Evaluation of sympathetic response in cases with failed back surgery syndrome

Başarısız bel cerrahisi sendromlu olgularda sempatik deri yanıtının değerlendirilmesi

Nilay ŞAHİN,[1] Lütfiye MÜSLÜMANOĞLU,[2] Ömer KARATAŞ,[3]
Ayşegül ÇAKMAK,[2] Emel ÖZCAN,[2] Ender BERKER[4]

Summary

Objectives: The aim of this study was to investigate whether sympathetic skin response (SSR) was affected in cases with failed back surgery syndrome (FBSS).

Methods: Twenty-nine cases admitted to our department and diagnosed as FBSS were recruited for the study. All the cases had back, leg or back and leg pain in the months or in one year following spinal surgery. The control group consisted of 13 healthy hospital personnel. Electrophysiologic nerve conduction studies and SSR recordings were applied on the symptomatic side (29 legs) in study cases and both sides (26 legs) in the control group. SSRs of the study group were compared with those of the sex-, body mass index- and age-matched control group of 13 people. Patients having peripheral nerve entrapment syndromes, peripheral vascular disease, neurologic or psychiatric disease, alcoholism, or drug abuse were excluded from the study. Pain intensity was recorded by visual analog scale (VAS) and depression was recorded by Beck Depression Inventory (BDI).

Results: Latency duration in SSR in the study group was significantly higher (p=0.006) when compared with the healthy controls. There was no SSR in 4 patients and there was a positive correlation between BDI and SSR (r=0.46).

Conclusion: It was concluded that the sympathetic nervous system is affected in FBSS patients with changes in SSR, and that the dysfunction of the sympathetic nervous system may contribute to the intensity and chronicity of pain states in this group of patients.

Key words: Chronic pain; failed back surgery syndrome; low back pain; sympathetic skin response.

Özet

Amaç: *Bu çalışmada, başarısız bel cerrahisi sendromlu (BBCS) olgularda sempatik sinir sisteminin etkilenip etkilenmediği araştırıldı.*

Gereç ve Yöntem: *Polikliniğimize başvuran ve BBCS tanısı konulan 29 hasta çalışmaya alındı. Tüm olguların bel operasyonu sonrası bir yıl veya aylar içerisinde başlayan, bel, bacak veya bel-bacak ağrısı vardı. Kontrol grubu ise 13 sağlıklı hastane personelinden oluşturuldu. Elektrofizyolojik sinir iletim çalışmaları ve sempatik deri yanıtı (SDY) ölçümleri hasta grubun semptomatik olan (29 bacak) ve kontrol grubunun ise her iki bacağında (26 bacak) yapıldı. Hasta grubunun SSR değerleri cinsiyet ve yaşları eşleştirilmiş 13 sağlam kontrol grubunun SSR değerleri ile karşılaştırıldı. Periferik sinir sıkışması, periferik dolaşım yetersizliği, nörolojik veya psikiyatrik hastalıklar, alkol veya kötü ilaç kullanımı olan hastalar çalışmaya dahil edilmedi. Hastalarda ağrı şiddeti Visuel Analog Skala (VAS) ile ve depresyon varlığı Beck Depresyon İndeksi (BDİ) ile araştırıldı.*

Bulgular: *Sağlıklı kontroller ile karşılaştırıldığında, SDY elde edilen latans sürelerinde hasta grubunda istatistiksel olarak anlamlı bir artış saptandı (p=0.006). BBCS'li hastaların 4'ünde SDY alınamadı ve BDİ ile SDY'nin arasında pozitif korelasyon belirlendi (r=0.46).*

Sonuç: *Başarısız bel cerrahisi sendromlu hastalarda sempatik sistemin etkilendiği, SDY değişikliklerin olduğu saptandı. Sempatik sinir sistemi tutulumunun BBCS'de görülen kronik ağrı gelişimine katkıda bulunabileceği düşünüldü.*

Anahtar sözcükler: Kronik ağrı; başarısız bel cerrahisi sendromu; bel ğarısı; sempatik deri yanıtı.

