International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

The Electromyography Study of Paracervical Spinal Muscle and Its Correlation with MRI and Physical Examination in Cervical Radiculopathy

Meenakshi Garg, Sushma Sood, Saurabh Gupta

Department of Physiology, P.G.I.M.S Rohtak Medical College, Rohtak.

Corresponding Author: Meenakshi Garg

Received: 26/02/2016 *Revised: 17/03/2016* *Accepted: 22/03/2016*

ABSTRACT

Cervical radiculopathy is usually an age related condition common affecting people mostly in 4th and 5th decade of life. It is sensorimotor disorder presenting with the complain of neck pain on one side as well as on both side. Pain increases with the extension, lateral bending or rotation towards the symptomatic side. Patient also complains of tingling, numbness or loss of sensation along with the nerve root dermatome. This represents compression of an existing cervical nerve root by either a herniated disc or a degenerative cervical spondylotic change. Most patients will improve with nonoperative treatment, and a small percentage will require further diagnostic evaluation and ultimately surgical intervention. For the extensive diagnostic evaluation EMG used and records the electrical activity produced by skeletal muscle. It evaluates motor axonal loss or motor axon conduction block. EMG of paracervical spinal muscle plays important role in the diagnosis of cervical radiculopathy when the symptoms and MRI findings are not clear. In this study EMG of paracervical muscle done in 30 clinically proven cervical radiculopathy patients and result shows that 94% patients have abnormal EMG findings in symptomatic side and abnormality was also observed in asymptomatic side almost in more than 80% of patients. We concluded that paracervical spinal muscle EMG must be included in the diagnostic evaluation of cervical radiculopathy for the better plan of treatment.

Keywords: Electromyography, Cervical radiculopathy, Paracervical spinal muscle.

INTRODUCTION

The erect posture in the mankind renders human vertebral column and its accessories in general, and the cervical spine and the intervertebral disc spaces in particular prone to damage and susceptible to dysfunction studies have shown that the biomechanics of this region is a function of many influential factors such as age, sex, occupation, and weight. Even some harmless daily activities such as standing, walking, and lying down can trigger spine problems. [1]

Cervical radiculopathy (CR) is a neurologic condition characterized by dysfunction of a cervical spinal nerve, root of the nerve, or both. It is a substantial cause of disability and morbidity and is a common condition after middle age affecting both sexes. [2] It is a sensorimotor deficit syndrome that is defined as being caused by compression of cervical nerve root. [3] The compression can occur as a result of disc herniation, spondylosis, instability, trauma, or rarely, tumors. It usually presents with pain in the neck and one arm or both, with a combination of sensory loss, loss of motor function, or reflex changes in the affected nerve root distribution. It can be a debilitating disease that can cause patients

significant impairment. This effects the population significantly by both ways economically as well as psychologically, so the goal for clinicians should be the efficient & early diagnosis to reduce pain and disability and also minimize the direct and indirect costs of care. [4]

Radiculopathy arises from a process that affects the nerve root. These processes can be divided into compressive and noncompressive causes. Compressive causes include cervical spondylosis, disc herniation. From which cervical spondylosis is more common than disc herniation. Noncompressive causes include demyelination, infection, tumor infiltration, root avulsion, and nerve root infarction. [3]

Conventional radiographs are often obtained for the evaluation of neck pain, but there utility in establishing a diagnosis is somewhat limited. Radiographs have relatively low sensitivity in detecting tumor, infection, and disc herniation. Plain radiographs may be completely normal in patients with tumor or infection. [5]

