

The role of occipital nerve block with ultrasound guidance in occipital neuralgia cases

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ABSTRACT

Introduction. Occipital neuralgia (ON) is a well-known cause of headache that affecting the posterior head at the occipital nerve(s) distribution. It is a multiple-factor clinical condition resulting from the pathology of the greater, lesser or third occipital nerve. Interventional therapy, such as occipital nerve block (ONB), is one of the various modalities that could be normally considered when the conservative wasn't satisfying. Besides as effective treatment, ONB also used as an important diagnostic procedure for occipital neuralgia.

Content. Currently, there is no a complete consensus among practitioners regarding the optimal therapy for occipital neuralgia although many modalities offered. ONB traditionally performed with blinded approach relying on anatomic landmarks create the higher risks of injection in the occipital artery and/or block failure. Therefore, ONB with ultrasound guidance becomes solution to improve the safety and efficacy of therapy especially in occipital neuralgia cases.

Conclusion. Occipital nerve block with ultrasound guidance is recommended as primary interventional therapy for occipital neuralgia cases.

Keywords: interventional therapy, occipital nerve block, occipital neuralgia, ultrasound guidance

INTRODUCTION

Occipital neuralgia (ON) is a well-known cause of headache that affecting the posterior head. ON or Arnold's neuralgia is categorized as secondary headache which commonly occurs in patients with other coexisting headache disorders. A study in a community hospital-based found that 25% patients were presenting mixed-type headache and only 15% among them presented ON without other complaints. Undiagnosed and inadequate treatment of ON might increase the frequency and intensity of other comorbid headache disorder, also prolonged the morbidity rate. [1] Therefore, a basis knowledge and comprehensive evaluations influence the accurateness of diagnosis and treatment choices.

Injection of local anaesthetic around occipital nerve or occipital nerve block (ONB) was included as diagnosis criteria of ON. It simply applies both diagnostic and therapeutic aspect with minimally in-

vasive procedure. Nevertheless, blind injection approach still has undeniable risk that disadvantages both clinician and patient. An anatomical malformation, as example, did not always visible or palpable from physical examination, it might brings block failure also higher uncomfortable effect for patients. The misdiagnosed and under/over-therapy might resulting higher morbidity to patients. [2,3]

Ultrasound (US) or sonography is an imaging method that produce real-time and dynamic images of the body. It widely used in pain clinics for identifying structures/abnormalities and assisting procedures. Portable and radiation-free are other advantages of ultrasound guidance compared other tools. Hence, utilization of US is required for assisting injection procedural. In several cases beside ONB, US be used for facilitating other interventional therapy in occipital neuralgia such as pulsed radiofrequency and neurostimulation.[4]

CONTENT

Definition

According to the International Headache Society, occipital neuralgia is defined as unilateral or bilateral paroxysmal shooting or stabbing pain in the dermatomes of the occipital nerve with/without sensory disturbances and commonly associated with tenderness over the affected nerve(s). [2,3,5,6,7] ON may extend the fronto-orbital area through trigeminocervical interneuronal connections in the spinal nuclei. [3]

Anatomy

Occipital nerves are a group of nerves that arise from C2 and C3 spinal nerves that innervate the posterior scalp. Occipital nerves are divided to three main nerves such as greater occipital nerve (GON), lesser (or small) occipital nerve (LON) and third (or least) occipital nerve (TON). [2,8,9] The GON as biggest afferent of occipital nerve is originate from the medial branch of the dorsal ramus of the C2 spinal nerve, with contributions from the C3 dorsal ramus. It exits below posterior arch of the second cervical vertebrae, curves around inferior oblique capitis (IOC) muscle and travels cephalad in an oblique trajectory between the IOC and semispinalis capitis (SSC) muscle. This complex is susceptible to potential entrapments, compression or irritation. The GON then perforates the trapezius muscle and ascends medial to the occipital artery to innervate the neck and scalp. [2,8,9,10] The LON is the most cephalad branch of the superficial cervical plexus beneath the sternocleidomastoid muscle. It originates from the ventral rami of C2 and C3 and curves around its posterior border to run cranially to the parieto-occipital area then it splits in its terminal branches (auricular, mastoid and occipital branches). It innervate of lateral part of head.[8] Meanwhile the TON as superficial part of C3 medial branch is solely innervates each zygapophyseal joint at the C2/C3 level. It relates GON and penetrates splenicus caputis, trapezius, semispinalis capitis and skin under the nuchal line. [10,11] (Figure 1)

