DIAGNOSTIC SENSITIVITY OF PARASPINAL NEEDLE EMG IN CERVICAL RADICULOPATHY

SERVİKAL RADİKÜLOPATİ TANISINDA PARASPİNAL İĞNE EMG'SİNİN DUYARLILIĞI

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Gazi Medical Journal 2004; 15: 19-22

ABSTRACT

Purpose: *To assess the frequency of paraspinal needle electromyography (EMG) abnormalities in cervical radiculopathy.* ***Methods:*** *The charts of patients with radicular pain and objective neurological deficits, in whom an electromyographically definite cervical radiculopathy had been established, were reviewed. Diagnostic criteria included fibrillation potentials or positive sharp waves in the paraspinal muscles. Alternatively, such spontaneous activity or giant motor unit potentials had to be present in a myotomal pattern in at least 2 muscles of the upper extremity.* ***Results:*** *Out of 46 patients analyzed, paraspinal EMG abnormalities were detected in 31 (67.5%). In 14 (30.5%), this was the sole electrodiagnostic finding. There was no significant difference in the incidence of spontaneous activity in the subjects with shorter symptom duration, compared to individuals with a more protracted course (p>0.05).* ***Conclusion:*** *Because of the high diagnostic yield of paraspinal muscle EMG in cervical radiculopathy, this examination should be an integral part of routine electrodiagnostic studies at all stages of this condition.*

Key Words: *Cervical Radiculopathy, Electromyography, Electrodiagnosis.*

ÖZET

Amaç: *Servikal radikülopatide paraspinal iğne elektromyografisi (EMG) anormalliklerinin sıklığını değerlendirmeyi hedefledik.* ***Yöntem:*** *Elektromyografik olarak kesin servikal radikülopati tanısı alan, aynı zamanda radiküler ağrı ve objektif nörolojik defisiti de bulunan hastaların kayıtları incelendi. Tanı, paraspinal kaslarda fibrillasyon potansiyelleri veya positif keskin dalgaların bulunmasıyla kondu. Bu koşulun karşılanmadığı durumlarda, bu tür spontan aktivite veya dev motor ünite aksiyon potansiyellerinin en az 2 üst ekstremite kasında myotomal dağılımda bulunması gerekiyordu.* ***Bulgular:*** *İncelediğimiz 46 hastanın 31 (% 67.5) inde paraspinal EMG anormallikleri mevcuttu. Olguların14 (% 30.5) ünde bu anormalliğin tek başına bulunduğu dikkati çekiyordu. Semptomları kısa süreli olan olgularla, daha uzun süredir hasta olanlar kıyaslandığında, spontan aktivitenin mevcudiyeti açısından önemli fark izlenmedi (p>0.05).* ***Sonuç:*** *Paraspinal EMG, yüksek tanı değerine sahip olması nedeniyle, servikal radikülopatinin tüm evrelerinde gündelik elektodiyagnostik çalışmaların bir parçası olmalıdır.*

Anahtar Kelimeler: *Servikal Radikülopati, Elektromyografi, Elektrodiyagnoz.*

INTRODUCTION

Although paraspinal needle electromyography (EMG) is usually performed in the electrodiagnostic evaluation of cervical radicular syndromes, the validity and sensitivity of this procedure have not been questioned in previous studies (1-3). One study observed that "paraspinal denervation" did not occur in isolation (3). Recently this question has been addressed and 41% of electrophysiologically confirmed patients with cervical radiculopathy were found to demonstrate fibrillation potentials and positive sharp waves restricted only to the paraspinal muscles (4). As we routinely perform paraspinal needle EMG in the work-up for cervical radiculopathy, we decided to analyze the frequency of paraspinal EMG abnormalities in our series.

PATIENTS AND METHODS

Patients

We retrospectively reviewed the records of patients referred to the EMG laboratory between 1995 and 2001 with a suspected diagnosis of cervical radiculopathy. We included cases with a history of neck pain radiating into the arm, and at least one objective neurological deficit, such as muscle weakness, sensory loss in a segmental dermatome or loss of a tendon jerk. The diagnosis was confirmed in all patients by EMG examination. Patients with a history of previous neck surgery, plexopathy, peripheral neuropathy, arachnoiditis, diabetes, motor neuron disease or malignant disorders or with an incomplete electrodiagnostic work-up were excluded. Patients diagnosed with polyradiculopathy on the basis of multisegmental abnormalities were also excluded, as motor neuron disease or menengial disease could not be reliably ruled out.

