

THE VALUE OF DERMATOMAL SOMATOSENSORY-EVOKED POTENTIAL IN EVALUATION OF HERNIATED LUMBAR DISC

Sait Naderi, M.D., Nihat Egemen, M.D., Hamit Gökalp, M.D., Adil Çulcuoğlu, M.D., Ahmet Erdoğan M.D., Mustafa K. Başkaya M.D.,

Ankara University, Faculty of Medicine, Departments of Neurosurgery (SN, NE, HG, AE, MKB) and Neurology (AÇ), Ankara - TÜRKİYE.

Turkish Neurosurgery 2 : 139 - 143, 1992

SUMMARY:

In this study 33 patients with Herniated Lumbar Disc (HLD) were investigated. Dermatomal Somatosensory Evoked Potential (SEP) values were compared with needle Electromyography (EMG), myelography and operative findings. According to the operative findings the patients were divided into two groups: 1) protruded HLD (18 cases) and 2) extruded HLD (15 cases). We found a 26% correlation between the operative findings and the SEP results in patients with extruded HLD, and 11.2% in the protruded HLD group. As a result we found an 18.1% overall correlation between the operative findings and the SEP results. We suggest that dermatomal SEP is not a sensitive method for the diagnosis of HLD.

KEY WORD:

Dermatomal Somatosensory Evoked Potential, Herniated Lumbar Disc

INTRODUCTION:

HLD is one of the most frequent medical problems. Electrodiagnostic studies are a recognised tool for evaluating patients with HLD, primarily because the data can provide evidence of root injury.

Current methods evaluate efferent fibres (needle EMG and F responses) or a combination of afferent and efferent conduction (H reflexes) (1,5). On the other hand, dermatomal SEP has been used to investigate sensory roots in root lesions caused by HLD (12).

Nevertheless, the use of SEP in the patients with HLD is controversial (2-11). There is no report in the literature about differences between protruded and extruded HLD and the role of SEP. This report is a prospective study that was investigated this subject.

METHOD AND PATIENTS:

Thirty three patients with HLD verified by operation, were examined by needle EMG, myelography and dermatomal SEP and the results compared with the operation findings.

Dermatomal SEP's were recorded over the scalp, following sapheneus (L4), peroneal (L5) and suralis (S1) nerve stimulation. For recording, Fpz-Cz recording montage was used. Stimulus intensity was adjusted to 2.5 times the sensory threshold. The sural nerve was stimulated at the ankle, the superficial peroneal nerve at a hand's breadth above the lateral malleolus, and the sapheneus nerve above and anterior to the medial malleolus. The data of the patient group was compared with the control group, which included 15 patients between 151-160 cm., 19 patients between 161-170 cm. and 15 patients

between 171-180 cm (Table 1). For this evaluation we used the "Z" test and evaluated "Z" values pathologically when this value was more than 1.96. This value reflected statistically correct results within 95% confidence limits.

Table 1 : Mean values of SEP results in the control group according to height

R-SP	R-Pr	R-Sr	L-SP	L-Pr	L-Sr
151-160 cm (n=15)					
41.83±3.45	39.4±3.78	39.43±3.16	40.33±2.93	38.9±4.6	39.1±3.57
161-170 cm (n=19)					
42.14±1.92	39.35±1.92	39.99±1.69	42.25±2.3	39.49±2.1	40.18±2.35
171-180 cm (n=15)					
44.27±3.8	41.67±2.99	41.43±1.85	43.79±2.3	41.61±2.58	41.3±1.42

Recording was made with using of HF:1 KHz, LF:2 KHz, analyse time 100 ms, 5 uv/div, averaging of 200 stimules and two times repetition. Stimulus in an electrical pulse of 200 us duration delivered and its frequency is 2 Hz. Automatic artifact rejection was performed during the recording. When there was significant difference between the number of averaging and artifact image, averaging procedure was stopped.

Patients: According to the operative findings the patients were divided into 2 groups: 1) protruded HLD (18 cases) and 2) extruded HLD (15 cases).

The age range was 24-53 (mean 35.5) in patients with protruded HLD and 26-60 (mean 38.9) in the extruded HLD group, SEP data in the 2 groups is given in (Tables 2,3).