Magnetic resonance imaging (MRI) is the imaging modality of choice for investigating cervical radiculopathy. It generally provides superior evaluation of the soft tissues compared to compute tomography**.** CT myelography is considered the gold standard for evaluating foraminal compression. CT myelography is superior to MRI in distinguishing osteophyte from soft tissue material. Diagnostic criteria for cervical radiculopathy are not well defined, and there are no universally accepted criteria for its diagnosis. Imaging with CT myelogram or MRI scans can usually identify the presence of a structural lesion entrapping the nerve roots. However, it is important to note that radiculopathy and polyradiculopathy may both occur without a structural lesion seen on MRI or CT myelogram. [6] The patient's history and physical examination are inadequate to distinguish cervical radiculopathy from other neurologic causes of neck and arm pain. In these cases Electro diagnosis plays a critical role in the assessment of patients with symptoms and signs of cervical radiculopathy. Electrodiagnosis is often referred to as an extension of the neurologic examination, as it is able to provide physiologic evidence of nerve dysfunction. The electrodiagnostic study can aid in clarifying the diagnosis of radiculopathy and is critical in identifying other possible nonroot level which causes the neurologic dysfunction. The electrodiagnostic information, history, physical, and imaging findings are evaluated to confirm the most likely diagnosis and guide future treatment. Electrodiagnostic findings can be particularly useful for patients with atypical symptoms, potential pain-mediated weakness, and nonfocal imaging findings. Various types of electrodiagnostic studies may be considered when evaluating a patient for cervical radiculopathy in the electrodiagnostic laboratory. Potential tests include electromyography, motor & sensory nerve conduction studies, late responses, and somatosensory evoked potentials. [7] The most important is EMG, is a technique for evaluating and recording the electrical activity produced by skeletal muscles. An electromyography detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, and recruitment order or to analyze the biomechanics of movements. It can be recorded by needle electrodes or surface electrodes. The EMG only evaluates motor axonal loss or motor axon conduction block, a radiculopathy affecting the sensory root will not yield any abnormalities by electromyography. [8]

Radiculopathy is a common neurologic disorder. Electrodiagnosis can provide a physiologic assessment of the localization, degree of axon loss, severity, and chronicity of the intraspinal canal lesion, and distinguish it from other neuromuscular disorders. [9] The incidence of Cervical Spondylosis and related conditions is increasing in the present scenario and the use of radiologic

examination is time consuming and uneconomical for the common Indian setup. Thus, there is a definite need to establish a cost effective, reliable, and accurate means for establishing the diagnosis of cervical radiculopathy. Electrodiagnostic tests are to fulfill this criterion. Neurophysiological studies are often used by both neurosurgeons and neurologists to supplement neuroimaging findings in the diagnosis of CR and in operative decision making.

MATERIALS AND METHODS

The study include 30 clinically and radiologically confirmed patients, between 35 to 55 years of age of either sex suffering from cervical radiculopathy excluding the Patients of neck pain with other causes e.g.: non compressive cause- demyelination, infection, tumor infiltration, traumatic and nerve root infarction. Detailed history, general physical and neurological examination was carried out. Patient with neck pain having radiation to the ipsilateral or bilateral side of the limb was clinical neurologically evaluated, including both motor as well as sensory system examination as per particular myotomal or dermatomal involvement by noting the signs such as Position of the head and neck contours, Paraspinal cervical muscle spasm, Restriction in neck movements and carrying out the Upper limb tension test, Spurling test or the foraminal compression test and Lhermitte test. Patient underwent for radiological examination. Anteroposterior view of chest X-ray and MRI of cervical spine was done to rule out the other causes of neck pain and to confirm the diagnosis of cervical radiculopathy. All the disc involvement patients are come in the category of MRI positive. Electrophysiological study was carried out to record the electromyogram of paracervical spinal muscle with the Concentric needle electrode of 24-26 gauge, bevelled tip exposed to give an oval recording area of 125×580 μm^2 was used. The method of recording EMG of Paraspinal cervical muscle was that the patient was made to sit down comfortably in chair with the flexion of the neck. The needle was inserted approximately 1-2 cm lateral to the spinous process of vertebra, at the appropriate level. Tip of the needle was reached the junction between the spinous and transverse process of vertebral body. The muscle was activated by extension of the neck. In this study we do the EMG for the middle and low cervical part. We check the insertional activity, spontaneous activity and voluntary activity as recruitment of MUP (%) and peak to peak amplitude (µV). The criteria for taken the abnormal EMG include presence of spontaneous activity or recruitment of MUP was less than 90%, peak to peak amplitude was also reduced.

