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CASE REPORT

Ultrasound-guided nerve hydrodissection for sciatic neuropathy caused by piriformis rhabdomyolysis: A case report

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ABSTRACT

Peripheral entrapment neuropathy is a rare complication of rhabdomyolysis and lacks successful treatment. In this article, we report a case of sciatic neuropathy caused by piriformis rhabdomyolysis which was successfully treated with ultrasound-guided sciatic nerve hydrodissection. A 27-year-old male patient with left buttock pain and left lower limb weakness received ultrasound-guided nerve hydrodissection via injection of dexamethasone and 5% dextrose water into the area surrounding the left sciatic nerve. After injection, the patient's pain and left lower extremity weakness subsided. In conclusion, although peripheral entrapment neuropathy due to rhabdomyolysis is rare, early diagnosis and treatment using ultrasound-guided nerve hydrodissection may yield favorable clinical outcomes.

Keywords: Hydrodissection, rhabdomyolysis, sciatic neuropathy, ultrasonography.

Entrapment neuropathy, among the most common causes of focal neuropathy, can occur when a peripheral nerve passes through a ligament, osseofibrous tunnel, or muscle.[1] Piriformis syndrome is thought to result from compression of the sciatic nerve around the piriformis muscle.[2] Piriformis syndrome can be caused by a variety of factors including congenital abnormalities, muscle spasms, trauma or injury to the muscle such as hematoma, overuse injuries commonly seen in athletes, muscle hypertrophy, muscle shortening, infections within the muscle, and postural problems.[2,3] Rhabdomyolysis can cause muscle degeneration and swelling, the latter of which can lead to peripheral nerve compression.[4] Previous studies have shown that peripheral neuropathies are caused by rhabdomyolysis. Sciatic neuropathy due to piriformis rhabdomyolysis is extremely rare.[5,6]

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Although several studies have reported rhabdomyolysis-induced entrapment neuropathy, its successful treatment has not been described yet.[4,6,7] Lee et al.[5] reported sciatic neuropathy due to rhabdomyolysis after carbon monoxide intoxication. After three weeks of comprehensive rehabilitation, lower extremity weakness improved; however, the rehabilitation program was not described in detail in their report.

Conservative treatments for entrapment neuropathy include physiotherapy, oral medications, and local steroid injections.[1] Nerve hydrodissection has recently been used to treat entrapped peripheral nerves. The main goal of this treatment is to remove peripheral nerves from the surrounding structures.[8]

In this article, we present a rare case of successful treatment of sciatic neuropathy due to piriformis rhabdomyolysis using ultrasound (US)-guided nerve hydrodissection.

CASE REPORT

A 27-year-old male patient was admitted to our rehabilitation department with severe left buttock pain radiating to the sole which developed after rock climbing 12 days prior. The day after the patient went rock climbing, he visited an external clinic with severe left buttock pain. An evaluation revealed that his serum creatine kinase (CK) level was elevated at 14,928 IU/L. After intensive hydration therapy, the serum CK level normalized to 74 IU/L, but the painful weakness of the left lower extremity persisted. Upon admission to our department, the Visual Analog Scale (VAS) score of the left buttock pain radiating to the sole was 7. The Manual Muscle Testing (MMT) revealed a Medical Research Council (MRC) Grade 3 in the left knee flexor, MRC Grade 4 in the left ankle plantar flexor and hip extensor, MRC Grade 4 in the left ankle dorsiflexor, and MRC Grade 4+ in the left hip abductor. The strengths of the other muscles in the left lower extremity were normal. In the sensory test, hypesthesia and hypoalgesia of the dorsum of the left foot were provoked by light touch and pinprick, and paresthesia of the left sole and fifth toe were induced by pinprick. Deep tendon reflexes were absent in the left ankle. The patient could not walk independently due to pain and weakness of the left buttock and lower extremity.

Pelvic magnetic resonance imaging (MRI) demonstrated edematous changes in the left gluteus maximus, medius, and minimus muscles; piriformis muscle; and soft tissues around the left sciatic nerve (Figure 1). The US showed hyperechogenicity in the left gluteus medius, minimus, and piriformis muscles and swelling of the left sciatic nerve in the upper portion of piriformis muscle versus the right one.

