Emerging role of ultrasound guided interventional management in cervicogenic headache

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Abstract

The objective of this mini review is to discuss the role of musculoskeletal ultrasound (MSK US) in identification and treatment of pain generators in cervical spine in patients presenting with cervicogenic headache (CEH). CEH is a secondary headache arising from cervical nociceptive structures emerging from facet joints, intervertebral discs, nerves, muscles, fascia and ligaments. It presents a complex challenge in clinical management.

Traditional treatments often provide limited relief, prompting the exploration of innovative interventions like US guided techniques. MSK US is gaining momentum since last 2 decades and it has transformed the interventional management options for diverse conditions including CEH with improved accuracy and efficacy. The management of CEH needs to be multidisciplinary keeping biopsychosocial model of pain in mind. In countries like Pakistan, there is a huge potential to apply US guided procedures in its population, as it reduces the number of visits by the patient and reduces the overall healthcare cost. By targetting specific pain generators and minimizing collateral damage, these interventions hold immense promise in improving the management. Herein, we briefly discuss the diagnosis of CEH and evidence based US guided interventions on cervical pain generators.

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Introduction

Cervicogenic headache is a relatively uncommon form of headache presenting with mimicking features of migraine (without aura) and tension headache (TTH). There is lack of data regarding prevalence of CEH in Pakistani cohort, but according to a study, the prevalence of 0.4 - 4.1 % has been estimated in the Norwegian population.[1] It is important but difficult to find out the definite etiological pain generator to be in the cervical spine. Hence, diagnostic blocks of the cervical pain generators play a role as an important diagnostic step in the evaluation of CEH .[2]

The main challenge for the clinicians is to differentiate CEH from migraine without aura. The similarities between the two conditions include unilaterality of headache, predominant occurrence in women and associated nausea and vomiting. The differentiating features of CEH and migraine (without aura) include unilateral headache without shift, which is provoked by continuous backward titling of neck or mechanical pressure, associated with limitation of neck movement and ipsilateral non radicular shoulder/arm pain. Another feature is that migraine starts from the fronto-temporal region while CEH starts from the neck and then spreads to fronto-temporal and supra orbital regions.[2]

The proposed mechanism behind the overlapping features of CEH and TTH or migraine is the trigemino-cervical nucleus complex. It is formed by spinal nucleus of trigeminal nerve and C1-C3 cervical spinal cord segments. . Nociceptive afferents from the structures supplied by C1-3 spinal nerves interact and overlap in this nucleus and converge on second order neurons. This convergence results in perception of cervical pain in the sensory receptive fields of trigeminal nerve and vice versa.[2]

Generally, the initial management plan includes conservative treatment with medication, physiotherapy and manual therapy. More recently, various diagnostic blocks could be offered using US guidance to precisely determine the pain generator in the neck as a cause of CEH. Various interventional procedures can be offered to treat the target, mostly done under image guidance like fluoroscope or ultrasound. We underscore the importance of making an accurate diagnosis and locating the source of pain after careful history, clinical examination and relevant investigations before any intervention.

Herein, we highlight the use of US to identify and treat pain generators resulting in CEH. Its role has already been established in interventional pain management, not only

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Table-1: Cervical pain generators and the corresponding ultrasound guided interventions.

Cervical pain generators:	US guided procedures:
Atlanto-occipital	• Intra articular injection
Atlanto-axial joints	• Intra articular injection
C2-3 facet joints	• Medial branch block (LA, CS, PRF) • Intra articular facet injection
Third occipital nerve (TON)	• TON block (LA, CS, PRF)
Greater occipital nerve (GON)	• GON block (LA, CS, PRF)
Lesser occipital nerve (LON)	• LON block (LA, CS, PRF)
Paravertebral, trapezius or sternocleidomastoid muscles	• Trigger point injection • Fascial plane injections

(LA: Local anaesthetic; CS: Corticosteroids; PRF: Pulsed radiofrequency)

for diagnostic blocks using local anaesthesia or corticosteroid (CS) injections but also for hydro-dissection, aspiration, pulsed radiofrequency (PRF) procedures and neuromodulation etc.[3] Simultaneously, the risk of iatrogenic injury to vital neurovascular structures in and around the procedure site has reduced due to real time visualization of the target and surrounding tissues.[4] The commonly encountered pain generators in CEH and the US guided procedures that can be employed to address the pain generators are summarized in Table 1.

