Intraneural ganglion cyst of the peroneal nerve at the lateral knee: A case report and literature review

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Abstract

Introduction: Intraneural ganglion cysts can arise from the peroneal nerve at the lateral knee secondary to synovial fluid tracking along the articular branch and transforming within the nerve into a mucinous cyst, resulting in nerve compression.

Case Report: A 17-year-old right-handed male presented with a four-month history of right foot drop. He is physically active and attributed the foot drop to a sprained ankle. EMG/NCS showed a right common peroneal neuropathy distal to the innervation of the biceps femoris short head with active denervation. MRI showed an intraneural ganglion cyst in the common peroneal nerve starting at the level of biceps femoris. On exam, he had right foot drop and sensory deficits referable to the peroneal distribution, along with a right steppage gait. He had successful decompression of the ganglion cyst, excision of the articular branch and resection of the proximal tibiofibular joint, with clinical improvement.

Conclusion: Early recognition and surgical treatment leads to better outcomes for patients when an intraneural ganglion cyst results in neurologic deficits. Physical activities and trauma, which increase stress on the knee joints, may predispose ganglion cyst formation within peroneal nerves. Fibers of the deep peroneal nerve may be preferentially affected when compared to the superficial peroneal nerve. Disconnection of the articular branch and proximal tibiofibular joint resection may decrease risk of recurrence.

Introduction

Patients with foot drop complain of difficulty walking, recurrent falls, and limitations in daily activities. The differential diagnosis is broad, from central causes such as stroke to peripheral ones such as lumbar radiculopathy or neuropathy; timely diagnosis is critical as early intervention/treatment can improve deficits in some cases. One uncommon cause of focal peroneal neuropathy mimicking entrapment neuropathy is an intraneural ganglion cyst. The cyst can arise from the peroneal nerve at the lateral knee secondary to synovial fluid tracking through the articular branch and transforming within the nerve into a mucinous cyst. If sufficiently large, it may compress the peroneal nerve resulting in neurologic deficits. Electrodiagnostic and imaging studies such as ultrasonography (US) and MRI aid in localization and diagnosis. Early recognition and surgical treatment lead to better neurologic outcomes for patients.

We report a patient with foot drop due to an intraneural ganglion cyst of the common peroneal nerve and discuss the multimodal approach to diagnosis through electromyography/nerve conduction study (EMG/NCS), US, and MRI. We also discuss the surgical treatment technique and how recurrence of the cyst can be minimized.

