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Extraneural cyst compression of the common and deep peroneal nerve: A case report and review of the literature

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Abstract:

Cysts are very common lesions around the knee although they seldom cause complications. Peripheral neuropathy caused by these structures most commonly occurs by compression of the common peroneal nerve and its branches, at the level of the fibular neck. We report a case of a 44-year-old male admitted to the emergency department with complaints of right foot drop and numbness on the lateral side of the right leg caused by an extraneural synovial cyst compressing the peroneal nerve. Ultrasonography and magnetic resonance aided on the diagnosis. The cyst was removed surgically. Three months after the procedure, the patient was without complaints, with full motor and sensory function.

Keywords:

Knee, cysts, peroneal nerve palsy

Introduction

Many cystic lesions can be found around the knee joint.[1] Of these, ganglion and synovial cysts are the most prevalent, although literature differentiation between the two entities still lacks, and they are perceived as one and the same. On the lower limb, cysts can cause compression of the nerve structures, mainly the peroneal nerve and its branches.[2] This compression can be caused by an intraneural or an extraneural cyst, and presents itself clinically with leg pain, sensory loss, and weakness in ankle dorsiflexion.[3] The differential diagnosis involves spine pathology, neural injuries, and vascular disease.[4] A proper clinical history and physical examination, aided with ultrasonography and magnetic resonance, are the key to the final diagnosis. The mainstay of treatment is surgical exploration and excision of the lesion, although other options exist.[5,6] We describe a case of an extraneural synovial cyst compression of the common and deep peroneal nerves.

Case Report

We report a case of a 44-year-old Caucasian male, who presented to the emergency department because of right leg swelling and pain, right drop foot, and numbness on the lateral side of the right leg, symptoms with 3 days of evolution and without a trauma history. Seen in the orthopedic department, total paralysis of the foot was objectified. He was not able to do foot dorsiflexion and eversion, or toe extension. Diminished sensation at the dorsum of the foot, extending to the lateral side of the leg, was also noticed. There was diffuse

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swelling of the leg, but no other inflammatory signs were encountered. An X-ray was done, and it was normal. He proceeded to do an ultrasonography of the right leg, that reported, on the transition between the upper and middle-thirds of the leg, a voluminous cystic formation, localized at the depth of the lateral compartment, measuring 4.3 cm × 3 cm × 2.8 cm [Figure 1]. The reported lesion was lobulated and seemed to prolong itself superiorly, by a sinuous neck of 4 mm, to what most likely was the superior tibiofibular articulation. There were no signs of deep vein thrombosis. The examination concluded to be an extrinsic nerve compression by a synovial cyst of the upper tibiofibular joint.

A magnetic resonance was required, and it confirmed the existence of a voluminous and lobulated cystic formation with 7 cm × 4 cm × 3 cm of longitudinal, transversal, and anteroposterior axes, respectively, localized at the depths of the anterior and lateral compartments, with connection to the upper tibiofibular joint. It caused extrinsic compression of the common and deep peroneal nerve [Figure 2]. Within a week, the patient was submitted to surgery. By a lateral approach, the common peroneal nerve was recognized and the cyst was removed completely [Figure 3]. The peroneal nerve and its branches were left intact. The material was sent to histopathological examination, which confirmed the existence of a synovial cyst. The immediate postoperative period was without recovery of the motor status but with improvement of the sensibility. Progressively with time and with aid of a rehabilitation program, the right leg strength and neurological capacity began to increase. Three months after the surgery, the patient recovered full motor function, with no complaint of pain or dysesthesia of the right foot and leg.

Discussion

A variety of cystic lesions may be encountered around the knee joint, from benign cysts to complications of various disorders such as infection, inflammatory or degenerative arthritis, and malignant lesions.[1] Most cystic lesions around the knee represent encapsulated fluid collections. The most common para-articular cysts that cause compression of nervous structures are ganglion cysts and proximal tibiofibular synovial cysts. A ganglion cyst is a benign tumor that contains clear, highly viscous fluid rich in hyaluronic acid and other mucopolysaccharides, with dense fibrous connective tissue wall without a synovial lining.[1] On the other hand, a synovial cyst can be defined as a cystic bulging of the joint synovium itself, with the walls consisting of synovial fluid-producing cells.[7] Despite these differences, the literature pertaining this topic of cyst nerve compression not always differentiates between these two entities, with both terms used interchangeably and being considered mainly different from an anatomophatologic point of view.[8] The pathogenesis of these para-articular cysts remains unclear, with the most accepted theory being the articular, or synovial, theory. This unifying theory hypothesizes synovial joints as the etiologic origin of para-articular cysts accompanied by compression neuropathy. Following the articular theory, synovial fluid dissects through a capsular rent in the pathologic synovium, through which an articular branch of the peroneal nerve is "invaded."[7] Cysts can be divided into intraneural or extraneural. Intraneural cysts arise within the epineural sheet whereas the extraneural cysts cause compression by proximity, but are anatomically

