Journal of Cell and Tissue Research Vol. 9(1) 1777-1780 (2009)
ISSN: 0974- 0910 *(Available online at www.tcrjournals.com)*

Clinical Research Report

COMPARATIVE EVALUATION OF EMG, NCV, SSEP, X RAY AND MRI FOR DIAGNOSIS OF CERVICAL RADICULOPATHY

MOUSAVI, S. A., CHITSAZ, A., KHORVASH, F.? AND LAELBAKHSH, A. K.

Department of Neurology, AlZahra Hospital, Isfahan University of Medical Sciences, Isfahan, Iran
E. mail: fkhorvash@gmail.com

Received: December 12, 2008; Accepted: March 1, 2009

Abstract: Cervical radiculopathy is one of the most common diseases that must be diagnosed early and properly for prevention of serious side effects. For this purpose, different diagnostic techniques such as MRI, X-Ray, EMG, NCV and SSEP are used. In the current study, we evaluated and compared the significance of aforementioned techniques for the diagnosis of cervical radiculopathy. This prospective study was performed in AlZahra hospital. 36 patients (22 female, 14 male) complaining of cervical pain that radiated to upper limbs were evaluated. Diagnostic techniques including EMG, NCV, MRI, X-Ray and SSEP were performed for all patients. All collected data were analyzed using SPSS program. The sensitivity and specificity of SSEP for diagnosis of cervical radiculopathy were calculated to be 28.6% and 100%, respectively. Abnormal EMG and NCV were observed in 50 % and 5.6 % of the patients, respectively. Abnormal X-ray and MRI were observed in 33.3 % and 77.8 % of the patients. There was no significant correlation between the results of the MRI and SSEP (p=0.086). According to the results of our study, SSEP does not have high diagnostic yield for cervical radiculopathy and EMG can be regarded as a better choice. However, for more advanced conditions (such as spinal cord involvement), the SSEP is of higher value for diagnostic purposes.

Key words: EMG, NCV, SSEP, X ray, MRI , Cervical Radiculopathy

INTRODUCTION

The diagnosis of cervical spondylitis (CS) is based on three factors viz., clinical, neuroradiolo-gical and neurophysiological data. However, in spite of being universally used, the validity of each of these diagnostic instruments has still to be clarified [1].

The true diagnostic accuracy of clinical examination for cervical radiculopathy is debatable. In these patients, sensory deficit, deep tendon reflexes and motor weakness may be present to a varying degree. It is generally said that loss of deep tendon reflexes is the most reliable clinical finding, with the biceps reflex affected by C5 injury, the brachioradialis by C6, and the triceps by C7 [2].

Plain radiographs may be helpful, but clinical symptoms often correlate poorly with the radiological findings [3]. Imaging techniques are mainly directed to localize the abnormality, identify compression of the spinal cord, nerve roots, and to exclude intraspinal lesions. It has been reported that correlation between MRI and surgical findings is frequently unreliable [4] and abnormalities in MRI have been found in asymptomatic subjects.

Neurophysiological investigations are usually regarded as being helpful in the diagnosis of cervical radiculopathy and are also useful in excluding peripheral nerve lesions. In addition, concentric needle EMG appears to be the best and widely accepted method among all electrodiagnostic procedures for the diagnosis of radiculopathy [5] with sensitivity in cervical radiculopathy varying from 50 to 93 %. Neurophysiological studies (NPS) are often used by both neurosurgeons and neurologists to supplement neuroimaging findings in the diagnosis of cervical radiculopathy and in operative decision-making [6]. The objective of our study was to evaluate

comparatively the significance of EMG, NCV, SSEP, X ray and MRI for diagnosis of cervical radiculopathy.

MATERIALS AND METHODS

This prospective clinical trial was performed in AlZahra hospital, Isfahan, Iran. Subjects participated on a voluntary basis after signing written informed consent. The study protocol was approved by the appropriate Institutional Review Committee at Isfahan University of Medical Sciences.

After careful physical examination and exclusion of the causes such as fracture, luxation, inflammation or infection, 36 patients with presence of symptoms and signs of cervical root involvement were recruited. These included pain in the neck and shoulder which radiated down to the arm; stiffness in the neck and shoulder, weakness and muscle atrophy in myotomal distribution, dermatomal sensory impairment and depressed or absent reflexes.

There was no limitation in the age or sex of selected patients. For all of the patients, elecrtoneurodiagnostic techniques including EMG (electromyography), NCV (Nerve conduction velocity) and SSEP (Somato-sensory Evoked Potential) and imaging techniques including plain radiography and MRI (magnetic resonance imaging) were performed.