Etiology

Most cases of ON are multiple clinical condition without specific causes. [4,5,6] However, in its manifestations, several factors may be identified such as traumatic factors (fracture, hematoma, iatrogenic), tumors factors (osteochondroma, neuroma, multiple myeloma, atlanto lateral masses), degenerative changes (atlantoaxial lateral osteoarthritis, C1-2 arthrosis syndrome), anatomical factors (Chiari malformation, pinching, compression sensitivity), dan infections factors (pyomyositis, neurosyphilis, pa-

chymeningitis). [6] The GON is affected in 90% of occipital neuralgia cases, but LON and TON must be considered too. [5] Trescot et al. also discussed that microtraumatic factors such as flexion or tension injuries, myofascial spasm and repetitive neck con-tactions were leading entrapment of the GON. Several entrapment sites which responsible in ON cases were [1] inter atlas-axis (GON appears from C2 dorsal root ganglia), [2] between IOC and SSC, [3] when nerve penetrates to SSC and [4] aponeurosis of trapezius muscle. [9]

Symptoms-Pathophysiology

Pain is characterized as persistent and paroxysmally aggravating with retro-orbital distribution. The pain usually originates at the base of the skull (Figure 2) and radiates near at the back or along the side of the scalp and orbital due to the convergence of the C2 dorsal root and the nucleus trigeminus pars caudalis. [2] The pain is felt most often on one side of the head, but may also affect both sides of the head. It might be also associated with photophobia and phonophobia too.[9]

ON is described as a very severe pain which indicates cutaneous sensitization and increase pain duration. The pain sensitive structure may be stimulated by a variety of pathologic processes (etiologic factors). Prolonged contact, pressure or deformation of the nerve may cause superficial cutaneous sensitization which is currently considered an indicator of central sensitization and linger duration of occipital neuralgia headache. [12,13]

Due to connections with the VIII, IX and X cranial nerves and the cervical sympathetic, vision impairment/ ocular pain, tinnitus, dizziness, nausea and congested nose can also be present. [2] Neck movements might be also triggering pain in some patients. In extreme cases, allodynia might be found due to constant activation of long-term potentiation in the trigeminocervical nucleus. [13] The scalp may be tender to the touch, and an activity like brushing the hair may increase pain.

The pain is often described as migraine-like and some patients experience other symptoms common to migraine and cluster headache. [7,9] Study of Molina et al found that neuropathic symptoms presented exclusively in ON patients. It might used to differentiate ON from another headache types such as tension type headache and migrain. The neuropathic symptoms that mentioned were electric shock-like, stabbing or shooting pain, numbness, very intense pain, a burning description, pain generating zone and intermittent description. [12] On physical examination, tenderness along the course of the occipital nerve (particularly in GON) can be observed. [2]

Diagnosis

Occipital neuralgia has included to the "neuropathies, facial pains and other headaches" groups based on third edition of the International Classification of Headache Disorder (ICHD-3) 2018. The diagnostic criteria are: (A) unilateral or bilateral pain in the distribution(s) of the greater, lesser, and/or third occipital nerves with comply B-D criteria; (B) pain has at least two of the following criteria: recurring in paroxysmal attacks lasting from a few seconds to minutes, severe in intensity, shooting or stabbing or sharp quality; (C) pain is associated with both of the following: [1] dysaesthesia and/or allodynia apparent during unharmed stimulation of the scalp and/or hair, [2] either or both of the following tenderness over the affected nerve branches, trigger points at the emergence of the GON or in the distribution of C2; (D) pain is relieved temporarily by local anesthetic block at the affected nerves. [2,3]

