Ultrasonographic Findings in Isolated Neuritis of the Posterior Interosseous Nerve

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Isolated palsy of the posterior interosseous nerve (PIN) can occur without nerve compression and is often referred to as isolated neuritis or neuralgic amyotrophy because of its characteristic elbow pain at the onset, lasting days to weeks with subsequent weakness. The diagnosis is based on the clinical course because, to our knowledge, there have been no objective tests, in particular imaging features, that can be used to differentiate this from other disorders. In this report, we describe the ultrasonographic findings of a case of isolated PIN palsy and compare the findings with those in unaffected individuals. In addition, the images were correlated with surgical findings.

Case Report

A 24-year-old male office worker had a rapid onset of left elbow pain lasting for approximately 2 weeks. After the pain subsided, the patient was unable to extend his thumb and fingers but was able to extend his wrist. He had no history of trauma or other diseases. On physical examination, there was tenderness along the course of the PIN. According to the Medical Research Council scale, strength scores for the triceps, brachioradialis, and extensor carpi radialis longus were all 5/5, but scores for the extensor carpi radialis brevis, extensor digitorum communis, extensor carpi ulnaris, abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis proprius, and extensor digitii minimi were all 0/5. (The extensor carpi radialis longus and brevis were tested by palpating tendon tension at the wrist.) Although the strength of the supinator alone was difficult to measure, forearm supination was also weakened. He had no

Abbreviations

PIN, posterior interosseous nerve

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sensory loss. Electromyographic examination revealed complete denervation (fibrillations and positive sharp waves without voluntary potentials) of the supinator, extensor digitorum communis, and extensor carpi ulnaris. In contrast, the triceps, brachioradialis, and extensor carpi radialis longus had no abnormalities.

Ultrasonographic examination was performed with a 10 MHz linear array transducer (ProSound SSD-5500 system; Aloka Co, Ltd, Tokyo, Japan). First, transverse images of the PIN were obtained in the distal arm between the brachialis and brachioradialis. The nerve appeared as a hypoechoic round structure with a 2.5-mm diameter at the level of the capitellum and maintained this size throughout its course from the distal arm to the elbow. While tracing it proximally to distally, we found a localized mild reduction in caliber (1.5-mm diameter) at the level of the capitellum. Longitudinal images at this level showed a mild hourglasslike constriction with an intraneural hyperechoic band (Figure 1). The PIN was traced farther distally in a transverse plane and found to become almost invisible at the level of the radial head. Longitudinal images also showed a severe constriction with an intraneural hyperechoic band (Figure 2). There were no findings suggestive of supinator syndrome (nerve compression by the proximal boundary of the supinator), such as nerve swelling proximal to or caliber reduction at the level of the entry of the PIN into the supinator1,2 or a space-occupying lesion.

The patient showed no clinical or electromyographic improvement after 3 months of nonsur-

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**Figure 1.** Sonograms at the level of the capitellum. **A–C,** Transverse images. The PIN (arrows) was swollen. It was traced proximally (A) to distally (C). Along its course, there was a level showing a localized mild caliber reduction (B). Distally (C), it regained caliber. B indicates brachialis; BR, brachioradialis; and inset, schematic PIN and scanning level. Left is medial; and top, anterior. **D,** Longitudinal image. There was a mild constriction (arrow, asterisk) of the PIN at the level of the proximal part of the capitellum (Ca). The nerve was interrupted by a hyperechoic band at the constriction. Left is distal; and top, anterior.
gical management. The PIN was then explored surgically to confirm the abnormality. The nerve was diffusely swollen and constricted, as shown by the preoperative sonograms (Figure 3). There were no fibrous bands or adhesions at the constrictions. The nerve was not compressed by the proximal boundary of the supinator. There was no space-occupying lesion. The innervation to the extensor carpi radialis brevis arose from the PIN slightly distal to the level where the radial nerve bifurcated into the superficial radial nerve and PIN. On the basis of the clinical course and the ultrasonographic and surgical findings, we diagnosed isolated neuritis of the PIN. Internal neurolysis was performed at the constrictions with an operating microscope. The thumb and finger extensors began to recover 2 months after surgery. Full recovery occurred at 5 months.

**Findings in Unaffected Volunteers**

For comparison, we performed a separate institution-approved study. Informed consent was obtained from all participating volunteers. We investigated sonograms of the PINs in 10 elbows of 5 control subjects (age-matched healthy male volunteers). In transverse images, each nerve appeared as a hypoechoic round structure. The caliber of each nerve was uniform throughout the course from the distal arm to elbow, and the mean diameter ± SD was 1.3 ± 0.2 mm at the level of the capitellum. This indicated our patient’s PIN was swollen, with the diameter approximately twice that of the control subjects. None of the control subjects showed nerve constrictions, and our patient’s nerve constrictions were considered abnormal.

