근전도검사 이후에 발생한 전경골근의 혈종: 증례보고

문원식, 강인현, 최종경, 황기훈

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A Case Report of Iatrogenic Hematoma on Anterior Tibialis Muscle after Electromyography

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Needle electromyography (EMG) is valid investigation routinely performed by physiatrists and neurologists, and quite safe when performed by an experienced examiner. Needle EMG is generally well tolerated and rarely thought to be associated with any significant side effects, other than mild pain, so practitioners usually overlook any potential complications. However, needle EMG is an invasive procedure and under certain situations has the potential to be associated with bleeding complications such as hematoma or acute compartment syndrome (ACS). We report a case of ACS after EMG in the left lower extremity that led to a lawsuit. To prevent complications such as hematoma and ACS resulting from needle EMG, we should be familiar with the clinical features of ACS and perform immediate evaluation and treatment to improve patient prognosis.

Key Words: hematoma, electromyography, compartment syndrome

Introduction

EMG can be performed with relative safety despite being painful for the patient. However, needle EMG does have the potential to cause adverse events, and an idiopathic or iatrogenic coagulation disorder is considered a relative contraindication to needle EMG.^{1,2}

Despite the possible risks, adverse events following needle EMG are often ignored since their frequency is extremely low. Due to its low cost and convenience compared with other examinations for assessment of nerve damage, needle EMG is still performed in cases with no absolute contraindication simply by weighing the benefits and risks.

We report the case of a female who was diagnosed with ACS by a hematoma that occurred after needle EMG on the lower extremity. We also report her subsequent surgeries and a series of disputes, as well as the determination by the Korea Medical Dispute Mediation and Arbitration Agency.

Received December 18, 2017

Revised March 15, 2018

Accepted April 23, 2018

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Case Report

A 50-year-old female was admitted for hypoesthesia and pain in her left foot for 2~3 years. During her initial visit, she was using crutches and indicated that weakness in her left leg was severe, to the point where she would collapse after intermittent walking. She had a history of gout and Haglund's deformity a few years earlier, for which she underwent surgeries for removal of typhi and bony prominence for each. In addition, she was taking psychiatric medication for insomnia and depression. She often took aspirin to control sudden episodes of pain, but had not taken any in the 2 weeks prior. Despite her complaints, actual muscle weakness and notable muscle atrophy in the left leg were not found on a manual muscle test. And her muscle tone and her patella and Achilles tendon reflexes were also normal. She had no specific findings on spinal magnetic resonance imaging (MRI) performed at another hospital. Laboratory studies revealed a hemoglobin level of 12.4 g/dl (normal, 12.0~14.3 g/dl), platelet count of 183×10^9 per liter (normal, $169\sim365 \times 10^9$ per liter), international normalized ratio of 1.01 (normal, 0.8~1.2), and an activated partial thromboplastin time of 38.4 s (normal, 27~45 s). We assumed her past history and current medical conditions were not related to her symptoms. Subsequently, EMG was performed for differentiation of lumbar radiculopathy, peripheral polyneuropathy, and other disorders.

The deep peroneal and tibial motor nerve conduction study and the superficial peroneal and sural sensory nerve conduction study showed normal latency, amplitude, conduction velocity, and normal findings were also seen in the late response. Needle EMG performed on the lumbar paraspinal muscles and left leg including the vastus medialis, anterior tibialis, peroneus longus, medial gastrocnemius muscles, with 26-gauge 50 mm monopolar needle electrode, showed no abnormal spontaneous activity and also normal motor unit action potentials were noted. About an hour after the test was completed, the patient complained of severe

left leg pain and hypoesthesia in the left foot. The pain was localized to the anterior tibialis muscle area where the needle EMG was performed. Swelling localized to the anterior tibialis muscle without any symptoms of infection such as fever, heat sensations revealed the possibility of a hemorrhage that formed a hematoma. Presumably this, developed after the needle EMG, and other differential diagnoses such as cellulitis, deep vein thrombosis, arterial occlusion were ruled out.

Initial intracompartmental pressure (ICP) measured in the anterior tibialis muscle was 20 mmHg by the gold standard direct invasive measurement and the left dorsalis pedis artery was palpable. Therefore, the diagnostic criteria for ACS were not met at that point. Initial treatment was performed using elastic bandage compression and ice packs, and progress was monitored, but the symptoms worsened, while swelling and ecchymosis were noted at the suspected lesion site (Fig. 1). MRI was performed on the left leg to confirm the problem immediately, approximately 7 hours had passed since the first symptoms occurred. An oval-shaped hematoma measuring $20 \times 16 \times 38$ mm was found in the anterior tibialis muscle, but there was no evidence of compression on the anterior tibialis artery or vein or the deep peroneal nerve. In addition, injuries to the major arteries that can cause hematoma, such as

Fig. 1. Swelling and ecchymosis are seen on left lower limb (arrow). (A) Frontal aspects of lower extremity and (B) lateral aspect of lower extremity.

