

Cheiralgia Paresthetica: An Isolated Neuropathy of the Superficial Branch of the Radial Nerve

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Objective: “Cheiralgia paresthetica” is the term suggested by Wartenberg in 1932, to define isolated neuropathy of the superficial branch of the radial nerve (SRN). Radial nerve compression can occur throughout its course in the forearm, especially in the tunnel region beneath the tendon of the brachioradialis muscle. The authors report three cases with review of the literatures.

Methods: The authors experienced three cases of cheiralgia paresthesia during the last 5 years. The cause of injury was; acupuncture-related injury, a direct, blunt trauma to the SRN, and a cephalic venipuncture-related injury.

Results: In two of the three patients, medical treatment was not effective and an exploration with external neurolysis was performed to relieve chronic neuropathic pain of the SRN injury. Medical treatment with neuropathic medication was effective in one patient. Severe adhesions with scar formation around the SRN were found during exploration. The pain and paresthesia improved immediately after operation by about 50% preoperatively and the residual pain and allodynia progressively alleviated in about 3 to 6 months. There were some residual sensory loss and dysesthesia despite of aggressive treatment at the last follow-up at 12 months.

Conclusion: Although the injury to the SRN is known to be rare, according to our experiences, it seemed more popular than we thought. An attention and education with anatomic knowledge of the SRN should be paid in cephalic venipuncture or acupuncture treatment.

Key Words: Cheiralgia paresthetica • Cephalic vein • Radial nerve • superficial branch of the radial nerve • Venipuncture injury • Acupuncture injury

INTRODUCTION

The superficial branch of the radial nerve (SRN) is a terminal sensory branch of the radial nerve that passes along the front of the radial side of the forearm and run beneath the tendon of the brachioradialis, piercing the deep fascia. The SRN is susceptible to injury or compression because it lies between the brachioradialis and the radius or between the brachioradialis and the extensor carpi radialis longus (ECRL) tendons¹⁷. After leaving the deep fascia, the SRN lies superficial, just beneath the skin. Therefore external compression or injuries can occur. The name “cheiralgia paresthetica” is the term suggested by Wartenberg in 1932, to define isolated neuropathy of the

SRN²³). Also known as Wartenberg's disease, cheiralgia paresthetica presents as pain and associated paresthesia and numbness of the radial aspect of the dorsum of the hand and to the base of the thumb²²).

The authors report three cases of cheiralgia paresthetica with review of the anatomy of the superficial branch of the radial nerve and its clinical implications.

MATERIALS AND METHODS

1. Demographics and Characteristics of the Patient with Cheiralgia Paresthetica

During the last 5 years, three patients who had been diagnosed and treated as cheiralgia paresthetica in the authors' clinic were retrospectively evaluated. There were two females and one man. The demographics are summarized in Table 1.

The causes of injuries were iatrogenic (venipuncture and acupuncture-related, n=2) and direct blunt trauma (n=1). The duration of symptoms ranged from one to four months after

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Table 1. Demographics and treatment of the patients with cheiralgia paresthetica

Patient	Age/ sex	R/L	Cause of injury	Duration of pain (months)	Medical treatment	NRS, pretreatment	Surgery	Operative findings	NRS, post- treatment	Remarks
#1	65/F	R	acupuncture	3	NSAIDs, GPT, TMD, AMI	6	neurolysis	adhesion scar	3	immediate improvement of pain (50%), Moderate allodynia remained
#2	64/M	R	blunt trauma	4	NSAIDs, GPT, oxycodone	5	neurolysis	adhesion scar	2	delayed improvement, 6 mo
#3	33/F	L	venipuncture	1	NSAIDs, GPT	4	N/A	N/A	0	spontaneous improvement in 4 weeks

AMI: amitriptyline; GPT: gabapentin; L: left; NSAIDs: nonsteroidal anti-inflammatory drugs; NRS: numerical rating scale; R: right; TMD: tramadol.

the onset. Their symptoms were; spontaneous pain (burning and aching) and tenderness, and allodynia to light touch and pressure. Paresthesia and dysesthesia were present in the distribution of the territory of SRN. The diagnosis was made by typical distribution of pain and sensory change and the history. No motor weakness was found. An exact electrodiagnostic study (nerve conduction velocity) could not be performed because of poor cooperation of the patients with severe allodynia (patients #1 and #2, Table 1). Magnetic resonance imaging was not performed as an ancillary examination for diagnosis because the history and physical examination were typical injury to the SRN.