Table 2 : SEP results in patients with protruded HLD (SP: N. sapheneus, Pr: N. Peronealis, Sr: N. Suralis, L: Left, R: Right)

Care	R-SP	R-Pr	R-Sr	L-SP	L-Pr	L-Sr
1. İK	43.8	40.2	46.8	42.0	40.7	42.8
2. RS	40.4	40.6	42.8	41.1	41.3	43.8
3. RA	41.1	40.74	6.64	1.54	0.84	47.7
4. KB	38.5	39.4	43.6	40.3	39.0	42.8
5. FE	40.2	41.2	48.6	41.2	41.8	48.0
6. NÖ	38.0	35.6	43.4	39.6	38.6	42.6
7. RS	34.7	35.0	37.8	33.8	34.4	36.6
8. SÖ	39.6	40.2	50.9	40.6	40.8	40.7
9. AE	39.0	44.4	44.8	38.6	38.0	42.4
10. KK	43.2	40.4	39.1	44.8	42.0	47.8
11. EA	40.6	44.2	44.0	38.2	39.4	42.3
12. HB	39.4	43.2	45.7	40.2	40.2	41.5
13. NK	38.5	47.2	39.8	37.1	40.4	39.2
14. KY	45.4	45.2	49.1	44.6	46.4	49.1
15. LD	40.6	40.3	41.4	40.6	38.9	40.0
16. SG	36.7	36.6	41.1	36.0	40.0	37.2
17. HA	39.1	39.0	42.2	39.2	37.9	42.2
18. CS	39.0	38.1	41.4	39.2	39.4	40.1

Table 3 : SEP results in patients with extruded SEP

Care	R-SP	R-Pr	R-Sr	L-SP	L-Pr	L-Sr
1. HA	40.5	42.4	48.2	40.0	40.0	48.8
2. AK	39.8	41.4	43.3	35.0	41.3	43.5
3. SY	37.6	37.4	43.6	38.6	39.4	43.4
4. MK	44.1	40.6	48.4	44.2	47.2	46.7
5. İB	41.2	43.7	40.7	40.1	37.2	39.6
6. VK	38.4	37.2	40.0	40.0	38.0	41.7
7. İP	37.9	39.2	48.0	37.9	40.0	43.8
8. AB	45.8	46.8	48.2	44.6	46.8	48.8
9. ZŞ	38.0	48.2	44.4	38.8	38.8	42.2
10. AS	42.0	42.6	44.6	42.4	42.6	44.7
11. FK	42.4	43.8	48.8	42.0	46.4	49.4
12. HE	42.8	39.9	49.0	42.4	43.4	46.4
13. HG	39.6	41.2	46.8	40.2	42.8	45.6
14. EY	39.6	39.2	42.2	38.8	39.4	42.7
15. GA	41.4	42.4	43.7	40.0	44.4	42.8

The needle EMG results were classified as: mild, moderate and severe root compression. We found mild root compression in 3 patients, moderate in 12 and severe in 18 (Tables 4,5).

Table 4 : Age, height and needle EMG results in patients with protruded HLD (RC: Root Compression)

Age	Height	Needle EMG results
1.	30	170 R L5 moderated RC
2.	30	171 L S1 severe RC
3.	37	179 R S1 moderate RC
4.	37	174 R S1 and L5 severe RC
5.	24	174 R S1 severe RC
6.	51	152 bilateral mild L5 RC
7.	38	155 L L5 mild RC
8.	30	174 L L4 moderate RC
9.	53	164 R L5 severe, R S1 moderate RC
10.	28	179 R S1 severe, L S1 moderate RC
11.	42	165 L L5 moderate, S1 moderate RC
12.	36	170 R S1 severe, R L5 mild RC
13.	32	163 R L5 mild RC
14.	29	184 L L5 moderate, R L5 moderate RC
15.	51	160 L L5 moderate RC
16.	21	160 bilateral L5 severe RC
17.	38	175 R L5 severe RC
18.	32	169 R L5 moderate RC

Table 5 : Age, height and needle EMG results in patients with extruded HLD

Age	Height	Needle EMG results
1.	39	171 R L5 moderate, L L5 mild RC
2.	34	162 R L4,5 severe RC
3.	33	159 Bilateral S1 moderate RC
4.	44	172 L L5 severe, R L5 moderate RC
5.	34	158 L S1 moderate, R L5 moderate RC
6.	34	153 R L5 severe RC
7.	26	165 R S1 severe RC
8.	38	164 L L5 severe RC
9.	35	160 R S1 severe RC
10.	39	172 R L3, 4,5 severe L L5 severe RC
11.	60	165 bilateral L5 moderate RC
12.	46	169 R L4 moderate, R L5 moderate RC
13.	38	170 L L5 severe RC
14.	53	172 L L5 severe, R L5 moderate RC
15.	31	166 L L5 moderate RC

Myelography was done in all cases. We found root amputation in 7 cases, filling defects in 14 cases and a total block in 12 cases (Tables 6,7).

