Review Article

Nerve and ganglion blocks in the management of headache disorders: a narrative review

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Background and Objective: Headaches, facial pain, and related entities form a significant source of pain, morbidity, and reduced quality of life for the general population worldwide. Medications form a large component of medical management of many headaches. However, various systemic and other factors may preclude the use of medications. Some patients may be refractory to the conventional methods of management. In a selected group of these headache cases, various peripheral nerve blocks and nerve stimulation can significantly positively affect the diagnosis, prognosis, and quality of life of the patient. In this article, we reviewed the evidence, indications, clinical anatomy, landmarks, techniques, risks and adverse effects of nerve and ganglion block procedures that have been employed for a selected group of patients.

Methods: The search for this narrative review was performed between November 1st, 2021, and January 20th, 2022. The databases searched included PubMed, Ovid, Science Direct, and textbooks on pain management. The search terms included nerve blocks, headaches, pain management, migraine, individual pain entities, individual nerve blocks, and ganglion blocks. The complete articles written in the English language were retrieved. Only articles published in English between 1992 and 2022 were included. Exclusion criteria included articles other than in English; articles published prior to 1992 and articles whose complete published form were not available.

Key Content and Findings: This literature contains nerve anatomy specific to the orofacial region, it's distribution, innervation, nerve block technique, pharmacology and adverse effects of specific nerve blocks used to manage headache disorders.

Conclusions: Nerve blocks appear in the literature as an accepted technique aiding in the diagnosis, prognosis determination, pain relief and management of headache disorders. The nerve blocks provide considerable improvement in the quality of life of patients affected by headaches. These blocks can greatly enhance accurate diagnosis, thereby potentially preventing difficulties in diagnosis and enabling the clinician in succinct pain management. There is a need for further retrospective and prospective studies exploring the efficacies of various types of nerve blocks as compared to other conventional modalities in the management of headache disorders.

Keywords: Headache; pain; nerve block; migraine; pain management

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Introduction

Headaches, facial pain, and related entities form a significant source of pain, morbidity, and reduced quality of life for the general population worldwide. The International Headache Society (IHS) came out with its latest classification of headaches in 2018 (1). Since then, there has been an explosive number of manuscripts published on various aspects of headaches. Medications form a large component of medical management of many headaches. Consequently, there are numerous newer medications available in the market over the last few decades. These include many newer triptans, gepants, and other medications that were approved for migraines (2-4). However, various systemic and other factors may preclude the use of medications. Some patients may be refractory to the conventional methods of management (5-9). For some of these refractory cases, various surgical ablative and other invasive procedures have been proposed. In a selected group of these headache cases, considerable methods of peripheral nerve blocks and nerve stimulation can significantly positively affect the diagnosis, prognosis, and quality of life of the patient. In this article, we review the evidence, risks, techniques, and landmarks of nerve and ganglion block procedures, that have been employed for headaches, neuralgias, and other pain entities. The readers are encouraged to refer to the cited articles in this manuscript, for the details of the procedural techniques. The IHS-3 has included trigeminal and other craniofacial neuralgias under its classification of headaches (1). Therefore, although for a practicing clinician, neuralgias may not confirm the traditional definition of 'headache', we have included a brief section under the utility of nerve blocks for management of neuralgias as well.

The rationale for using peripheral nerve blocks stem from the ability of local anesthesia to block afferent pain sensations. Various pharmaceutical agents including local anesthetics (LAs) and steroids have been used singularly or in combination for these procedures. Many of the LAs bring about good conduction block of pain sensations without appreciably blocking the motor function. The properties of LA such as the onset of action and duration of anesthesia may affect the level of pain relief. Caution should also be expressed in the possible placebo effect that may come with the anesthetic blockage of pain, and the resultant numbness (9,10).

There seems to be no real consensus on the absolute indication and the timing of the use of peripheral nerve blocks in the management of headaches (11,12). There is also considerable variability in the actual anesthetic drug, its concentration, the amount used, the frequencies of the blocks, the proposed time interval between consecutive blocks, and whether to use anesthetics with corticosteroids (11,13-15). Further, an added benefit from blocking an afferent nerve in the head and neck maybe while virtue of its positive effect on pain emanating from other anatomic regions outside the area of supply of the same nerve (case in point: the phenomena of convergence). The procedure is minimally invasive and may be of great therapeutic and management value in many patients suffering from headaches (11). Peripheral nerve blocks are mostly well tolerated, readily accepted by patients and mostly associated with minimal or no serious side effects (11,13) and adverse effects (11,16-20). Many of the nerve block procedures lack true rigorously controlled studies, and some may have been anecdotally reported.