We briefly describe the commonly performed US guided procedures below

Atlanto-occipital (AOJ) and Atlanto-axial joint (AAJ) injections:

The degenerative, osteoarthritic or posttraumatic (especially whiplash injuries) changes in atlantoaxial joint (AAJ) may account for up to 16% of CEH cases. The lateral AAJ is C1–C2 facet joint, supplied by C2 ventral ramus. The patient may present with pain and local tenderness in occipital or sub occipital region with restricted painful rotation of C1 on C2, provoked by passive rotation of atlas in neck flexion. These clinical tests have positive predictive value of up to 60%. A diagnostic block with intra-articular local anaesthetic (LA) injection is required to confirm the diagnosis.[6]

The AAJ injections may be indicated for diagnostic and therapeutic purposes or to predict the response before radiofrequency ablation and arthrodesis. These injections are done traditionally under CT or fluoroscopic guidance, but recently US has emerged as a safety tool to scan surrounding structures like vertebral artery laterally and the C2 dorsal root ganglion medially and to advance needle under real time visualization. The injection should be strictly intra articular without periarticular infiltration.[6]

Third occipital nerve block (TON) block/ C2-3 Facet intra-articular injection:

The C2–3 facet joints are a common source of pain in CEH, accounting for up to 70% cases.[7] Each cervical facet joint is innervated by the medial branch above and below it, except C2/C3 level, which is solely innervated by third occipital nerve (TON), which is superficial medial branch of C3 dorsal ramus. These are diarthrodial joints having a fibrous capsule, which provides attachment (>20 % of the capsule area) to the semispinalis, multifidus, and rotator neck muscles. Any trauma or stretching of these muscles or degenerative changes in elderly patients (as seen in other synovial joints).lead to facetogenic pain. In addition, the facet joint itself and the capsule contain nociceptive receptors, which act as independent pain generators.[8]

Typically TON block and intra articular facet injections have been administered under CT or fluoroscope guidance, but now it has been seen that US is able to visualize small nerves like TON (fig 1. B), which is only 1-3 mm (average of 2mm) in diameter.[9] The additional benefit is avoidance of injury to nearby vital structures. Diagnostic block with LA is followed by therapeutic block or radiofrequency ablation, where needle can be placed under direct US visualistaion.

Greater Occipital nerve (GON)/Lesser occipital nerve (LON) block:

Occipital neuralgia is defined as unilateral or bilateral paroxysmal, shooting or stabbing pain in the posterior part of scalp, in the distribution of the greater, lesser, or third occipital nerves, sometimes accompanied by diminished sensation or dysesthesia in the affected area and commonly associated with tenderness over the involved nerve.[10]

The greater occipital nerve is the terminal branch of the dorsal ramus of C2 with contribution from C3. The lesser occipital nerve is one of the terminal branches of the superficial cervical plexus. It arises from the lateral branch of the ventral ramus of C2 with contributions from C3. Segmental nerve blocks at C2 and C3 may be necessary to make the diagnosis in some cases.

Blocks of the GON have been performed without target visualization for a long time, based on surface landmarks only. An US-guided technique was first introduced in 2010,[11] since then GON block has been done using high frequency probe, distally at nuchal line or proximally at C1-C2 level, where it can be seen running between the inferior oblique capitis and the semispinalis capitis muscle.[12] The GON can easily be visualized in the fascia between semispinalis capitis muscle above and inferior obliquus capitis muscle below (Fig 1 B). Occipital nerve entrapment may appear as an enlarged, abnormal

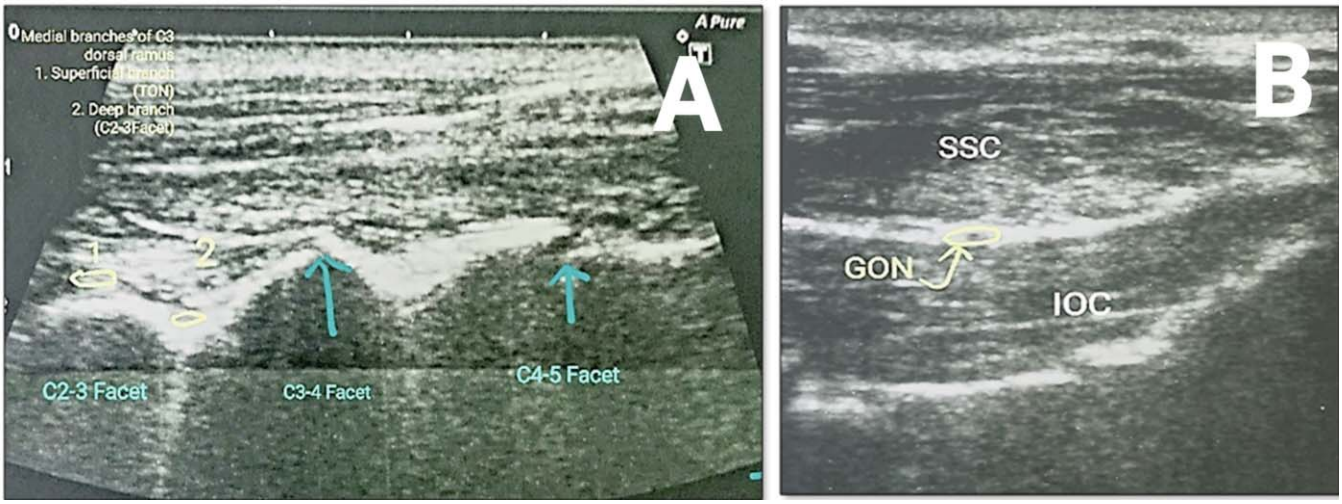

Figure: A. Sagittal view, (high frequency probe) patient side lying, upper end of probe just below the mastoid process. 1) Third occipital nerve (TON); 2) Deep branch of C3 dorsal ramus. Facet joints are labelled with teal arrows. B. Transvers oblique view at C2 spinous process level. Greater occipital nerve (GON) is shown by yellow circle, running in the fascial plane between the two muscles. SSC-Semispinalis capitis muscle; IOC: Inferior obliquus capitis muscle.

looking and swollen nerve. The site of entrapment can be identified and targetted accordingly. Tracing GON from its origin at C2 nerve root all the way till it becomes subcutaneous at the trapezius aponeurosis can be done and any abnormal mass/lesion or aneurysm/arterial malformation can be seen. Similarly, US guided interventions like occipital nerve block, Botulinum toxin injection into the tight sub occipital muscles and occipital peripheral nerve stimulation can be performed.

