The usefulness of the somatosensory evoked potentials of the pudendal nerve in diagnosis of probable multiple sclerosis

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Study design: The aim of the study was to evaluate the sensitivity of pSEP in patients affected by probable MS.

Objectives: Bladder dysfunction is the presenting symptom in 2% of patients affected by multiple sclerosis (MS) and may be present in up to 78% of them. Abnormalities of somatosensory evoked potentials of the pudendal nerve (pSEP) have been found by many authors in patients affected by clinically defined MS, but little is known of diagnostic reliability of pSEP in early stage of MS.

Methods: Sixteen patients, eleven females and five males, aged between 18 and 45 years old (mean age 28.9), affected by clinically probable MS, were studied. Six of them reported retention or urge incontinence. pSEP with P1 (P40) scalp wave was analyzed. All patients also underwent visual evoked potentials (VEP), SEP of median and tibial nerves (mSEP, tSEP), brainstem acoustic evoked potentials (BAEPs), MRI of the brain and cerebrospinal fluid (CSF) evaluation. Urodynamic study with simultaneous measurement of intravesical, intraurethral and abdominal pressures with external sphincter electromyography was performed.

Results: Abnormalities of the evoked potentials were found in all patients. Abnormalities of the pSEP were observed in all the symptomatic cases and in eight of the remaining ten patients; ten showed no responses from the scalp and four showed P1 increased latency. Urodynamic abnormalities were found in 12 patients and MRI showed demyelinating lesions in 13 patients and oligoclonal bands were found in eight of them.

Conclusion: pSEP can be worthwhile as part of the initial diagnostic evaluation in patients affected by MS. It provides information of diagnostic relevance and plays a role in screening patients for urodynamic testing, which, however, is more specific for detecting urethrovessical dysfunctions and preventing urological complications.

Keywords: multiple sclerosis; bladder dysfunction; somatosensory evoked potential (SEP); pudendal nerve

Introduction

Multiple sclerosis (MS) is a disabling neurologic disease usually affecting young adults. Urinary incontinence, retention and/or sexual impotence are the common disturbances in patients affected by multiple sclerosis. Bladder dysfunctions are the presenting symptom in 2% of patients and may be present in up to 78% of patients.¹ In order to define the kind of bladder dysfunction in MS, many authors carried out urodynamic studies and observed three different patterns of abnormality: detrusor hyperreflexia, detrusor-sphincter dyssynergy and detrusor areflexia.^{2–6} It has been suggested by pathological⁷ and MRI studies¹ that these abnormalities are due to the involvement of the spinal cord, particularly of the

cervical tract. Abnormalities of somatosensory evoked potential of the pudendal nerve have been found by many authors in patients affected by clinically defined MS with symptomatic bladder dysfunctions^{6,8–10} but little is known on the diagnostic reliability of pSEP in the early stage of MS. The aim of the present study was to evaluate the diagnostic sensitivity of pSEP in patients affected by probable MS and to correlate the neurophysiological findings with bladder functional abnormalities.

Material and methods

Sixteen patients, 11 females and 5 males, aged between 18 and 45 years (mean age 28.9), affected by clinically probable MS according to Poser's diagnostic criteria¹¹ were studied. The patients were examined within 15 days of their admission to the Neurological clinic of

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the University of Sassari. The clinical data are shown in Table 1. Six patients reported retention or urge incontinence. None had signs or symptoms or peripheral neuropathy. The pSEP in men was recorded by stimulating the pudendal nerve with ring electrodes placed around the penis, with the cathode proximally and the anode 3 cm distally. In women a probe with the cathode on the clitoris and the anode 15 mm away was used. Subjects were examined in the supine position. Rectangular stimuli of 0.1 ms duration were delivered at 3 Hz frequency. The stimulus intensity was twice the individual sensory threshold. An active platinum-iridium needle electrode was placed on the scalp 2 cm behind Cz and reference electrodes were placed on the ear lobes. The amplifier bandpass was setted from 5 Hz–5 KHz, the analysis time was 100 ms and 1000 artifact-free responses were averaged twice. The p1 (P40) scalp wave was analyzed. pSEP was thought to be abnormal when the P1 wave was absent or the latency increased according to our normal values¹² (Figures 1 and 2). In all patients, VEP, SEP of median and tibial nerves (mSEP, tSEP), BAEP and MRI of the brain were performed and CSF was studied to assess the presence of oligoclonal bands (OB). Urodynamic evaluation, including simultaneous measurement of intravesical, intraurethral and intra-abdominal pressures, and external sphincter electromyography was also carried out.