As alluded to earlier, the craniofacial neuralgias deserve special mention. The inclusion of these entities under headaches by the IHS may have everything to do with the distribution of pain being in the head and neck region. It must be noted that the duration of pain in neuralgias may not be consistent with the common concept of 'headaches'. However, entities like occipital neuralgia, presumably due to the larger area of the head and neck involved in the pain, and due to the duration and triggers, may possibly be seen as headaches by patients and clinicians. In the case of trigeminal and glossopharyngeal neuralgias, it is common practice for the patient to either be referred or self-referred to the dentist/orofacial pain specialist due to the possible 'dental' nature of the pain symptoms. We present the following article in accordance with the Narrative Review reporting checklist (available at https://joma.amegroups.com/article/view/10.21037/joma-22-6/rc).

Methods

The detailed method used to identify potential literatures is summarized in *Table 1*.

Occipital nerve block

Occipital nerve block has been variably described as a lesser occipital (C3) block or greater occipital (C2) or a combined (C2-C3) block (21-24).

Nerve anatomy and distribution

The sensory nerves arising from the dorsal roots at levels C2 and C3 of the spinal cord comprise the 'occipital nerves' (25,26). These nerves innervate the scalp from

Table 1 The search strategy summary

Items	Specification
Date of search	1st November 2021 to 20th January 2022
Databases and other sources searched	PubMed, Ovid, Science Direct, and textbooks
Search terms used (Table S1)	Nerve blocks, headaches, pain management, migraine, individual pain entities, individual nerve blocks and ganglion blocks
Timeframe	January 1st 1992 to January 1st 2022
Inclusion and exclusion criteria	Inclusion criteria
	(I) Articles describing nerve blocks related to orofacial pain in general, and management of headaches in particular
	(II) Articles published in English between 1992 and 2022
	(III) Articles whose complete form/PDFs are available
	Exclusion criteria
	(I) Articles in language other than English
	(II) Articles published prior to 1992
	(III) Articles whose complete form was not available
Selection process	All the authors (DCT, DC, SP, PKP, SDM, BCM) conducted independent searches; the results were discussed as a group; selection decisions were unanimous; any differences of opinion were reconciled in discussion with the first author DCT

its posterior part to the vertex, and encompasses other anatomic structures including the external ear (26). C2 is known as greater occipital, C3 is known as lesser occipital, and a branch of C3 that supplies C2-C3 facet joint (27) is known as third occipital nerve (*Figure 1A*) (25). The greater occipital nerve (GON) C2 originates between C1 and C2 vertebrae, and proceeds between two muscles namely inferior oblique and semispinalis capitis (26). This nerve penetrates the semispinalis capitis and sometimes the trapezius and the inferior oblique and is associated with sternocleidomastoid (21,25,26). The lesser occipital nerve (LON) innervates the scalp in the lateral region of the head behind the ear and the cranial surface of the ear (25).

Indications

The indications for these blocks vary widely in the literature. Some of the literature refers to the GON block as routinely used for two conditions, namely occipital neuralgia and cervicogenic headaches. It should be noted that the GON block could be diagnostic, prognostic and/or therapeutic in these conditions (1,9,12,22). GON blocks are also effectively used for the management of cluster headaches and migraines. GON block is also used for diagnostic and therapeutic purposes in cases of C2 entrapment neuropathy (25). Other indications for this GON block include cluster, migraine, chronic daily headache, hemicrania continua, new daily persistent headache, post traumatic headache, post-dural puncture headache, and trigeminal neuralgia (28-36). Occipital nerve block is one of the preferred methods for management of refractory occipital neuralgia (23). The use of GON block in neuralgias of nerve that are anatomically distinct, i.e., trigeminal neuralgia, stems from the explanation that both these entities show convergence at trigeminal nucleus caudalis level (22,25,37,38). Used alone or with steroids, the success rate for pain relief from GON blocks is reported to range from 15 to 35 % in terms of sustained prolonged pain relief extending over several months (16,25,39). The explanation for this benefit given in the literature is the inhibition of the afferent barrage to the nucleus caudalis of the trigeminal nerve and cervical dorsal horn via the GON (37,39). Abortive management of migraine with aura includes bilateral GON blocks (40).