Statistical analysis

All the data are computed in the MS Excel sheet. Categorical data were presented as number (n) or in percentage (%). Normally distributed data were presented as means and standard deviation. For comparing two variables paired t test was used and for comparing two groups containing quantitative variables, independent sample t-test was used. Pearson's correlation was used for measuring correlation coefficient between two quantitative variables. All tests were performed at a 5% level significance, thus a difference was significant if the value was less than 0.05 (p value< 0.05).

RESULTS

A total of 35 clinical and MRI examinations of the cervical spine were carried out during the period, out of which 30 were included in this study. There were 22 (73.3%) females and 8 (26.6%) males (female: male 2.77:1). The mean age was 47.5±7.07 (range is 35-45 years). 25 patients had complained of unilateral pain and 5 bilateral pains. In maximum patients the position of head and neck contour was shifted towards the affected side in 70.67%. Paraspinal cervical muscle spasm was present in 22 patients (70.33%). Deep tendon reflexes were absent in almost 80 %

patients. Spurling test was positive and restriction of neck movements was present in 60.33% patients. Upper limb tension test was positive in 12 patients (40%). Loss of sensations was present in 14 patients (46.6%). Fasciculation were present in 43.3% and wasting of the muscle seen in 10.34% patients. In MRI most common finding present in subjects were loss of cervical lordosis seen in 93.3% (n=28), disc bulging or protrusion in 86.67% (n=26) and disc herniation in 33.3% (n=10). Disc space narrowing in 73.33% (n=22). Canal stenosis seen in only 6.66% and osteophytosis in 63.33% (n=19). Disc bulging, Disc space narrowing present most commonly in the C_6-C_7 level and after that C_5-C_6.

EMG finding of Paracervical spinal muscle of study group in symptomatic side mean recruitment of MUP (40.16±25.8) with range (5-90) and peak to peak amplitude (357.5±272.6) were reduced when compared with normal even in asymptomatic side mean recruitment of MUP (54.5±22.8) with range (10-95) and peak to peak amplitude (609.26±406.07) were also reduced. Spontaneous activity was positive in 24(80%) of patients in symptomatic side whereas 12(40%) in asymptomatic side. Overall, all the patients had positive physical examination, 86.66 % had positive MRI. 28 (93.3%) of the participants had abnormal EDX of paracervical muscle in symptomatic side and 23 (76.6%) in asymptomatic side. Statistically significant relationship observed between MRI and affected side paracervical EMG but less with non affected side. In this study the MRI positive patients had abnormal EMG findings, except 2 patients where normal EMG was observed and abnormal EMG finding present in patients of negative MRI i.e.4 patients.

Table 1: Electromyographic findings of paracervical muscle in study group.

n (%)	Symptomatic side	Asymptomatic side
Spontaneous activity	24 (80%)	12 (40%)
Peak to peak amplitude	22 (73.3%)	11 (36.6%)
Recruitment of MUP	28(93.3%)	23(76.6%)

Table 2

mean±SD	Symptomatic side	Asymptomatic side
Recruitment of MUP (%)	40.16±25.8	54.5±22.8
Peak to peak amplitude (μV)	357.5±272.6	609.26±406.07

DISCUSSION

Neck pain is the fourth leading cause of disability, with an annual prevalence rate exceeding 30%. Most episodes of acute pain will resolve with or without treatment, but nearly 50% of individual will continue to experience some degree of pain. [10] Cervical radiculopathy is a neurologic condition characterized by dysfunction of a cervical spinal nerve, the roots of the nerve, or both. It usually presents with pain in the neck and one arm, with a combination of sensory loss, loss of motor function, or reflex changes in the affected nerve-root distribution.

