손목터널증후군에서 동반된 정중신경 회귀운동분지의 신경병증: 증례 보고

노준수¹, 박종웅², 권희규¹

고려대학교 안암병원 재활의학과¹, 정형외과²

Concomitant Neuropathy of Recurrent Motor Branch of Median Nerve in Carpal Tunnel Syndrome: A Case Report

Jun Soo Noh¹, Jong Woong Park², Hee-Kyu Kwon¹

Departments of ¹Physical Medicine & Rehabilitation, ²Orthopedic Surgery, Korea University Anam Hospital, Seoul, Korea

Selective fascicular involvement of median nerve in carpal tunnel syndrome (CTS) has been reported, such as predominant involvement of volar-radially located motor and sensory fibers to thumb. Also, recurrent motor branch (RMB) of median nerve could be affected separately. A man has suffered from right-hand weakness and mild tingling sense on I to III digits visited. Thenar muscles wasting and weakness were noted without sensory loss. Whereas the results of sensory conduction and comparison of median-second-lumbrical/ulnar-interossei studies suggested mild CTS, motor responses revealed severe neuropathy. The patient was diagnosed with right CTS, mild degree and concomitant incomplete but severe neuropathy of RMB. The patient underwent an operation. The RMB was found as the transligamentous type with a degenerative change and severely compressed by ligament and thenar muscles. Open carpal tunnel release and decompression with neurolysis were done. Through precise analysis of electrodiagnostic findings, correct diagnosis and proper management were achieved.

Key Words: carpal tunnel syndrome, electrodiagnosis, median nerve

Introduction

Carpal tunnel syndrome (CTS) is one of the most common entrapment neuropathy.¹ In CTS, selective

involvement of median motor fibers is rare, and the incidence varies from 0.6% to 1.2%.² Selective fascicular involvement of median nerve has been reported in some cases, such as predominant involvement of volar-radially located motor fibers and sensory fibers to thumb.²⁻⁵ Furthermore, recurrent motor branch (RMB) of median nerve can be affected separately.^{6,7}

We report a mild CTS patient with concomitant neuropathy of the RMB of median nerve and also describe the atypical clinical features of motor dominant

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Corresponding Author: Hee-Kyu Kwon

Department of Physical Medicine & Rehabilitation, Korea University Anam Hospital, 73 Goryeodae-ro, Seongbuk-gu, Seoul 02841, Korea

Tel: 82-2-920-6471, Fax: 82-2-929-9951, E-mail: hkkwon@korea.ac.kr

symptoms, pre- and post-operative electrophysiologic features, and operative findings. To our knowledge, this is the first case of separate neuropathy of the RMB of median nerve which was diagnosed by precise evaluation of electrophysiologic findings and confirmed by surgery, and also demonstrated improvement of symptoms and electrophysiologic findings after surgery.

Case Report

A 25-year-old right-handed man has suffered from a right hand weakness for 18 months and mild tingling sensation on right thumb to middle fingers for 6 months. He works as a chef in a Japanese restaurant for 3 years. He uses his right hand to hold his knife and realized difficulty in holding it gradually.

On physical examination, thenar muscle wasting accompanying tenderness was observed. The patient did not complain cervicalgia and there was no change of color and temperature sensation in the hand. Medical Research Council (MRC) grades of right thumb abduction and opposition were 3/5 whereas all the other muscles

were normal. There was no sensory loss. Tinel's sign, Phalen's test, and the arm elevation test were positive on the right side.

Electrodiagnostic examination was performed on the same day in the bilateral upper extremities nerves (Table 1). Right median motor NCS showed prolongation of distal latency and reduced amplitude (6.5 msec, 0.5 mV). The right "median-second-lumbrical and ulnar-interossei (M2L-UI) comparison study" revealed positive finding (M2L, 4.6 msec; UI: 3.9 msec, M2L-UI difference > 0.6 msec), but the amplitude of second lumbrical muscle recorded compound motor unit action potential (CMAP) was normal (right, 3.8 mV; left, 3.6 mV) (Table 1). Sensory nerve response of right median nerve with middle finger recording revealed prolonged latency and reduced amplitude with wrist stimulation (wrist: 4.2 msec, 23.9 μ V; palm: 1.2 msec, 46.6 μ V). The median sensory responses with thumb and index fingers recordings were also obtained to figure out the selectivity in fascicular involvement but showed no difference among three fingers. The F-wave was unobtainable with the right median nerve