A nerve conduction study showed low-amplitude compound muscle action potentials (CMAPs) of the left tibial and common peroneal nerves, sensory nerve action potential (SNAP) of the left sural nerve, and H-reflex of the left gastrocnemius muscle. However, no remarkable difference was noted in the latency of the H-reflexes between the two gastrocnemius muscles (Table I). Needle electromyography revealed abnormal spontaneous activity in the left gluteus maximus and medius,

TABLE I

Initial and follow-up nerve conduction studies for incomplete left sciatic neuropathy

	Nerve	Left			Right		
		Distal latency (ms)	Amplitude (μV)	Velocity (m/s)	Distal latency (ms)	Amplitude (μV)	Velocity (m/s)
One week pre-injection	SNAP						
	Sup. peroneal	1.96	9.9		1.88	9.6	
	Sural	1.88	9.2		1.93	21.2	
	Saphenous	1.61	11.5		1.77	12.5	
	CMAP						
	Com. peroneal	3.54	2.5	46.1	3.13	10.0	45.3
	Tibial	4.27	5.7	45.7	3.65	18.2	50.0
	Femoral	5.26	13.7		5.16	15.1	
	H-reflex						
	Tibial	31.61	0.5		31.25	12.7	
Five months post-injection	SNAP						
	Sup. peroneal	1.82	9.9				
	Sural	2.19	9.6				
	CMAP						
	Com. peroneal	3.39	6.4	42.9			
	Tibial	3.44	6.3	41.9			

Amp: Amplitude; CMAP: Compound muscle action potential; Com.: Peroneal, common peroneal; DL: Distal latency; SNAP: Sensory nerve action potential; Sup.: Peroneal, superficial peroneal.

tibialis anterior, peroneus longus, gastrocnemius, semimembranosus, and short head of the biceps femoris muscles. Electrodiagnostic findings revealed left incomplete sciatic neuropathy with gluteal myopathy. Based on all these findings, the patient was diagnosed with sciatic neuropathy caused by piriformis rhabdomyolysis. The patient underwent US-guided sciatic nerve hydrodissection.

Ultrasound-guided nerve hydrodissection was performed by the injection of dexamethasone (5 mg, 1 mL) and 5% dextrose water (5 mL) around the left sciatic nerve in the piriformis muscle (Figure 1). The MRC Grade of the left knee flexor increased from 3 to 4 and the VAS score decreased from 7 to 5 on the day after injection. Oral medications including meloxicam, gabapentin, and amitriptyline were administered to reduce the

