

Type 2 complex regional pain syndrome following needle electromyography: A case report

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This case report was presented as a poster at the 2026 annual meeting of Academic Association of Psychiatrists in San Juan, PR February 16-21st, 2026.

Abstract: Complex regional pain syndrome describes pain, typically in an extremity, that is more prolonged or severe than expected given the nature of its triggering event. This case report details a 43-year-old female who was initially seen for electrodiagnostic study for right hand weakness with some numbness and tingling. One month later, the patient was evaluated for significant increase in pain and swelling of right upper extremity. At this time, patient met 4/4 on subjective Budapest criteria and at least the sensory and sudomotor objective criteria and was diagnosed with CRPS type 2 (causalgia). To our knowledge, there have been no reports of CRPS or local nerve injury as a direct result of needle EMG. This report highlights the novelty and perhaps underreported nature of iatrogenic nerve injury secondary to needle EMG.

Key Words: Complex Regional Pain Syndromes, Electromyography, Iatrogenic, Nerve Injuries, Case Report

Complex regional pain syndrome (CRPS) is characterized by burning, tingling, and shock-like sensation, that persists longer and is more profound than expected with respect to the inciting event.^{1,2} Typical presentation includes sensory abnormalities such as hyperesthesia and allodynia, autonomic dysfunction such as changes in temperature and color of skin, and loss of motor function.^{1,2} There are two types of CRPS: type 1, which shows injury with no nerve involvement, and type 2, or causalgia, which involves nerve injury. Diagnosis of CRPS is clinical and follows the Budapest criteria, which is known to have higher specificity than formerly used International Association for the Study of Pain (IASP) diagnostic criteria.³ Per Budapest criteria, to be diagnosed with CRPS a patient must exhibit symptoms both subjectively (3/4) and objectively (2+). Subjective criteria include sensory, vasomotor, sudomotor/edema, and motor/tropic categories and is assessed via history taking and patient experience. Objective criteria include the same four categories and are appreciated on physical exam of the affected area.³ The main goal in treating CRPS is pain management and

restoration of function. Treatment modalities include physical therapy, occupational therapy, pain management with oral medications, stellate ganglion blocks, and psychological support.^{1,2} Many cases of CRPS naturally resolve, however this condition can become chronic.² CRPS is often precipitated by direct trauma, such as injury or surgery, and its pathogenesis is not fully understood but could be linked to inflammatory process, dysfunction of autonomic nervous system, or central pain processing.¹

Nerve conduction studies and needle electromyography (EMG) are generally thought to be low risk, barring a moment of discomfort at the point of needle insertion. Iatrogenic complications with a needle electrode include bleeding, infection, local trauma, and pneumothorax. Some studies have cited nerve injury as a potential risk, though this outcome has not been reported in the existing literature.^{4,5} A recent quality improvement project aimed to more accurately highlight risk factors for needle EMG identified 3 incidences of complication directly related to needle EMG procedure out of 24,772 cases screened, confirming the low risk of this diagnostic test.⁶ There are several areas where nerves travel close to common muscles of diagnostic interest for needle EMG study such as the median nerve's proximity to the pronator teres. To our knowledge, there are no reported cases of nerve injury secondary to needle electromyography.⁷ This manuscript adheres to the CARE (Case Report) guidelines for case reports.⁸

Case Presentation

A 43-year-old female patient with a past medical history of depression and hypertension was referred for an electrodiagnostic examination to evaluate for median mononeuropathy. She reported numbness and tingling at the right hand at the palmar aspect including the first digit to the radial half of the fourth digit. Her symptoms started 10 years ago with no recall of an inciting event, however 6 months prior to visit the patient reports increased dull pain in the hand, including the elbow and shoulder. The patient expressed concern over these symptoms impacting her activities of daily living. The patient also endorsed neck pain that is worse on the right side but denied any shooting pain or pain traveling down the arm. At this point, differential diagnosis included radiculopathy vs. carpal tunnel. Additional pathologies considered were entrapment at the level of the brachial plexus or proximal median nerve. Physical exam was unremarkable for atrophy, scarring, or edema. Neurological exam demonstrated normal strength over bilateral upper extremities. Sensation was intact to light touch over bilateral upper extremities except for right arm at the medial aspect of the forearm and at the hand on the palmar side including digits 1 through 3, and the radial half of the 4th digit. Deep tendon reflexes on the left arm were 2+ in the biceps, brachioradialis, and triceps. On the right upper extremity, reflexes were 3+ to brachioradialis and biceps and 2+ for triceps. This patient did not have any underlying

condition that would explain the hyperreflexia appreciated in the right upper extremity. Spurling maneuver was negative bilaterally. Tinel's sign at both the medial epicondyle and wrist were negative bilaterally. Nerve conduction study results demonstrated prolonged latency of the median motor response with normal amplitude, and a comparison study of the sensory nerve action potentials of the right median and radial nerves showed a latency difference of 0.7 ms in the median nerve indicating evidence of right sensorimotor median nerve mononeuropathy localized to the wrist, as seen in moderate carpal tunnel syndrome. There was no electrodiagnostic evidence of right cervical C5-T1 radiculopathy. NCS/EMG findings seemed to correlate well with patient's symptoms of numbness and paresthesias in digits 1-4, and we hypothesized that other symptoms such as neck pain and forearm sensory disturbances may have been due to non-neuromuscular conditions such as myofascial pain with trigger points or musculoskeletal etiologies. During needle EMG of the bicep, the patient reported intense pain radiating down to the forearm. The needle was removed and re-inserted with improvement of discomfort.

