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CASE REPORTS/CASE SERIES

Ultrasound-guided perineural steroid injection to treat intractable pain due to sciatic nerve injury

Injection périneurale échoguidée de stéroïdes pour le traitement de la douleur rebelle due à une lésion du nerf sciatique

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Abstract

Purpose *Sciatic neuropathy is a rare but serious complication of cardiac surgery. Neuropathic pain following nerve injury can be severely debilitating and largely resistant to treatment. We present a case of this complication where ultrasound-guided perineural steroid injection at the site of the sciatic nerve injury provided excellent pain relief and facilitated subsequent rehabilitation.*

Clinical features *A 17-yr-old boy developed bilateral sciatic neuropathy after a nine-hour cardiac surgical procedure in the supine position, resulting in debilitating dysesthesia refractory to neuropathic pain therapies and leading to severe functional limitation. With magnetic resonance imaging of the lower extremities, the location of the lesion was determined to be from the level of the superior gemellus to the level of the quadratus femoris. An ultrasound-guided injection of triamcinolone 20 mg and lidocaine 40 mg around both sciatic nerves at the level of the lesion was administered two months after the surgery, and the pain score (rated on a scale 0-10) at rest decreased from 9-10 to 1 two weeks after the injection.*

Conclusions *There are a limited number of reports in the literature on sciatic nerve injuries associated with cardiac surgery. This case illustrates the efficacy of ultrasound-guided steroid injection around sciatic nerves at the level of superior gemellus in treating our patient's neuropathic pain.*

Résumé

Objectif *La neuropathie sciatique est une complication rare mais grave de la chirurgie cardiaque. La douleur neuropathique suivant une lésion nerveuse peut être extrêmement débilitante et très résistante au traitement. Nous présentons un cas de cette complication dans lequel l'injection périneurale échoguidée de stéroïdes au site de la lésion du nerf sciatique a fourni un excellent soulagement de la douleur et facilité la réhabilitation subséquente.*

Éléments cliniques *Un garçon de 17 ans a commencé à souffrir de neuropathie sciatique bilatérale après une intervention chirurgicale cardiaque de 9 heures en position dorsale, résultant en une dysesthésie débilitante réfractaire aux traitements contre la douleur neuropathique et entraînant des limites fonctionnelles graves. En réalisant une imagerie par résonance magnétique des membres inférieurs, on a pu déterminer l'emplacement de la lésion, allant du muscle jumeau supérieur au muscle carré fémoral. Une injection échoguidée de triamcinolone 20 mg et de lidocaïne 40 mg autour des deux nerfs*

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sciatiques au niveau de la lésion a été administrée deux mois après la chirurgie, et le score de douleur (évaluée sur une échelle de 0 à 10) au repos a baissé de 9-10 à 1 deux semaines après l'injection.

Conclusion *Il n'existe qu'un nombre limité de comptes rendus dans la littérature portant sur les lésions du nerf sciatique associées à une chirurgie cardiaque. Ce cas illustre l'efficacité d'une injection échoguidée de stéroïdes autour des nerfs sciatiques au niveau du muscle jumeau supérieur pour le traitement de la douleur neuropathique de notre patient.*

Sciatic neuropathy is a rare but serious complication of cardiac surgery. After nerve injury, patients may experience incapacitating neuropathic pain. The treatment of neuropathic pain is difficult and the results are often unsatisfactory. Perineural corticosteroid injections produce excellent analgesia in a variety of pain-related disorders, including neuromas[1] and nerve entrapments.[2] Nevertheless, only a few trials have been reported on perineural corticosteroid injections for neuropathic pain due to nerve injury.[3,4] Herein, we report the case of a 17-year-old boy who developed bilateral sciatic neuropathy leading to severe dysesthesia in both lower extremities after a nine-hour cardiac surgical procedure. An ultrasound-guided perineural steroid injection at the site of the sciatic nerve injury provided excellent pain relief and facilitated subsequent rehabilitation. The patient provided written informed consent for publication of this article.

