



## August 1998 EMG Case-of-the-Month

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### **HISTORY**

The patient is a 39-year-old man who has had aching pain in both feet for 9 months. It was initially noted when he awoke from a nap during a cross-country plane trip. At that time the aching pain was associated with a burning sensation which has subsequently subsided. He states that he may have slept with his neck "crooked", but he remembers no neck pain. He also had no significant low back pain at the time, but about 2 months later he did notice the gradual onset of mild low back pain followed by coccygeal pain 3 months after that. Since the episode on the plane, he has had persistent aching pain and a "pins and needles" sensation from the lower calves into the feet. He also continues to have low back pain and aching and burning pain in the "tail bone". This latter discomfort does not extend into the lower limbs.

- **Prior to continuing, please develop a differential diagnosis, and list each diagnosis in order of likelihood.**
- **Is there any additional information from the clinical history that might be helpful in clarifying your differential list or changing its order of priority?**

### **COMMENTARY I**

The following diagnoses should be included on the differential list of possibilities:

1. Sciatic neuropathy
2. Lumbosacral radiculopathy
3. Medial/lateral plantar neuropathy (Tarsal Tunnel Syndrome)
4. Lumbosacral plexopathy
5. Cervical myelopathy
6. Peripheral polyneuropathy, especially hereditary susceptibility to pressure palsies

Since the onset of symptoms began during sleep on an airplane, the most likely cause of the problem is compression neuropathy. The fact that symptoms are bilateral raises the possibility of more than one lesion, perhaps symmetrical compression neuropathies. If two (or more) lesions occurred simultaneously, the possibility that the patient's nerves are unduly susceptible to injury from pressure should be considered.

The contour of airplane seats results in pressure across the back of the thighs, thus raising the possibility of prolonged pressure on the sciatic nerves. Airplane leg/footrests, if present, could conceivably cause pressure on the tibial or plantar nerves. Either of these would require two sites of compression. A much less likely site of compression neuropathy requiring bilateral lesions to explain the patient's symptoms would be the lumbosacral plexus.



When bilateral symptoms are present, one must always consider the possibility of a single site of pathology, in this case, the lumbosacral nerves or perhaps the cervical spinal cord. The history thus far does not suggest either of these sites.

Additional history should include a search for a possible episode of compression. Also, symptoms relating to the neck and lower back should be probed. Finally, additional information including a family history relating to a possible peripheral neuropathy should be explored.

## **HISTORY, continued**

The patient does not recall any sites of pressure on his lower limbs during the flight. However, he does remember one episode of bilateral foot pain and numbness after falling asleep on a plane for 8 hours about 2 years ago. These symptoms lasted a few days and resolved spontaneously. He also describes an episode of numbness of both hands in a glove distribution occurring 5-6 months ago and lasting about one hour.

The patient's foot pain is constant and not aggravated or alleviated by ambulation, medication or other factors. He states he had considerable swelling of his feet during his first episode of foot pain 2 years ago and swelling of a lesser degree 9 months ago when his foot pain became constant.

Sitting or standing stationary increases the patient's low back pain within minutes. Walking and running seem to help alleviate the low back pain, as does lying supine with his lower limbs elevated. Naproxen also gives some relief. His symptoms remain unchanged with coughing, sneezing and Valsalva. He has experienced no changes in bowel or bladder function.

The patient denies neck pain and has no pain, numbness or tingling in the upper limbs. He does not feel weak. There is no history of diabetes or alcohol abuse. There is no family history of neuromuscular disease.

- **If necessary, revise your differential diagnosis based on the additional clinical history.**
- **On which details of the physical examination should you focus at this point?**

## **COMMENTARY II**

The differential diagnosis requires some revision in light of the additional history:

1. Sciatic neuropathy
2. Medial/lateral plantar neuropathy (tarsal tunnel syndrome)
3. Hereditary polyneuropathy with susceptibility to pressure palsies
4. Lumbosacral radiculopathy
5. Cervical myelopathy
6. Lumbosacral plexopathy

The patient's history of transient episodes of numbness and/or pain in the upper and lower limbs and the persistent symptoms in the distal lower limbs brings the diagnosis of hereditary neuropathy with susceptibility to pressure palsies under serious consideration. The patient's age is consistent with this condition as well, but the absence of a family history reduces the probability.