ON can easily be misdiagnosed and treated as another PHD (Primary Headache Disease) because of the common features. [7] It must be distinguished from occipital referral of pain arising from the atlantoaxial or upper zygapophyseal joints or from tender trigger points in neck and muscles or their insertions. [3] A thorough evaluation will include a medical history, physical examination and diagnostic test.

Treatment

The therapeutic approach in occipital neuralgia is very broad from the conservative to surgical therapy for alleviating the pain as ultimate goal. Unfortunately, there is no consensus among clinicians which established the superior method to manage ON. [13] Regarding treatment, the conservative therapy such as oral medication (antiepileptics, antidepressants, nonsteroidal analgesics, muscle relaxant) and/or physical therapy primary used after diagnosis was established. [5,6] Surgical therapies like neurectomy, rhizomy-ganglionectomy, C1-C2 fusion, radiofrequency ablation and peripheral nerve stimulation, also approved as the last therapeutic option though the absolute pain remission isn't guarantee. [6]

ONB is a fast and effective treatment method. [13] Blockade of the occipital nerves has been implicated in different type of chronic headaches, including primary and secondary headaches. The basis is likely related to convergence of the functional connection between sensory inputs in occipital area-trigemino-cervical complex. The neural circuit connects further to thalamus and cortex. It leads modulation of central nociceptive pathways and reduces central sensitization. [8] For some patients, this procedure might be repeated several times depending on the inflammation process. [7]

According to ICHD-3, local anesthetic (LA) is using as diagnostic block of occipital neuralgia. Simultaneously, it widely used as therapeutic agent for occipital neuralgia cases. [2,3,7,10] LA has reversible effect with blocked voltage-gated sodium channel that interrupted nerve conduction. [10] Combination with corticosteroid also relatively effective as adjuvant therapy in ON with prolonged duration of pain-free after the injection. A study calculated that 58.8% patient experienced pain reduction after the procedure. [5] Beside of the LA and corticosteroid, some studies evaluated botulinum toxin (botox) as therapeutic agent because of the indirect analgesic action and inhibitory effect on the motor plaque as a muscle relaxant. It resulted the decreasing acute and pungent ON pain for long time. [5,7] Although that, this agent's relatively expensive and hasn't been specifically approved yet by Food and Drug Administration (FDA) for occipital neuralgia cases. [14] A prospective study about platelet rich plasma (PRP) in occipital neuralgia also on-progressing. [15]

In addition, technique of procedural also influenced precise diagnostic and therapeutic. ONB traditionally performed with blinded approach relying on anatomic landmarks create the higher risks of injection in the occipital artery and/or block failure. Side effects that related ONB are dizziness, blurred vision, syncope, risk of allergic and irritation at the injection therapy. [7,8,10] Therefore, imaging-guidance might truly helpful to avoid misplacement of injection procedure.

Ultrasonography is a safe method for examining the occipital nerve and other anatomical around, also assisting the therapy procedural in occipital neuralgia cases. There are some approachable procedures to identify the anatomical origins and placement of medical tools with ultrasound guidance. Several therapeutic procedural that related with ultrasound guidance for diagnostic and treatment of occipital neuralgia, such as occipital nerve stimulation, pulsed radiofrequency, and nerve block. [4,16,17]

The use of GON Block with ultrasound guidance for Occipital Neuralgia

Because of the majority cases on ON was GON related, most of studies were more discussing about the GON injection than LON or TON. The GON block is performed for some chronic headaches including occipital neuralgia, cervicogenic, migraine, cluster and post concussion headache. [8,18] This procedure was suggested as headache therapy because of its role as antagonizing putative "windup-like effect" and as convergence of sensory input from nerve fibers to nucleus. [19] The temporary suppression from this procedure might lead modulation of