Table 1. Motor and Sensory Nerve Conduction Study Data

Motor nerve conduction								
Side	Nerve	Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	Distance (cm)	NCV (m/sec)	F wave (msec)
Right	Median	Wrist	APB	6.5* (> 4.2)	0.5* (< 5.0)	29	69	NR*
	Ulnar	Wrist	ADM	3.0	13.5	23	59	28.47
Right	Median	Wrist	2 nd lumbrical	4.6* (> 3.4)	3.8			
	Ulnar	Wrist	1 st palmar interosseous	3.9	10.6			
Sensory nerve conduction								
Side	Nerve	Stimulation site	Recording site	Onset/peak latency (msec)	Amplitude (μ V)	Distance (cm)		
Right	Median	Wrist	III digit	4.2*/4.9* (> 3.7)	23.9*	14		
		Palm	III digit	1.2/2.1	46.6	7		
		Wrist	II digit	4.4*/5.5* (> 3.7)	22.6*	14		
		Wrist	I digit	3.7*/4.5* (> 3.7)	24.6*	10		
	Ulnar	Wrist	V digit	2.7/3.5	56.0	14		
Left	Median	Wrist	III digit	2.9/3.7	53.1	14		
		Palm	III digit	1.2/1.9	57.8	7		
		Wrist	II digit	2.9/3.7	52.4	14		
		Wrist	I digit	3.1/3.9	52.4	10		

Abnormal cutoff value based on median-to-2nd lumbrical compared with ulnar-to-palmar interosseous > 0.6 msec. Reference values are represented in parentheses and abnormal values are represented with asterisk

NCV: nerve conduction velocity, APB: abductor pollicis brevis, ADM: abductor digiti minimi, NR: no response

stimulations. The latency difference between the median and ulnar nerves in M2L-UI study and the sensory conduction study revealed mild CTS of demyelination and some axonal degeneration, but the findings of motor conduction study were compatible with severe neuropathy with severe axonal degeneration and some demyelination.

Needle electromyogram (EMG) was done in the right upper extremity muscles. Abnormal spontaneous activities and polyphasic, large amplitude and long duration motor unit potentials with discrete recruitment patterns were noted in the right APB muscle. Normal motor unit potentials were noted in all the other muscles examined (Table 2). Sonography was performed on the same day. Mild swelling of the right median nerve was found at the distal wrist crease level (cross-sectional area: 0.137 cm²) which were also compatible with mild CTS. There were no other abnormal findings at the palm. In conclusion, the patient was diagnosed with a mild degree right carpal tunnel syndrome and concomitant incomplete but severe neuropathy of right RMB of median nerve.

The patient underwent a surgery a month after the examination. On operation, the RMB was found as the transligamentous type with a whitish degenerative change, and severely compressed by thickened ligament and fascia of thenar muscles. Open carpal tunnel release and decompression and neurolysis of RMB of median nerve were done (Fig. 1).

Follow-up NCS was done at one, two and five months after the surgery. On the first follow-up visit, tingling sense was reduced to half and the latency and

amplitude of median CMAP revealed improvement (4.7 msec, 1.3 mV). On the second follow-up visit, the sensory symptom disappeared and the right thumb abduction improved to 4/5 in MRC grade. Median CMAP latency and amplitude were 4.6 msec and 1.9 mV, respectively. The latency of right median sensory response also showed improvement with the middle finger recording (wrist: 3.5 msec, 24.0 μ V; palm: 1.1 msec, 46.6 μ V) (Table 3). On the third follow-up visit, strength of right thumb abduction was restored to almost normal grade. Previously existed tenderness on right thenar muscle was disappeared. Latency and amplitude of median CMAP (3.7 msec, 2.6 mV) were improved as well those of median sensory response (wrist: 3.6 msec, 34.0 μ V; palm: 1.1 msec, 51.0 μ V).

Fig. 1. The right recurrent motor branch of median nerve (arrow, A) was found perforating the ligament (arrowhead, A) and showed whitish degenerative change (arrow, B).

