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Case Report

정중신경 손상에서 초음파 유도 하 신경주위 포도당 용액 주사치료의 효과

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Effect of Ultrasound-Guided Perineural Injection with Dextrose for Direct Traumatic Injury of Median Nerve

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Ultrasound (US)-guided hydrodissection (HD) is a widely applied therapeutic method to release the entrapped peripheral nerve. However, this therapy has only been studied for the nerve entrapments such as carpal tunnel syndrome, and there are no reports of its effect on direct nerve injuries with incomplete axonal damage. Here, we report a case of direct traumatic injury of a median nerve with incomplete axonal injury in a 28-year-old man. He presented hypoesthesia and weakness along with the median nerve territory of the left hand after a laceration wound of the wrist. The patient underwent a surgical procedure, but did not experience prominent improvement for the next six months. Symptoms improved after we performed the US-guided HD with dextrose. We propose this procedure as one of the new treatment methods for direct axonal injury of nerves including the median nerve. **(Clinical Pain 2021;20:127-130)**

Key Words: Median nerve, Direct injury, Hydrodissection, Dextrose

INTRODUCTION

Ultrasound (US)-guided perineural injection, also called the nerve hydrodissection (HD), is a technique that injects anesthetic or solution around the target nerves to separate them from the surrounding tissues, fascia, or adjacent structures [1]. Due to its mechanical benefit in relieving compression on nervi nervorum or vasa nervorum, US-guided HD is widely used in treating various nerve entrapments [2].

Among the various substances used for HD, dextrose 5% in water (D5W) outperformed normal saline or triamcinolone in improvement of symptom severity and functional status [3]. While numerous studies on the effect of HD in the carpal tunnel syndrome have been conducted, no previous reports have attempted HD in the direct traumatic injury of the median nerve to the best of our knowledge.

Here we present a case of symptom improvement through US-guided HD with D5W in a patient complaining of hypoesthesia and weakness after median nerve traumatic injury. Written informed consent was obtained from the patient for publication of this report.

CASE PRESENTATION

A 28-year-old man without any medical history was wounded in the left wrist by a sharp blade (Fig. 1). An explorative operation was performed on the open wound on the day of injury, and a partial tear of the flexor tendon at the left wrist was found and repaired. During the surgical procedure, partial discontinuity of the median nerve was suspicious. However, additional treatment was not per-

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formed in considering the risk and benefit of the procedure.

Immediately after the surgical procedure, mobility of the left thumb was partially recovered. The patient, however, did not experience prominent improvement for the next six months despite undergoing rehabilitation programs including range of motion and strengthening exercises. Due to the lack of improvement in muscle strength and functional usage of the left thumb, he visited our outpatient clinic. At the time of the visit, he complained of persisting hypoesthesia in the palmar side of the left 1^{st}～3^{rd} fingers and weakness of the left thumb opposition and abduction. He was able to flex the left thumb only to the midline of the index finger and could hardly perform functional movements such as holding a pen or typing on a mobile phone. In addition, the median nerve territory of the left hand, including the thenar eminence, showed a 10:2 hypoesthesia compared to the intact side.

The electrodiagnostic examination was done 6 months after the surgical procedure. The nerve conduction study showed slow conduction velocity, conduction block, and low amplitude of compound muscle action potential (CMAP) at the left median nerve. There was no response of sensory nerve action potential (SNAP) at the left median nerve. In the needle electromyographic examination study, abnormal spontaneous activities such as positive sharp potential and decreased volitional activities were observed on the left abductor pollicis brevis muscle.

Ultrasound revealed an irregular margin of the left median nerve with suspicious perineural adhesion and axonal damage (Fig. 2-A, 2-B). The transducer was placed in the longitudinal axis, and US-guided HD was performed using a total of 5 mL of D5W by in-plane technique (Fig. 2-C).

US-guided HD with D5W were performed two times at an interval of two weeks. Immediately after the first procedure, the active joint range of motion of the left thumb improved, and the follow-up electrodiagnostic examination revealed recovery of the amplitude of CMAP at the left median nerve (Table 1). Two weeks after the second procedure, the left thumb was able to flex to the midline of the 4^{th} finger. In addition to the improvement in the range of motion, functional improvement was also accompanied, that the patient became possible to open a bottle cap, write, and type on a mobile phone. Hypoesthesia, which was decreased to 10:2 compared to the intact side, improved to 10:5.

Fig. 1. Images of the wound of the left wrist (A) immediately after injury and (B) 6 months after injury.