Fig. 2. Transverse T1 weighted (A) and T2 weighted (B) left lower limb MRI scan demonstrates that hemorrhagic fluid collection in the intermuscular space at anterior tibialis muscle (20 x 16 x 38 mm).

the peroneal or anterior tibial artery were not observed on MRI (Fig. 2). Approximately 12 hours after bleeding began, the pain and dysesthesia became more severe. As a result, surgical treatment was deemed necessary and the department of orthopedic surgery was consulted to perform a fasciotomy and hematoma removal. After surgery, the symptoms improved, but the surgical fasciotomy wound was left open. Approximately 3 months of rehabilitation therapy was required as a result of muscle weakness that developed after long-term bed rest for wound healing and suture removal. The patient was discharged when she was able to walk on her own with crutches and has now recovered to the point of being able to perform the tasks of daily living without assistive devices.

Discussion

A characteristic feature of intramuscular hematoma is edema, which is caused by interstitial fluid accumulation in the muscle due to the osmotic gradient created by blood pooling in a confined area. Pain, tenderness, and impaired muscle contraction and relaxation are also commonly present. Intramuscular hematoma may cause increased ICP and ACS.

ACS collectively refers to various symptoms that occur when the tissue pressure within a closed muscle compartment exceeds the perfusion pressure to cause

muscle and nerve ischemia. ACS mainly occurs in the extremities, most often following trauma, such as a fracture.³ ACS can be diagnosed based on clinical features such as the 6 Ps: pressure, pain, paresthesias, paresis, pink skin, and presence of a distal pulse. And absence of these findings can be used to exclude the diagnosis of ACS.⁴ Without proper treatment ACS can lead to necrosis of intracompartmental muscle and nerves. Moreover, it can lead to a Volkmann contraction in an extremity, while severe cases have the potential to cause renal failure and even death.⁵ Early diagnosis and decompression are essential for successful treatment.

The current gold standard for diagnosis of ACS is invasive ICP measurement.⁶ ACS is suspected when ICP is ≥ 30 mmHg, while surgical treatment is considered when it reaches ≥ 40 mmHg. ICP measurement is a method in which a slit catheter or a similar needle is inserted in the muscle compartment to directly send measurements to a pressure transducer. As a second diagnostic tool, ultrasonography is a non-invasive measurement tool that can be useful in diagnosing ACS.⁷ It can be diagnosed by a variety of methods via ultrasonography. For example, measurement of pulsatile tissue motion using ultrasound has comparable diagnostic sensitivity and specificity to invasive measurements.⁸ Recording diastolic retrograde arterial flow via pulsed Doppler also correlates with the degree of pressure ap-

plied to the limb, suggesting that Doppler analysis of retrograde flow may be a useful tool for detecting and evaluating hemodynamics in potential ACS cases.⁹

A variety of possible complications may occur after needle EMG, and because it is an invasive procedure, the risk of bleeding cannot be eliminated. However, amongst cases in which complications do occur, bleeding is often resolved within just a few days, with mild sequelae in some cases.

To date, the literature reveals only a handful of case reports of symptomatic bleeding complications after EMG, especially ACS.¹⁰ Farrel et al. reported a case of ACS occurring after needle EMG performed on the legs.¹¹ Even though bleeding complication prevalence is low, in those patients thought to be at an increased risk for bleeding, it is reasonable to ensure that examiners following guidelines to minimize the chance of complication. The American Association of Neuromuscular and Electrodiagnostic Medicine recommends that for patients who are taking anticoagulants, examination of the superficial muscles should be conducted first, followed by examination of the deep muscles, and that compression should be sustained after removing the needle.²

This patient filed a request for medical dispute mediation in relation to this case. Consequently, the appropriateness of EMG and the need for written consent, as well as treatment in response to hematoma were reviewed by the Korea Medical Dispute Mediation and Arbitration Agency.

Even though we received confirmation that there were no inappropriate processes as we went through dispute mediation in this case, there were some compensations and remedies that could have helped to relieve the patient's discomfort and minimize hospital costs. First of all, electromyographers should have carefully evaluated the patient's medical and past history, physical condition, and risk factors, while keeping in mind the potential onset of complications. Second,

when we consider the time required for MRI and surgery after ACS had occurred, it would have been better to consider ultrasonography as an ancillary image diagnostic tool prior to MRI, so that we could have saved time and operated sooner.

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