Radiological assessment involved flexion and extension lateral radiographs in four directions and MRI of the cervical spine. Nerve conduction velocity study (NCS) and concentric needle EMG study were performed using a computerised EMG machine (Toennis ®).

EMG was performed by the bipolar needles at deltoid (C5–6), biceps (C5–6), triceps (C7–8), extensor digitorum communis (C7–8), flexor carpi radialis (C6–7) and first dorsal interosseous (C8–T1) muscles.

Evidence of denervation changes on needle EMG included the presence of spontaneous activities (fibrillations, positive sharp waves and fasciculations) and long duration polyphasic motor units. For performing SSEP, median nerve was stimulated at the wrist and the recording was performed at cortical level. The median nerve was stimulated 200 times with the stimulus intensity was 5-15mA. The impedance values were kept below 5 kÙ.

Statistical analysis: The collected results were analyzed using SPSS software (ver 13.00) and statistical tests including correlation coefficient, Chi square and kappa coefficient.

RESULTS

Overall, 36 patients were included in this study. 38.9% of the evaluated patients were male and the remaining 61.1% were female. The mean age of the patients was 51.2 ± 11.86. Out of 36 patients, 28 patients had abnormal MRI with variable severity and 8 patients had abnormal SSEP. The sensitivity and specificity of SSEP were, therefore, calculated to be 28.6% and 100%, respectively (Table 1).

According to Kappa coefficient assessment, there was no agreement between SSEP and MRI for diagnosis of cervical radiculopathy (Table-2). The prevalence distribution of abnormal EMG, NCV, MRI and X-ray were 50%, 5.6% 77.8% and 33.3%, respectively (Table 3). There was a proportional agreement between EMG and X-ray with MRI. However, no significant agreement was found between NCV and MRI (Tables 4,5).

DISCUSSION

To clarify the relationships between electro-myography (EMG) and magnetic resonance imaging (MRI), Tsai et al. [7] compared findings in 37 selected patients who presented with cervical root avulsion injuries. Nerve root repair with C4-T1 hemilaminectomy was subsequently performed on 19 patients. The agreement between the two evaluative modalities with complete or incomplete lesions of ventral root and pre- or postganglionic lesions of dorsal root was measured for each root level. Both with ventral and dorsal root evaluation, C6, C7, and C8 yielded high agreement values, ranging from 86% to 94%. C5 manifested the lowest agreement values: 54% on ventral root assessment. Additionally, EMG, in comparison with MRI, revealed a higher quantity of implicated injured components. The authors

Table 1: The sensitivity and specificity of SEP for diagnosis of positive and negative cervical radiculopathy in the evaluated patients:

Results of SSEP	Results of MRI	
	Abnormal	Normal
Abnormal	8	0
Normal	20	80

Table 2: Proportional agreement between SSEP and MRI (Kappa coefficient) in the evaluated patients. P=0.086, Kappa=0.151

SEP / MRI	Normal	Abnormal	Total
Normal	100% 8 22.2%	0% 0 0%	100% 8 22.2%
Abnormal	77.8% 20 77.8%	22.2% 8 100%	100% 28 77.8%
Total	77.8% 28 100%	22,2% 8 100%	100% 36 100%

Table 3: The prevalence distribution of abnormal EMG, NCV, MRI and X-ray in the evaluated patients:

Diagnostic technique:	Prevalence		Percent (%)	
	Normal	Abnormal	Normal	Abnormal
EMG	18	18	50	50
NCV	34	2	94.4	5.6
MRI	8	28	22.2	77.8
X-ray	24	12	66.7	33.3
SSSEP	28	8	77.8	22.2

Table 4: Proportional agreement between EMG and MRI (Kappa coefficient) in the evaluated patients. P=0.001, Kappa=0.444

EMG / MRI	Normal	Abnormal	Total
Normal	100% 8 44.4%	0% 0 0%	100% 8 44.4%
Abnormal	35.7% 10 55.6%	64.3% 18 100%	100% 28 77.8%
Total	50% 18 100%	50% 18 100%	100% 36 100%

Table 5: Proportional agreement between NCV and MRI (Kappa coefficient) in the evaluated patients. P=0.437, Kappa = 0.033

EMG / MRI	Normal	Abnormal	Total
Normal	100% 8 23.5%	0% 0 0%	100% 8 22.2%
Abnormal	92.9% 26 76.5%	7.1% 2 100%	100% 28 77.8%
Total	94.3% 34 100%	5.6% 2 100%	100% 36 100%

concluded that both EMG and the MRI played crucial roles in preoperative assessment, and they might complement each other [7].