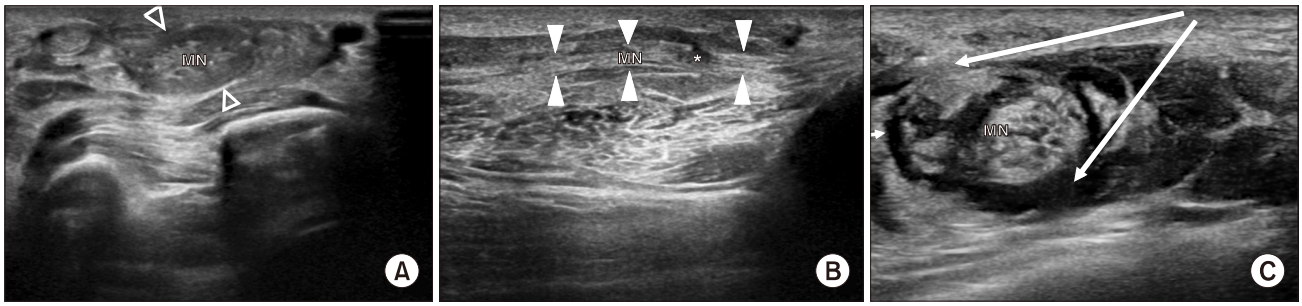

Fig. 2. Ultrasound image showing the left median nerve. (A) Cross-sectional image of the left median nerve with suspicious perineural adhesion (unfilled arrowhead). (B) Longitudinal image of the left median nerve (filled arrowhead) showing axonal damage (*). (C) Cross-sectional image after US-guided HD with D5W. Arrows show the needle approaching. MN: median nerve.

Table 1. Motor and Sensory Nerve Conduction Study Data

		Sensory nerve conduction			Motor nerve conduction			
		Recording	Latency (msec)	Amplitude (μV)	Recording	Latency (msec)	Amplitude (mV)	Velocity (m/sec)
Initial								
Left median	Wrist	II digit	No response*		APB	3.37*	3.30*	44.0*
Left ulnar	Wrist	V digit	1.61	26.4	ADM	1.93	11.01	72.7
Follow-up								
Left median	Wrist	II digit	No response*		APB	3.23*	5.09	46.2*
Left ulnar	Wrist	V digit	1.75	25.8	ADM	1.97	10.68	71.5

Abnormal values are represented with asterisk.
APB: abductor pollicis brevis, ADM: abductor digiti minimi.

DISCUSSION

Seddon and Sunderland proposed classifications of nerve injury which is still in use today [4,5]. Resolution of conduction block in neurapraxic lesions, distal axonal sprouting in axonotmetric lesions, and axonal regeneration in axonotmetic and neurotmetic lesions are proven mechanisms of peripheral nerve recovery. Despite the clear pathophysiologic distinctions, nerve lesions in most traumatic injuries are mixed, resulting in a combination of neurapraxia, axonotmesis, and neurotmesis in various degrees [6].

Lately, US-guided HD has emerged as the prevailing treatment for nerve entrapment such as carpal tunnel syndrome [7]. However, there are no reports on its use in cases of direct traumatic injuries to peripheral nerves. In this case, a lesion of the axonal loss with conduction block was suspected. The US-guided HD with D5W was performed, and evident improvement of symptoms was observed. We speculated the following mechanisms that could have led to this recovery.

It is difficult to consider that the direct axonal damage was recovered through the procedure, as the symptom improvement was too prompt. Rather, we suppose that the median nerve adhesion mimicking nerve entrapment occurred after the surgical procedure, and the underestimated conduction block was immediately resolved through HD.

Postoperative adhesions and perineural scarring are limitations of surgical procedures, which may cause nerve compression with resulting functional loss and pain [8]. In the nerve entrapment, structures such as nervi nervorum, vasa nervorum, and lymphatic systems are compressed, resulting in stasis and accumulation of toxins, and eventually, dysfunction of adjacent nerves occurs [2]. HD inhibits the process of ischemic damage and improves the flow of nerve impulses. Indeed, after two consecutive US-guided HD with D5W procedures, remarkable amelioration of the symptoms was noticed.

Additionally, it is known that D5W inhibits the action of transient receptor potential vanilloid receptor-1 (TRPV-1) in the peripheral nerves and blocks the release of neural peptides that mediate the inflammation cascade. Therefore, D5W reduces neuropathy and promotes nerve recovery [9]. Since it is difficult to confirm that this molecular process directly contributed to the improvements immediately after the procedure, long-term follow-up is still necessary.

This case report has limitations in that quantitative evaluations such as the Jebsen hand function test, grasp power, and quantitative sensory nerve test was not performed in the assessment. And this is a single case so it is not possible to reveal the mechanism of recovery but only propose the possibility of nerve HD as a novel alternative treatment option. Nevertheless, as this case showed significant improvement, further research is required on the effect and mechanism of US-guided HD with D5W in nerve damage through more diverse cases.

In conclusion, this case showed the therapeutic potential of US-guided HD with D5W in direct nerve injury, which may be due to resolving conduction block that is often underestimated after traumatic nerve injury or surgical procedures. The US-guided HD with D5W can be considered as another treatment option for direct injury to peripheral nerves, such as a median nerve.

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