In the study group 30 patients with cervical radiculopathy had mean age of patients was 47.5±7.07. The age of the patients ranged from 35-55 years. The most affected age group was 46-55 years forming 66.7% of total study group. This indicated that most of the patients were of fourth and fifth decade of life. Females are most affected in our study group mainly comprised 73.3 %. Radhakrishnan et al conducted an epidemiological survey of cervical radiculopathy in patients that the age ranged from 13 to 91 years; the mean age was 47.6 ± 13.1 years for males and 48.2 ± 13.8 years for females. [11] In present study the most frequent presenting symptoms noted were neck and shoulder pain radiated to one arm in 95% patients, 70.67% patients showed changes in position of head and neck contour. Paracervical muscle spasm was present in 70.33% of patients. Some authors revealed that approximately 80-100% of patients with CR present with neck pain and limb pain similar to our study. [12-14]

The mechanisms for radicular pain are poorly understood. Nerve-root compression by itself did not always lead to pain unless the dorsal-root ganglion was also compressed. Hypoxia of the nerve root

and dorsal ganglion can aggravate the effect of compression. Many past studies indicates that inflammatory mediators including matrix metalloproteinase, prostaglandin E, interleukin-6, and nitric oxide are released by herniated cervical intervertebral disc, responsible for pain. [15-17]

In our study mostly affected root level was C6-C7, followed by C5-C6, C7-C8. Radhakrishnan et al reported that a monoradiculopathy involving C7 nerve root was the most frequent, followed by C6.[5]Some authors found most common disc involvement was C4-C5, followed by C3-C4 and C5-C6. [18-20] Jennifer et al found that the most common level was C5-C6, and then decreasing order of frequency was C6-C7, C4-C5, C3-C4, and C2-C3 not similar to our results. [21] Many study in literature reported that most common disc involvement was C6-C7, and then C5-C6 [22-25] these findings were similar to our results. Cervical spines 3-7 were considered to be the motion segments of the C-spine with mobility being maximal at C5-C6 levels and it is the most frequently affected by disc prolapsed, after that C6-C7 was most commonly affected. [26]

The mechanism showed Disc height reduction occurs due to dehydration of the inner nucleus pulposus, associated degeneration of the outer annulus fibrosus of the disc material leads to osteophytosis. Disc prolapsed occurs due to compromised annulus fibrosus permitting the degenerating nucleus pulposus to migrate and seen as bulging of the disk material. With all these processes occurring simultaneously and progressively, there may be an exacerbation of the symptoms of neck pain and findings of spinal cord and nerve compression.

Electromyography of paracervical spinal muscle was abnormal in 28(93.3%) patients of CR out of which 80% of patients had positive spontaneous activity and 93.3% had decreased recruitment of MUP in affected side whereas in the non affected side 12 patients (40 %) had spontaneous activity and had less than 50% of recruitment of MUPs. 11(37.7%) patients had 50-90% and 7 (20.6%) patients had more than 90% recruitment of MUP.

Dillingham et al revealed that testing 6 muscles including the cervical PSPs achieved a sensitivity of 94% to 98% for the presence of radiculopathy. If PSPs were not tested, testing of 8 limb muscles to achieve a sensitivity of 92% to 95%. Paraspinal muscle was one of the screening muscles. [27] Czyrrny et al found that 20 out of 49 (40.8%) of the CR had abnormalities only in the paracervical spinal muscle. A criterion for abnormality was the presence of spontaneous activity in the paraspinal cervical muscle. [28] Whereas Date et al concluded that 8 of the 66(12 %) of patients showed abnormal EMG on affected side. The spontaneous activity and abnormal EMG sharp waves was also seen in non affected side. [29] Dasher et al concluded that 50 % of patients of CR had abnormal EMG findings in paraspinal cervical muscle. [30] Gilad et al found PSWs in 92% of PSPs in subjects older than 40 years old and fibrillations in 8% of subjects greater than 40 years old. They found no PSWs or fibrillations in patients under 40 years old in normal individual. [31]

Some author concluded that EMG sensitivity test was higher in paraspinal cervical muscles and most prominent abnormalities were signs of denervation. The percentage of abnormalities of paraspinal cervical muscle was highly significant than limb muscles. They concluded that abnormalities in PSPs EMG and motor end potentials (MEPs) examinations are sensitive in localizing that the lesion whether after or proximal to the roots.