![Figure 2. Sonograms at the level of the radial head. A–C, Transverse images. The swollen PIN (arrow) was traced proximally (A) to distally (C). Along its course, there was a level where it became almost invisible (B). Distally (C), it became visible again. B indicates brachialis; BR, brachioradialis; and inset, schematic PIN and scanning level. Left is medial; and top, anterior.](image)
Discussion

After innervating the brachioradialis and extensor carpi radialis longus in the distal arm, the radial nerve bifurcates into the superficial radial nerve and PIN at the level of the capitellum. The PIN enters the supinator through an inverted arch referred to as the arcade of Frohse (Figure 4). It then passes between the superficial and deep heads of the supinator, innervating this muscle. After emerging from the supinator, the PIN innervates the extensor digitorum communis, extensor digiti minimi, extensor carpi ulnaris, abductor pollicis longus, extensor pollicis longus and brevis, and extensor indicis proprius. Paralysis of the PIN-innervated muscles results in weakness of thumb and finger extension and radially deviated wrist extension. The innervation to the extensor carpi radialis brevis usually arises from the superficial radial nerve (Figure 4). In our patient, however, this was from the PIN slightly distal to the bifurcation and therefore was also affected by the palsy.

There are 3 major causes of nontraumatic isolated PIN palsy: space-occupying lesions, supinator syndrome, and isolated neuritis. It is important to differentiate between these because treatment differs depending on the cause. Space-occupying lesions include ganglia, lipomas, intracapsular chondromas, synovial hemangiomas, myxomas, and synovial chondromatosis, with ganglia being most commonly seen. These lesions should all be excised early. Supinator syndrome occurs when the PIN is compressed by the proximal boundary of the supinator. The first form of treatment includes rest, modification of activity, and splinting. If these nonsurgical treatments fail, surgical decompression is necessary. In contrast, isolated neuritis is first managed with benign observation (no specific treatment) because it sometimes recovers spontaneously. However, there are no reliable clinical signs and symptoms to differentiate between these causes. Electromyography and nerve conduction studies may not produce cause-specific results because the former may show neurogenic changes, and the latter may show a conduction block in any of them.

Previous reports have shown that ultrasonography is useful in diagnosing space-occupying lesions, particularly ganglia, as well as supinator syndrome. In the latter, the PIN has swelling (pseudoneuroma) proximal to and caliber reduction at the level where it enters the supinator. However, to our knowledge, nerve imaging in isolated neuritis has not been reported. In our patient, there were 2 distinctive PIN findings when compared with those in unaffected individuals. One was variable degrees of hourglasslike constrictions, with an intraneural hyperechoic band. Similar constrictions have been described in recent surgical case reports, although there have been no methods to confirm these without surgery. The other finding, which, to our knowledge, has not been described in the literature, was diffuse swelling from the distal arm to the elbow. Because of this, the nerve was readily recognized. These changes may be specific to isolated PIN
neuritis; thus, ultrasonographic detection of them may be noninvasive and objective findings for this disorder.

How the PIN swelling and constrictions are formed, as well as the cause of the neuritis, is unclear. It has been reported that patients have no contributory diseases, and the areas of the constrictions do not correspond to fibrous bands or adhesions.9,10 This was also the case with our patient; thus, the cause was considered idiopathic. Some investigators have performed biopsies of the epineurium at the constrictions and found inflammatory cells.10 Others have experimentally produced similar constrictions by injecting a rabbit median nerve with saline and then repeating limb pronation and supination.11 On the basis of these findings, the pathologic mechanism is speculated to be as follows: the PIN swells because of inflammation, reducing nerve flexibility; the nerve then becomes constricted as it kinks and twists sharply at certain levels with elbow flexion-extension and forearm rotation.

Ultrasonography is convenient and noninvasive. In addition, it produces soft tissue images continuously over a large anatomic region, and our imaging technique takes advantage of this feature. We first identify the PIN in the distal arm between the brachialis and brachioradialis in a transverse plane. If the PIN is swollen, it is easy to recognize. We then look for caliber reductions by tracing transverse images and confirm constrictions with longitudinal images.

Although we performed internal neurolysis, it has not been established that this procedure facilitates recovery. Recently, the PIN has been occasionally explored in those without spontaneous recovery mainly for clarification of abnormalities.9,10 In these reports, nerve constrictions, when present, were treated with internal neurolysis for intraneural decompression. Because these reported cases generally showed good recovery, we treated our patient similarly.

In summary, we have described a case of isolated neuritis of the PIN, with ultrasonographic examination revealing a swollen and constricted PIN. These findings were considered abnormal when compared with those in unaffected individuals and may be specific to this type of palsy. Therefore, ultrasonography may provide a noninvasive and objective test for this type of palsy. When surgical treatment is considered, ultrasonography is also useful for preoperative planning, such as determining the extent of nerve exploration. Further studies would be useful to investigate whether the number and severity of constrictions influence spontaneous recovery, or whether internal neurolysis is beneficial. In addition, similar nerve constrictions have also been found after surgery for neuritis involving the anterior interosseous nerve,12 to which our imaging technique may be applied.

References