DETECTION OF SENSORY DISTURBANCES IN 23 HAVS CASES WITH TYPICAL ARTERIAL DISORDERS: 15 HYPOTHENAR HAMMER SYNDROME, 3 THROMBOANGIITIS OBLITERANS AND 5 ARTERIOSCLEROSIS OBLITERANS

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1. INTRODUCTION

We have been engaged in the diagnosis and treatment of HAVS, especially from the standpoint of peripheral circulation and peripheral sensorineural disorders (Kaji, 1992, 1993, 1998, 2007; Honma, 2000, 2003). In our daily practice, evaluation of the complaints in HAVS, such as numbness, tingling and pain in hands and fingers, is one of the most important and difficult diagnostic problems in the clinical management of patients and the workers' accident compensation. In our previous studies, sensory nerve conduction velocities such as anti-dromic sensory nerve conduction velocity and N9 latency of short-latency somatosensory-evoked potentials (SSEPs) were significantly prolonged in vibration-exposed workers with cervical spondylosis, both in HAVS and in non-HAVS subjects (Kaji, 1998, 2007). In this study, we reinvestigated the peripheral sensorineural disturbances in vibration-exposed HAVS subjects accompanied with arteriographically typical peripheral arterial disorders, such as hypothenar hammer syndrome (HHS), thromboangiitis obliterans (TAO), and arteriosclerosis obliterans (ASO). This study may provide evidence of whether peripheral circulation disorders of HAVS are always accompanied with peripheral sensorineural abnormalities.

2. SUBJECTS and METHODS

All the HAVS subjects were male with mean ages: HHS 57.7 ± 6.3, TAO 54.0 ± 10.0, and ASO 60.8 ± 5.0years. Mean vibration-exposures were in HHS 18.9 ± 7.3, TAO 14.7 ± 1.5 and ASO 22.6 ± 10.5 years, respectively. Clinical diagnoses had been made by arteriography of upper and/or lower extremities, in addition to the routine clinical examinations for HAVS.

Since diabetes mellitus and cervical spondylosis (CSP) are the most common confounding disorders in adults over the age 40 years in Japan, diabetes mellitus was checked by blood HbA1c levels, and CSP was also diagnosed radiographically (Kaji, 2007). In the present study, subjects with clinical carpal tunnel syndrome were not found in these three clinical entities.

Following the electric supra-maximal square pulse stimulations at the wrist of the right median nerve, the anti-dromic sensory nerve conduction velocity (SCV) and the SSEPs (N9, N13, N20) were obtained. The SSEPs parameters (the N9 latency and the interpeak conduction times N9/13 & N13/20) were corrected by body height (msec/mBody height). The apparatus and the test conditions have been described elsewhere (Kaji, 1992).

Normal limit values of each electrophysiological parameter (M±2SD) had been determined prior to the present study in 43 healthy males with ages between 40 and 69 years (Table 1). In these healthy controls, the subjects with both diabetes and CSP had been carefully excluded beforehand.

Table 1. Normal limits of sensorineural parameters (N=43)

SCV	M−2SD	46.1	m/sec
N9	M+2SD	6.29	Msec/mBody height
N9/13	M+2SD	2.80	Msec/mBody height
N13/20	M+2SD	4.33	Msec/mBody height

The severity of neurological disorders, based on SCV and SSEP measurements, were graded as follows –

SCV	Symbol	SSEP
M-3SD < x ≤ M-2SD	+	M+2SD ≤ x < M+3SD
M-4SD < x ≤ M-3SD	++	M+3SD ≤ x < M+4SD
x < M-4SD	+++	M+4SD ≤ x

3. RESULTS

Among 23 HAVS subjects with typical arterial disorders, nine cases had delayed or prolonged electrophysiological parameters as listed in Table 2.

