Lumbosacral radiculopathy. The sensitivity of electromyographical studies compared to imaging techniques and clinical findings

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Abstract

In this retrospective study, we evaluated the sensitivity of electromyography studies (EMG) in patients with suspected lumbosacral radiculopathy in comparison with imaging and clinical findings.

A total of 56 patients were included in the analysis. Thirty-five patients had abnormal EMG results. Thirty-one had unilateral and four bilateral, root involvement. In five patients, there was no concordance between the imaging and EMG findings (false--positive results); one of the patients had Brucellosis. Twenty-one patients had normal electromyography tests, and ten of them had normal imaging studies. Of the remaining eleven, only one had imaging abnormalities with obvious root compromise and a normal EMG (false-negative result). Patients with abnormal EMG had often, a pattern of reduced tendon reflexes, segmental weakness and sensory-motor symptoms, in comparison to the group with normal EMG studies.

We conclude that the electromyography study can give important information in the evaluation of patients with suspected lumbosacral radiculopathy. It is easy to get, low cost and reliable what would make it a first choice additional test.

Key words: electromyography, lumbosacral radiculopathies.

Introduction

Low back pain is one of the most common symptoms in clinical practice, prompting many patients to seek medical support.[1] When assessing this complaint, it is necessary to know whether or not it is accompanied by lesion of the nerve structures, in this case, the lumbosacral roots.

The clinical assessment is the first step in the differential diagnosis. In some situations, where the radicular lesion is obvious, complementary diagnostic studies are generally needed to confirm the clinical impression and reveal the cause of the lesion (whether structural or not). Electromyographic studies (EMG) are one of the oldest forms of evaluation of patients with low back pain[2] and their value has been documented, on various occasions, by different authors.[3] Recently, with the appearance of new imaging techniques, the usefulness of EMG has been questioned. In some centers, there is a tendency to favor imaging techniques, placing less value on the contribution of electromyographic information.

In this retrospective work, we analyze the sensitivity of EMG in the diagnosis of radicular lesion in patients with low back pain, and compare the results with the imaging findings and the clinical signs and symptoms.

Material and methods

In 1994, a total of eighty-two patients were assessed at the Electromyography Laboratory with suspected lumbosacral radicular lesion. Of these, twenty-six patients were not included in the analysis: three due to incomplete information, eight due to inadequate imaging studies, and fifteen due to electromyographic diagnoses, made at the time, that were different and justified the clinical symptoms.

The nerve conduction and needle electrode test were carried out in accordance with internationally

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TABLE I

	Normal EMG	Abnormal EMG
No. of patients	**n= 21**	**n= 35**
Side affected		
Right	5 (24%)	5 (14.2%)
Left	8 (38%)	19 (54.2%)
Both	8 (38%)	11 (31.4%)
Evolution of the symptoms		
< 3 months	4 (19.2%)	8 (22.8%)
> 3 <12 months	3 (14.2%)	1 (2.8%)
> 12 months	13 (61.9%)	26 (74.2%)
Not known	1 (4.7%)	0
Clinical symptoms		
Sensitive-painful	13 (62%)	11 (31.5%)
Motor-muscle weakness	0	3 (8.5%)
Mixed (sensitive-motor)	8 (38%)	21 (60%)
Neurological Assessment		
Normal	15 (71.5%)	11 (31.5%)
Global muscle weakness	5 (23.8%)	0
Segmental muscle weakness	1 (4.7%)	24 (68.5%)
Myotatic reflexes		
Normal	11 (52.4%)	9 (25.7%)
Rotulian reflex	3 (14.3%)	2 (5.7%)
Achillean reflex	2 (9.5%)	13 (37.2%)
Rotulian+achillean	5 (23.8%)	8 (22.9%)
Not assessed	0	3 (8.5%)

recommended methods.[4]

The electromyographic diagnosis of the radicular lesion was established when two muscles innervated by the same root, but by different nerves, showed signs of lesion i.e. acute denervation, fibrillations and/or slow waves (acute radicular lesion) and/or signs of partial denervation with chronic collateral muscle reinnervation (chronic radicular lesion) associated with a pattern of decreased muscle recruitment pattern.[5]

The muscles innervated by adjacent roots and by at least one muscle in the contralateral limb at the same level, were always assessed if there were signs of lesion of the dependant muscles of the root(s) being studied.

For inclusion of the patient in the present analysis, the results of their nerve conduction study had to be normal, and in particular, sensitive, except where there was a clear explanation for the changes found.

A radicular lesion was probably defined only when a muscle presented signs of acute and/or chronic lesion, and in relation to the S1 root, if the needle electrode exam was normal, when there was an evident asymmetry in the range of response of the reflex H (>50%).