In 28 patients of CR EMG of PSPs muscle was abnormal in symptomatic side as well as in asymptomatic side, [23] these results indicate that especially in the cervical spine, a significant percentage of patients with radiculopathy were missed if examinations of paraspinal cervical muscles were not part of EDX evaluation of CR patients. When we compare the symptomatic and asymptomatis side all the

patients had abnormal EMG on symptomatic side also had abnormal EMG in asymptomatic side. All the patients with positive MRI had abnormal EMG in paracervical muscle in affected side; in present study abnormality in EMG of PSPs was observed in patients with negative MRI. The EMG changes come first as compared to physical symptoms and signs in asymptomatic side. By the EMG we can see the changes in electromyography without any signs and symptoms. When we correlate the EMG of PSPs muscle with the physical examination and with MRI, it was more correlated with the physical examination as compared to MRI in symptomatic side. So EMG of PSPs must be included in the diagnostic evaluation of cervical radiculopathy.

CONCLUSION

Based upon above observations and discussion, we are of the opinion that Electromyography plays important role in the localizing lesion and diagnosis of cervical radiculopathy. Electromyography of paracervical muscle must be done to diagnose cervical radiculopathy as it was well correlated with the clinical findings and magnetic resonance imaging. We want to further conclude that electromyography was significantly more correlated with clinical data than magnetic resonance imaging in present study. So it is reasonable to add needle electromyography when there is a discrepancy between magnetic resonance imaging and clinical findings. Electromyography is most valuable as a supplement to imaging modalities in helping to localize the appropriate levels in patients with inconclusive imaging.

REFERENCES

1. Hashemi H, Firouznia K, Saraush H, Amirorang J, Foghani A, Pakravan M. MRI findings of cervical spine among symptomatic patients and their risk factors. Iran J Radiol. 2003; 132-6.
2. American Association of Electrodiagnostic Medicine: Practice parameter for needle electromyographic evaluation of patients with suspected cervical radiculopathy. Muscle Nerve. 1999; 22: S209-21.
3. Hakimi K, Spanier D. Electrodiagnosis of cervical radiculopathy. Phys Med Rehabil Clin N Am. 2013; 24: 1-12.
4. Carette S, Fehlings MG. Clinical practice. Cervical radiculopathy. N Engl J Med. 2005; 353: 92.
5. Pyhtinen J, Laitinen J. Cervical intervertebral foramen narrowing and myelographic nerve root sleeve deformities. Neuroradiology. 1993; 35: 596-7.
6. Houser OW, Onofrio BM, Miller GM, Folger WN, Smith PL, Kallman DA. Cervical neural foraminal canal stenosis: computerized tomographic myelography diagnosis. J Neurosurg. 1993; 79(1): 84-8.
7. Cohen I, Jouve C. Cervical radiculopathy.In: frontera WR, Silver JK, Rizzo TD Jr, editors. Essentials of physical medicine and rehabilitataion. 2nd ed. Philadelphia: Saunders Elsevier; 2008.46-55.
8. Jay J.H, George H.K. Electrodiagnosis of neck pain. Phys Med Rehabil Clin North Am. 2003; 14: 549-67.
9. Levin KH. Approach to the patient with suspected radiculopathy. Neurol Clin.2012; 30(2):581-604.
10. Cohen SP. Epidemiology, diagnosis and treatment of neck pain. Mayo Clin Proc.2015; 90(2):284-99.
11. Radhakrishnan K. Epidemiology of cervical radiculopathy. A population based study from Rochester, Minnesota, 1976 through 1990. Brain. 1994; 117(2): 325-35.
12. Murphy F, Simmons JCH. Ruptured cervical disc: experience with 250 cases. Am Surg. 1966; 32(2):83-8.
13. Odom GL, Finney W, Woodhalll B. Cervical lesions. J Am Med Assoc. 1958; 166(1):23-8.
14. Garvey TA, Eismont FJ: Diagnosis and treatment of cervical radiculopathy and myelopathy. Orthop Rev.1991; 20:595-603.
15. Kang JD, Stefanovic-Racic M, McIntyre LA, Georgescu HI, Evans CH. Toward a biochemical understanding of human intervertebral disc degeneration and herniation: contributions of nitric