Results

The results obtained on the 16 patients are summarized in Table 2 and Table 3. Abnormalities of the evoked potentials were found in all patients. VEP showed increased P100 latency in three patients with history or clinical signs of optic neuritis and in four of the 13 remaining patients. Absence or increased N20 latency was found in two of the six symptomatic patients and in three of the asymptomatic patients. tSEP was impaired in two of the four symptomatic and in three

of the remaining cases. Abnormalities of the pSEP were observed in all the symptomatic cases and in eight of the remaining ten patients; ten showed no responses from the scalp and four showed P1 increased latency.

Figure 1 Normal pSEP

Figure 2 Pathological pSEP

Table 1 Clinical data

Patient	Age	Sex	Symptoms at onset	Bladder dysfunction
1 FG	26	F	Diplopia	No
2 PS	22	F	Paresthesias of upper limb	No
3 SP	25	F	Monolateral hypoaesthesia of upper limb	No
4 SG	28	M	Monolateral hypoaesthesia of upper limb	No
5 FL	24	F	Hemihypoaesthesia	No
6 MA	36	F	Hemiparesis and hemihypoaesthesia	No
7 SG	29	M	Monolateral trigeminal hypoaesthesia	No
8 RF	22	F	Monolateral trigeminal hypoaesthesia	No
9 AR	22	F	Monolateral hypoaesthesia of upper limb	Yes
10 MP	18	M	Paresthesias of lower limbs and diplopia	No
11 PP	38	F	Tetraparesis and monolateral hypoaesthesia of upper limb	Yes
12 PG	29	F	Optic neuritis	Yes
13 CL	42	F	Hemiparesis	Yes
14 NV	35	M	Monoparesis of lower limb and paresthesia of upper limb	Yes
15 EA	46	M	Paraparesis	No
16 IG	33	F	Optic neuritis	Yes

An increased III-V interpeak interval or the absence of the V wave of BAEP were found in four patients in spite of the absence of subjective and instrumental hearing impairment.

Urodynamic abnormalities were found in 12 patients: detrusor-sphincter dyssynergy was observed in seven patients (four symptom free and three affected by urge incontinence); four subjects, two asymptomatic and two with urge incontinence, showed detrusor hyperreflexia, while the remaining patient with retention showed detrusor areflexia. In the four remaining asymptomatic patients the urodynamic evaluation was normal. In the 12 patients with urodynamic impairment and in two of the four remaining patients pSEP were found to be abnormal.

MRI showed demyelinating lesions in 13 patients and oligoclonal bands were found in eight of them.

Discussion

MRI is suggested to be the most sensitive exam in the diagnosis of MS.¹³ The severity of the MRI abnormalities (number and size of lesions) does not always correlate with the duration of disease or the degree of disability.¹⁴ MRI showed demyelinating lesions in 81% of our patients. Evoked potentials may identify lesions in the different sensory pathways and play an important role as a diagnostic tool in MS. It is well known that the abnormality rate of multimodality evoked potentials increases with the duration of the disease and with clinical disability.¹⁵⁻¹⁹ A greater increase in VEP latency was found in patients with a greater disability rate,²⁰ without relation between VEP delay and duration of