Results

A total of fifty-six patients met the clinical, imaging and electromyographic criteria defined; thirty-six were female and twenty were male, with average ages of 48 years (14.6) and 56.6 years (16.2), respectively.

Two groups were defined, with a normal EMG (21 patients) and the other with abnormal EMG (positive), i.e. revealing radicular lesion (35 patients).

There was a prevalence of symptoms on the left side, both in general, and in the patients with positive EMG (*Table I*). The clinical symptoms were long-term (>12 months) in thirty-nine patients (69.6%) and short-term (<3 months) in twelve patients (21.4%). The clinical symptomology 'sensitive-painful' was predominant in the normal EMG group, and the 'sensorial-motor' (mixed) was predominant in the other group. In the first, only one patient presented segmental muscle weakness and the majority did not show any changes in myotatic reflexes, while segmental muscle weakness and alterations in myotatic reflexes were common in the group with positive EMG (68.5% and 59.9%, respectively).

The most significant and frequent change in the study of motor nerve conduction test was the decrease in range or absence of distal motor response of the deep peroneal nerve, which was seen in fourteen patients (40%) in the abnormal EMG group (*Table II*).

In the study of sensitive nerve conduction, the number of patients with responses with decreased range was the same in both groups, and was absent in two patients in the abnormal EMG group. These alterations were not considered to invalidate the diagnostic EMG for radiculopathy, because they occurred in patients aged over sixty years, who did not present other clinical signs or symptoms other than those resulting from the radicular lesion (*Table III*).

In the normal EMG group (*Table IV*), ten patients

TABLE II

Study of motor nerve conduction

	Normal EMG n = 21		Abnormal EMG n = 35	
Nerve	**Deep Peroneal**	**Tibial**	**Deep peroneal**	**Tibial**
	n =20	**n = 14**	**n = 29**	**n = 19**
Distal latency (ms)	5.4 ± 0.8 (3.2-7.6)	6.5 ± 1 (5.1-9.1)	6 ± 1.3 (5.5-9.2)	6.8 ± 1.1 4.2-9.4)
Distal range (mV)	8.9 ± 4.9 (2.1-21.6)	15.7 ± 8.5 (6.7-31.2)	4.9 ± 4 (0.1-15.4)	11.5 ± 7.2 (1-24.4)
Conduction speed (m/s)	53 ± 8 (38.5-67.1)	60.3 ± 11 (45.2-85.5)	51.3 ± 7.3 (34.2-65)	54.2 ± 8.9 (35.7-71.7)
Number of absent responses	—	—	4	1
Responses with decrease in distal range	—	—	10	5

TABLE III

Study of sensitive nerve conduction

	Normal EMG n = 21		Abnormal EMG n = 35	
Nerve	**Sural**	**Superficial peroneal**	**Sural**	**Superficial peroneal**
	n =19	**n = 17**	**n = 32**	**n = 29**
Distal range (V)	15.1 ± 9.5 (2.5-22)	21.2 ± 15.9 (6.6-72)	9.8 ± 5.6 (2.4-20)	12.4 ± 7.6 2.2-28.8)
Conduction speed (m/s)	41.9 ± 3.2 (36.3-47.9)	45.3 ± 5.4 (31.2-60)	40.6 ± 4.2 (35.8-48.3)	44.3 ± 7.2 (32-60)
Number of absent responses	—	—	—	2
Responses with range < 6mV	1 (2.5 mV)	—	1 (2.4 mV)	—

(47.6%) had normal results in the imaging studies. In the remaining eleven patients, the alterations present were not directly related to the lumbar sacral radicular studies (four patients – sacroiliitis, metastasis of L2 – the EMG was carried out to assess roots L5 and S1, marginal osteophytosis and degenerative changes in L4 to S1), another group of three patients had imaging alterations in which radicular lesion may have been possible (previous laminectomies), another three present lumbar stenosis without disc hernias, and only one revealed alterations with intracanalicular and foraminal compression. None of the latter seven patients was submitted to subsequent surgical intervention (*Table V*).

In the abnormal EMG group (*Table VI*), the patients with electromyographic diagnoses of root L5 lesion showed adequate structural lesions that justified the radicular lesion. In relation to the electromyographic S1 lesions, four had normal CAT scan, three alterations with potential for radicular lesions, and the last, an idiopathic stenosis of the lumbar canal without disc hernia.

The most significant imaging changes were present in bilateral and unilateral radiculopathies L5 and S1.

