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Conduction Studies of the Saphenous Nerve in Normal Subjects and Pathients with Femoral Neuropathy

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Conduction velocity of the saphenous nerve was studied antidromically. The value in 20 control subjects was 42.22 ± 4.83 (SD) m/sec.

In 7 patients with femoral neuropathy, the sensory nerve conduction in the symptomatic nerves was definitely abnormal : nerve potential was absent in 4 and conduction velocity was slow in 2. In 1 patient, a possible asymptomatic femoral neuropathy was suggested by this test.

Conduction velocity of the saphenous nerve can be used as an objective diagnostic aid in femoral neuropathy, saphenous neuropathy and polyneuropathy.

Key Words: femoral neuropathy, saphenous neuropathy, antidromically.

Since Dawson and Scott (1948) demonstrated that it was possible to detect evoked potentials with surface electrode stimulation and Dawson (1956) recorded the first purely sensory action potentials in man, the measurement of sensory nerve conduction has proved to be a valuable electrodiagnostic technique (Goodgold and Eberstein, 1977).

Although the sensory portions of nerves in extremities have been extensively studied, the corresponding branches of the femoral nerve have been relatively neglected (Ertekin, 1969; Wainapel, *et al.*, 1978).

The saphenous nerve is the largest and longest branch of the femoral nerve, a purely sensory nerve and derived from the Arabic word for "visible" (Fig. 1).

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This is a report of saphenous nerve conduction velocity in normal subjects and patients with femoral neuropathy.

MATERIALS AND METHODS

Twenty volunteers (11 men and 9 women) 23 to 55 years old, served as controls. Skin temperatures varied from 29 to 32.5°C.

Diagnosis of femoral and/or Saphenous neuropathy was made when weakness of quadriceps muscles and/or subjective burning pain and objective altered touch and pain sensation over the territory of the saphenous nerve on the medical aspect of the knee and leg as well as a small area on the foot occurred together (Calverly and Mulder, 1960; Wainapel, *et al.*, 1978).

Five patients with femoral neuropathy and two patients with saphenous neuropathy were

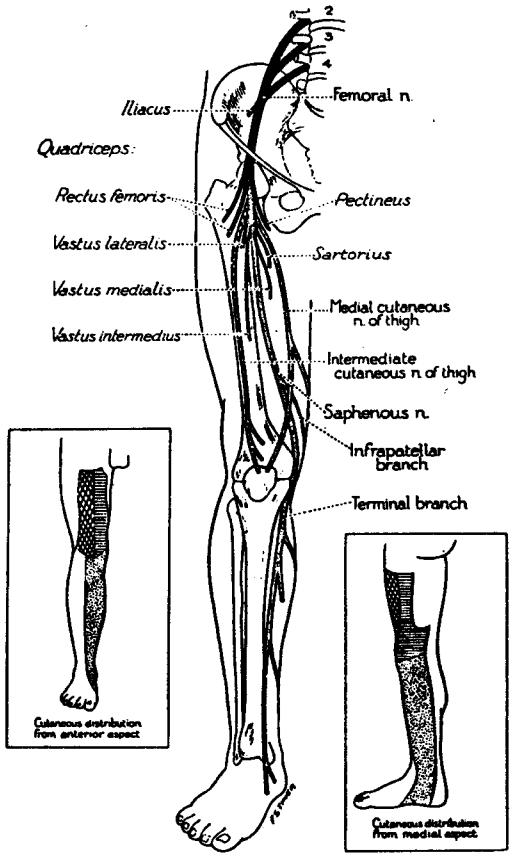

Fig. 1. The course and distribution of the saphenous nerve.

electrophysiologically evaluated (Table 1). The symptoms were confined to one side in all patients : to the left in 5 and the right in 2.

Five patients were men and two were women, and ages ranged from 25 to 51 years.

Femoral neuropathy was due to a complication following injury, hernia operation or gun shot.

No cause identified in 2 patients with saphenous neuropathy.

Sensory nerve conduction in the saphenous was studied with the pickup surface disc electrodes (9 mm in diameter), placed just anterior to the highest prominence of the medial malleolus, in the space between the malleolus and the medial border of the tibialis anterior tendon.

The proximal electrode is located 3 cm above the other and just medial to the aforementioned tendon, whose direction is paralleled by a line down between pickup electrodes.

The site of stimulation is located approximately 11 to 18 cm above the proximal pickup electrode, deep to the medial border of the tibia. Firm pressure should be exerted on the stimulating electrodes, pushing them between the medial gastrocnemius and the tibia. To facilitate this, the gastrocnemius should be relaxed by position the ankle in slight plantar flexion.

The 32 to 64 stimuli were often average with a signal averager. Latency was measured from the start of the stimulus to the negative peak of nerve potential.