the disease.²¹⁻²³ BAEP and tSEP abnormality rates increase significantly with disease duration and clinical disability.²⁴ BAEP have been found more frequently to be abnormal in patients with clinical signs of brainstem dysfunction.^{18,24,25} Median nerve SEP correlate well with clinical disability.²⁴ In previous studies a statistical correlation was found between detrusor hyperactivity or detrusor hypoactivity with disease duration, disability and neurophysiological findings.²⁶ Cortical evoked potentials following stimulation of the pudendal nerve were delayed in a high percentage of MS patients with bladder dysfunction,²⁷ however the real impairment rate of the pSEP is at present not well known in early stages of MS. Classical multimodality evoked potentials recorded in our patients showed an abnormality rate of 68.7%. VEP was abnormal in 43.7%, BAEP in 25%, mSEP and tSEP in 31.2%. The pSEP was found to be abnormal in 87.5% of our patients, showing a higher abnormality rate. Abnormalities of evoked potentials included the pSEP were found in 100% patients, and at least one asymptomatic lesion was observed in 87.5%. The urodynamic study showed an abnormality rate of 75% and all the patients with urodynamic impairment showed pSEP pathology. Our findings confirm the frequent involvement of the urinary central pathway in MS. The pSEP actually is a non-conventional somatosensory evoked potential in the diagnosis of MS and there is no data from the literature about the correlation of the pSEP with the duration of the disease and with the disability, but our data indicates a high abnormality rate since the early stages of the disease. We can conclude that lower urinary tract abnormalities can be found in the majority of patients affected by MS, independently of

Table 2 Results

Patient	VEP	BAEP	m SEP	t SEP	p SEP	Urodynamic study	MRI	CSF
1 Fg	N	N	N	N	N	N	A	N
2 PS	N	N	A	N	A	VSD	N	A
3 SP	A	A	N	A	A	N	A	N
4 SG	N	N	N	N	A	VSD	A	N
5 FL	N	N	N	N	A	N	A	N
6 MA	A	N	A	N	A	VSD	A	A
7 SG	A	A	A	A	A	DH	A	N
8 RF	A	N	N	N	A	N	A	A
9 AR	N	N	N	A	A	VSD	N	N
10 MP	N	N	N	N	A	VSD	A	A
11 PP	N	N	N	A	N	VSD	N	N
12 PG	A	A	N	N	A	DA	A	A
13 CL	A	N	A	A	A	DH	A	A
14 NV	N	N	N	N	A	VSD	A	A
15 EA	N	N	N	N	A	DH	A	A
16 IG	A	A	A	N	N	DH	A	N
I. rate	43.7%	25.0%	31.2%	31.2%	87.5%	75%	81.2%	50.0%

I. Rate: Impairment rate; A: Abdominal; N: Normal; VSD: Vesico-sphincter dyssynergia; DH: Detrusor hyper-reflexia; DA: Detrusor areflexia

Table 3(A) Evoked potentials: normative and patients data

	Normal values	Patients recordings		
		FG L-R	PS L-R	SG L-R
<i>VEP</i>				
Stimulus size	Highest P100 latency (ms), ($\times \pm 2.5$ SD)			
60'	114.7	101-102	106-108	106-105
30'	119.0	105-106	111-113	112-112
15'	126.5	108-110	120-121	123-120
<i>BAEPs</i>				
Components	Highest normal values (ms), ($\times \pm 2.5$ SD)			
I	1.8	1.5-1.7	1.2-1.4	1.6-1.6
III	3.9	3.0-3.2	3.3-3.3	3.3-3.1
V	5.9	5.4-5.4	5.5-5.5	5.6-5.5
<i>Interspike-intervals</i>				
I-III	2.56	1.5-1.5	2.1-2.2	1.7-1.5
I-V	4.45	3.9-3.7	4.3-4.1	4.0-3.9
III-V	2.34	2.3-2.2	2.1-1.9	2.3-2.4
<i>Median Nerve SEP</i>				
Components	Highest normal values (ms), ($\times \pm 2.5$ SD)			
N9	11.2	8.8-8.6	9.2-9.5	9.6-9.8
N13	15.0	12.4-12.3	13.7-13.7	12.7-12.6
N20	21.8	17.1-17.2	18.5-n.e.	18.3-18.1
<i>Interspike-intervals</i>				
N9-N13	5.0	3.6-3.7	4.5-4.2	3.1-2.8
N13-N20	7.5	4.7-4.9	4.8-	5.6-5.5
<i>Tibial nerve SEP</i>				
Components	Highest normal values (ms), ($\times \pm 2.5$ SD)			
N22	25.0	20.0-20.3	20.4-21.0	23.0-24.1
P37	46.0	37.0-37.1	38.3-38.5	44.2-43.9
<i>Pudendal nerve SEP</i>				
Components	Highest normal values (ms), ($\times \pm 2.5$ SD)			
P1	49.5	43.5	n.e.	n.e.

