요골동맥의 압박에 의한 후골간 신경 비틀림과 그로 인한 신경병증: 증례 보고

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Posterior Interosseous Neuropathy Caused by Torsion due to Leash of Henry: A Case Report

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A 34-year-old man was referred for electrodiagnosis of left forearm and elbow pain with concurrent left wrist and finger extension weakness. Symptom developed abruptly, after waking up from sleep. After 11 days of onset, electromyography was performed. In nerve conduction study, the left radial motor response was unobtainable and in needle electromyography, abnormal spontaneous activities and no motor unit potential were noted in the left supinator, extensor digitorum communis, extensor carpi ulnaris and extensor indicis proprius muscles, suggesting left posterior interosseous neuropathy involving the supinator muscle and all the distal muscles to it. Subsequent ultrasonography of the left upper arm revealed multiple nerve torsions, and surgical exploration finally confirmed that the main torsion site was caused by the recurrent branch of radial artery, the Leash of Henry. We report an unusual case of spontaneous posterior interosseous nerve neuropathy due to nerve torsion caused by Leash of Henry.

Key Words: posterior interosseous nerve syndrome, electrodiagnosis, nerve compression syndromes

Introduction

The posterior interosseous nerve (PIN) is a deep

branch of radial nerve, liable to compression. Compression can occur spontaneously (entrapment) or secondary to mass lesions (lipoma, ganglion).¹ The common entrapment sites are as followings: fibrous band of the radial head, radial recurrent vessels at the level of radial neck, extensor carpi ulnaris brevis, arcade of Frohse and distal part of supinator muscle.¹⁻³ Here we report a case of PIN neuropathy due to torsion of the nerve caused by compression of Leash of Henry, a recurrent branch of radial artery. Electrodiagnostic findings were

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compatible with PIN neuropathy, ultrasonography exposed multiple PIN torsions and finally, operative findings confirmed the main torsion site caused by Leash of Henry. This case emphasizes correct diagnosis based on electrophysiologic findings, ultrasonography and operative findings with the follow up studies.

Case Report

A 34-year-old man visited department of Physical Medicine and Rehabilitation presenting left forearm and elbow pain with concurrent left wrist and finger extension weakness which started 10 days ago, abruptly without any trauma history, after waking up from sleep. Left forearm pain started first, and then wrist extension and finger extension weakness progressively developed. First, the patient visited a private clinic and an orthopedic surgeon prescribed a long arm splint and the patient applied it for approximately 10 days. However, the pain aggravated especially with elbow extension and pronation. X-ray findings showed no sign of

fracture or any other abnormality. On physical examination, Medical Research Council (MRC) grades of left extensor carpi radialis was 5/5 but extensor carpi ulnaris was 0/5 and finger metacarpophalangeal extension 0/5. No sensory abnormalities were present. Range of motion was restricted in elbow extension.

Eletrodiagnostic examination was performed 11 days after onset. Nerve conduction study (NCS) showed no left radial motor response. Needle electromyography (EMG) showed increased insertional activities and no motor unit potential were noted in the left supinator, extensor digitorum communis, extensor carpi ulnaris and extensor indicis proprius muscles but the brachioradialis and extensor carpi radialis revealed normal findings (Table 1). In conclusion, the patient was diagnosed as complete left posterior interosseous neuropathy involving from supinator to all the distal muscles innervated by the PIN. Additionally, the patient underwent sonography. Sonography of the left upper arm revealed multiple torsions of PIN (Fig. 1A, B). The most obvious torsion was noticed at just proximal to

Table 1. Needle Electromyography Data

Needle Electromyography								
Side	Muscle	Insertional Activity	Spontaneous Activity	Motor Unit Action Potentials				
				Normal	Polyphasia	Amplitude	Duration	RP
Pre-Operation								
Left	Brachioradialis	N	-	N				F
	Pronator teres	N	-	N				F
	Flexor carpi ulnaris	IIA	-	N				F
	Extensor carpi radialis	N	-	N				F
	Supinator	IIA	-					No MUAP
	Ext. digitorum communis	IIA	-					No MUAP
	Ext. carpi ulnaris	IIA	-					No MUAP
	Ext. indicis proprius	IIA	-					No MUAP
Follow-up study: 6 months after surgery								
Left	Supinator	IIA	-					No MUAP
	Ext. digitorum communis	IIA	F&P(++)					No MUAP
	Ext. carpi ulnaris	IIA	F&P(++)					No MUAP
	Ext. indicis proprius	IIA	F&P(++)					No MUAP
Follow-up study: 9 months after surgery								
Left	Supinator	IIA	F&P(+)		Polyphasic	200 μV		2 MUAP
	Ext. digitorum communis	IIA	F&P(+)		Polyphasic	200 μV		3-4 MUAP
	Ext. carpi ulnaris	IIA	F&P(++)		Polyphasic	200~400 μV		Single
	Ext. indicis proprius	IIA	F&P(+++)					No MUAP
	Ext. pollicis longus	IIA	F&P(++)					No MUAP

Ext: extensor, N: normal, IIA: increased insertional activities, F&P: fibrillation potentials & positive sharp wave, RP: recruitment pattern, F: full, MUAP: motor unit action potentials, Single: single unit recruitment pattern

Fig. 1. (A, B) Sonographic findings of PIN showing torsion at multiple sites at distal humerus level (arrow). (C) Most obvious torsion (arrowhead) was noticed just proximal to innervating the supinator muscle. (D) Color Doppler image shows increased vascularity near the torsion site.