Case report

A slender 17-yr-old boy (height 167 cm, weight 40 kg, body mass index 14.3 $kg \cdot m^{-2}$) with complex congenital heart disease consisting of a double outlet right ventricle, transposition of the great arteries, pulmonary stenosis, atrial septal defect, and ventricular septal defect had undergone a palliative Glenn shunt and ligation of the main pulmonary artery when he was four years old. Throughout the two years before admission, the patient experienced symptoms of chest tightness and pain, fatigue during daily activities, and increasing cyanosis. Consequently, he was admitted to the Department of Cardiothoracic Surgery for a Fontan procedure. Preoperatively, he had no neurological disease and no neurological deficit in his lower extremities. His oxygen saturation was 60-70% on room air. He could walk without assistance, but dyspnea prevented him from walking more than 200 m.

The patient remained in the supine position during the operation which lasted for approximately nine hours. During the next few days following surgery, he experienced weakness in his legs and unrelenting burning discomfort in the bilateral calves and feet, particularly the soles of both feet.

The patient was given nonsteroidal anti-inflammatory agents for two weeks; however, pain, allodynia, and hyperalgesia became progressively pronounced and incapacitating. One month after surgery, the patient described the pain as continuous and burning and evaluated its intensity at 10 on a numeric rating scale (NRS) of 0-10. One month after surgery, he was admitted to hospital for evaluation and treatment for his pain. On examination, muscle power was decreased in the lower extremity: left ankle dorsiflexion (2/5); left ankle plantarflexion (2/5); right ankle dorsiflexion (3/5); right ankle plantarflexion (2/5); and knee flexion (4/5) on both sides. Knee extension, hip flexion, and extension and abduction of both lower limbs were normal. Sensory disturbance to light touch and pinprick was detected below the knee on both sides, except along the medial calves (saphenous nerve distribution). Severe allodynia and hyperalgesia were detected over both feet as well as the posterior and lateral calf areas in both lower extremities. Bilateral ankle jerk was depressed. Passive straight leg raising on both sides was limited to 0° and resulted in increased leg pain.

Nerve conduction studies revealed the absence of bilateral tibial and sural sensory nerve action potential and H-reflex as well as low-amplitude bilateral peroneal compound motor action potential. Needle electromyography of both lower limbs revealed active denervation with reduced recruitment of motor unit action potentials in the left gluteus maximus (innervated by the inferior gluteal nerve) peroneal-innervated muscles, including the short head of the biceps femoris and tibial-innervated muscles and the semitendinosus. No abnormalities were observed in the quadriceps, adductor longus, iliopsoas, and paraspinal muscles. The electrophysiological findings were consistent with left inferior gluteal neuropathy and axonal bilateral sciatic neuropathy proximal to the branch to hamstring muscles; the condition predominantly affects the tibial division. Magnetic resonance imaging (MRI) of the lower extremities was performed ten days later to rule out space-occupying lesions and to define the site of nerve injury. Axial fat-saturated fast spin-echo T2-weighted image showed high signal intensity and bilateral swelling of the sciatic nerves from the level of the superior gemellus to the level of the quadratus femoris (Fig. 1).

Following admission to hospital, various medications for neuropathic pain, including opioids, nonsteroidal anti-inflammatory drugs, paracetamol, antidepressants, and anticonvulsants were administered with only minimal relief. The NRS score at rest remained at 9-10 in both