L = left side; R = right side; n.e. = not elicitable

Table 3(B) Evoked potentials: normative and patients data

FL	Patients recordings										IG	
	MA	SG	RF	AR	MP	PP	PG	CL	NV	EA		
L-R	L-R	L-R	L-R	L-R	L-R	L-R	L-R	L-R	L-R	L-R	L-R	L-R
103-105	102-111	103-108	121-116	101-103	99-100	108-107	118-108	113-107	104-104	98-100	106-111	
110-108	112-122	115-128	130-125	109-106	105-105	114-114	125-118	122-118	110-112	106-107	127-115	
116-118	118-135	122-134	140-132	118-114	110-110	121-123	132-124	130-124	116-118	111-113	n.e.-122	
1.5-1.6	1.4-1.2	1.5-1.5	1.6-1.5	1.4-1.4	1.4-1.5	1.3-1.4	1.3-1.3	1.6-1.6	1.4-1.6	1.4-1.3	1.6-1.5	
	3.4-3.4	3.8-3.7	3.6-3.6	3.3-3.3	3.3-3.3	3.0-3.0	3.7-3.4	3.7-3.8	3.5-3.5	3.4-3.6	3.8-3.4	
	5.6-5.5	6.8-5.6	5.5-5.4	5.2-5.2	5.4-5.4	5.4-5.2	6.1-5.8	5.7-5.7	5.7-5.7	5.4-5.5	n.e.-5.8	
1.7-1.8	2.0-2.2	2.3-2.2	2.0-2.1	1.9-1.9	1.9-1.8	1.7-1.6	2.4-2.1	2.1-2.2	2.1-1.9	2.0-2.3	2.2-1.9	
	4.2-4.3	5.3-4.1	3.9-3.9	3.8-3.8	4.0-3.9	4.1-3.8	4.8-4.5	4.1-4.1	4.3-4.1	4.0-4.2	?-4.3	
	2.2-2.1	2.3-2.5	1.9-1.8	1.9-1.9	2.1-2.1	2.4-2.2	2.4-2.4	2.0-1.9	2.2-2.2	2.0-1.9	?-2.4	
9.4-9.6	9.4-9.3	9.8-9.2	9.2-8.8	7.4-7.3	8.5-8.4	11.0-10.9	8.7-9.0	10.0-10.6	9.0-9.0	10.0-10.3	10.2-9.7	
	12.4-12.1	13.6-13.0	12.2-11.8	10.6-10.4	12.0-11.5	13.8-13.9	12.6-12.6	13.8-14.1	12.1-12.2	13.2-13.2	13.6-1.40	
	18.7-n.e	26.7-18.9	18.1-17.6	17.5-16.4	17.1-16.7	19.2-19.2	17.0-17.0	19.1-n.e.	17.0-17.2	17.7-18.0	18.8-24.7	
3.0-3.1	3.0-2.8	3.8-3.8	3.0-3.0	3.2-3.1	3.5-3.1	2.8-3.0	3.9-3.6	3.8-3.5	3.1-3.2	3.2-2.9	3.4-4.3	
	6.3-	13.1-5.9	5.9-5.8	6.9-6.0	5.1-5.2	5.4-5.3	4.4-4.4	5.3-	4.9-5.0	4.5-4.8	5.2-10.7	
22.2-22.6	19.6-20.2	18.6-19.6	17.2-18.2	20.4-21.0	21.0-21.0	19.4-19.6	18.1-18.5	21.1-22.0	19.0-18.8	22.2-22.4	20.4-21.1	
	36.8-36.0	48.0-48.0	35.8-36.8	36.6-n.e.	37.0-36.8	n.e.-39.0	37.8-38.2	45.0-48.0	38.2-38.6	41.8-42.3	38.6-40.3	
52.8	61.5	n.e.	52.0	55.0	n.e.	44.0	50.0	n.e.	51.0	54.0	45.0	

L = left side; R = right side; n.e. = not elicitable

the stage of the disease. pSEP is a worthwhile part of the initial diagnostic evaluation in patients affected by MS, providing information of diagnostic relevance. It helps in screening patients for urodynamic testing which, however, is more specific and by detecting urethrovesical dysfunctions may prevent urological complications.

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