2. Surgical Procedure

Under the general endotracheal anesthesia, the patients were placed in the supine position with the forearm abducted and supinated. The styloid process of the radius is palpated at the junction of the wrist and forearm. Measuring from the styloid process to 10 cm proximally, an incision is laid out that follows the border of the brachioradialis muscle for about 10 cm¹⁶⁾. The center of the incision was placed over the maximal tenderness and allodynia. The tendons of the brachioradialis and extensor carpi radialis longus muscles were sought and the SRN could be seen emerging from between the two tendons. After isolation of the SRN, the swollen and inflamed segment of the SRN was carefully dissected and mobilized from surrounding adhesion and scars under the microscopic vision (Fig. 1). An anti-adhesion gel was spread along the course of the injured segment and the nerve was carefully replaced under normal adipose tissue.

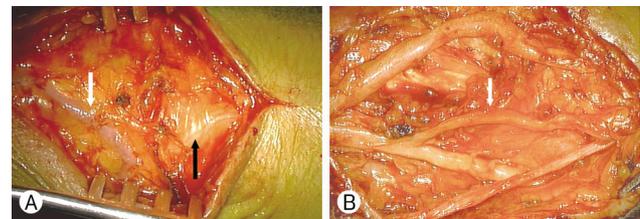


Fig. 1. Intraoperative photographs during neurolysis of the superficial branch of the radial nerve in the left forearm. (A) Intraoperative photograph showing initial exposure of the cephalic vein (white arrow) and the superficial branch of the radial nerve (black arrow) after skin incision. (B) Exposure of the injured portion of the superficial branch of the radial nerve (white arrow).

RESULTS

In two patients, pain did not respond to maximal medical treatment with neuropathic pain and opioid, including gabapentin (up to 1,800 mg), tramadol 150 mg, amitriptyline 20 mg, IR-codon 20 mg a day in four weeks, and exploration with external neurolysis was performed. Medical treatment was effective in one patient with a venipuncture-related SRN injury in three weeks with resolution of symptoms (Table 1).

Immediately after the operation, spontaneous pain and paresthesia showed a significant improvement in about 50-60% in two patients. However, allodynia along the distribution of the SRN still remained and medical treatment with anticonvulsants was maintained until significant improvement was ensued. At the last follow-up of 12 months postoperative, the patients assessed the operation as successful in reduction of pain and