Fig. 2. (A) Surgical findings confirmed Leash of Henry (black arrow) being the culprit of causing PIN torsion. (B) Ligation of Leash of Henry reveals nerve torsion (white arrow) more clearly. Notice the color change of the nerve. (C) The surgeon resected the degenerated portion of the PIN and performed microscopic neurorrhaphy (arrowhead).

innervating the supinator muscle and demonstrated an hourglass-like appearance (Fig. 1C). Color Doppler image demonstrated increased vascularity at the main PIN torsion site (Fig. 1D).

The patient underwent surgery 26 days after symptom onset. Incision extending from the biceps muscle to the border of the brachioradialis was made. With further dissection, compression and torsion of PIN at

the level of and just proximal to arcade of Froshe by recurrent branches of the radial artery, the Leash of Henry, was discovered (Fig. 2A, B). The vessel's location was in accordance with the ultrasonographic findings showing increased vascularity near the nerve torsion site. The orthopedic surgeon ligated the Leash of Henry, performed decompression and neurolysis of the PIN and finally resected the degenerated portion of

the nerve and performed direct neurorrhaphy (Fig. 2C). Long arm cast with elbow flexed 90 degrees was applied for one month.

Follow-up electrodiagnostic examination was performed 6 months and 9 months after surgery. The patient no longer complained of pain but no motor improvement was noticed. On physical examination, MRC grades of left extensor carpi radialis was 5/5 but extensor carpi ulnaris was 0/5 and finger metacarpophalangeal extension 0/5. Radial motor NCS and needle EMG revealed no interval change 6 months after surgery but 9 months later, needle EMG revealed reinnervation evidence in supinator, extensor digitorum communis, and extensor carpi ulnaris muscles (Table 1).

Discussion

The radial nerve divides into two branches at the level of the lateral epicondyle: the superficial radial nerve and the PIN. The PIN supplies the radial and dorsal forearm muscles: extensor carpi radialis, supinator, extensor digitorum communis, extensor carpi ulnaris, extensor pollicis longus/brevis, and extensor indicis.¹⁻³ The PIN is predominantly a motor nerve, thus patients with posterior interosseous neuropathy will suffer metacarpophalangeal joint extension weakness, or so-called finger drop, and radial wrist deviation on extension, but no sensory symptoms.¹⁻⁴ The PIN is susceptible to compression at five sites.^{1,2,4} First is located at the level of the radial head, where fibrous bands confluence with brachialis, brachioradialis, extensor carpi radialis brevis and the supinator. Second is at the level of the radial neck, where radial recurrent arteries (Leash of Henry) cross the nerve. Third is beneath the tendon of extensor carpi radialis brevis. Fourth and the most common site for compression is the arcade of Frohse, located at the most superior part of the supinator muscle. Finally, the distal edge of supinator can cause compression.

Usually NCS is sufficient to diagnose nerve compression, but in PIN, NCS can be inconclusive that needle

EMG is crucial to confirm the diagnosis and demarcate the lesion site in many cases. In this case, NCS could only diagnose left radial neuropathy but needle EMG could localize the lesion involving supinator to all the distal muscles innervated by PIN. Regarding the fact that the supinator is involved in this patient, we can assume that the nerve injury level is above the supinator. This patient revealed restricted elbow motion due to pain, especially in elbow extension and pronation and this phenomenon suggested nerve torsion rather than compression.^{5,6} Ultrasonography is known to localize the lesion so we additionally performed upper arm ultrasound examination and multiple sites of hourglass-like appearance of the nerve were exposed.⁷ With surgical exploration, the Leash of Henry was discovered to be the main culprit causing PIN torsion.

Spontaneous PIN torsion is uncommon.^{5,6} Various theories exist trying to explain the mechanism of spontaneous nerve torsion but the etiology remains unclear.⁷ However, in this case, the operative findings showed leash of Henry directly above the main PIN torsion site, suggesting that leash of Henry caused PIN torsion. Without surgical findings the etiology may have remained inconclusive.

In all the reported cases with PIN neuropathy, patients underwent EMG, ultrasonography and eventually surgery.⁸ Studies concerning prognosis of PIN neuropathy have confirmed timely surgical exploration is beneficial both diagnostically and therapeutically.^{8,9} In this case, taking electrodiagnostic and ultrasonographic findings into account, we identified that the nerve torsion caused all the patient's symptoms and immediately consulted the orthopedic surgeon. With the help of electrodiagnostic and sonographic findings, the surgeon was able to reasonably assume the lesion site and minimize surgical incision and operation time. The surgeon untangled the twisted PIN and the patient no longer complained pain after surgery. The prognosis of spontaneous nerve torsion is usually good.⁷ In previous cases of PIN torsion, most reported spontaneous incomplete or complete recovery and surgical explora-

tion fastened recovery.^{8,9} However, this patient took 9 months to show some sign of reinnervation, which is relatively slower than previous cases. This could be explained by the fact that this patient had multiple torsions along the PIN. Also, PIN degeneration and atrophy was already noticed in the surgical field, implicating slow recovery (Fig. 2).

In conclusion, we report a case of PIN neuropathy caused by nerve torsion due to anomalous compression of vessels that has been successfully diagnosed with electrodiagnosis and ultrasonography and decompressed by surgery. Thus, when a PIN compression or torsion is suspected, prompt and precise electrodiagnostic confirmation followed by subsequent ultrasonography and eventually surgery is important for the patient's prognosis.

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