Case Description

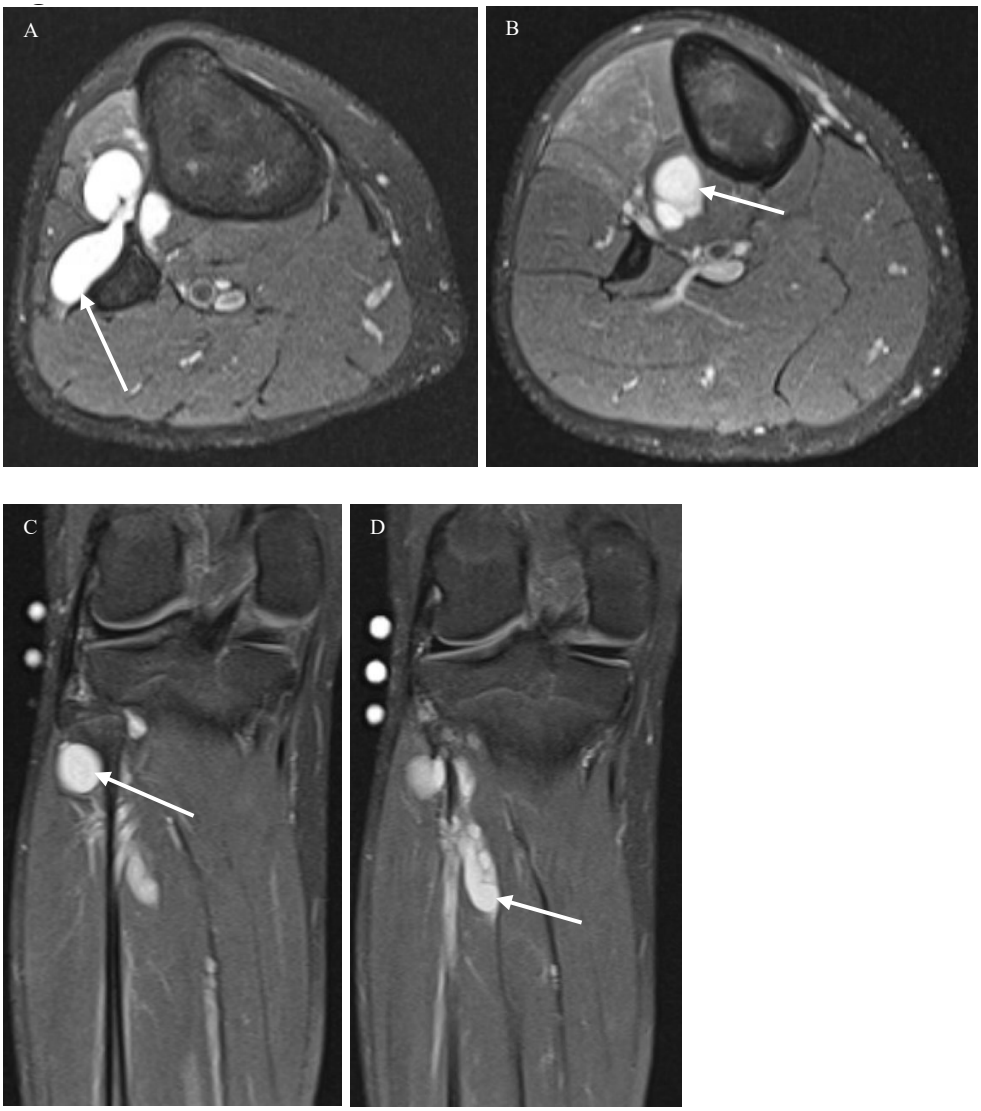
A 17-year-old right-handed male presented with a four-month history of right foot drop. He rode mountain bikes frequently and attributed his weakness to an ankle sprain sustained two weeks prior. He saw his pediatrician who diagnosed right sciatica as there was positive straight leg raise test and prescribed physical therapy. He was noted to have a progressive foot drop with therapy, so he consulted a pediatric neurologist. He had evaluation with EMG/NCS which showed an active and chronic common peroneal neuropathy at the fibular head. MRI of the right knee showed an intraneural ganglion cyst involving the common peroneal nerve from the medial head of the biceps femoris to just below the bifurcation of the superficial and deep peroneal nerves, with deep peroneal greater than superficial peroneal involvement (Figure 1). He was referred to our institution for further treatment.

In addition to right leg weakness and numbness, the patient noted pain at the lateral right knee and popliteal fossa. On exam, he had weakness in right foot dorsiflexion (MRC grade 2), extensor hallucis longus (EHL) (MRC grade 1), and foot eversion (MRC grade 4), with intact strength at ankle and toe plantarflexion and ankle inversion. There was decreased sensibility to light touch and pin on the dorsal aspect of the right foot including the webspace between the first and second toe. He had a right steppage gait and inability to heel walk on the right. Reflexes were intact. Repeat electrodiagnostic studies

showed an active right common peroneal neuropathy distal to the innervation of the biceps femoris short head with worsened axon loss across the fibular neck. He was referred for surgical removal of the intraneural ganglion cyst causing his peroneal neuropathy. He had aspiration of the cyst under ultrasound guidance for temporary decompression of the cyst prior to resection. Sonographic images demonstrated a large multiseptated intraneural ganglion cyst involving the common peroneal and deep peroneal nerves, largest foci measuring up to 3.4 x 1.5 cm distal to the proximal tibiofibular joint (Figure 2). 15 mL of thick gelatinous fluid was aspirated and there was complete collapse of the distal portion of the cyst. However, attempt of aspiration failed to return fluid in the proximal segment of the cyst. The patient did not have clinical improvement after cyst aspiration. About 5 months from onset of his right foot drop, he had surgical decompression of the ganglion cyst, with excision of the articular branch and resection of the proximal tibiofibular joint. At two-week follow up, he had stable motor examination with improved sensation and pain. At five-month follow up, his dorsiflexion improved to MRC grade 4 strength, with stable EHL (MRC grade 1) and eversion (MRC grade 4) weakness and normal sensation. He had no pain or symptoms from the proximal tibiofibular joint resection.