Conduction velocity was calculated by dividing the distance by the latency.

For comparison, the symptomatic saphenous nerve was also studied in all patients. Femoral nerve was also studied in patients with femoral neuropathy (Gassel, 1963).

Nerve conduction velocity measurements that differed from normal mean values by more than 2 SD were considered abnormal. Skin temperature of the thigh was recorded in every patient and ranged from 30 to 32.8°C.

RESULTS

In the controls, conduction velocity of the saphenous nerve was 42.33 ± 4.83 m/sec (mean ± SD), ranging from 35.1 to 54.55 m/sec. The amplitude of nerve potential was 4 to 10 μV.

In 6 of 7 patients, nerve conduction velocity of the asymptomatic saphenous nerve was normal; in 1 patient; it was slow (Table 1). The amplitude of nerve potentials ranged 1.5 to 10 μV. In the sumptomatic saphenous nerves, the nerve potential was not recordable in 4 patients. In 2 patients, the sensory nerve conduction velocities were slow, ranging from 27.2

Table 1. Clinical and Electrophysiological Data on 7 Patients with Femoral Neuropathy and 20 Controls

Patient	Age(yr)	Sex	Clinical Data	Latency (m/sec)	Distance (cm)	Amplitude (μV)	N.C.V. (m/sec)
1	51	F	Left femoral neuropathy, left hernia Op. No D.M.	Lt. N.P*	16.5		N.P
				Rt 5.3	16.5	1.5	30.5
2	26	M	Left femoral neuropathy, injury	Lt 6.3	18.3	1	29.4
				Rt 4.8	17	10	35.4
3	42	M	Left femoral neuropathy, injury	Lt N.P	14.3		N.P
				Rt 3.2	14.3	5	44.7
4	29	M	Right femoral neuropathy, gun shot	Lt 3.5	16.5	10	47.1
				Rt N.P	16.5		N.P
5	25	M	Right femoral neuropathy, injury	Lt 3.9	16	1.5	41
				Rt N.P	16		N.P
6	26	M	Left saphenous neuropathy, idiopathic	Lt 6.7	26	7	27.2
				Rt 5.0	18	2.5	36
7	39	F	Left saphenous neuropathy, idiopathic	Lt 3.9	14	5	35.8
				Rt 3.9	16	7.5	40
Controls	23-55	M:11 F : 9		2.1-4.7	11-17.5	4-10	32.67-51.99 (mean±2SD)

* N.P : No recordable potentials

** Normal N.C.V of femoral nerve in 5 patients with femoral neuropathy

to 29.4 m/sec, and in the remaining one patient, the sensory nerve conduction velocity was within normal limit, but slower (35.8 m/sec) than a asymptomatic saphenous nerve (40 m/sec).

The amplitude of nerve potential as 1 to 7 μV.

The motor nerve conduction veloc of the femoral nerve was within normal limits in 5 patients with femoral neuropathy.

DISCUSSION

In 1969, Ertekin reported the technique of determining sensory nerve conduction velocity of the saphenous nerve.

The nerve potential was orthodromically obtained by stimulating with surface electrodes at the level of the medial malleolus or medial to the knee and recording with needle electrodes placed in close proximity to the femoral nerve trunk at the inguinal ligament.

Using Ertekin's technique, the mean amplitude of the evoked response was 4.2 μV in normal subjects with the mean age of 26 years and 3.6 μV in those with a mean age of 51.

Conduction velocities were 52.3 ± 2.3 m/sec in the ankle-to-knee segment of the nerve (N=10) and 59.6 ± 2.3 m/sec in the knee-to-groin segment (N=33).

In 1978, Wainapel, Kim and Ebel described the antidromic technique using this study. The mean amplitude of the evoked response was 9 μV in normal subjects. Conduction velocities were 41.7 ± 3.4 m/sec.

Compared with Ertekin's orthdromic method, the antidromic technique had the following advantages : 1) It is less painful, eliminating the need for needle electrode pickup of evoked

responses or prior localization of the femoral nerve by electrical stimulation through the needle. 2) The mean amplitude of the evoked response is 2 to 2½ times greater. 3) It is technically simpler to perform.

Compared with 2 previous studies, the mean noraml valve of conduction velocity in my study is slower and the mean amplitude of the evoked potential was greater than that of Ertekin, and lower than that of Wainapel, *et al.*

Conductive velocities in the clinically unaffected nerves of my patients were within normal limits, with one exception. This could have been caused by asymptomatic neuropathy. In all patients, conduction velocity in the symptomatic nerves was definitely either slow or unobtainable when compared with the asymptomatic side or with valves recorded in the controls.

This finding indicates that determination of conduction velocity in the saphenous nerve can be used as a diagnostic test in femoral neuropathy, saphenous neuropathy and polyneuropathy.

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