Electrophysiologic Studies

Motor and sensory nerve conduction studies of the median and ulnar nerves on the affected side were carried out in all patients. For the diagnosis of radiculopathy, fibrillation potentials or positive sharp waves had to be present in the paraspinal muscles. Alternatively, such spontaneous activity or giant motor unit potentials (>3 mV in amplitude or >16 ms in duration) should be observed in two muscles of the upper extremity innervated by the same myotome, but by separate peripheral nerves. A concentric needle electrode was used. For the paraspinal muscle examination, the needle electrode was inserted between the spinous processes of the corresponding and the upper vertebra, 2 to 2.5 cm lateral to the midline for C5-C7 roots, and between the spinous processes of C7 and T1 vertebrae for the C8 root. During the examination, the patient lay sideways on the opposite shoulder, with his/her back against the examiner and the side to be tested uppermost. A pillow was placed under the head to prevent lateral flexion of the neck. The patient was also asked to flex the neck towards the chest to ensure total relaxation of the paraspinal muscles (5). The electrode was placed deep inside the muscle and at least 4 insertions in 4 quadrants were made. Needle EMG of the deltoid, triceps, biceps and abductor pollicis brevis muscles was routinely performed. However, to confirm the diagnosis in the event of abnormal findings in only one extremity muscle, another muscle innervated by the same myotome but by a different peripheral nerve could be tested. The charts prepared by Wilbourn and Aminoff (6) were utilized to determine the involved myotomes in extremity muscles.

Statistical Analysis

The data were stored in the Statistical Package for Social Sciences program and the analysis was performed between the relatively acute and more chronic cases by the chi-square test. Fisher's exact test was used when the number of patients in one group was less than 5. A p level of less than 0.05 was considered significant.

RESULTS

Patients

The records of 848 patients referred to the EMG laboratory with a diagnosis of cervical radiculopathy were analyzed. The diagnosis was confirmed by EMG in 185 patients. Ninety-seven of these patients had a normal neurological examination. Of the remaining 88 patients, 4 had diabetes, and 5 underwent a neurosurgical operation to the cervical spine; in 12 patients a brachial plexus lesion could not be ruled out, and in 5 motor neuron disease was suspected, one of whom had a history of previous poliomyelitis. In 16 patients more than 2 segments were involved. Twenty-two males (48%) and 24 females (52%), a total of 46 patients with a mean age of 47, were analyzed. The duration of symptoms varied from 15 days to 14 years with an average of 23.5 months. Pain radiated to the right arm in 21 cases (45.5%) and to the left arm in 25 (54.5%). Sensory loss was present in 30 (65%) cases. Weakness was detected in 24 (52%). Deep tendon reflexes were abolished or hypoactive in 9 (19.5%) patients.

Electrophysiologic Studies

Motor nerve conduction studies showed an abnormality in 1 (2%) case. This patient displayed reduced amplitudes of the compound muscle action potentials of the median and ulnar nerves. Another patient had a slow sensory nerve conduction velocity in the finger-wrist segment of the median nerve, which was interpreted as asymptomatic carpal tunnel syndrome.

Fibrillation potentials or positive sharp waves were found in the paraspinal muscles of 31 (67.5%) patients. In 14 (30.5%) it was the sole electrodiagnostic abnormality. Furthermore, 15 (32.5%) patients displayed neurogenic involvement, diagnostic of radiculopathy, in the upper extremity myotomes alone (Table 1). Patients with symptoms of less than 2- ($p>0.05$) or 6- ($p>0.05$) month duration did not demonstrate an increased percentage of fibrillation potentials or positive sharp waves compared to the more chronic cases, either in the paraspinal or limb muscles.

Table-1: Frequency of EMG abnormalities in 46 cases of cervical radiculopathy. Numbers in parentheses indicate percentages.