Two weeks after the needle EMG procedure, the patient contacted primary care reporting shooting pain from the upper to lower forearm when reaching to grab something or moving arm, associated with erythema and swelling. Pain began immediately after the procedure and had not improved. Self-care efforts such as heat/cold therapy, NSAIDs, and therapy exercises did not provide any relief. Patient was recommended to visit urgent care to have the area assessed for signs of infection, which was ruled out.

About one week later, the patient returned to clinic for follow-up concerns of ongoing pain and swelling. The patient described burning pain and allodynia affecting the medial forearm as well as slight redness of the area. On exam, mild swelling was appreciated on the upper medial aspect of the forearm extending to the medial epicondyle. In addition, erythema was noted on the medial forearm. There was giveaway weakness with deltoid testing and finger abduction. Sensory testing was notable for allodynia and hyperalgesia in the right medial antebrachial cutaneous (MAC) distribution. Nerve conduction study yielded a normal result in the left MAC, but a non-recordable result in the right MAC, indicating injury through this nerve. At this time, the patient met 4/4 subjective Budapest criteria and at least the sensory and sudomotor objective criteria, leading to diagnosis of type 2 CRPS.

The patient was started on gabapentin and was recommended to start on alpha lipoic acid to promote nerve recovery. Other treatment modalities have included occupational therapy and acupuncture. Four months after the inciting event, the patient received a stellate ganglion block under ultrasound guidance. The procedure was uncomplicated and technically successful due to lack of manifestation of Horner syndrome but did not alleviate pain.

The patient has had gradual improvement with pain helped by acupuncture and titration of gabapentin; however, pain level has not returned to baseline. We obtained consent from the patient to write this case as a case report.

Discussion

This case report presents a novel case of iatrogenic nerve injury caused by needle electromyography resulting in CRPS. In this case, needle electromyography was indicated for evaluation for radiculopathy vs. carpal tunnel.

Needle EMG is often used as a diagnostic tool.⁵ Significant complications are rare, but have included bleeding, pneumothorax, and compartment syndrome.⁷ Iatrogenic nerve injuries have been reported secondary to other medical procedures such as venipuncture, but to our knowledge has not previously been reported from EMG. One study reported 11 patients who developed causalgia after routine venipuncture.⁹ Affected nerves reported were the medial antebrachial cutaneous, the lateral antebrachial cutaneous, the superficial radial and the radial and ulnar dorsal sensory branches.⁹ These locations follow logically with the proximity of nerves to veins. It is also logical to presume that the branches of the medial antebrachial cutaneous nerve are at greater risk for injury given their course along the medial border of the biceps brachii muscle. This case supports this idea, as the MAC nerve sustained injury after needle insertion into the biceps.

One study suggests that carpal tunnel syndrome (CTS) is one of the most common diagnoses associated with CRPS.¹⁰ This could indicate that this patient's presentation put her at higher risk for development of CRPS; however, this study also concludes that surgery is the most common triggering event of CRPS, and the cases screened in this study were patients who elected for surgical treatment of CTS and then went on to develop CRPS.¹⁰ Another study describes causalgia following major traumatic nerve injury and describes a case of a 60 year old female who developed paresthesia in the right median nerve distribution as well as constant pain and tenderness over the wrist and thenar regions. The case reports mild edema, cool temperature, and pale complexion of the right hand compared to the left. Nerve conduction studies confirmed right carpal tunnel syndrome.¹¹ It is difficult to discern whether the CTS in the case of our patient put her at higher risk for development of causalgia following needle EMG.

To our knowledge, there have been no reports of CRPS or local nerve injury as a direct result of needle EMG. We speculate that it is possible that iatrogenic nerve injuries secondary to needle EMG are underreported due to difficulty discriminating its clinical presentation from the underlying neuropathic complaints that often prompt the EMG, as well as generally not having any follow up with the electromyographer.

Conclusion

CRPS is complex and can present with a varied clinical picture from patient to patient. Commonly used diagnostic procedures such as needle EMG have not been linked to or identified as a risk factor for manifestation of CRPS. There are no reported cases of CRPS secondary to needle EMG. Further study is indicated to identify the frequency of nerve injury secondary to needle diagnostic procedures.

Financial Disclosure: This was an unfunded project. No authors have any conflicts of interest to report.

Author Contributions: ES conceived of idea for case report. MO reviewed clinical notes and gathered pertinent details. MO drafted the initial manuscript. All authors contributed to its revision. ES is the senior investigator and made final editorial decisions.

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