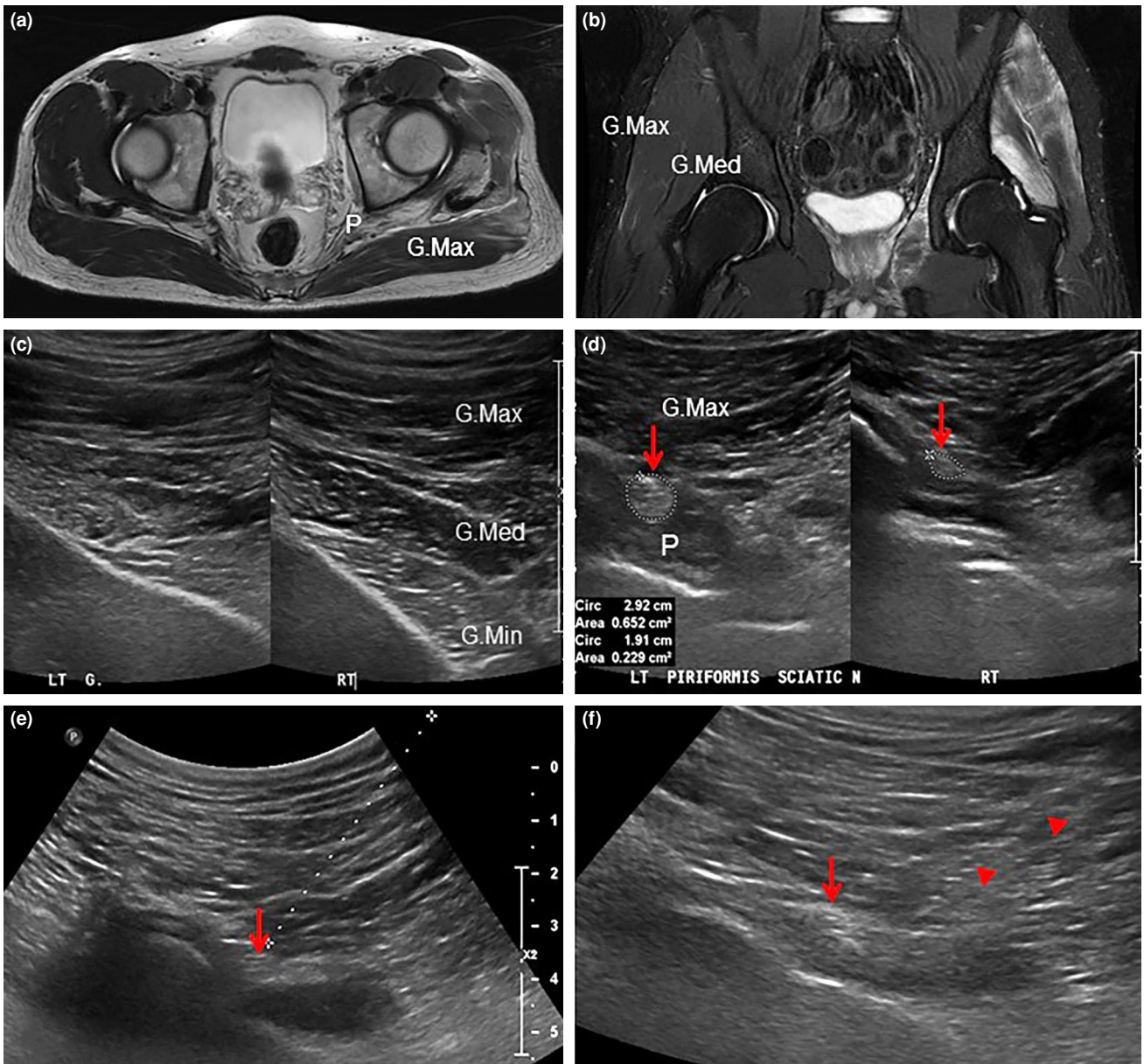


FIGURE 1. (a) Axial and **(b)** coronal magnetic resonance images of left buttock. Increased signal intensity was found in the left gluteus maximus, medius, and piriformis muscles and sciatic nerve. **(c, d)** Transverse ultrasound image showed hyperechogenicity of left gluteus medius and minimus muscles and swelling of left sciatic nerve (arrow) versus to the right one. **(e, f)** Ultrasound-guided nerve hydrodissection was performed using dexamethasone (1 mL) and 5% dextrose water (5 mL) around the left sciatic nerve (arrow) in the piriformis muscle. Needle (arrowheads).
P: Piriformis; G. max: Gluteus maximus; G. med: Gluteus medius; G. min: Gluteus minimus.

pain and tingling sensations. At two weeks post-injection, the VAS score of the left buttock pain radiating to the sole was 5, and muscle strength increased to MRC Grade 4 in the left knee flexor, hip extensor, and ankle plantar flexor muscles. Meanwhile, the patient was able to walk indoors independently. Five months post-injection, the VAS score was 1 and the muscle strength increased to MRC Grade 4+ in the left ankle plantar flexor and Grade 5 in the other left lower-extremity muscles. In addition, the patient resumed his previous functional activities. A follow-up nerve conduction study showed increased-amplitude CMAPs in the left tibial and common peroneal nerves and an increased SNAP in the left sural nerve (Table I). A written informed consent was obtained from the patient.

DISCUSSION

Rhabdomyolysis is a medical condition characterized by muscle necrosis and the secretion of intracellular muscle components such as electrolytes, myoglobin, and creatinine kinase into the circulatory system. Although the most common cause of rhabdomyolysis is a direct muscle injury, it can also be caused by drugs, toxins, infections, muscle ischemia, prolonged bed rest, or exertion.[9] Rhabdomyolysis can cause various complications such as acute renal failure, acute compartment syndrome, and peripheral entrapment neuropathy. Rhabdomyolysis can cause degeneration and swelling of the involved muscles; subsequent swelling of the affected muscle can compress the peripheral nerves. Peripheral entrapment neuropathy caused by rhabdomyolysis is rare. Lee et al.[4] reported peripheral neuropathy in patients with rhabdomyolysis caused by immobilization and long-term alcohol consumption. However, no previous studies reported the incidence of entrapment peripheral neuropathy due to rhabdomyolysis. A recent study reviewed eight consecutive patients with rhabdomyolysis-associated sciatic neuropathy.[10] Ko et al.[6] reported bilateral sciatic neuropathy with rhabdomyolysis following a venlafaxine overdose. Other studies reported rhabdomyolysis-induced entrapment neuropathy in the femoral, ulnar, and radial nerves.[4,7]

The left sciatic neuropathy in the present case was caused by piriformis rhabdomyolysis after exertion (i.e., rock climbing). Electrodiagnostic tests showed low-amplitude CMAPs, SNAPs, and H-reflexes of the left lower-extremity nerves. Abnormal spontaneous activity in the left lower-extremity muscles innervated by the left sciatic nerve with preserved conduction velocity of the left lower-extremity nerves was also observed. Therefore, our electrodiagnostic interpretation was incomplete sciatic neuropathy (axonopathy). Pelvic MRI and US revealed swelling in the left gluteus maximus, medius, and minimus muscles; piriformis muscle; soft tissue around the left sciatic nerve; and the left sciatic nerve in the piriformis. Based on the electrophysiological and imaging findings, the pain and left lower-extremity weakness were caused by entrapment sciatic neuropathy associated with the rhabdomyolytic piriformis and gluteal muscles.