Compression neuropathy remains the likely cause of the patient's symptoms with sciatic neuropathy and tarsal tunnel syndrome as the most likely sites. The former would be due to pressure on the thighs by the seat. The latter could be due either from external pressure or from ankle swelling.

Lumbosacral radiculopathy, lumbosacral plexopathy and cervical myelopathy seem unlikely at this point, but the physical examination should be geared toward excluding these possibilities. Signs of nerve root tension and indications of upper motor neuron involvement should be explored. Also, an examination for localization of focal compression should be performed including Tinel's signs at the ankles and posterior thighs, and a detailed sensory examination including proprioception, soft touch, and vibration testing.

## PHYSICAL EXAMINATION

The patient is alert, cooperative and of normal build. On manual muscle testing, no weakness is detected in the upper or lower limbs. Specifically, the patient is easily able to perform 10 toe raises bilaterally. Muscle stretch reflexes are easily elicited and symmetric bilaterally: 3+ for biceps, brachioradialis, triceps, knee jerks, 2+ for medial hamstrings, ankle jerks. There is no Babinski sign. No sensory deficit is detected in the upper limbs. In the lower limbs, the patient is dysesthetic to pinprick over the tibial nerve distribution. No loss of light touch, vibration or proprioception is found. Gait and tandem gait are within normal limits. There is tenderness over the coccyx. Straight leg raising is within normal limits bilaterally in combination with ankle dorsiflexion and neck flexion. There is no medial or lateral laxity of the ankles and no tenderness to palpation over the ankles or digits in the feet bilaterally. There is no swelling, edema or erythema of the feet or ankles. Tinel's sign was not present over the tibial nerves at the ankles.

- **At this point, review your differential diagnosis and revise as appropriate.**
- **Are there additional observations on physical examination that might be helpful in narrowing your differential list?**

## COMMENTARY III

In the absence of long tract signs, cervical myelopathy, at this point, has been effectively excluded. Since lumbosacral plexopathy was never strongly considered, the absence of physical findings to support that diagnosis leads to its exclusion. Lumbosacral radiculopathy (perhaps limited to the S1 segmental levels bilaterally) remains no more than a slight possibility for the same reason.

The most likely diagnosis at this point is focal compression neuropathy of the medial and/or lateral plantar nerves since sensory loss is confined to that distribution. Compression neuropathy of the sciatic nerves is the next most likely possibility. If either of these proves to be the problem, hereditary sensitivity to pressure palsies needs to be considered. The differential list is thus revised as follows:

1. Medial/lateral plantar neuropathy (tarsal tunnel syndrome)
2. Sciatic neuropathy
3. Hereditary polyneuropathy with sensitivity to pressure palsies
4. Lumbosacral radiculopathy



**PHYSICAL EXAMINATION, continued**

No additional physical findings were observed.

- **Design your approach to the electrophysiologic examination based on the existing data.**

**ELECTROPHYSIOLOGIC DATA**

<b>ELECTROMYOGRAPHY</b>										
N = normal incr = increased decr = decreased 0 = absent 1+ = minimal 4+ = maximal crd = complex repetitive discharge fasc = fasciculation potential myk = myokymic discharge myt = myotonic discharge nmt = neuromyotonic discharge p wave = positive sharp waves fib = fibrillation potentials recr = recruitment amp = amplitude dur = duration poly = polyphasic potential										
R/L	MUSCLE	INSERTION		SPONTAN		VOLUNTARY				
		activ	p wave	fib	other	recr	amp	dur	poly	effort
R/L	paraspinal, lower cervical	N	0	0	0	N	N	N	N	-
R/L	paraspinal, upper lumbar	N	0	0	0	N	N	N	N	-
R/L	paraspinals, lumbosacral	N	0	0	0	N	N	N	N	-
L	vastus lateralis	N	0	0	0	N	N	N	N	full
L	anterior tibialis	N	0	0	0	N	N	N	N	full
L	medial hamstrings	N	0	0	0	N	N	N	N	-
L	peroneus longus	N	0	0	0	N	N	N	N	full
L	posterior tibialis	N	0	0	0	N	N	N	N	-
L	biceps femoris	N	0	0	0	N	N	N	N	-
L	gluteus maximus	N	0	0	0	N	N	N	N	full
L	lateral gastrocnemius	N	0	0	0	N	N	N	N	-
R/L	medial gastrocnemius	N	0	0	0	N	N	N	N	-
R/L	abductor hallucis	N	0	0	0	N	N	N	N	-
L	abductor digiti quinti	N	0	0	0	N	N	N	N	-