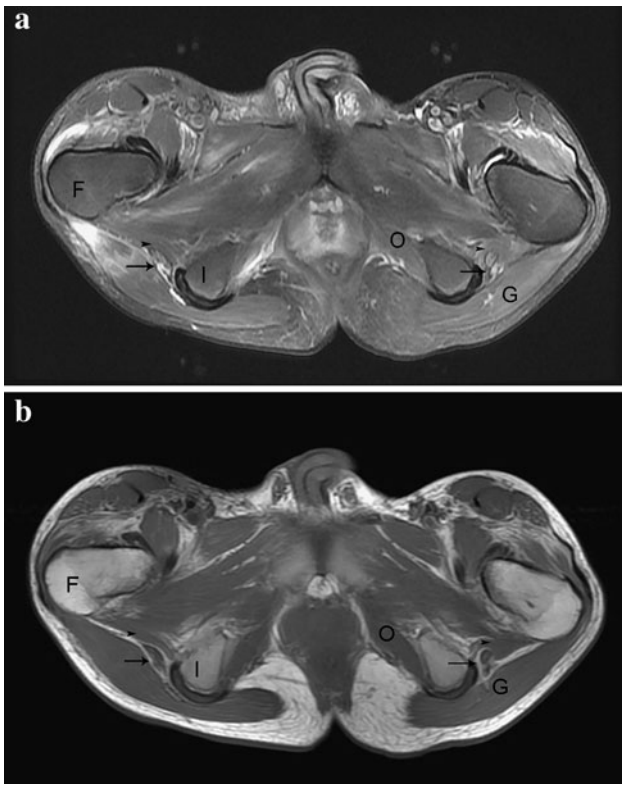

Fig. 1 Magnetic resonance imaging (MRI) of the proximal sciatic nerves. a. Axial fat-saturated fast spin echo T2-weighted image at the level of the quadratus femoris (arrowhead) showing high signal intensity and swelling of both sciatic nerves (arrow). b. Axial T1-weighted image at the same level. I = ischial tuberosity; F = femur; G = gluteus maximus muscle; O = obturator internus muscle

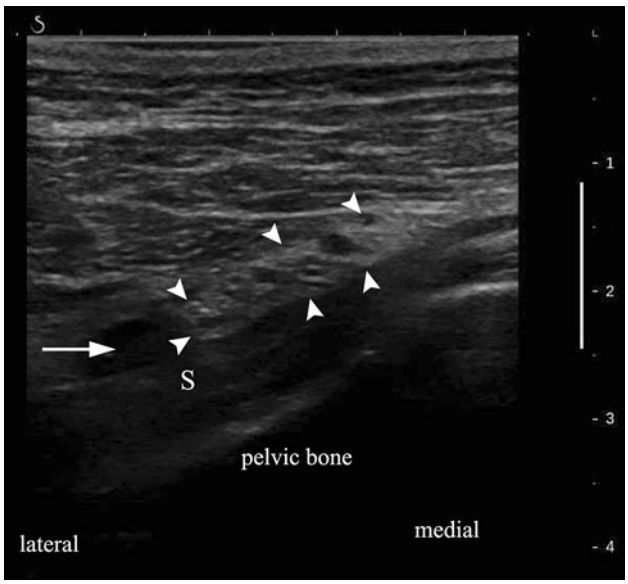

Fig. 2 Transverse sonographic images of the left sciatic nerve (arrowhead) at the level of the superior gemellus muscle as the linear ultrasound transducer is placed from midline to lateral position. The images show steroid anesthetic mixture (arrow) around the sciatic nerve during perineural injection. S = superior gemellus muscle

limbs. The severe pain and allodynia limited mobility and led the patient to become wheelchair bound. He could not tolerate his feet touching any surface. When he sat in the wheelchair, he lifted his legs to prevent his feet from touching the footplate. During the day, he stayed in bed lying on his side with both knees flexed because the pain was exacerbated when knees were extended. The pain also prevented him from participating in rehabilitation programs. Two months after surgery, bilateral knee flexion contracture (10° and 20° lack of knee extension on the left and right lower limbs, respectively) had developed.