Table 2. Needle Electromyography Study

	Muscle	Insertional activity	Spontaneous activity	Motor unit action potentials				IP
				N	Polyphasia	Amplitude	Duration	
Right	Brachioradialis	N	-	N				F
	Pronator teres	N	-	N				F
	EDC	N	-	N				F
	FDI	N	-	N				F
	APB		F&P (+)		Polys	Large	Long	DIS (3~4 MUAPs)

IP: interference pattern, N: normal, F: full, F&P: fibrillation potentials & positive sharp waves, R: reduced, DIS: discrete, MUAP: motor unit action potential, EDC: extensor digitorum communis, FDI: first dorsal interosseous, APB: abductor pollicis brevis, -: not applicable

Table 3. Pre- and Post-operative Median Motor Conduction Study

Time	Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	NCV (m/sec)	F wave (msec)
Pre-op.	Wrist	APB	6.5*	0.5*	69	NR*
Post-op. 1 months	Wrist	APB	4.7*	1.3*		
Post-op. 2 months	Wrist	APB	4.6*	1.9*	73	40.6*
Post-op. 5 months	Wrist	APB	3.7	2.6*	51	35.2*

Abnormal values are represented with asterisk

NCV: nerve conduction velocity, op.: operation, APB: abductor pollicis brevis, NR: no response

Discussion

Separate injury to the RMB of the median nerve is relatively rare, but several cases have been reported: after repetitive compression damage due to cycling or weightlifting, compression due to mass-like lesions such as schwannoma and palmar ganglion, or iatrogenic injuries from carpal tunnel release.^{7,8} In most of these cases, abnormal median motor response with normal median sensory conduction study suggested neuropathy of RMB of the median nerve, but only few of them proved the neuropathy through surgery.

Typically, RMB of median nerve branches out distal to the flexor retinaculum and innervates APB, opponens pollicis (OP), and superficial head of the flexor pollicis brevis (FPB) muscles. We can think of two distinct mechanisms considering the compressive etiology of a RMB of the median nerve neuropathy. First is a compression of the nerve at the palm level which is closely associated with the anatomical variation of the nerve. Poisel classified variations into three subtypes, and named them extraligamentous, subligamentous, and transligamentous types. Among the types, transligamentous type is at the highest risk for injury. It is known to be more vulnerable because not only it can easily be compressed by hypertrophy of muscle and ligament but also it can easily be damaged during carpal tunnel surgery if not properly identified. The incidence of transligamentous type is quite confusing⁹ as Ahn has provided relatively low incidence (1.1%) of transligamentous type in Koreans in his prospective cadaveric study.¹⁰

The second is related to the intraneural topography

of motor fibers before an emergence of the recurrent motor thenar branch and sensory fibers to thumb which are located at the most volar-radial quadrant. This may explain the reason why the RMB of median nerve and sensory fibers to thumb are more susceptible in certain cases of CTS: selective fascicular involvement within the median nerve at the level of carpal tunnel.³⁻⁵

In this case, the patient had a history of frequent use of knife and pressing sushi rice. These activities may have caused compression of RMB of median nerve other than CTS itself. The patient also had weakness and atrophy of thenar muscle rather than numbness of fingers. Tenderness on thenar eminence could be caused by chronic muscle pain considering his job which is not directly related to injury of RMB of median nerve. On electrodiagnostic examination, APB-recorded CMAP revealed very low amplitude and delayed latency while the sensory responses were mildly involved. Although M2L-UI study revealed positive finding, 2L-recorded CMAP was normal. We also evaluated the sensory responses of thumb and index fingers to rule out the fascicular involvement of volar-radial side, but revealed no difference among thumb, index and middle fingers. Ultrasonography also revealed the only mild swelling of median nerve at the wrist and no abnormal finding at palm. These findings lead us to make the diagnosis of separate neuropathy of RMB of median nerve, and this was proved by surgery. The RMB of median nerve was found as the transligamentous type and the reason of compressive neuropathy of the patient thought to be the anatomical variation of the nerve.

Identifying a neuropathy of RMB of median nerve could be difficult, as the case is rare and relatively

unexpected. These patients typically complain more motor symptoms than sensory symptoms. Electrophysiologic examination is useful when utilized properly. Findings are typically normal for median sensory nerve conduction and M2L-UI studies, but APB recorded CMAP amplitudes are significantly reduced.

In conclusion, we report a case of CTS patient who has concomitant neuropathy of RMB of median nerve. If the patient only underwent an endoscopic surgery, a release of separately involved RMB could have been omitted. Through precise analysis of electrodiagnostic findings, correct diagnosis was achieved and could guide proper surgery.

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