SENSORY/ MIXED NERVE CONDUCTION									
nr = no response									
NERVE	LATENCY (ms)			AMPLITUDE (µV)			CONDUCT VEL(m/s)		
	R	L	Norm	R	L	Norm	R	L	Norm
ulnar	-	-	-	-	-	-	-	-	-
wrist to little finger	2.9	-	<3.6	25.0	-	>20.0	-	-	-
superficial peroneal	-	-	-	-	-	-	-	-	-
mid-leg to ankle	3.4	3.4	<4.0	14.0	12.0	>5.0	-	-	-
sural	-	-	-	-	-	-	-	-	-
calf to ankle	3.4	3.3	<4.0	25.0	23.0	>20.0	-	-	-
medial plantar	-	-	-	-	-	-	-	-	-
forefoot to above ankle	6.9	nr	<3.6	10.0	-	>15.0	-	-	-
lateral plantar	-	-	-	-	-	-	-	-	-
forefoot to above ankle	nr	nr	-	-	-	-	-	-	-

MOTOR NERVE CONDUCTION									
nr = no response									
NERVE	LATENCY (ms)			AMPLITUDE (mV)			CONDUCT VEL(m/s)		
	R	L	Norm	R	L	Norm	R	L	Norm
tibial	-	-	-	-	-	-	-	-	-
popl. fossa to med. foot	13.4	13.4	-	13.0	12.0	-	-	-	-
ankle to medial foot	4.4	4.5	<4.9	12.0	14.0	>5.0	47.0	47.0	>40.0

H-REFLEX							
NERVE	LATENCY (ms)			AMPLITUDE(mV)			
	R	L	Norm	R	L	Norm	
tibial	-	-	-	-	-	-	-
popl. fossa to med. gastroc.	31.1	30.8	<34.4 Bryant & Eng	8.0	7.0	-	-

\*The needle electromyogram was within normal limits including the intrinsic muscles of the feet. Stimulation of the plantar nerves bilaterally evoked no recordable response from the lateral plantar nerves or the left medial plantar nerve. The right medial plantar nerve had a normal latency but an abnormally small amplitude. The remainder of the nerve conduction studies were within normal limits including H-reflexes across the sciatic nerve and the S1 segmental level.

- **Are there additional electrophysiologic data that you feel would further delineate the diagnosis? (Remember, collecting data that are not needed for the diagnosis is costly and uncomfortable for the patient.)**



**COMMENTARY IV**

The lack of findings on physical examination plus the normal EMG and H-reflexes excludes both sciatic neuropathy and lumbosacral radiculopathy. The next step is to confirm the bilateral plantar nerve problem and to search for evidence of nerve damage at common sites of compression (e.g. ulnar nerve at the elbow, peroneal nerve at the head of the fibula, etc.). The latter is to determine if electrodiagnostic data might support the diagnosis of hereditary susceptibility to pressure palsies.

**ELECTROPHYSIOLOGIC DATA, continued**

NEAR-NERVE CONDUCTION (NEEDLE RECORDING)			
nr = no response			
NERVE	LATENCY (ms)		
	R	L	Norm
medial plantar	-	-	-
forefoot to above ankle	7.1	7.5	<3.6
lateral plantar	-	-	-
forefoot to above ankle	7.0	nr	<3.4

MOTOR NERVE CONDUCTION									
nr = no response									
NERVE	LATENCY (ms)			AMPLITUDE (mV)			CONDUc VEL(m/s)		
	R	L	Norm	R	L	Norm	R	L	Norm
ulnar	-	-	-	-	-	-	-	-	-
above elbow to hypothenar	8.9	9.1	-	10.0	9.0	-	-	-	-
below elbow to hypothenar	7.0	7.3	-	11.0	11.0	-	53.0	56.0	-
wrist to hypothenar	3.1	3.2	<4.0	11.0	12.0	>6.0	62.0	58.0	>50.0
peroneal	-	-	-	-	-	-	-	-	-
above head of fibula to EDB	11.5	11.4	-	6.0	6.0	-	-	-	-
below head of fibula to EDB	9.4	9.2	-	7.0	7.0	-	47.0	45.0	-
ankle to EDB	3.9	3.7	<4.2	7.0	8.0	>5.0	49.0	49.0	>40.0

- **This is the conclusion of data collection. On the basis of both the clinical and electrophysiologic evaluations, formulate your diagnostic impression. List the most likely diagnosis first and follow in order with the other possibilities**



**that are not excluded by the data. Eliminate those diagnoses not supported by the data.**

## **DIAGNOSTIC IMPRESSION**

1. There are focal neuropathies of the medial and lateral plantar nerves at the ankle, left worse than right.
2. Hereditary neuropathy with susceptibility to pressure palsies has not been excluded, but does not seem likely.