At eleven-month follow up (nine months post surgery), his EHL improved to MRC grade 3 strength and eversion improved to normal strength. His dorsiflexion MRC grade strength was stable and his gait improved to a minimal right steppage gait only seen with longer distances.

Figure 1: MRI of intraneural ganglion cyst (arrows) at the lateral knee in the axial (A) and coronal (C) view. The cyst tracks distally predominantly involving the deep peroneal nerve (B and D).



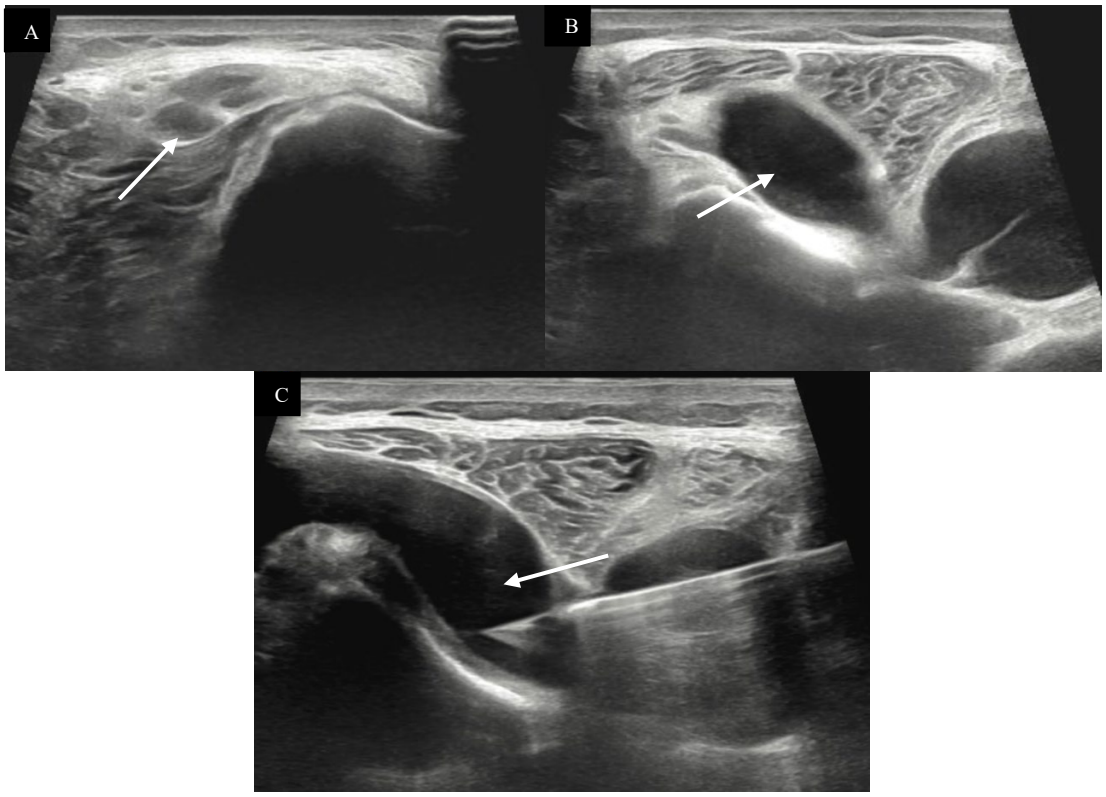


Figure 2:
A) Ultrasound of intraneural ganglion cyst (arrow) of the common peroneal nerve around the fibular head.
B) Large multiseptated intraneural ganglion cyst (arrow) distal to the proximal tibiofibular joint.
C) Needle placement leading to aspiration of the distal portion of the cyst (arrow).