In the study that was performed by Szabela et al. [8], the use of EMG for diagnosis of radiculopathy was reviewed from years 1981-2000. The selected studies reported a wide range of needle EMG abnormalities from about 30 to 100 % of pathological EMGs. That was caused by wide variety of patient populations and various EMG protocols. The authors concluded that needle EMG abnormalities correlated with radiological findings in limited range as would be expected from the occurrence of radiological findings in asymptomatic patients and overlapping innervations of myotomes [8].

In the other study that was performed by Ashkan et al. [6], 48 patients who underwent both preoperative NPS and MRI for cervical radiculopathy were evaluated. Sensitivity of MRI and NPS for diagnosing cervical radiculopathy was reported to be 93% and 42%, respectively. Whilst the positive predictive values for MRI and NPS were similar (91% versus 86%), the former had a higher negative predictive value (25% versus 7%). It was concluded that in patients with clinical and MRI evidence of cervical radiculopathy, NPS had limited additional diagnostic value [6].

It is reported that needle EMG correlates with root injury at surgery in 79% of patients based on the presence of fibrillations and positive sharp waves in limb muscles [9]. Falck et al.[10] reported that a normal EMG finding both at one year and five years following surgical decompression was related to a good outcome and normalization of cervical SSEP (somatosensory evoked potential) in patients who had completely recovered after surgery [3,10].

The present study shows that SSEP has low sensitivity but high specificity value for diagnosis of cervical radiculopathy. This is not consistent with some of previous studies [11,12]. This may be due to the fact that only median nerve SSEP was performed in the current study. In addition, out of 36 patients in the current study, only 2 patients had spinal cord involvement and both of these patients had abnormal SSEP. Nevertheless, in the patients with mildly abnormal or normal MRI, SSEP was found to be normal that is consistent with the observations made by Berthier et al. [13].

In consistent with literature (14), the sensitivity of plain radiography and EMG was higher than SSEP and NCV had the lowest sensitivity.Overall , our results showed that although all of the aforementioned techniques have of value in the diagnosis of cervical radiculopathy, performing MRI and EMG are of priority for accurate diagnosis of cervical radiculopathy .In addition, as SSEP is able to show physiologic changes of the spinal cord, its results are of high value candidate for surgical interventions. However, performing NCV is of not significant value and it is best reserved for the patients who suspected to be suffering from conditions such as neuropathy. In fact, normal NCV does not exclude the diagnosis of cervical radiculopathy.

REFERENCES

[1] Serrano Castro, P.J.: Rev. Neurol., 33(12): 1185-1193 (2001).

[2] Fisher, M.A.: Clin. Neurophysiol., 113(3): 317-335 (2002).

[3] Khan, M.R., Mclnnes, A. and Hughes, S.P.: J. Spinal Disord., 2(3): 163-169 (1989).

[4] Shafaie, F.F., Wippold, F.J. , Gado, M., Pilgram, T.K. and Riew, K.D.: Spine, 24(17): 1781-785 (1999).

[5] Dumitru, D.: In: *Electrodiagnostic Medicine*, Hanley and Belfus, Philadelphia, PA. 523-584 (1995).

[6] Ashkan, K., Johnston, P. and Moore, A.J.A : Br. J. Neurosurg., 16(2):146-148 (2002).

[7] Tsai, P.Y., Chuang, T.Y., Cheng, H., Wu, H.M., Chang, Y.C. and Wang, C.J.: Neurotrauma, 23(8): 1274-1281 (2006).

[8] Szabela, D.A., Zawirski, M.: Neurol. Neurochir. Pol., 36(1):157-171 (2002).

[9] Knutsson, B.: Acta Orthop. Scand., Suppl 49: 130-135 (1961).

[10] Falck, B., Nykvist, F., Hurme, M. and Alaranta, H.: . Electromyogr. Clin. Neurophysiol., 33(1): 19-26 (1993)

[11] Jasayeri, A.: Ir. J. Med. Sci., 25(1&2) : 62-66 (2000).

[12] Bednarík, J., Kadanka, Z., Vohánka, S., Novotný, O., Surelová, D, Filipovicová, D. and Prokes, B.: Eur. Spine J., 7(6): 493-500 (1998).

[13] Berthier, E., Turjman, F. and Mauguière, F.: Neurophysiol. Clin., 26(5): 300-310 (1996).

[14] Chiappa, K.H.: Short latency somatosensory evoked potentials. In: Evoked Potentials in Clinical Medicine (Chiappa, K.H, d), Lippincott-Raven, pp 233-453 (1997).