## **COMMENTARY**

The near-nerve recordings from the plantar nerves confirm the diagnosis of tarsal tunnel syndrome that had been rather well established by surface recordings.

Multiple sites of nerve compression as determined from the history, physical examination and electrodiagnostic studies, some transient, raised the possibility of hereditary susceptibility to pressure palsies. However, there is no family history, and there are normal values for nerve conduction across common sites of nerve compression, neither of which support this diagnosis. Although the diagnosis has not been entirely excluded, it is not sufficiently likely to warrant further investigation, ie. nerve biopsy, at this time. The primary treatment is to take steps to avoid pressure on nerves, something patients often do on their own. This patient was advised accordingly.

The initial referral for electrodiagnostic medicine consultation was made with the provisional diagnosis of peripheral neuropathy, although extensive laboratory work-up till that time was essentially negative. Also, the acute presentation during sleep with little subsequent change over a 9-month period makes this diagnosis unlikely. The findings on this examination also fail to support the diagnosis.

At the time EMG and nerve conduction studies were performed, the patient had already had an MRI of the cervical and lumbar spine, later read as normal.

Typical symptoms of tarsal tunnel syndrome include numbness and paresthesias of the toes and soles of feet, with burning pain. There also may be proximal extension of the symptoms into the calf. In this case, associated ankle swelling was the clue leading to the suspicion of tarsal tunnel syndrome, but the case was confused by the onset of unrelenting low back pain. Tinel's sign at the ankle would correlate with Wallerian degeneration/regeneration, but in this case it was not present. Its absence is consistent with the lack of fibrillation in the intrinsic muscles of the foot.

Although fibrillation with needle electromyography of intrinsic muscles of the normal foot has been reported, the abductor hallucis muscles in this patient were studied bilaterally and showed no spontaneous activity.

The mixed nerve technique for recording compound nerve action potentials of the medial and lateral plantar nerves is relatively easy to perform and more sensitive to early change than a motor conduction potential. In our case, the tibial motor studies were normal but the mixed nerve action potentials for the medial and lateral plantar nerves were either absent or diminished in amplitude. Surface recordings are useful for detection of entrapment in tarsal tunnel syndrome, but are at times the compound nerve action potentials are



technically difficult to elicit. Near-nerve recording using a needle electrode is a sensitive technique, and in this study helped to confirm the diagnosis.

## **BIBLIOGRAPHY**

1. Madrid R, Bradley WG: The pathology of neuropathies with focal thickening of the myelin sheath (tomaculous neuropathy). *J Neurol Sci* 1975; 25: 45.
2. DeLisa JA, Saeed MA: AAEE case report #8: The tarsal tunnel syndrome. *Muscle Nerve* 1983; 6: 664-670.
3. Mackinnon SE, Dellon AL, Daneshvar A: Tarsal tunnel syndrome: histopathologic examination of a human posterior tibial nerve. *Contemporary Orthopaedics* 1984; 9: 43-48.
4. Gatens PF, Saeed MA: Electromyographic findings in the intrinsic muscles of normal feet. *Arch Phys Med Rehabil* 1982; 63: 317-318.
5. Saeed MA, Gatens PF: Compound nerve action potential of the medial and plantar nerves through the tarsal tunnel. *Arch Phys Med Rehabil* 1982; 63: 304-307.
6. Oh SJ, Sarala PK, Kuba T, Elmore RS: Tarsal tunnel syndrome: electrophysiological study. *Ann Neurol* 1979; 5: 327-330.
7. Oh SJ, Kim HS, Ahmad BK: The near-nerve sensory nerve conduction in tarsal tunnel syndrome. *J Neurol Neurosurg Psychiatry* 1985; 48: 999-1003.