A steroid injection at the site of the sciatic nerve injury was considered for refractory neuropathic pain because local steroid administration has been shown to be successful in such cases.[3,4] Since the MRI identified the site of the sciatic nerve injury to be a segment from the level of the superior gemellus to the level of the quadratus femoris, an ultrasound-guided injection was planned in an attempt to place the medication precisely at the level of nerve damage. Two months after surgery, an ultrasound-guided sciatic nerve block was performed at the level of the superior gemellus with the patient placed in the prone position. An ultrasound system (Aixplorer®, SuperSonic Imaging, Aix-en-Provence, France) was used with a 4-15 MHz linear probe. The probe was placed transversely to scan the sciatic notch and then moved caudally to visualize the ischial spine and superior gemellus muscle. At this level, the sciatic nerve can be observed deeper than the superior gemellus muscle. Once the sciatic nerve was identified, a perineural injection of 2% lidocaine 2 mL (40 mg) and triamcinolone 2 mL (20 mg) was given using a 21G needle at the level of the superior gemellus under direct ultrasound guidance with an in-plane technique (Fig. 2). The procedure was well tolerated without any complications. The patient responded very positively to the injection and could progressively proceed with rehabilitation programs (40 min·day^{-1} on weekdays), including strengthening exercises (bilateral quadriceps, gluteus, dorsiflexor and plantarflexor muscles), hip flexor and hamstring stretching exercises, knee joint mobilization, and gait training. Nine days later, his pain was greatly relieved (NRS at rest was 3-4 for both limbs), and he was discharged from the hospital on diclofenac (25 mg tid) and tramadol (100 mg·day^{-1}). He continued the rehabilitation programs after discharge. Two weeks after the injection, the NRS score at rest was reported as 1 in both limbs without the use of opioids. His muscle strength with ankle dorsiflexion had improved by one grade bilaterally; the angle of passive straight leg raise had improved to 30°/45° in both extremities, and his bilateral knee flexion

contracture had resolved. Furthermore, he could ambulate with a walker. Over the next two weeks, the patient was able to walk without assistance, and he rated bilateral foot pain during walking as 3 on the NRS score. Three months later, bilateral foot pain persisted, remaining at a NRS of 3 during walking. As a result, a second injection for bilateral sciatic nerve block was performed. Two weeks after the second injection, the pain during walking improved to a NRS of 1. On follow-up four months later, the patient's NRS was stable at 0 while resting and 1 while walking, and the muscle power of bilateral ankle dorsiflexion and plantarflexion was 5/5 and 4/5, respectively.

Discussion

The number of reports in the literature is limited regarding sciatic nerve injuries associated with cardiac surgery and their optimal treatments. Also, the precise location and extent of sciatic nerve injury following cardiac surgery has not been well documented. Herein, we report a case where the exact site of sciatic nerve injury after cardiac surgery was identified by MRI as being localized from the level of the superior gemellus to the level of the quadratus femoris. Moreover, this case illustrates the efficacy of ultrasound-guided steroid injection around sciatic nerves at the level of superior gemellus in treating neuropathic pain caused by sciatic nerve injury following cardiac surgery.

Sciatic neuropathy can result from a variety of conditions, including trauma, compression, intragluteal injection, mass lesion, or nerve infarction. Cardiac surgery has also been reported as a cause of sciatic neuropathy.[5,6] Kempster *et al.* identified ten patients in a period of six years who underwent cardiac surgery and developed bilateral but asymmetrical sciatic neuropathy leading to prominent causalgic pain.[5] McManis *et al*. reviewed the cardiac surgeries performed at the Mayo Clinic over 15 years and found only six instances of sciatic neuropathy.[6]

The precise mechanism and location of sciatic nerve injury following cardiac surgery is unknown. The site of sciatic nerve injury was thought to be at the level of the buttocks due to prolonged nerve compression under reduced arterial perfusion during cardiopulmonary bypass[5] or in the mid-thigh due to the presence of a watershed area between the superior and inferior vessels supplying the sciatic nerve in the thigh;[6] however, precise localization of the nerve lesion has not been established.