Myofascial trigger point/fascial plane injections:
Cervical myofascial trigger points located mainly in upper trapezius, sternocleidomastoid and splenius capitis muscles have been documented as a cause of CEH.[13,14] Interventional techniques may include local anaesthetic injections with or without its 'CS' targetting trigger points or taut bands. Recent studies show that inter-fascial plane blocks provide better pain relief as it has been found to block nerve fibers within inter-fascial plane, hence decreasing the sensitivity of trigger points, minimizing afferent impulses and allowing relaxation of the muscles leading to adequate pain relief.[15]

The emerging role of US guided interventions in CEH treatment presents a promising avenue for in improving healthcare outcomes not only in Pakistan but also other low and middle income countries. By offering a cost effective, minimally invasive and accessible solution, US guided interventions have the potential to alleviate the burden of CEH, reduce the healthcare cost and improve patient's quality of life.

Conclusion

Considering the importance of implementing bio-psychosocial model in the management of chronic pain and CEH, while considering Interventional pain management options in CEH, ultrasound guidance should be utilized. As these techniques continue to evolve and gain acceptance within healthcare systems, concrete efforts in training, equipment acquisition and research collaborations will be crucial in realizing their full potential and ensuring equal access to advanced healthcare solutions across diverse socioeconomic groups in Pakistan.

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References

1. Sjaastad O, Bakketeig LS. Prevalence of cervicogenic headache: Vaga study of headache epidemiology. Acta Neurol Scand. 2008;117:73–80.
2. Antonaci F, Inan LE. Headache and neck. Cephalalgia. 2021;41:438-42. doi: 10.1177/0333102420944878.
3. Manolitsis N, Elahi F. Pulsed radiofrequency for occipital neuralgia. Pain Physician. 2014;17:709-17.
4. Korbe S, Udoji EN, Ness TJ, Udoji MA. Ultrasound-guided interventional procedures for chronic pain management. Pain Manag. 2015;5:465-82.
5. Narouze SN, Casanova J, Mekhail N. The longitudinal effectiveness of lateral atlanto-axial intra-articular steroid injection in the management of cervicogenic headache. Pain Med. 2007;8:184–8.
6. Hurley RW, Adams MCB, Barad M, Bhaskar A, Bhatia A, Chadwick A, et al. Consensus practice guidelines on interventions for cervical spine (facet) joint pain from a multispecialty international working group. Pain Medicine 2021;22:2443-524.

7. Bogduk N, Govind J. Cervicogenic headache: an assessment of the evidence on clinical diagnosis, invasive tests, and treatment. Lancet Neurol. 2009;8:959-68.
8. Wong MJ, Rajarathinam M. Ultrasound-guided axial facet joint interventions for chronic spinal pain: A narrative review. Can J Pain 2023;7:2193617. doi: 10.1080/24740527.2023.2193617.
9. Vanderhoek MD, Hoang HT, Goff B. Ultrasound-guided greater occipital nerve blocks and pulsed radiofrequency ablation for diagnosis and treatment of occipital neuralgia. Anesth Pain Med. 2013;3:256-9. doi: 10.5812/aapm.10985. Epub 2013 Sep 1. PMID: 24282778; PMCID: PMC3833045
10. Headache Classification Committee of the International Headache Society (IHS). The international classification of headache disorders, 3rd edition (beta version). Cephalalgia. 2013;33:629–808.
11. Greher M, Moriggl B, Curatolo M, Kirchmair L, Eichenberger U. Sonographic visualization and ultrasound-guided blockade of the greater occipital nerve: a comparison of two selective techniques confirmed by anatomical dissection. Br J Anaesth. 2010;104:637–42.
12. Narouze S. Occipital neuralgia diagnosis and treatment: the role of ultrasound. Headache. 2016;56:801–7.
13. Simons DG. New views of myofascial trigger points: Etiology and diagnosis. Arch Phys Med Rehabil 2008;89:157–9.
14. Arıcı T, Akpınar ÇK, Bilgiç AB, Köken İŞ. Ultrasound-guided interfascial blocks of the trapezius muscle for cervicogenic headache. Agri 2023;35:16-21.
15. Ma D, Maimaitimin A, Wang Y. A Novel Ultrasound-Guided "Three in One" Approach Plus Interfascial Plane Blocks for the Treatment of Cervicogenic Headache. Local Reg Anesth. 2024;17:1-8. doi: 10.2147/LRA.S446667.