[1]Department of Physical Medicine and Rehabilitation, Selcuk University, Meram Faculty of Medicine, Konya, Turkey
[2]Department of Physical Medicine and Rehabilitation, Istanbul University, Istanbul Faculty of Medicine, Istanbul, Turkey
[3]Department of Physical Medicine and Rehabilitation, Bilecik State Hospital, Bilecik, Turkey
[4]Department of Physical Medicine and Rehabilitation, Vehbi Koc Foundation, American Hospital, Istanbul, Turkey

[1]Selçuk Üniversitesi Meram Tıp Fakültesi, Fiziksel Tıp ve Rehabilitasyon Anabilim Dalı, Konya
[2]İstanbul Üniversitesi, İstanbul Tıp Fakültesi, Fiziksel Tıp ve Rehabilitasyon Anabilim Dalı, İstanbul
[3]Bilecik Devlet Hastanesi, Fiziksel Tıp ve Rehabilitasyon Bölümü, Bilecik
[4]Vehbi Koç Vakfı Amerikan Hastanesi, Fiziksel Tıp ve Rehabilitasyon Bölümü, İstanbul

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Correspondence ***(İletişim):*** Nilay Şahin, M.D. Selçuk Üniversitesi, Meram Tıp Fakültesi, Fiziksel Tıp ve Rehabilitasyon Anabilim Dalı, Meram 42001 Konya, Turkey.
Tel: +90 - 332 - 233 71 50 **Fax** ***(Faks):*** +90 - 212 - 676 62 00 **e-mail** ***(e-posta):*** nilaysahin@gmail.com

Introduction

Low back pain (LBP) after the common cold is the second major health problem around the world.[1] 65-80% of the world's population may suffer from LBP sometimes in their lives and 80-90% or according to some studies 70-93% of those with LBP recover with or without simple treatments and only 1-2% this population are in real need of back surgery.[2] Among the population with LBP the prevelance of disc herniation is 5%, yet surgery to the lower back with this diagnosis is the most commonly performed procedure.[3,4] There is no concensus on surgical or non-surgical treatment choice in cases with herniated disc, excluding cauda-equina syndrome and progressive neurological deficit and this affects the positive out-comes of both treatments. Failed back surgery syndrome (FBSS) is a syndrome characterized by low back, leg or back and leg pain and functional impairment following back surgery and has a prevelance of 10-40%. The three main causes of this and uncommon lesions.[5]

These factors have variable prevelances and research reports state that lateral spinal stenosis has a prevelance of 29-58% and is the major cause for FBSS whereas recurring discal hernia, arachnoiditis, central stenosis, epidural fibrosis, instability, pseudoartrosis, discitis and psychological factors have frequencies of 12-17%, 1.1-16%, 7-29%, 6-9%, 5%, 14.8%, 0.1-3% and 3% respectively. Other causes of FBSS are unnecessary disc surgery, psychosocial factors like compresation, litigation demands and depressive syndromes.[5-10] Sympathetic skin response (SSR) is a temprorary change following internal external stimuli which evokes electrical skin potentials. It involves the polysynaptic reflex arc, myelinated afferents, central coordination modulation in posterior hypothalamus, reticular formation, efferent pathways in the spinal cord, sympathetic ganglions and preganglionic nerve fibers. SSR pictures the function of sympathetic patways and the dysfunction of the peripheral and central systems.[11]

Regarding FBSS as a chronic pain state and the contribution of the otonomous nervous system in the evaluation and maintenance of chronic pain, we have aimed to investigate whether sympathetic nervous was affected in cases with FBSS.

Materials and Methods

Design of the Study

The study group consisted of 29 cases with FBSS referred from our clinic. The control group consisted of 13 age, gender and body mass index (BMI) matched healty hospital personnel. The patients were fully informed about FBSS and both the patient oral/written consent and ethical conset was obtained.

Exclusion and Inclusion Criteria

Patients aged 20-60 who gave both verbal and written consent to undergo the study who formerly underwent back surgery and had pain of leg, back or back and leg the following month to a year after the surgery were recruited for the study. Those with high levels of liver enzymes, hepatic failure, high levels of creatinin as well as those with diabetes, vitamin defficiency, connective tissue disease, neuropathic pain of multiple lesions, peripheral vascular disease, nerve entrapment syndromes, cardiovascular syndromes like unstabil angina and hypertension and those with alcohol and drug abuse were excluded from the study.