Piriformis syndrome is a rare disease which accounts for approximately 6% of all sciatic pain cases.[11] The anatomical variations of the sciatic nerve in relation to the piriformis muscle were categorized into the six types.[12] In our case, the left sciatic nerve passed through the swollen piriformis muscle on imaging studies and was classified into type D (i.e., the sciatic nerve exits through the piriformis muscle). The pain and muscle weakness of the left lower extremity were severe, as the left sciatic nerve in the piriformis muscle was compressed by muscle swelling and inflammation. Conservative treatments for piriformis syndrome include medication, physical therapy, steroid injections, and botulinum injections.[13] Surgical treatment is performed to achieve sciatic nerve decompression and neurolysis after conservative treatment fails.

Rosales et al.[14] examined perisciatic nerve infiltration under US guidance in 49 patients with deep gluteal syndrome. They injected a large volume of a mixed solution of saline (20 mL), 2% lidocaine (4 mL), and corticosteroids (1 mL; 40 mg methylprednisolone acetate) to separate the sciatic nerve from the surrounding tissue. After the injection, pain relief was achieved in 73.7% of patients. A case report demonstrated the effectiveness of perineural dextrose injections in the treatment of radial nerve palsy.[15] After two US-guided perineural injections with 5% dextrose (15 mL) at a one-month interval were performed, a significant improvement in sensory and motor functions was observed. Nerve hydrodissection involves the injection of an anesthetic, saline, or 5% dextrose water to separate the nerve from the surrounding tissue, fascia, or adjacent structures.[9] Although the exact mechanisms of nerve hydrodissection using 5% dextrose water are unclear, mechanical and pharmacological

effects have been proposed.[16,17] Accordingly, the hydrodissection can detach the nerve by the injectate, and the mechanical effect may reduce adhesion, mobilize the nerve, and increase circulation. Dextrose can reduce neurogenic inflammation by inhibiting capsaicin-sensitive receptors in terms of the pharmacological effect. These receptors inhibit the secretion of substance P and calcitonin gene-related peptides, which are known to induce nerve pain and swelling.[16] The mechanical effect of nerve hydrodissection plays an important role in early symptom improvement, followed by the pharmacological effect of dextrose enhancing the long-term effect.[17]

The detection of sciatic nerve variants is crucial in piriformis syndrome while performing US-guided sciatic nerve blockade and piriformis muscle injection. In the present case, US-guided sciatic nerve hydrodissection in piriformis muscle was performed using a mixture of dexamethasone and 5% dextrose water to relieve neuropathic pain and improve muscle strength. Steroids were added to 5% dextrose water, as the patient was injected two weeks after symptom onset and the left sciatic nerve and piriformis muscle were swollen due to inflammation. Steroids were used to reduce inflammation around the sciatic nerve, and 5% dextrose water was used to detach the compressed sciatic nerve surrounded by the swollen piriformis muscle. After one injection, the patient's symptoms improved rapidly because sciatic nerve hydrodissection was performed early after symptom onset and the injectate was accurately delivered to the target area under the US guidance. Furthermore, the rapid post-injection improvement in left knee flexor muscle strength might be the results of mechanical effect of nerve hydrodissection and pain reduction, achieved by separating the piriformis muscle compressing the sciatic nerve. A rather long-term successful treatment outcome was observed with a single US-guided nerve hydrodissection in this case study. However, some patients with deep gluteal syndrome may require more than one injection (maximum three injections) to achieve favorable outcomes.[18]

In conclusion, to the best of our knowledge, this case is the first known case of successful treatment of sciatic neuropathy due to piriformis rhabdomyolysis using US-guided sciatic nerve hydrodissection. Although peripheral entrapment neuropathy due to rhabdomyolysis is rare, its early diagnosis and treatment using US-guided nerve hydrodissection may prevent severe neurological complications and yield favorable clinical outcomes.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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