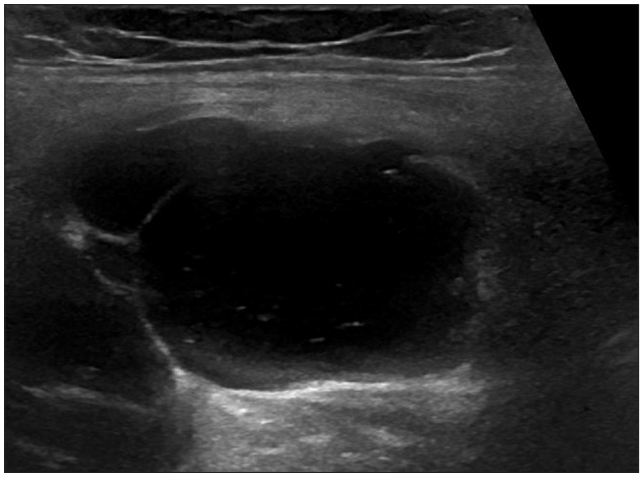

Figure 1: Ultrasonography: Cystic formation

Figure 2: Lobulated cystic formation causing extrinsic compression of the common and deep peroneal nerve

Figure 3: Lateral approach; identification of the common peroneal nerve and its compressive cyst

separated from the nerve itself. There is somewhat a vast literature involving intraneural ganglion cyst nerve compression, but reports regarding extraneural cyst compression of the common and deep peroneal nerve are lacking.[3] Our case reports an extraneural synovial cyst compressing the common and deep peroneal nerve.

Cysts are the most frequent tumors of the upper and lower extremity, but peripheral nerve compression due to these tumors is a rare condition, especially in the lower limb, in which the peak incidence is at the fourth decade of life.[4] A list of causes of peroneal nerve palsies include prolonged squatting, infection, varicose veins, rapid marked weight reduction, schwannoma, nerve herniation through a facial defect, neurofibromatosis, pneumatic compression, knee arthroplasty, high tibial osteotomy, and cysts.[9] The first described case of a peroneal nerve compression due to a synovial cyst was made in 1921 by Sultan.[10] The most common site of compression in the lower limb is the common peroneal nerve and its branches.[2]

The common peroneal nerve is derived from the dorsal branches of the fourth (motor supply to the tibialis anterior muscle) and fifth lumbar nerves and the first and second sacral nerves. It descends obliquely along the lateral division of the sciatic nerve. It courses from the posterolateral side of the knee around the biceps femoris tendon and the fibular head to the anterolateral side of the lower leg. When exiting the fibular tunnel, the peroneal nerve typically trifurcates into the deep and superficial peroneal nerve and a smaller articular branch. The articular branch provides sensory information from the proximal tibiofibular joint. The superficial peroneal nerve transverses the lateral compartment. First, it runs along the peroneal muscle. At the junction of the proximal and middle thirds, it runs between the peroneal muscles and the extensor digitorum longus muscle. At the distal one-fourth of the leg, it passes through the fascia and runs superficial to divide into terminal sensory branches. It provides motor innervation to the muscles of the lateral compartment, the peroneus longus and brevis muscle. Sensory innervation is provided to the anterolateral side of the lower leg, where the nerve pierces the crural fascia, and to the dorsum of the foot. The deep peroneal nerve passes obliquely from the lateral to the anterior compartment, through the intermuscular septum, and runs away from the fibula. It follows a path beneath the extensor digitorum longus muscle, then between the extensor digitorum longus and the tibialis anterior muscle. It provides motor innervation to the four muscles of the anterior compartment: the tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius muscle. Together, these muscles are responsible for dorsiflexion of the foot and extension of the toes. It also innervates intrinsic muscles of the foot including the extensor digitorum brevis and the extensor hallucis brevis. The nerve ends with a terminal sensory branch to the fist web space.

The proximal tibiofibular joint consists of the articulating surfaces of the upper end of the fibular head and the tibial lateral condyle. Both these surfaces are covered with hyaline cartilage. This joint is lined by a synovial membrane and is often in communication with the knee joint. The joint is surrounded by an articular capsule which is reinforced by the anterior and posterior ligaments.[2] It is hypothesized that the origin of peroneal nerve ganglia is the proximal tibiofibular joint, through the articular branch.

Muscle weakness is more common than sensory impairment.[2] Almost all patients with compression neuropathy of the common peroneal nerve have tibialis anterior muscle weakness as their main complaint, clinically objectified by the inability to perform foot dorsal flexion.[11] The patients often complain of altered ambulation secondary to paretic or paralyzed ankle dorsiflexors. A steppage gait pattern is common, wherein the affected foot requires extra lift from the ground during the swing phase of ambulation to clear the foot.[9] Most patients also have weakness of foot evertors and toe extensors because of the involvement of the superficial peroneal fibers that innervate the lateral compartment muscles. Pain is not universal. When present, it is often related to the specific site of the common peroneal nerve compression or its branches (superficial or deep) radiating to the lateral malleolus. Swelling of the proximal tibiofibular joint and hypoesthesia may be present, but are less common.[12]

Ganglion cysts are commonly accompanied by signs of nerve irritation such as numbness, tingling, and pain in the distribution of the affected nerve.[3] Sensory loss

is of little importance clinically, and if it is present, it is limited to just large myelinated fiber junction, i.e., vibration and position sense. The small myelinated and unmyelinated fibers (conduction of pain and temperature) are sparsed.[2] Tinel's sign is generally positive in the sensory distribution of the peroneal nerve.[9] Isolated peroneal nerve compression can mimic lumbar disc disease.