Evaluation

Both groups were given a comprehensive physical examination and demographic data were recorded. The study group was also examined for the intensity of pain, lumbar range of motion, muscle strength, muscular atrophy of the attacked extremity and sensory integrity. Pain at rest, in motion and at night was also noted on a 1-10 mm VAS and pain intensity in the past week was also noted.[12] Beck depression inventory (BDI) was used for psychological evaluation for depression which is a commone symptom in FBSS and higher scores as 24 or higher indicate severe depression.[13]

Electrophysiologic Study

The testing was performed with a ESAOTE-phasis apparatus in a quiet, ventilated room with a temprature of 25-26°C, keeping the skin temprature at 32°C. Tibial, sural and peroneal nerves were electromyography (EMG) tested and SSR of the tibial nerve was recorded in both groups. The affected lower extremity of the study group was also EMG tested. Both groups were asked to have a good

Table 1. Demographic features of the study (FBSS) and control groups (CG)

	FBSS (n:29)	CG (n:13)	p
Gender (Female) (%)	65.5	61.5	0.772
Age	48.17± 8.93	48.17± 6.98	0.759
Body mass index	26.81±2.72	26.11±2.59	0.331
Pain duration (Month)	24.38±27.83		
Sensory deficit (%)	20.7		
VAS (0-10 mm) *			
on motion		7.10±1.67	
at rest		5.03±2.38	
at night		4.52±2.54	
Beck depression inventory **		18.65±11.11	

Mean values ± SD.
* 0-10 mm scale; 0: no pain; 10 intense intolerable pain.
** >18 there is depression.

night's sleep and refrain from alcohol and caffein, stop taking anti-cholinergic drugs 48 hours before testing. Motor conduction velocities of the tibial and peroneal nerves were recorded and amplitude and latency were recorded from abductor hallucis brevis and extensor digitorum brevis muscles. Sensory conduction was recorded from the sural nerve.

Motor distal latency (>6 ms) for tibial and peroneal nerves, amplitude (<5.3) and (>16) for tibial nerve, amplitude (<2) ve (>8.2) for peroneal nerve, distal latency (>3.6) and amplitude (<10) and (>43) for sural nerve was interpreted as abnormal. L3-S1 innervated muscles of both legs of the study group was also tested by needle EMG. Electrophysiological recordings: tibial nerve was stimulated by supramaximal stimulus (0.5-1/h) by applying active recording electrode on the plantar and reference electrode on dorsal side of the foot. Stimulus was given with intervals longer than 1 min. Basal duration was 5 sec and amplifier filter was set at 2 Hz for low frequency and at 200 Hz for high frequency with a sensitivity of 200 μV/div. The 10 best individual responses and their mean was recorded. SSR latency was evaluated due to variable amplitudes applied in this study. Latency was measured from the start of the stimulus artefact to the first negative deflexion. Patients with no response to 3 maximal stimulus recordings with 50 μV/div voltage sensitivity were accepted as non-responders. SSR was recorded at lower extremities of both the study and the control groups and recordings were compared.

Statistical Analysis

Independent samples t-test was used for evaluation of the difference between age and BMI among the groups. Maximum SSR latency of 20 was accepted as latency value in FBSS cases with no SSR and non-parametric test was used for the comparison between groups. Non-parametric test was used for the correlation between SSR and BDI.

Results

The study group consisted of 10 males and 19 females with a mean age of 48.84±6.98 and the control group consisted of four males and nine females with a mean age of 48.17±8.93. There was no statistical difference in regard to age, gender, height and weight between the groups (p>0.05) (Table 1). 3.4% of the FBSS patients had surgery on the L2-3 level, 52% on the L4-5 level and 13.8% on the L5-S1. 27.6% of the study group had multiple level operations, 6.9% had three operations whereas 10.3% had two and 82.8% had only one operation. The surgical interventions were discectomy in 48.3%, laminectomy in 13.8% discectomy plus laminectomy in 31% and fusion in 6.9% of the cases. The indication for surgery was lumbar disc hernia in 89.7%, lumbar spinal stenosis in 6.8% and other indications in 3.4% of the cases (Table 2). The mean duration of pain was 24.38±27.83 months.

The cases had pain radiating from the back to the right leg (n:16) and to the left leg (n:13) and 20.7%

Table 2. Diagnosis and surgical intervention in FBSS cases

		Ratio (%)
Level	L2-3	3.4
	L4-5	55.2
	L5-S1	13.8
	Many levels	27.6
Causes of operation	Lumbar disc herniation	89.7
	Lumbar spinal stenosis	3.4
	Lumbar osteoarthiritis	3.4
	Others reasons	3.4
Types of operation	Discectomy	48.3
	Laminectomy	13.8
	Discectomy + Laminectomy	31.0
	Fusion	6.9

of them had dermatomal sensory deficit noted in physical examination.