In relation to radiculopathies L4 and L5, one patient had sufficient medical disease for radicular lesion with normal CAT scan, and the other two showed structural lesions that were clearly related to radicular lesion, both clinically and electromyographically.

For radicular lesions S1 and S2 (two patients), lumbar stenosis was the only change present.

Of the eleven patients with abnormal EMG and normal clinical exam (*Table VII*), six had a diagnostic EMG of lesion of root L5, four of S1 and one, a lesion of roots L4 and L5. In the imaging studies, eight of these patients had alterations with radicular impairment; one was normal; there was one other lumbar

TABLE IV

Imaging findings in the patients with normal EMG

1) Nuclear Magnetic Resonance Imaging (MRI):

Normal: 6

Abnormal: 4

1) Sacroiliitis.

2) Lumbar stenosis + diffuse disc prolapse of L2 and S1.

3) Lumbar stenosis + disc bulging L4-L5 and L5-S1.

4) Laminectomy L3-L4-L5.

2) Computed Axial Tomography (CAT):

Normal: 4

Abnormal: 7

1) Marginal osteophytosis

2) Spondylolisthesis L1-L2 and L4-L5, with intracanalicular and foraminal compression.

3) Laminectomy L5-S1, without disc hernia.

Normal lumbar canal.

4) Lumbar stenosis L3-L4 with disc bulging of L3 to S1.

5) Partial laminectomy L5 and S1.

Spondylolisthesis L5-S1 without disc hernia.

6) Metastasis in the vertebral body of L2.

7) Degenerative changes of L4 to S1.

TABLE V

Normal EMG: Abnormal imaging studies (CAT/MRI) and clinical signs

Patient	Age	Imaging findings	Clinical Test	Diagnosis	Clinical surgery
1	18	Lumbar stenosis + slight disc bulging of L2 to S1	MR abolished distal muscle weakness (level 4)	Post-traumatic pubalgia	No
2	54	Lumbar stenosis. Disc bulging L4 to S1	MR hypoactive normal muscle strength	Degenerative osteoarticular disease	No
3	63	intracanalicular and foraminal DH in L1-L2 and L4-L5	MR and MS normal	DH at 2 lumbar levels	No
4	48	Signs of laminectomy L5-S1 without normal lumbar canal DH	MR and MS normal	--	No
5	50	Lumbar stenosis L3-L4 with diffuse disc bulging	Achillean reflexes abolished. MS normal	stenosis of the lumbar canal	No
6	52	Partial laminectomy L5 and S1 spondylolisthesis without disc hernia	MR and MS normal	spondylolisthesis L5-S1	No
7	70	laminectomy L3-L4--L5	Achillean MR abolished and level 4 weakness of the distal muscle	stenosis of the lumbar canal	No

MR= Myotatic Reflexes; MS = Muscle Strength; DH = Disc Hernia

stenosis; and the last one had degenerative changes in L5-S1.

Of the six patients with probable radicular lesion (four in relation to S1 and two in relation to L5), the imaging study was normal in two patients (root S1) and showed, in the remaining patients: lumbar stenosis (1 patient), spondylolisthesis L5-S1 (1 patient), L4-L5 (1 patient) and disc hernia L4-L5 (1 patient).

Discussion

The value of electromyographic study in the assessment of patients with low back pain and confirmation of radicular lesion has long been accepted.

Clearly, there are limitations, and false positive and false negative results will naturally occur.

In the present study, which included fifty-six patients, twenty-nine had electromyographic changes compatible

TABLE VI

Imaging findings in patients with normal EMG

Radiculopathy L5:

1) Fracture-luxation of L3.

2) Disc hernia (DH) L4-L5.

3) DH L5-S1 + lumbar stenosis.

4) Lumbar stenosis + DHs. L2-L3, L3-L4 and L4-L5.

5) Stenosis of the lateral recess + compression of the root of L5 and probably of S1.

6) DH L4-L5 posterolateral, with intraforaminal impairment.

7) Degenerative changes of L5 and S1.

8) DH L4-L5 posterolateral, with foraminal impairment

9) Multiple degenerative changes with lumbar stenosis.

10) Degenerative changes of L3-L4 and L4-L5.

11) Intraforaminal DHs in L3-L4 and L4-L5.

12) Spondylolisthesis L4-L5 with probable root compression.

13) Paramedian DH L4-L5.

Radiculopathy S1:

1) Normal = 4 (CAT).

5) Spondylolisthesis L5-S1.

6) Diffuse disc prolapse L5-S1.

7) Lumbar stenosis without disc hernia.

8) Posterolateral bulging disc L5-S1.