Table 6 : Myelography and operative results in patients with protruded HLD (FD: Filling Defect, RA: Root Amputation, HPL: Hemipartial Laminectomy, TL: Total Laminectomy, Pr: Protruded, CNL:

Myelography	Operation
1. R L4-5 FD	R L4 HPL+ R L4-5 Pr. discectomy
2. L L4-5 FD	L L4 HPL+ L L4-5 Pr. discectomy
3. R S1 RA	CNL
4. R S1 RA	CNL
5. R L5 RA	R L4 HPL+ R L4-5 Pr. discectomy
6. R L4-5 FD	R L4 HPL+ R L4-5 Pr. discectomy
7. L L4-5 FD	L L4 HPL+ L L4-5 Pr. discectomy
8. L L3-4 FD	L L3 HPL+ L L3-4 Pr. discectomy
9. R L3-4,14-5FD	R L3,4 HPL, R L3-4,L4-5 Pr. discectomy
10. R L5-S1 FD	R L5 HPL, R L5-S1 Pr. discectomy
11. L L5-S1 FD	L L5 HPL+ L L5-S1 Pr. discectomy
12. R S1-RA	R L5 HPL+ R L5-S1 Pr. discectomy
13. R L5-RA	R L4 HPL+ R L4-L5 Pr. discectomy
14. L L4-5 FD	L L4 HPL+ L L4-5 Pr. discectomy
15. L L5 RA	L L4HPL+ L L4-5 Pr. discectomy
16. L4L5 total block	L4 TL, L4-L5 midline Pr. discectomy
17. R L3-4, L4-5 FD	R L3, L4 HPL, R L4-5 Pr. discectomy
18. R L4-5 FD	R L4 HPL+ RL4-5 Pr. discectomy

Table 7 : Myelography and operative results in patients with extruded HLD (EX: Extruded)

Myelography	Operation
1. R L4-5 FD	R L4 HPL+ R L4-5 EX discectomy
2. R L5-S1 FD	R L5 HPL+ R L5-S1 EX discectomy
3. R L5-S1 FD	R L5 HPL+ R L5-S1 EX discectomy
4. L3-4 total block	L L3 HPL+ L L3-4 EX discectomy
5. L L4-5 FD	L L4 HPL+ L L5-5 EX discectomy
6. R L4-5 FD	R L4 HPL+ R L4-5 EX discectomy
7. R L5-S1 FD	R L5 HPL+ R L5-S1 EX discectomy
8. L L4-5 FD	L L4 HPL+ L L4-5 EX discectomy
9. R L5-S1 FD	R L5 HPL+ R L5-S1 EX discectomy
10. R L3-4,L4-5 FD	R L3,L4 HPL, R, L3-4 Pr., L4-5 EX discectomy
11. L4-5 Subtotal block	L4 TL, L4-5 mid line EX discectomy
12. R L4-5 FD	R L4 HPL+ R L4-5 EX discectomy
13. L L4-5 FD	L L4 HPL+ L L4-5 EX discectomy
14. L L4-5 FD	L L4 HPL+ L L4-5 EX discectomy
15. L L5-S1 FD	L L5 HPL+ L L5-S1 EX discectomy

The results from the patients and the control group were compared using the "Z test".

$$Z = \frac{\text{SEP value of the patients - mean value of the same height in the control group}}{\text{Standard Deviation of Control Group}}$$

The following values are accepted, if the derived values are greater than 1.96 (the standard value of the Z test) $P < 0.005$; if they are greater than 2.58 $P < 0.01$ and if they are greater than 3.29 $P = 0.001$. In another mean, they were evaluated in 95%, 99.9% confidence limits.