The VAS scores were 7.10±1.67 in motion, 5.03±2.38 at rest and 4.52±2.54 at night. Lower extremity tibial and peroneal motor, and sural sensory conductions were normal in all cases. Needle EMG studies on the FBSS cases demonstrated that six patients had only one nerve root compression on the symptomatic side, three patients had two nerve root compressions, two patients had two nerve root compressions on the same side, three patients had one root compression on the both sides, three patients had two root compression on both sides and one patient had multiple root compression on one side. Twelve patients had normal findings. Four patients had no SSR. There was a statistically significant longer duration of SSR latency of the painful leg in FBSS cases compared to 26 lower extremity values of normal controls (p=0.006) (Table 3). There was also a significant longer SSR latency between non-symptomatic extremities of FBSS cases and controls (p=0.005) (Table 3). BDI of the patients was 18.65±11.11 and there was a positive correlation between SSR (p=0.46).

Discussion

FBSS syndrome is one of the causes of chronic pain and is a mixture of neurogenic and nociceptif components.[14] The underlying pathology should be treated in the treatment of FBSS symptoms[15] and in these cases a comprehensive evaluation of the patient is the first step since this syndrome leads to severe chronic disability and is usually unresponsive to standard treatment with no general treatment algorythm.

The pain in FBSS may originate from shearing compression and deformation of the dorsal root during

Table 3. SSR of both groups

	Latency (ms)				p*
	Min	Max	Mean	S.D.	
CG		0.67	3.15	1.87	0.43
Symptomatic leg in FBSS	1.45	20.00	4.54	6.30	0.006
Asymptomatic leg in FBSS	1.43	20.00	4.04	5.64	0.005

* Statistical difference between SSR in CG and symptomatic leg and asymptomatic leg in FBSS (p<0.05 as statistical significance).

surgery which may trigger central sensitization yet this is not the sole factor.[16] Besides central sensitization and the inhibition of inhibitory pathways, another step in the generation and maintenance of chronic pain is the dysfunction of autonomic nervous system.[17] SSR which evaluated the integrity of sudomotor fibres with a reflex arc composed of myelinated fibres, brain, spinal cord, and pre-post ganglionic fibres demonstrates autonomic dysfunction.[18]

In this study we have demonstrates the involvement of the sympathetic nervous system which was severe with no SSR in FBSS cases. We have found that sympathetic nervous system was attacked on the non-painful leg also. Dysfunction of the sympathetic system in FBSS may be due to several factors and longer latency in SSR may be the result of loss of axons and preganglionic fibres since non-myelinated axons are four times more in concentration than myelinated axons in most somatic nerves and non-myelinated C fibres in somatic nerves are the ones affected in SSR.[18,19]

Injury to the somatic tissues leads to changes of excitability and neuronal activity in supraspinal and spinal centres and autonomic nervous system which is reflected in SSR.[20] Musculoskeletal injury during surgery may affect somatic tissues and autonomic nervous system which is reflected in SSR. Coupling between nociceptif afferents and sympathetic efferents may be another factor for autonomic involvement and SSR changes in FBSS cases.[21]

Chronic compression or constriction of the spinal nerves during surgery may induce the excitatory neurotransmitters like substance P, calcitonin genrelated peptide, vasoactive intestinal peptide and neuropeptide Y all of which play roles in allodynia and hyperalgesia.[22]

Changes in microcirculation of the tissues induced by surgery may also be responsible for dysfunction of the autonomic nervous system.[23] Another step in the induction and maintenance of pain is the stress system and stress response which may be induce by reduced homeostasis. In this case adaptation mechanisms may act as stressors and induce functional changes in the limbic system, pain transmission and psychologic systems.[17]

Activation of the nociceptif afferents is related to autonomic stimulation and this state has a negative effect on visceral function and homeostasis.[15] As a result autonomic nervous system dysfunction in FBSS cases leads to reduced homeostasis and contributes to pain maintenance. Our finding of SSR anomalies in the non-symptomatic leg of FBSS cases is interpreted as due to reduced homeostatic balance which induced stress and affected the central stress response with sympathetic response changes.[17]

Pain in FBSS also leads to sleep disturbances, familial and social problems and depression.[24] The positive correlation between BDI and SSR shown in our study supports this data.

Sympathetic nervous system changes in FBSS is a contibuting factor in pain induction and maintanence. Imaging procedures may direct to correct diagnosis in 90% of the cases with foraminal stenosis, recurrent disc or iatrogenic instability yet there are many other factors mentioned above that also induce pain and contibute to maintenance. The sympathetic nervous system dysfunction should be considered and evaluated in FBSS cases.

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