Level	Abnormality			
	Paraspinal	Extremity	Combination	Total
C-5	2	2	2	6 (13)
C-6	3	0	2	5 (10.9)
C-7	2	7	2	11 (23.9)
C-8	1	3	2	6 (13)
C-5, 6	2	0	0	2 (4.3)
C-6, 7	2	3	8	13 (28.3)
C-7, 8	2	0	1	3 (6.5)
Total	14 (30.4)	15 (32.6)	17 (37)	46 (100)

DISCUSSION

A high percentage of patients (67.5%) in our series displayed spontaneous activity in the form of fibrillation potentials or positive sharp waves in the cervical paraspinal muscles. This number exceeds the findings of Czyrny and Lawrence (4), who reported such abnormality in 49% of their patients. Therefore, the examination of paraspinal muscles in the cervical radiculopathy work-up is of extreme importance, with regard to the high diagnostic yield of this technique. In 30.5% of our cases paraspinal spontaneous activity was the sole electrophysiologic abnormality, in stark contrast to the findings of Berger et al. (3), who stated that such findings did not occur in isolation. Although it has been discovered that spontaneous activity can be observed in the lumbar paraspinal muscles of a substantial percentage of asymptomatic individuals (7), our patients were symptomatic and demonstrated neurological deficits, ruling out any abnormalities discovered by chance. The percentage of paraspinal fibrillation potentials or positive sharp waves in isolation is even greater than that found (23%) in lumbosacral radiculopathies (8). A higher incidence of paraspinal abnormalities in the cervical region has been noted previously, but the authors were unable to pinpoint the exact cause of this phenomenon (4). They postulated that anatomic differences may produce such different findings. Moreover, the etiologic causes of radiculopathy differ between the two regions, with spondylotic bone changes being more common in the cervical spine, while disc herniation is seen more frequently in the lumbar spine (4). Paraspinal abnormalities in isolation are less common in our series, compared to the 41% reported by Czyrny and Lawrence (4). This may be the result of different electrophysiologic criteria used for the diagnosis of radiculopathy. While these authors included patients with spontaneous activity only, giant motor unit potentials on voluntary activation were also used as a diagnostic criterion in our study. Therefore, limb abnormalities occurred more commonly in our series. Fibrillation potentials or positive sharp waves were present in either a C6 or C7 distribution in the paraspinal muscles of 52% of the cases. In contrast, such spontaneous activity in the paraspinal muscles was present in only 26% of the cases in either a C5 or C8 distribution (Table 1). These findings are in agreement with previous studies (9, 10), confirming that C6 and C7 are the most commonly involved roots in disorders of the cervical spine.

Duration of symptoms was not associated with the occurrence of fibrillation potentials or positive sharp waves, in parallel with previous reports (11, 12). The classical view holds that spontaneous activity is detected in paraspinal muscles at around 7 days, whereas the distal limb muscles are affected approximately 2 to 3 weeks after the neurogenic injury (5, 6). However, this statement may not be completely true, as it has been demonstrated that junctional failure of degenerating nerve stumps develops more rapidly

than previously thought. For each additional 1 cm length of stump, neuromuscular transmission failure is delayed 45 minutes. Therefore, it takes about 3 days for spontaneous activity to develop, after its appearance is noted in the paraspinal muscles (11, 12). In a previous study, it was observed that patients present with fewer lumbar paraspinal EMG abnormalities as the disease duration exceeds 6 months (8). It must be kept in mind that paraspinal muscles can be reinnervated in the interim between the onset of symptoms and the scheduled EMG examination, as early as 6 weeks, while in the distal limb muscles this may be delayed for 7 months (6, 11, 13). One must take into account the differences in disorders of the cervical spine compared to its lumbar counterpart. Reinnervation in the longer lower limb is delayed. Cervical roots may undergo repetitive injury during the course of disease. Lastly, the causes of the radiculopathy (spondylosis versus disc herniation) differ between cervical and lumbar areas.

Abnormalities in the motor nerve conduction studies were found in 2% of our cases, considerably lower than the 29% reported in lumbosacral radiculopathies (8). Actually, one of our patients had an additional carpal tunnel syndrome. C8 and T1 axons supply the abductor digit quinti and abductor pollicis brevis muscles. Disorders affecting these roots are rare. Axonal injury at the level of C5 or C6 roots has no effect on the median or ulnar compound muscle action potentials. In contrast, L5 and S1 axons innervate the extensor digitorum brevis and abductor hallucis muscles respectively, which may explain the high level of involvement in lumbosacral radiculopathies.

In conclusion, paraspinal EMG is mandatory in the cervical radiculopathy work-up, in view of the high diagnostic yield of the procedure. We also think that achieving relaxation in the paraspinal muscles is not difficult if the patient applies gentle flexion of the neck against the chest. When this maneuver is unsuccessful, the patient can bend his/her head towards the examiner's fist placed underneath his/her chin. This technique does not cause much discomfort and some patients may report more pain during the examination of intrinsic hand muscles. Moreover, the fear of iatrogenic damage (4) is unfounded, as we encountered no complications in our series.

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