

Management of painful cutaneous neuromas around the wrist

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Abstract

Three cutaneous nerves are particularly vulnerable to injury during orthopaedic procedures around the wrist, namely the superficial radial nerve, the palmar cutaneous branch of the median nerve and the dorsal cutaneous branch of the ulnar nerve. These nerves are prone to the development of painful neuromas when injured. In this article, the relevant anatomy and the principles of management of such neuromas are reviewed.

Keywords dorsal ulnar cutaneous nerve; neuroma; palmar cutaneous branch; superficial radial nerve

Introduction

Painful neuromas around the wrist can be debilitating to the patient and frustrating for the surgeon. Many potentially sound and satisfactory surgical reconstructions around the wrist are ruined only by the development of a painful neuroma.

A neuroma is a large number of nerve minifascicles arranged in a chaotic fashion, formed by a large proportion of small, unmyelinated fibres with unrestrained growth of perineurial cells.¹ A neuroma is a sequela of abnormal regeneration after a nerve injury. The pathophysiology of pain from a neuroma is not fully understood. However, it is believed to be associated with the unmyelinated fibres, molecular changes and mechanical activities.

Three cutaneous nerves are particularly vulnerable to injury during wrist procedures. First, the superficial radial nerve (SRN) is at risk during any thumb base procedure such as trapeziectomy, and procedures involving the distal radius such as percutaneous pinning of the distal radius and de Quervain's release.² Second, the palmar cutaneous branch (PCB) of the median nerve is at risk during any volar sided procedures to the radial half of the wrist, including plating of distal radius, volar

ganglion excision, scaphoid reconstruction and carpal tunnel release.³ Third, the dorsal cutaneous branch (DCB) of the ulnar nerve is at risk during any surgical procedures involving the distal ulna, triangular fibrocartilage complex, carpus and ulnar metacarpals.

The wrist is a high-risk site for the development of painful neuromas, perhaps due to the superficial location of the cutaneous nerves and the lack of substantial subcutaneous envelope.⁴ When a nerve has been cut, the best method of preventing neuroma formation is acute repair or grafting.⁵ Once a neuroma has formed, the management becomes more complex, with less predictable results. Prevention is thus paramount.

In this article, we will review the relevant anatomy of the cutaneous nerves followed by a discussion on the diagnosis and management options when they become painful neuromas.

Anatomy

The radial nerve divides into superficial and deep branches as it passes in front of the lateral epicondyle. At the distal third of the forearm, SRN travels beneath the tendon of brachioradialis and pierces the deep fascia approximately 8 cm proximal to the radial styloid process, to run along the dorsoradial aspect of the distal forearm.⁶ It divides into medial and lateral branches as it crosses the wrist. The lateral branch supplies the radial half of the base of the thumb. Often, the lateral branch of the SRN intersects with the lateral antebrachial cutaneous (LABC) nerve.⁷ The medial branch divides further into four digital nerves to supply the dorsum of the radial three-and-a-half digits.⁸ The posterior interosseous nerve (PIN) travels along the dorsum of the forearm and terminates at the wrist with its sensory filaments distributed to the ligaments, interosseous membrane and the articulations of carpal bones.⁹ It can be found in the floor of the fourth extensor compartment.

The PCB of the median nerve emerges from the median nerve around 4.5 cm proximal to the bityloid line on the palmar radial side of forearm.¹⁰ It pierces the antebrachial fascia and becomes very superficial around 0.5 cm proximal to the bityloid line. At the wrist, it enters the hand either superficial or deep to the flexor retinaculum before dividing into medial and lateral branches.¹⁰ PCB is responsible for sensation over the thenar eminence and lateral palm. Often, there is a communication branch between the PCB and radial nerve.¹⁰ Rarely, the PCB could be absent.¹¹

The distal ulnar nerve gives off its sensory dorsal branch around 5 cm proximal to the ulnar styloid process and 1.9 cm radial to the subcutaneous border of ulna on the palmar aspect of forearm.¹² As the dorsal branch emerges from the ulnar nerve, it travels beneath the tendon of flexor carpi ulnaris and pierces the deep fascia around 0.2 cm proximal to the head of ulnar styloid to run along the dorsoulnar aspect of the hand.¹² The dorsal branch divides into two digital nerves to innervate the dorsum of the ulnar one-and-a-half digits. In addition, there is also a branch that emerges from the DCB supplying the dorsal metacarpal region on the ulnar side. Mixed innervation of the radial and ulnar nerves in the dorsoulnar aspect of the hand has also been reported.¹³

Diagnosis

The diagnosis of a painful neuroma around the wrist is usually fairly straightforward.^{14,15} There is often a history of injury or an incision over the known course of the nerves together with

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clinical signs of a tender neuroma, sensory deficit in a predictable anatomical area and dysaesthesia would allow the diagnosis to be made.² The neuroma is not necessarily palpable and can be small in size yet very tender. It is however reliably associated with a positive Tinel's sign. A more subtle, yet useful, clinical sign of nerve injury is loss of autonomic function where the involved skin feels dry and smooth.

