S-28–S-34.
- 13- Rosenbaum, R&Ciaverella, D. (2008). Disorders of bones, joints, ligaments, and meninges. In: Bradley, G; Daroff, R; Fenichel, G; Jankovic, J; eds. Neurology in Clinical Practice. 5th ed. Philadelphia, Pa: Butterworth-Heinemann;(77):1324-1344.
- 14- Devereaux, M. (2009). Neck pain. Med Clin North Am;(93): 273-284.
- 15-Ichihara ,D; Okada , E; Chiba ,K; Toyama ,Y; Fujiwara ,H; Momoshima ,S&Nishiwaki ,Y. (2009).Longitudinal magnetic resonance imaging study on whiplash injury patients: minimum 10-year follow-up. J Orthop Sci. ;14(5):602–610.
- 16- McDonnell, M& Lucas, P .(2012). Cervical Spondylosis, Stenosis, and Rheumatoid Arthritis; .Medicine & Health/Rhode island. 95;(4): 105 - 109.
- 17- Shan ,C; MY,B; Rahman, A; Hassan, S& Ismail ,K.(2011). Prevalence of neck pain and associated factors with personal characteristics, physical workloads and psychosocial among male rubber workers in FELDA

- settlement Malaysia. *Glob J Health Sci.*;4(1):94-104.
- 18-Fisher, M. (2002). Electrophysiology of radiculopathies. *Clin Neurophysiol.* ;113 (3): 317-35.
- 19- Binder, A.(, 2004). Cervical pain syndromes. In: Isenberg, D; Maddison P; Woo, P; Glass, D&Breedveld, F. *Oxford textbook of rheumatology*. 3rd ed. Oxford: Oxford Medical Publications; (11): 1185-1195.
- 20-Nasca ,R.(2009). Cervical radiculopathy: current diagnostic and treatment options. *J SurgOrthop Adv.* ;18(1):13-18.
- 21-Radpasand ,M .(2011). Use of a multimodal conservative management protocol for the treatment of a patient with cervical radiculopathy. *J Chiropr Med.* ; 10(1): 36–46.
- 22- Nie, H; Arendt-Nielsen, L; Kawczynski, A & Madeleine, P. (2007). Gender effects on trapezius surface EMG during delayed onset muscle soreness due to eccentric shoulder exercise. *J Electromyogr Kinesiol.*;17(4):401-409.
- 23-Kane ,N& Oware , A. (2012). Nerve conduction and electromyography studies . *J Neurol.* ; 259 (7): 1502-1508.
- 24-Binder, A.(2007). Cervical spondylosis and neck pain. *BMJ* (334): 527-531.
- 25-Miranda ,P; Gomez ,P&Alday, R.(2008). Acute traumatic central cord syndrome: analysis of clinical and radiological correlations. *J Neurosurg Sci.* ;52(4):107-112.
- 26-Todd,A. (2011). Cervical spine: degenerative conditions.*Curr Rev Musculoskelet Med.* ; 4(4): 168–174.
- 27-Kelly,J ; Groarke, P ; Butler, J; Poynton, A & O'Byrne,J. (2012).The Natural History and Clinical Syndromes of Degenerative Cervical Spondylosis .*AdvOrthop.* ;(2012): 393-412.
- 28-Polston, D. (2007). Cervical radiculopathy. *Neurol Clin.* ;25(2):373-385.
- 29-Boyles, R ; Toy, P; Mellon ,J; Hayes, M& Hammer, B. (2011). Effectiveness of manual physical therapy in the treatment of cervical radiculopathy: a systematic review . *Journal of Manual and Manipulative Therapy* ; 19 (30): 135-142.
- 30-Mullin ,J; Shedid ,D&Benzel ,E . (2011). Overview of Cervical Spondylosis Pathophysiology and Biomechanics. *World Spinal Column Journal*; (2):89-97.
- 31-Schoeck ,A; Mellion ,M; Gilchrist, J& Christian, F. (2007). Safety of nerve conduction studies in patients with implanted cardiac devices. *Muscle Nerve.*;(35):521–524.
- 32-Huynh, W& Kiernan, M. (2011). clinical Nerve conduction studies: *Australian Family Physician*; 40(9);693-697.
- 33-Garg ,R; Bansal ,N; Kaur ,H & Arora ,K. (2013). Nerve Conduction Studies in the Upper Limb in the Malwa Region-Normative Data. *J Clin Diagn Res.* ; 7(2): 201–204.
- 34-Rhee ,J &Yoon ,T&Riew, K. (2007). Cervical radiculopathy. *J Am Acad Orthop Surg.* ;15(8):486–494.
- 35-Eubanks, J. (2010). Cervical Radiculopathy: Nonoperative Management of Neck Pain and Radicular Symptoms. *Am Fam Physician*;81(1):33-40.
- 36-El-Bestar, s ; El-Mitwalli, A & Khashaba, E. (2011). Neck–Upper Extremity Musculoskeletal Disorders Among Workers in the Telecommunications Company at Mansoura City. *International Journal of Occupational Safety and Ergonomics (JOSE)* ; 17(2) : 195–205.
- 37-Caridi, J; Pumberger, M & Hughes, A .(2011) . Cervical Radiculopathy: A Review . *HSS J*; 7(3): 265–272.

- 38- Bendszus, M; Wessig ,C; Reiners , K; Bartsch , A&Solymosi ,L. (2003). MR imaging in the differential diagnosis of neurogenic foot drop. AJNR Am J Neuroradiol. ;24(7):1283–1289.
- 39-Ando, T.(2012). Diagnosis and management of cervical spondylosis .RinshoShinkeigaku. Article in Japanese;52(7):469-479.
- 40-Zagaria, M. (2013). Cervical Spondylosis: Neck Pain, Stiffness, and Associated Features.US Pharm.; 38 (3): 20-24.
- 41-Doherty, M. & Ralston, S. (2010). Musculoskeletal Disorder. Davidson's, Principles and Practice of Medicine, editors; Nichi, R. Colledge; Brian, R. Walker; Stuart, H. Ralston and John, A. A. Hunter: 21th ed. Churchill Livingstone Elsevier. ;(25) : 1035-1088.