Table 2. Nine HAVS cases with prolonged sensory nerve conduction, with grades of severity, in a group of 23 HAVS cases with and without cervical spondylosis (CSP) and with typical arterial disorders: HHS, TAO and ASO

	Case/Age	SCV	N9	N9/13	N13/20
WITH CSP	HHS/62	++	++	−	−
	HHS/63	n.d.	+	+	++
	HHS/58	+++	−	−	−
	ASO/64	++	+	−	−
WITHOUT CSP	HHS/46	−	+	−	−
	HHS/66	−	−	+	−
	TAO/44	+++	++	−	++
	TAO/54	−	++	+++	−
	ASO/68	+	−	−	−

These 23 HAVS subjects were divided into two groups WITH and WITHOUT CSP (Table 3). Among 16 HAVS cases WITH CSP, only 25% of cases (3/12) had prolonged SCV ++ ~ +++. Prolonged N9 latency + ~ ++ was observed in 25% of these cases (4/16); however, the other 12 (of 16) subjects (75%) had no sensorineural abnormalities.

On the other hand, in the 7 HAVS cases WITHOUT CSP (Table 3), 5 of them (as shown in Table 2) had prolonged SCV and SSEPs, (71.4%). In total, as shown in Table 3, disordered SCV was observed in 5 out of 18 cases (27.8%), prolonged N9 latency in 6/23 cases (26.1%), prolonged interpeak conduction times N9/13 in 3/23 cases (13.0%), and N13/20 in 1/23 cases (4.3%) (Table 3).

Table 3. Frequency of prolonged sensory nerve conduction in 23 HAVS cases with and without cervical spondylosis (CSP) and with typical arterial disorders: HHS, TAO and ASO

	SCV	N9	N9/13	N13/20
WITH CSP	3/12	4/16	1/16	0/16
N=16	(25.0%)	(25.0%)	(6.25%)	(0%)
WITHOUT	2/6	2/7	2/7	1/7
CSP N=7	(33.3%)	(28.6%)	(28.6%)	(14.3%)
TOTAL	5/18	6/23	3/23	1/23
N=23	(27.8%)	(26.1%)	(13.0%)	(4.3%)

4. DISCUSSION AND CONCLUSION

HAVS is characterized by peripheral circulation, neurological, and musculoskeletal disturbances (Pelmear, 1992). However, one important problem of great concern is whether peripheral circulation disorders in HAVS always accompany peripheral neurological disturbances. In this investigation, sensorineural examinations were conducted after arteriographical diagnoses of HHS, TAO and ASO.

Previously, SCV and N9 latency in vibration-exposed workers WITH CSP have been observed to be significantly prolonged in HAVS, non-HAVS, diabetes, and healthy subjects when compared with those of healthy subjects WITHOUT CSP (Kaji, 1998, 2007). In this work, peripheral parameters (SCV and N9 latency) in HAVS subjects with typical peripheral arterial diseases (HHS, TAO and ASO) were not always disordered even in subjects WITH CSP, as 75% of cases had normal sensory nerve function (Table 3). When the normal limit values were lowered from M±2SD to M±1SD, the increase in number of cases in SCV group was only one WITH CSP. But in the N9 latency group, 5 cases WITH CSP and one case in WITHOUT CSP were added as subjects with sensory abnormalities. As a result, peripheral and/or distal sensorineural disorders were observed in 12/23 cases (52.2%). In other words, 47.8% of HAVS cases with typical arterial diseases had no detectable electrophysiological abnormalities. This frequency corresponded well to those of the work by House et al (2007), where nerve conduction studies in almost 1000 patients showed 47% of workers assessed for HAVS had no measurable abnormalities in peripheral nerve function in the upper extremities. Their most common neuropathies were mild carpal tunnel syndrome and ulnar neuropathy. Since the ulnar nerve is known to be easily injured from trauma or osteoarthrotic changes of the elbow joint, especially at the cubital tunnel, our clinical studies were conducted on the median nerve (Kaji, 1992).

Although the mechanism of how CSP affects sensorineural disorders in HAVS has not yet been elucidated, the double-crush hypothesis (Upton, 1973; Yu, 1985) seems to explain our present observations. It suggests that periodic medical examination for early detection of peripheral neuropathy in vibration-exposed workers and/or for diagnosing HAVS for workers' compensation, several tests of peripheral circulation disorders would be preferred, rather than electrophysiological determinations for sensorineural disorders. The presence CSP should always be taken into consideration as a prerequisite, when highly sensitive neurophysiological examinations are applied.

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