Bilateral radiculopathies L5 and S1:

1) Meningeal cyst D11-L1.

2) Lumbar stenosis with lateral recess in L4-L5 and L5-S1 and bilateral root compression.

3) Lumbar stenosis with narrowed lateral recess in L4-L5 and L5-S1.

4) Lumbar stenosis with diffuse multiple bulges of L3 to S1.

Unilateral radiculopathies L5 and S1:

1) Previous laminectomy and foraminectomy of L4 to S1.

2) Disc bulge of L4-L5 and L5-S1.

3) Intracanicular bullet in S1-S2.

4) Disc hernia L5-S1 (2 patients).

Radiculopathies L4 and L5:

A) bilateral

1) normal CAT scan – brucellosis.

2) Cystic teratoma of the conus medullaris.

B) unilateral

1) Voluminous DH L3-L4

Radiculopathies S1 and S2

1) Lumbar stenosis = 2

TABLE VII

Abnormal EMG, normal clinical examand imaging findings

Patient	Age	Diagnostic EMG	Imaging Findings	Surgery
1	52	Radiculopathy S1	Spondylolisthesis L5-S1	No
2	30	Radiculopathy S1	Normal	No
3	50	Radiculopathy L5	Lumbar stenosis	No
4	71	Radiculopathy L5	Lumbar stenosis + voluminous DH L4-L5	No
5	64	Radiculopathy L5	Lumbar stenosis + DH L4-L5.	No
6	65	Radiculopathy L5	Degenerative changes L5-S1	No
7	63	Radiculopathy S1	L5-S1 DH with root impairment	No
8	39	Radiculopathy S1	DH L5-S1.	No
9	65	Radiculopa-thies L4 and L5	Voluminous DH L4-L5	No
10	36	Radiculopathy L5	DH L3-L4 and L4-L5	No
11	52	Probable radiculopathy L5	DH L4-L5 para-median	No

HD = Disc Hernia

with definitive radicular lesion, and six were considered to have probable radiculopathies according to the electromyographic results (*Table VIII*). In this group of thirty-five patients, only four did not present any corresponding imaging changes (diagnostic EMG of radiculopathy S1) and nine (25.7%) presented lumbar stenosis as the only change present, which is considered responsible for the electromyographic changes detected in the lesion of root S1. For the remainder, the electromyographic study and imaging findings were compatible (sensitivity: 31/35x100=88.5%).

In patients with normal EMG, only one could be considered a false negative result (patient 3 – *Table*

TABLE VIII

Diagnosis by EMG

Radiculopathy L5 = 13 patients			
definite:	11	probable:	2
acute:	4 (2 on the le ft; 2 on the right)		0
chronic:	7 (4 on the left; 3 on the right)		2 (1 on the left; 1 one the right)
Radiculopathy S1 = 8 patients			
definite	4	probable:	4
acute:	2 (1 on the left; 1 on the right)		0
chronic:	2 (2 on the left)		4 (2 on the left; 2 on the right)
Radiculopathies L5 and S1 unilateral = 5 patients			
definite:	5	probable:	None
acute:	1 right		
chronic:	4 (2 on the left; 2 on the right)		
Bilateral radiculopathies L5 and S1 = 4 patients			
definite:	4	probable:	None
acute:	1		
chronic:	3		
Radiculopathies L4 and L5 = 3 patients			
definite:	3	probable:	None
unilateral:	1		
acute:	1 left		
bilateral:	2		
chronic:	2		
Radiculopathies S1 and S2 = 2 patients			
definite:	2		
	2 on the left, chronic		

V). It is recognized that lumbar stenosis may present even without electromyographical changes.[6] Three patients (*Table V*) were assessed for persistent symptoms following laminectomy in which, sometimes, the pain is not caused by the radicular lesion, but by the development of processes of fibrosis and arachnoiditis, which are responsible for the postoperative persistence or occurrence of pain, with normal roots (specificity: 20/24x100 = 83.3%; positive predictive value = 88.5% and negative predictive value = 83.3%).

Comparing the EMG results with the symptomology and alterations in the clinical exam, the complaints of weakness and signs of segmental weakness are rare in patients with normal EMG, while these are the most common alterations in patients with abnormal EMG.

It appears, based on these results, that there is a correct adaptation between the results of the EMG, imaging, and clinical exam in patients with low back pain and root impairment.

It is not clear whether EMG or lumbosacral CAT/MRI is superior in the diagnosis of radicular lesion. Both, apparently, have a high level of sensitivity, and their results, one structural and the other functional, being mutually interchangeable, are complementary, providing consistent information for subsequent therapeutic guidance of the patient. ■

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