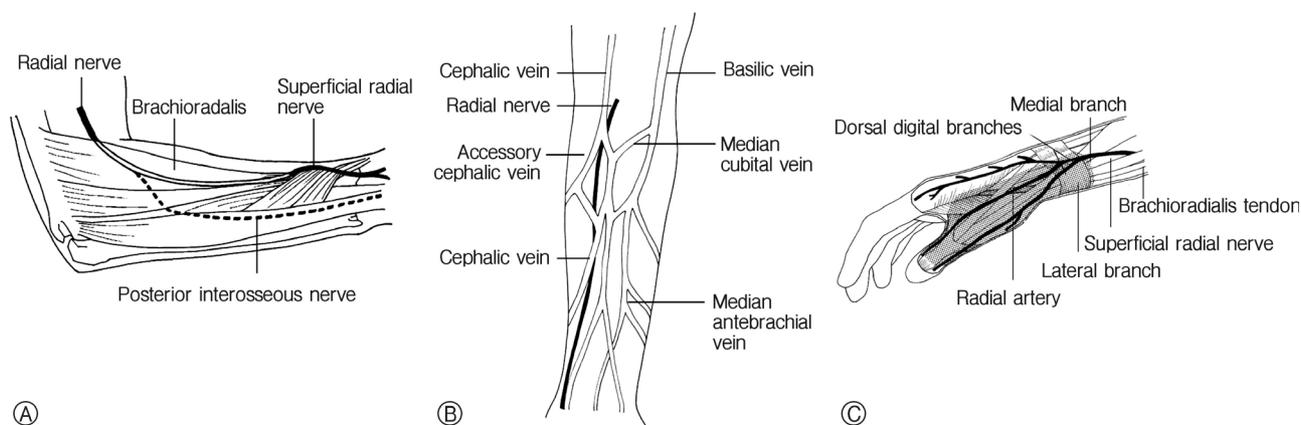


Fig. 2. (A) Schematic drawing of the radial nerve and its bifurcation into the posterior interosseous (PIN) and the superficial radial nerves (SRN). (B) Distribution of the SRN and cephalic vein in the forearm. (C) Schematic drawing of the forearm and hand supplied by the superficial branch of the radial nerve. The injury or compression of the superficial branch of the radial nerve causes paresthesia consisting of burning pain (dotted area), commonly known as cheiralgia paresthetica.

allodynia. However, the patients (#1 and #2) still have a mild allodynia and residual numbness. One patient (#1) still needed a neuropathic pain medication including gabapentin 900 mg, tramadol 150 mg, and amitriptyline 10 mg a day (Table 1).

DISCUSSION

1. Anatomy of the SRN

The radial nerve begins as the terminal branch of the posterior cord of the brachial plexus and it travels from the posterior compartment of the arm into the anterior compartment as it penetrates the lateral intermuscular septum approximately 10 to 12 cm proximal to the elbow. The radial nerve continues to travel distally and bifurcates into deep (posterior interosseous nerve, PIN) and superficial branches (SRN) approximately 6.0 to 10.5 cm distal to the lateral intermuscular septum and 3 to 4 cm proximal to the leading edge of the supinator (Fig. 2A)^{1,4}. The PIN is a motor nerve that courses deep beneath the supinator muscle; the SRN is a sensory nerve that travels anterior on the undersurface of the brachioradialis and in the distal one-third of the forearm, travels subcutaneously to provide sensation to the dorsolateral hand in the vicinity of cephalic vein (Fig. 2A, B)^{1,4}. The SRN, at a point between the middle and distal thirds of the radius, arches dorsally through a tunnel in the antebrachial fascia to terminate in the skin beyond the radial styloid. The dorsal digital nerves, the terminal branches of the superficial branch, supply sensation to the dorsal skin of the first, second, and radial side of the third digits to the base of the second phalanx (Fig. 2C). As skin dermatomes overlap, the only autonomous region of

the SRN is the dorsal web space closest to the thumb¹⁹.

2. Clinical Implication of the SRN

Due to its unique and superficial course of the SRN, it is vulnerable to injury during a variety of direct trauma, compression neuropathy, surgical procedures, even during the cephalic vein cannulation. Several, initial reports regarding the SRN injury described the cause of SRN injury as a direct blunt trauma to the forearm, a crush injury, and work-related hyperpronation twisting injury to the wrist⁶.

However, recent reports regarding the SRN injury stressed the importance of anatomic knowledge of the SRN to avoid iatrogenic injury to the SRN during surgeries or intravenous cannulation in the vicinity of the SRN. Iatrogenic injuries to the SRN have already been reported in common orthopedic procedures; including Kirschner wire fixation for distal radial fractures, percutaneous placement of external fixation pins in the proximal radius, and during portal insertion of the wrist arthroscopic surgery^{8,9,13,21}.

The risk of the SRN injury associated with intravenous cephalic vein cannulation is gaining more attention recently. The first report of the SRN injury during intravenous cannulation was reported in 1995²⁰. Since then, multiple reports addressed the occurrence and risks of SRN injuries during cephalic venipunctures. Venipuncture is a minimally invasive procedure that is ubiquitous in modern medicine and is ordinarily innocuous¹¹. However, peripheral nerve injuries can follow routine venipuncture and have severe and disabling consequences, although they are rare. The exact incidence of venipuncture-related nerve injuries is still unknown. Berry and Wallis and Newman and Waxman estimated that 1 of 21,000 to 26,700

patients suffered neurologic injuries severe enough to seek medical attention^{2,18}. Using nursing reports, Newman and Waxman identified additional patients with milder injuries, bringing their total incidence of local neurological injury to 1 in 6,300 (66/419,000)¹⁸.