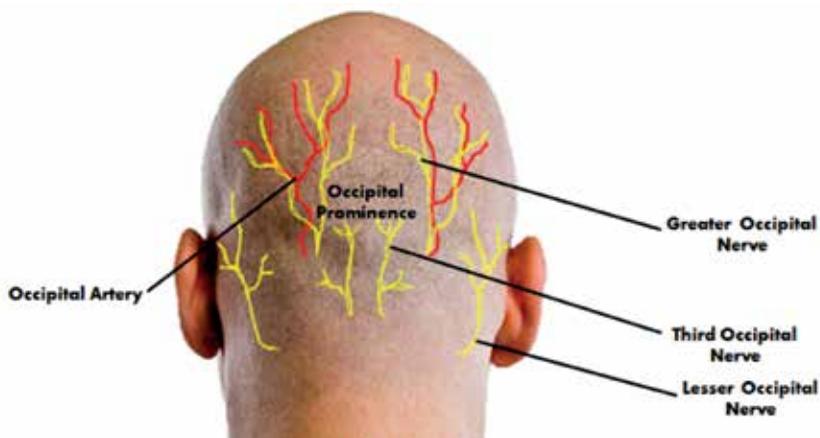


FIGURE 1. Surface anatomy of the occipital nerves [9]

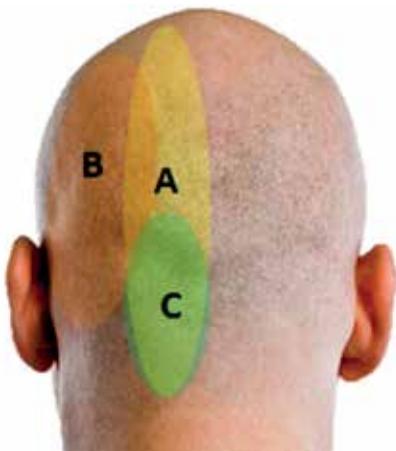


FIGURE 2. Pattern of occipital neuralgia (A) greater occipital nerve, (B) lesser occipital nerve, (C) third occipital nerve [9]

central nociceptive pathway and minimizing central sensitization. [8] Conventionally, GON block was relying solely on superficial bone-based anatomic landmarks to do the procedures. This approach poses higher risk of misplacement injection site into adjacent structures. Therefore, ultrasound has been highly used as guidance for improving the efficacy of GON block. In multiple studies, GON blockade with US guided was superior to decrease pain score than without. [9]

Two locations that commonly used as injection site with US guidance were proximal and distal approach (Figure 3). The proximal technique might enable for delivering the higher volume solution because of infiltrating the paraspinal muscle. Although, the distal approach is higher recommendation for the beginner interventionist. [8,10] Flamer et al was comparing both techniques for chronic migraine and resulting no significant differences in NRS pain scores of them. [18] Yet, prospective studies compared this technique in ON cases expected in the future.

The GON block with ultrasound guidance is considered as intermediate skill (level 2) that must be performed by pain specialist. While did the approaches, interventionist have to identify the landmark as key

point for scanning and injection procedure. The key landmark in distal approach of GON is the superior nuchal line and occipital ridge whereas the key landmark in proximal approach is spinous process of C2 and the inferior oblique capitis muscle. [8]

Scanning of distal approach followed the key landmark will show the superior nuchal line in the transverse view then moved the probe laterally to see the greater occipital artery (GOA) as a marker. The needle will inserted with in-plane technique toward the fascia plane at the medial site of GOA. [8] A study from Na and colleagues was comparing usage of flow-Doppler injection and blind injection at the nuchal ridge resulting 76.9% patients had complete anesthesia with Doppler-guided than only 30.8% with blinded injection. [21]