Discussion

Peroneal nerve palsy is a common cause of foot drop, typically from external compression, trauma, or complication post-surgery.[1] Intraneural ganglion cyst is an uncommon cause of peroneal nerve palsy, but has been reported in 18% of patients with an isolated peroneal mononeuropathy.[2] Intraneural ganglion cysts are non-neoplastic mucinous cysts within the peripheral nerve arising from an adjacent joint. Under the mechanism of formation proposed by the unified articular theory for those involving the peroneal nerve, there is a capsular defect of the neighboring superior tibiofibular joint that allows synovial fluid to track along the articular branch through the path of least resistance within the epineurium, and through a one-way valve mechanism to the common peroneal nerve.[3] The more medially located deep peroneal nerve is affected first, followed by the more lateral superficial peroneal nerve fascicles, then cutaneous sensory nerves.[4] This is likely why foot and toe dorsiflexion and EHL weakness are more prominent compared to eversion weakness, as seen in our patient. Frequent activities leading to pressure on the knee joints and trauma may be potential causes of the initial capsular defect and leakage of synovial fluid.

Symptoms of intraneural ganglion cysts of the common peroneal nerve are typical of peroneal neuropathy – weakness in foot dorsiflexion and eversion, pain and possibly Tinel sign around the lateral knee, and numbness and tingling in the lateral distal leg and dorsum of the foot. EMG/NCS abnormalities are consistent with those of common peroneal neuropathy across the fibular neck, including velocity slowing or a decrease in amplitude/conduction block across the fibular neck. Comparison to the contralateral asymptomatic side can help approximate the amount of axonal loss. In some patients, conduction block can be seen when recording at tibialis anterior (TA) but not at extensor digitorum brevis (EDB), reflecting the propensity for early involvement of deep peroneal nerve fibers. Peroneal F responses and superficial peroneal sensory responses are typically prolonged or absent. Needle EMG abnormalities can be seen in TA, EHL, and peroneus longus with sparing of short of the biceps femoris if the lesion is not proximal to the fibular head.[4] US of the nerve at the lateral knee is a useful adjunct to electrodiagnostic studies to provide direct structural assessment of the nerve for intrinsic or extrinsic lesions. Intraneural ganglion cysts on US typically appear as an anechoic or hypoechoic mass with well-defined margins and occasional internal septations. US has been shown to be more sensitive (93% vs 67%) and similarly specific (86%) compared to MRI in detecting nerve pathologies in

patients with mononeuropathies or brachial plexopathies.[5] US can be used as the initial radiographic evaluation as it can be performed at bedside and is less expensive than MRI. MRI, however, can image deeper structures with more clarity and can identify cyst connections to a joint, helping guide surgical planning. MRI is more likely to identify a joint connection compared to US. Surgical resection of a cyst without identifying and treating the feeding joint connection can risk cyst recurrence.[6] Intraneural ganglion cysts on MRI appear as T2 hyperintense lesions tracking along the course of the nerve.

In a study of 100 patients with tibiofibular ganglion cysts, recurrence rate after aspiration of the ganglion cyst was 81.8%. Recurrence was reduced to 27.4% with cyst excision, and 8.3% with additional proximal tibiofibular joint resection.[7] Historically, there has been a high recurrence rate with revision surgery required. A more recent surgical technique utilizing the consistent U-shape of the articular branch of the common peroneal nerve leads to a more efficient dissection. It consists of disconnection of the articular branch which removes the tract that the synovial fluid takes to reach the common peroneal nerve. Additional resection of the superior tibiofibular joint removes the synovium to prevent cyst recurrence. This technique can minimize risk of cyst recurrence, improving odds of recovery.[8]

Conclusion

In summary, for peroneal neuropathy caused by intraneural ganglion cyst, prompt, and accurate diagnosis is important, as earlier recognition and surgical treatment leads to better outcomes for patients. Dorsiflexion and EHL weakness can be affected disproportionately to eversion. US and MRI are both useful imaging techniques in evaluating intraneural ganglion cysts at the lateral knee, and furthermore MRI can help guide surgical planning. Cyst aspiration should not be used as a definitive treatment plan as there is a high risk of recurrence. Disconnection of the articular branch and proximal tibiofibular joint resection may decrease risk of recurrence.

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