The differential diagnosis should include L5 root pathology (compression), a nerve compression near the tendinous arch of the peroneal longus muscle, posttraumatic intraneural hemorrhage, a nerve sheath tumor, the osteocartilaginous exostosis at the proximal lower leg, and vascular claudication.[4]

Plain radiographs have little importance in the diagnosis of ganglion cyst, but may be beneficial in eliminating a bony anomaly or fracture of the proximal part of fibula.[12] Furthermore, it may be useful in excluding degenerative disc disease of the lumbar spine. Electromyography (EMG) studies may be helpful to distinguish the level of the palsy and the extent of sensory and motor impairment. Common peroneal nerve mononeuropathy produces a limited number of EMG patterns: (1) axon-loss (conduction failure) pattern (partial or complete); (2) conduction block pattern (partial or complete); (3) mixed axon loss–conduction block pattern; and (4) L5 radiculopathy–proximal deep peroneal mononeuropathy axon-loss pattern. Conduction block pattern is the most common pattern.[11] Patients with decreased sensory conduction velocity in the distal segment and/or abnormal motor conduction (distal to the fibular head) and a reduced or absent motor response with stimulation distal to the fibular head have been shown to have an incomplete recovery after surgical treatment.[13] Magnetic resonance imaging (MRI) is the noninvasive technique of choice for diagnosis.[14] As it provides better soft tissue contrast and multi-planar imaging capability than other imaging methods, it is considered the technique of choice to confirm the cystic nature of the lesion, to evaluate the anatomical relationship to the joint and surrounding tissues and to identify the associated intra-articular disorders. Ganglia characteristically present with low signal on T1-weighted images and high signal with homogeneous appearance on T2-weighted images.[15] It may be difficult to differentiate a ganglion cyst from nerve sheath tumors and also solid masses on MRI, as homogeneity of the lesion is also found in solid masses. Ultrasonography may be effective in showing the cystic nature of the mass (well circumscribed) and in differentiating it from solid tumors (anechoic lesion).[16] Although ultrasonography is a noninvasive and cheap screening method, it is not sensitive enough to distinguish ganglia from other nerve sheath tumors.[17] A combination of MRI and ultrasonography may be helpful in the differential diagnosis of doubtful cases.

Currently, the gold standard treatment for peroneal nerve palsy due to a peripheral nerve ganglion compression is surgical removal of the ganglion. To prevent the recurrence, removal of the stalk and the base of the cyst in the tibiofibular joint should be performed.[17] Sometimes, the small sensory articular branch of the joint has to be sacrificed.[2] Because of the extensive branching pattern of the peroneal nerve in the area of the fibular head, needle aspiration carries a substantial risk for nerve damage.[9] Cyst aspiration is of value as a diagnostic measure to distinguish between cystic and solid soft tissue masses and for temporary and partial cyst decompression but is associated with a high recurrence rate.[18] The prognosis of the peroneal nerve palsies of compressive origin following surgical excision is excellent. When conservatively treated, recovery may take 1 year or 2 years and it may be incomplete, requiring the patient to use a peroneal brace. Instead, recovery is much faster after operative decompression and will take place after few days or a few weeks.[3] Good to excellent recovery of motor function occurs if surgical exploration is done <1 year after the onset of foot drop. The course of recovery reflects the type of damage to the nerve; an immediate recovery indicates a metabolic block; whereas recovery over a period of weeks reflects neuropraxia, i.e., a local conduction block on myelin damage, but still axonal continuity. Cases requiring several months or 1 year to recover probably indicate axonal degeneration.[19]

Local cyst recurrence is reported postoperatively and can go up to 10% of cases,[17] and it stresses the importance of articular branch ligation to avoid this complication. Disarticulation of the proximal tibiofibular joint is also an option when treating primary cyst,[7] with the justification that this procedure removes the pathologic synovium (synovectomy), assuring the prevention of extraneural cyst recurrence. This surgical technique has no influence on joint stability since the lateral collateral ligament and the peroneal musculature provide enough remaining joint stability for lateral movements and torsional stresses.[5] Another technique described for the treatment of recurrent and (in selected cases) *de novo* cysts is a proximal fibulectomy, with good results reported.[6] Other reported complications include traction injuries, perineural fibrosis, and nerve transection.[9]

Conclusions

When confronted with a patient with sudden foot paralysis, peroneal nerve compression should be present when making differential diagnosis, mainly with lumbar spine pathology. A well-made clinical history and

physical examination, aided with correct radiologic support, by ultrasonography, magnetic resonance, or both, almost always permits the establishment of a correct diagnosis. The appropriate treatment of these compression diseases usually is excision, with emphasis on removing the stalk that connects the lesion to its origin.

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Conflicts of interest
There are no conflicts of interest.

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