Imaging in Headache Medicine

Occipital nerve entrapment within the semispinalis capitis muscle diagnosed with ultrasound

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A 33-year-old man presented with a nine-month history of severe, refractory unilateral occipital neuralgia. The diagnosis was made based on the International Classification for Headache Disorders (ICHD-II) criteria for occipital neuralgia, including paroxysmal stabbing pain with persistent aching between paroxysms in the distributions of the greater occipital nerve (GON), tenderness over the affected nerve, and temporary relief from local anesthetic nerve block (1). There was no history of known trauma, prior skull base surgery, or rheumatoid arthritis, and there was no evidence of craniovertebral junction abnormalities by magnetic resonance imaging (MRI). The patient failed to improve with physical therapy and multiple medication regimens, including nonsteroidal anti-inflammatory drugs, anticonvulsants, and antidepressants. Therefore, he was referred to our clinic for interventional pain management.

Ultrasound scan revealed entrapment of the right GON as the nerve pierces the belly of the semispinalis capitis (Figure 1(a), (b)). The cross-sectional area of the GON was significantly larger than previously reported (2). The nerve continued to be enlarged as it became superficial after piercing the trapezius aponeurosis (Figure 1(c)).

Increased cross-sectional nerve area in cases of entrapment neuropathy is well described (2). GON entrapment or irritation where the nerve pierces the belly of the semispinalis capitis is associated with GON axonal swelling, which is one of the proposed etiologies to the underlying occipital neuralgia. While this causal relationship has been proposed in the clinical literature, this entrapment zone has not been characterized with clinical imaging.

The normative sonographic data indicate that the GON cross-sectional area is \( 2.0 \pm 0.1 \text{ mm}^2 \) at this level (range, 1 to 4 \( \text{mm}^2 \)). The mean GON cross-sectional area in symptomatic patients following entrapment was \( 4.1 \pm 2.6 \text{ mm}^2 \) (range, 2 to 13 \( \text{mm}^2 \)). The size of the GON typically remains the same until it branches in the occipital area (3). The GON in our patient was significantly larger than previously described, 16.5 \( \text{mm}^2 \) (3.5 \( \text{mm} \times 2 \times \pi \)) (2,3).

In our patient, injection of 10 units of reconstituted botulinum toxin type-A to the belly of the semispinalis capitis on both sides of the entrapped GON produced sustained pain relief associated with occipital neuralgia. Figure 1(d) represents the normal sonographic appearance of the GON at the six-month follow-up visit. The patient continues to be pain free without supplemental medication use for more than a year now.

Recent studies have shown that injection of Botulinum toxin A into the “presumable” sites of GON entrapment provided some relief in symptomatic patients (4). It reduced headache and led to some quality of life improvement for three months without significant reduction in pain medication usage (5). Our observations indicate that Botulinum toxin may provide sustained relief in patients with GON neuralgia when injected into a “specific” entrapment location (rather than into the site of a potential or “presumed” entrapment). The appropriate site for injection may be identified with bedside ultrasound imaging. The patient’s own deregulatory and compensatory mechanisms have a tremendous role in development and cessation of chronic pain. The normalization of biomechanics after the release of the occipital nerve is likely the source of the long-term recovery, rather than prolonged action of the Botulinum toxin itself.

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References


Figure 1. (a) Short axis sonogram at C1–2 level showing the greater occipital nerve (arrows) as it runs between the inferior oblique muscle (IOM) and the semispinalis capitis (SSC). (b) Short axis sonogram at C1 level showing the greater occipital nerve (arrows) entrapped within the belly of the semispinalis capitis (SSC). Notice the swollen enlarged nerve with enhanced fascicular pattern. (c) Short axis sonogram at the occipital level showing the greater occipital nerve (arrows) as it pierces the trapezius muscle (Trap). Notice the swollen enlarged nerve and (d) Short axis sonogram at C1–2 level—six months post-Botox injection—showing a normal greater occipital nerve (arrows) as it runs between the inferior oblique muscle (IOM) and the semispinalis capitis (SSC). As the greater occipital nerve size normalized, it could no longer be traced within the substance of the SSC.