Electrodiagnostic studies are useful for diagnosing sciatic neuropathy; however, they may not be able to localize the site of injury. In addition to being an adjunct to conventional electrodiagnostic techniques, MRI can facilitate accurate localization of the level of nerve injury. A T2-weighted MRI may show high signal intensity in the nerve and/or increased nerve diameter.[7] In the present case, we used MRI to localize the precise level of the nerve injury, and MRI results showed bilateral sciatic nerve swelling from the level of the superior gemellus to the level of the quadratus femoris. Although ultrasonographic evaluation may offer some useful information about the site of nerve injury, the ultrasonographic interpretation criteria for identifying traumatic nerve abnormalities have not been clearly defined in the literature. In our case, relative swelling and hypoechogenicity of the bilateral sciatic nerves from the level of the superior gemellus to the level of the quadratus femoris were detected, which was in agreement with the MRI findings.

Presentation of sciatic nerve injury includes weakness of all muscles below the knee and hamstrings with sensory loss below the knee while sparing the saphenous nerve distribution. Numbness and paresthesia in the sciatic nerve distribution are also frequent symptoms. Moreover, in one series, significant dysesthetic pain, usually described as a constant burning sensation or sharp jabbing pain along the distal course of the sciatic nerve, was present in 56% of patients.[8]

The degree of recovery from painful dysesthesia is variable. Four of the ten cases reported by Kempster *et al*. had gradual recovery of sensory symptoms after a mean period of 14 months;[5] however, the remaining patients continued to experience painful dysesthesia. Treatment for neuropathic pain is quite challenging, and patients with neuropathic pain commonly do not respond to pharmacotherapy. Effective treatments should aim specifically at the mechanisms responsible for neuropathic pain symptoms. Nerve injury activates secretion of inflammatory mediators and increases ectopic discharge from the injured nerve, thereby contributing to the development of neuropathic pain.[9–11] Local corticosteroid administration may provide effective therapy for neuropathic pain following nerve injury by suppressing ectopic neural discharges from the injured nerve.[12] Eker *et al.* evaluated the effectiveness of transsacral steroid injection of methylprednisolone 80 mg and 1% lidocaine through the S1-S2-S3 sacral foramina in five patients with severe and persistent neuropathic pain due to accidental sciatic nerve injury. Nearly complete recovery from the neuropathic pain symptoms was achieved in all patients at the one-month follow-up.[3] These authors also compared peripheral nerve block using methylprednisolone acetate (Depo-Medrol®) plus lidocaine *vs* lidocaine alone for the management of refractory neuropathic pain following peripheral nerve damage. The injured nerve was identified using peripheral nerve stimulation and was blocked proximally to the site of nerve injury. The report showed that, methylprednisolone plus lidocaine was more effective than lidocaine alone in decreasing pain intensity, neuropathic symptoms and signs, and analgesic requirements.[4] In the present study, we used MRI for precise localization of sciatic nerve injury following cardiac surgery.

Furthermore, to inject steroids accurately at the nerve injury site, we used ultrasound guidance and injected the steroids around both sciatic nerves at the level of superior gemellus. Successful pain control was achieved safely and effectively in this case. One limitation of our case report was absence of time control; therefore, we cannot exclude the possibility of spontaneous healing. Nevertheless, because the pain improved only after each of the two steroid injections, it is reasonable to conclude that the injections were responsible for the patient's pain relief.

There is limited evidence regarding the efficacy of local corticosteroid administration for the treatment of neuropathic pain due to nerve injury. Additionally, the effect of the proximity of the injection to the site of nerve injury remains unknown, and further studies are needed. There is a possibility, however, of intraneural injection leading to further nerve injury during peripheral nerve block. Other complications include infection, bleeding, and local anesthetic systemic toxicity. Ultrasound guidance offers the ability to inject medication precisely at the nerve injury site and may reduce the likelihood of further nerve injury related to peripheral nerve block.

Conclusion

In this case, MRI established the exact location of sciatic nerve injury after cardiac surgery. Moreover, this case illustrates the efficacy of ultrasound-guided perineural steroid injection at the level of the superior gemellus in treating this devastating neuropathic pain caused by sciatic nerve injury following cardiac surgery.

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