oxide, interleukins, prostaglandin E2, and matrix metalloproteinases. Spine.1997; 22:1065-73.
16. Furusawa N, Baba H, Miyoshi N. Herniation of cervical intervertebral disc: immunohistochemical examination and measurement of nitric oxide production. Spine.2001; 26:1110-6.
17. Miyamoto H, Saura R, Doita M, Kurosaka M, Mizuno K. The role of cyclooxygenase-2 in lumbar disc herniation. Spine.2002; 27:2477-83.
18. Herring W. Recognizing some common causes of neck and back pain. Learning radiology: recognizing the basics. 1st ed; Mosby Elsevier, Philadelphia, pennysylvania.2007.
19. Sinan T, Al-Khawari H, Ismail M, Bennakhi A, Sheikh M. Spinal Tuberculosis: CT and MRI features. Ann Saudi Me.2004; 24(6):437-44.
20. Jennifer AT, Bartleson JD. Cervical spondylotic myelopathy. The neurologist. 2010; 16(3):176-87.
21. Brower RS. Cervical disc disease. In: Herkowitz HN, Garfin SR, Balderstone RA, Eismont FJ, Bell GR, Wiesel SW.edi. The Spine.4th ed. Philadelphia: W B Saunders. 1999: 455-92.
22. Boutin RD, Spaeth HJ, Resnick D. Degenerative disease of the spine .In: Orrison WW. Neuroimaging. Philadelphia: W B Saunders. 2000:1302-34.
23. Williams KD, Park AL. Lower back pain and disorders of intervertebral discs. In: Canale ST Campbell's operative orthopedics. 10th ed. St Louis:Mosby. 2003: 1955-2028.
24. Lauder TD, Dilligham TR, Andary M, Kumar S, Pezzin LE, Stephens RT, et al. Predicting Electrodiagnostic outcome in patients with upper limb symptoms: are the history and physical examination helpful. Arch Phys Med Rehabil.2000; 81:436-41.
25. Nardin RA, Patel MR, Gudas TF, Rutkove SB, Ratnor EM. Electromyogarphy and magnetic resonance imaging in the evaluation of radiculopathy. Muscle Nerve.1999; 22:151-5.
26. Balci K, Asil T, Tekinaslan I, Ir N. Does cervical radiculopathy have an effect on peripheral nerve conduction studies? An electrophysiological evaluation. Eur Neurol.2011; 66(1):53-8.
27. Dillingham TR, Lauder TD, Andary M, Kumar S, Pezzin LE, Stephens RT, et al. Identification of cervical radiculopathies: optimizing the electromyographer screen. Am J Phys Med Rehabil. 2001; 80:84-91.
28. Czyrny JJ, Lawrence J: The importance of paraspinal muscle EMG in cervical and lumbrosacral radiculopathy: review of 100 cases. Electromyogr Clin Neurophysiol.1996; 36:503-8.
29. Date ES, Kim B, Yoon JS, Park BK. Cervical paraspinal spontaneous activity in asymptomatic subjects. Muscle Nerve 2006; 34:361-4.
30. Miller MA, Pardo R, Yaworski R. Clinical utility of reflex studies in assessing cervical radiculopathy. Muscle Nerve.1999; 22(8):1075-9.
31. Gilad R, Dabby M, Boaz M, Sadeh M. Cervical paraspinal electromyography: normal values in 100 control subjects. J Clin Neurophysiol.2006; 23:573-6.

How to cite this article: Garg M, Sood S, Gupta S. The Electromyography study of paracervical spinal muscle and its correlation with MRI and physical examination in cervical radiculopathy. Int J Health Sci Res. 2016; 6(4):197-203.

****