Venipuncture-related peripheral nerve injury could result in chronic, disabling pain syndrome such as complex regional pain syndrome, type 2 (formerly-called, causalgia or posttraumatic neuralgia)^{10,11}. Horowitz reported an occurrence of causalgia in 25 patients with injury to the upper extremity cutaneous nerve after routine venipuncture¹⁰. The cutaneous nerves affected with causalgia after venipuncture included medial and lateral antebrachial cutaneous nerve, SRN, and dorsal sensory nerves of the hand¹¹. Initially, the nerve injury appeared secondary to direct trauma via “inappropriate” needle or bloused material entry into the plane of the nerve around the vein¹⁰. However, causalgia even developed after atraumatic and properly performed venipunctures in 3 of 25 patients¹¹.

One of present case (#1) of SRN injury is caused by acupuncture. Traditional acupuncture, which is defined as needle insertion techniques at acupuncture points, has become popular in the United States and the rest of the world in recent decades. Increased use of acupuncture brings attention to the safety and the quality of the modality. Although an exact incidence of peripheral nerve injury is unknown, Xu et al.²⁴ reported 4 cases of peripheral nerve injury in their systematic literature review of case reports between 2000 and 2011. The reported peripheral nerve injuries were; peroneal, facial, median nerves and L5 nerve root. Although most case reports did not report the training background of the practitioner, 3 cases reported to be treated by individuals with no medical training or license²⁴. However, the reported cases of peripheral nerve injuries were to have a good outcome with spontaneous recovery and it is difficult to find severe neurologic complication of peripheral nerve injury as shown in the present report²⁴.

Therefore, obtaining detailed knowledge on the anatomic pathway of SRN could help in approaching the radial region of the forearm and hand during treatment for De Quervain disease, nerve conduction study of the SRN, localization of regional nerve blockades, and venipuncture-related injury^{3,12,14}.

3. Symptoms and Signs of Cheiralgia Paresthetica

Patients with SRN compression typically present pain or dysesthesia on the dorsal radial forearm, radiating to the thumb and index finger, although the distribution of symptoms may vary owing to differences in anatomy⁷. When sensory disturbances are associated with the posterior interosseous nerve (PIN)-innervated muscles, the clinician should consider alternative diagnosis, such as a more proximal lesion (of the cervical

spine, posterior cord of the brachial plexus, or radial nerve proper) or perhaps a mass in the radial tunnel large enough to affect both PIN and SRN⁴. Because irritation of the SRN often occurs in the region of the first dorsal compartment, SRN compression may be confused with the symptoms of de Quervain’s stenosing tenosynovitis owing to pain with ulnar deviation of the wrist^{4,7}. A Tinel’s sign over the course of the SRN is the most common physical finding, although the clinician should be mindful that this may also be positive in patients with more proximal pain generators, such as a lateral antebrachial cutaneous neuritis. Although electrodiagnostic testing is often negative in cases of SRN, it is part of a thorough workup and may be helpful if positive⁴.

4. Management of Cheiralgia Paresthetica

Damage to the radial nerve can lead to disability, especially if the patient’s dominant hand is involved; therefore, extreme caution must be exercised when dissecting proximal to the base of the thumb and nerve the brachioradialis tendon¹⁹. As external compression is a common underlying etiology, removal of the inciting element such as a wristwatch or bracelet is an essential component of nonsurgical management⁴. In addition, rest, splinting, and nonsteroidal anti-inflammatory drugs are appropriate first-line treatments. The role of corticosteroid injection is less clear.

Surgical exploration may be necessary if conservative therapy fails^{6,19}. If the nerve is trapped by scar tissue, then release, neurolysis, and coverage with healthy tissue should be performed¹⁹. The presence of a neuroma produces a guarded prognosis for recovery and relief⁹. Lanzetta and Foucher reported a 71% success rate in 29 patients who underwent conservative treatment alone, which was defined as removal of a tight watch strap, splinting, and, in 3 cases, a corticosteroid therapy¹⁵. Surgical decompression had a 74% success rate in 23 patients. They recommended surgical decompression to patients whose symptoms were longstanding and had no distal progression of a Tinel’s sign¹⁵. Surgical decompression may also be indicated in posttraumatic situations in which scar tissue may be the critical compressive factor⁴.

CONCLUSION

The SRN has unique superficial course and it may be exposed to variety of blunt trauma and iatrogenic injuries, including venipuncture and acupuncture. The precise anatomic knowledge of the SRN would be essential in the management of the SRN.

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