The sensory disturbance can be reduced (numbness) or increased (hypersensitivity). The dysaesthesia does not improve with time and leads to considerable discomfort. It is important conceptually to distinguish the following symptoms of neuropathic pain:

- **Allodynia:** pain due to a stimulus, which normally does not provoke pain. For instance, light stroking the skin would cause extremely unpleasant sensation.
- **Hyperalgesia:** an intensified reaction to a stimulus, which is normally painful. It represents increased sensitivity to pain. For instance, a tap on a painful area would result in intense pain.
- **Paraesthesia:** unpleasant sensations of tingling or pins and needles that occur spontaneously.

The diagnosis of a painful neuroma can be confirmed by injection of a small amount of local anaesthetic around the presumed neuroma site and if the diagnosis is correct, this results in resolution of the pain and dysaesthesia.^{2,14–16} Patients are advised to watch for return of symptoms after the predicted working time of the anaesthetic agent. This can be regarded as a secondary level of confirmation.

Nerve conduction studies (NCS) can be used to confirm the diagnosis,⁴ but are often not necessary, as the diagnosis is usually obvious after a thorough clinical assessment. The SRN and DCB lend themselves to NCS due to their superficial locations but the PCB is technically more difficult to study due to its small and short distal branch. NCS can however help to distinguish between a complete or partial injury to the nerve and may give an indication of ongoing compression.⁵ The main advantage of NCS is a second opinion from another specialist and this may become more important in medicolegal disputes.

Imaging modalities such as ultrasound or MRI have limited clinical utility in demonstrating the neuroma as a negative scan would not negate a positive clinical diagnosis. However, they are potentially useful when clinically indicated, in excluding other associated pathology such as tendinopathy.

Management

Nonoperative treatment

Before embarking on surgical management, a trial of non-operative measures, involving a multidisciplinary approach, should always be attempted first. A pain specialist should be involved to optimize the medical treatment of these patients. Analgesic agents can be administered topically or systemically. Topical treatments such as a lidocaine patch or capsaicin may be applied over areas of hypersensitivity. Capsaicin cream, which exists in low strengths of 0.025% or 0.075%, can be prescribed by a non-specialist. The high-strength patch of 8% is applied under the supervision of a pain specialist only. Systemic or oral medications used to treat these patients can be broadly divided into four categories:

- simple oral analgesics such as paracetamol, ibuprofen
- opioids
- antidepressants such as amitriptyline
- anticonvulsants such as pregabalin or gabapentin.

Neuropathic pain tends to respond more favourably to the latter two categories while the first two categories are more effective for musculoskeletal pains.

In addition, it is important to involve a hand therapist who can initiate and supervise a desensitization programme or mirror therapy in order to re-engage the normal use of the injured hand. Patients who experience discomfort due to pressure or accidental injury may benefit from splints or gloves.¹⁶

Neuromodulation is a non-invasive, outpatient treatment of painful neuromas. It uses a low-voltage transdermal electrical stimulation proximal to the neuroma or over the nerve supplying the area of hypersensitivity. Similar to transcutaneous electrical nerve stimulation (TENS), it exploits the gate control theory¹⁷ but uses a much lower frequency (2 Hz) compared to TENS (>50 Hz). A typical treatment course involves 6–8 weekly outpatient visits with each session lasting 10 min. This has shown some promising results, with up to 30% of patients experiencing complete resolution of pain.⁵

It also may be of benefit to some patients to involve a psychologist, as living with intense pain for an extended period of time can lead to emotional and psychological issues. It is crucial to impress upon the patients that this does not imply that the pain is due to mental health issues, nor does it imply that the pain is not genuine. Rather, a psychologist can help the patients develop coping mechanisms to better deal with the pain, in conjunction with other treatments.

Operative treatment

Various surgical strategies targeted at the peripheral or central nervous system have been developed in order to alleviate the symptoms caused by painful neuromas. The principle is to employ the intervention that is associated with the least potential morbidity in order to achieve adequate pain relief, thus allowing the patient to resume functional use of the hand. Surgery should never be undertaken outwith the context of multidisciplinary care. The close collaboration of pain specialist, therapist and surgeon are particularly important during the perioperative period in order to maximize the therapeutic values of the operation.

For surgical management purposes, neuromas can be broadly categorized into end-neuromas or neuromas in-continuity.¹⁶ The surgical options include neurolysis, with or without nerve wrapping, excision of the neuroma and nerve grafting, or proximal relocation.

Neurolysis and nerve wrapping

Neurolysis refers to surgical release of any constricting fibrosis or scar around the nerve. It is often attempted first if the nerve concerned is found to be in continuity (Figure 1). The aim is to reduce pain while preserving distal function, which is sensation only for the neuromas discussed. Pain is believed to be caused by scar adherence to the nerve and the loss of normal nerve gliding.¹⁸ There is thus a potential role for nerve wrapping after neurolysis in order to prevent recurrence. The ideal wrapping material should protect the nerve from compression by scar

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