While scanning of proximal approach between the occipital protuberance and spinous process of C2, the bifid bone structure will be showed. Moved the transducer laterally to visualize IOC and SSC muscle. GON is localized between those muscles. Doppler scan might be used to revealed the vessel. Needle injected in an in-plane (or out-plane for experienced interventionist) technique from lateral to medial between IOC and SSC. [8] The GON will be founded as hyperechoic round/oval structure above the inferi-



Number	GON Block	Landmark	Patient Position	Probe
1	Distal approach at level of occiput	Superior nuchal line and occipital protuberance	Prone or sitting	Linear, 12-18MHz
2	Proximal approach at level of C2	Spinous process of C2 and the inferior oblique capitis muscle (IOC)	Prone with head and neck flexed	

FIGURE 3. Transducer positions of GON Block [1] distal approach [2] proximal approach [22]



FIGURE 4. Distal approach of GON Block

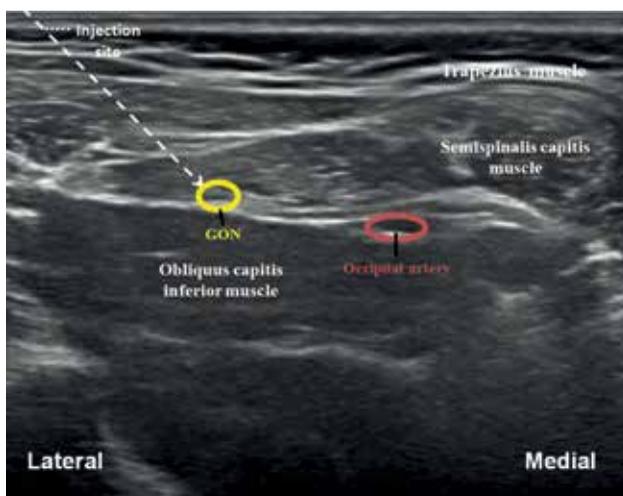


FIGURE 5. Proximal approach of GON Block

or oblique muscle. Interventionist have to distinguish the GON from the second dorsal root ganglia (DRG) that is deeper and localized at anterior of OCI.

After procedures, sensory and motor evaluation is necessary. The successful procedure was defined as absence of light touch sensation in the GON dermatomal. [9]

Greher et al. mentioned that GON blockade with ultrasound at C2 level (proximal) has higher success rate compared at the superior nuchal line level (distal). This cadaveric study showed the success rate was 80% (95% CI: 58%, 93%) at distal site opposed 100% (95% CI: 86%, 100%) at proximal site. They claimed that the proximal technique is superior because of the precise target with highly visual sonographic than distal technique, especially nerve entrapment is almost always in proximal site. Although that, the caution is higher in proximal site because of the vertebral artery and the spinal cord are close in proximity. [20]

The use of LON and TON Block with ultrasound guidance for Occipital Neuralgia

Indication to do the LON block is similar with the GON block, it indicated for several chronic headaches that had pain pattern associated lesser occipital. The procedural is performed in prone/sitting position with a linear probe 12-18 MHz. The operator must visualize the posterior border of the sternocleidomastoid muscle as the landmark, then probe is moved cranially and caudally until the nerve is identified. [8] LON block is rarely singly discussed in several studies and generally approach along with GON block.

Whilst TON block might be used as diagnostic tool in investigation of cervical headache that related with cervical facet joints.[11,23] This procedure began with neck scanned in coronal plane along the posterior edge of the articular pillar (AP) to identify

the C2-C3 level. Then, rotated the probe to transverse plane for identifying C2-C3 zygapophyseal joint. The needle is inserted with in-plane technique to that joint. [11] Due to the variability in muscle bulk, soft tissue thickness, and cervical vertebral size, TON block with imaging guidance is highly recommended than blinded injection. [24]

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