RESULT:

In all cases myelographic results were correlated with operative findings (100%). In 16 patients with protruded HLD (88.8%) and in 12 with extruded HLD (80%) the needle EMG was consistent with the operation. At the $P < 0.05$ accuracy limit, we found SEP abnormality in 16 out of 33 HLD cases; 7 patients with protruded HLD (38.8), and 9 extruded HLD cases (60%) had SEP abnormalities. As Considering root level: 2 of the 7 protruded HLD cases (11.2%), 4 of the 9 (26.6%) extruded HLD cases were correlated with SEP abnormality and operative findings. The correlation was 18.1% for all the HLD cases (Table 8)

Table 8 : SEP abnormality and root correlation in patients with extruded and protruded HLD

Cases	Abnormal SEP	Root Correlation
Extruded HLD	9 (60.0 %)	4 (26.6 %)
Protruded HLD	7 (38.8 %)	2 (11.2 %)

DISCUSSION:

Published data on the diagnostic yield of scalp-recorded SEP in the evaluation of HLD are conflicting. Some authors concluded that scalp-recorded SEP's are rarely helpful in the diagnosis of prediction of radiculopathies (1,2,3). On the other hand, other authors report that scalp-recorded SEP following dermatomal stimulation very sensitive in the detection of HLD (4,6,7,8,9,11).

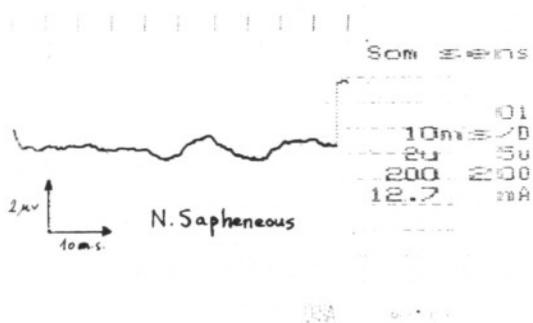


Fig. 1a : Normal waveform pattern from N. Sapheneus

Scarf et al., in (92%) of 38 cases with radiculopathies verified by operation, found abnormalities of SEP which correctly localised lesion levels (1). Perlik et al., reported correlation between focal root dysfunction and SEP abnormality in 17 out of 21 cases with radiculopathy (10). Feinsod reported peroneal SEP abnormalities in 77 patients with HLD, detected by myelography (4). Katifi et al., similarly reported dermatomal SEP abnormality in 19 of 20 operated HLD cases (5).

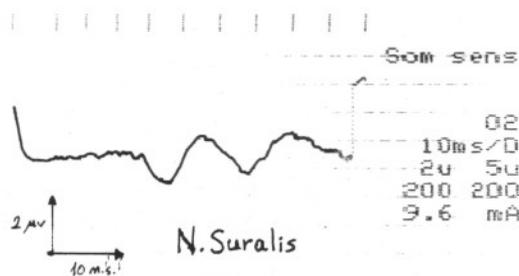


Fig. 1b : Normal waveform pattern from N. Suralis

On the other hand, Eisen et al., detected SEP abnormalities in 16 out of 28 (57%) suspected lumbosacral and cervical radiculopathy cases (3). Aminof et al., detected SEP abnormalities in 5 out of 19 radiculopathy cases, diagnosed by clinical examination, and reported that SEP is not a valuable diagnostic method for the detection of radiculopathies (1). Yiannikas concluded that SEP investigation has some limitations in the diagnosis of lumbosacral and cervical

radiculopathies and emphasized that this investigation must be integrated with needle EMG (12).

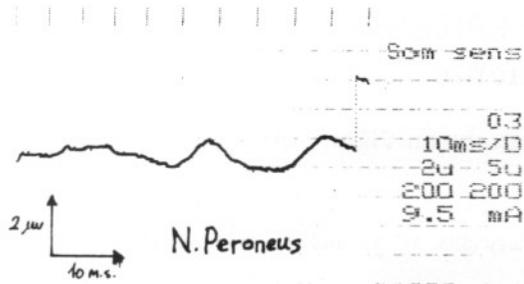


Figure 1c : Normal waveform pattern from N. Peroneus

We found SEP abnormalities in 16 out of 33 cases (48.4%); considering root level. 6 of the 33 cases had a correlation between abnormal SEP and operative findings. This correlation was 26.6% in extruded HLD cases and 11.2% in protruded HLD cases.

We concluded that this low SEP abnormality detection in our patients was due to compression at the short radicular segment of the peripheral nerves and this will not be the cause of latency differentiation because peripheral nerves enter the spinal cord with different fibres and roots. Lesions of one root can be compensated by other intact roots, and shortsegment conduction slowing can be diluted through the nerve with normal SEP responses.

We also found that extruded HLD cases with severe root compression increases SEP abnormalities.

Correspondence: Dr. Nihat EGEMEN
Ankara Üniversitesi
Tıp Fakültesi
İbni Sina Hastanesi
Nöroşürji Anabilim Dalı
Sıhhye, Ankara - TÜRKİYE
Tel : 3103333 / 2934

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