Indications for GON block

Indications for GON block are occipital neuralgia, entrapment neuropathy, cervicogenic headache, cluster (episodic & chronic), migraine (episodic & chronic), status migrainosus, chronic daily headache, hemicrania continua,

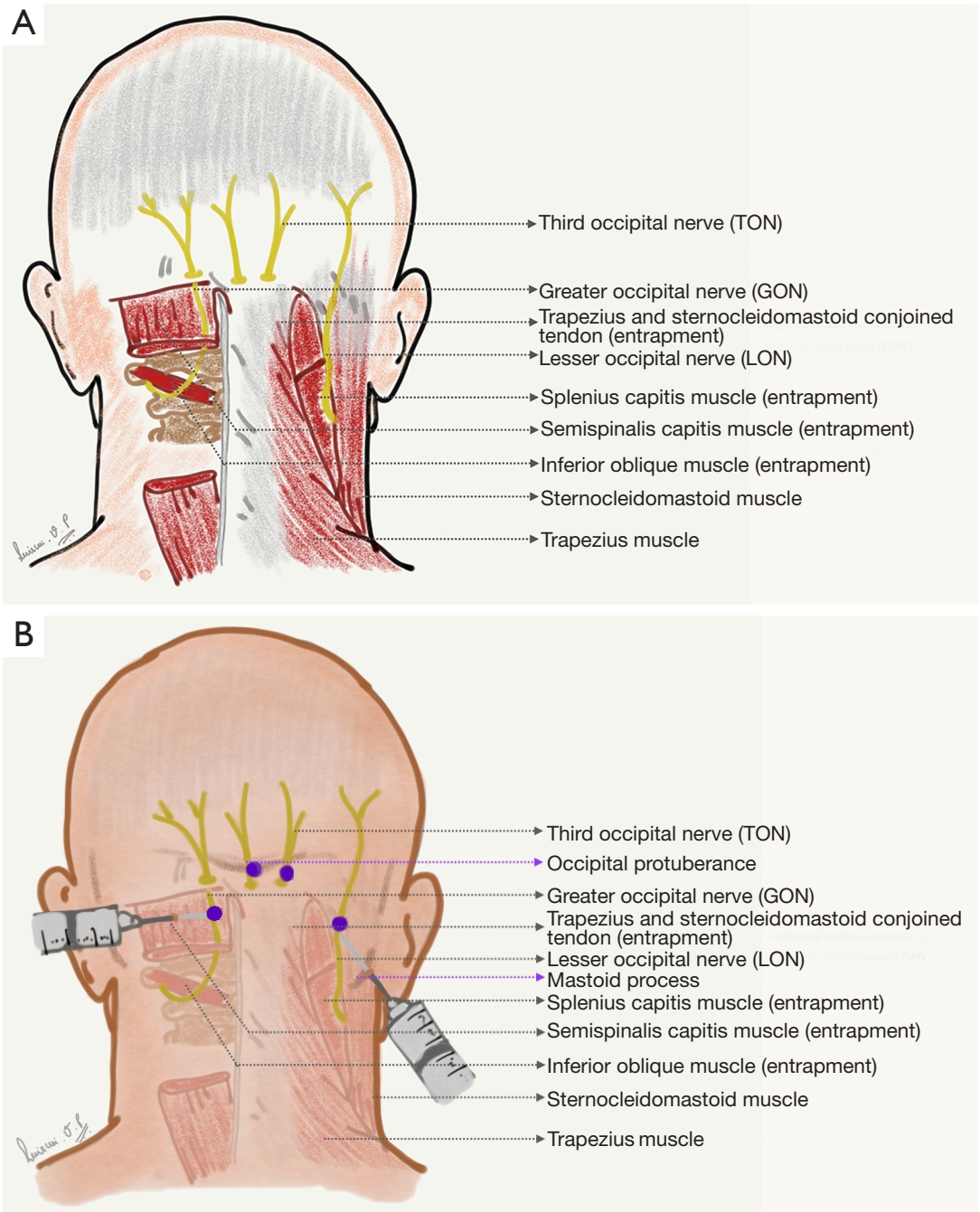

Figure 1 Occipital nerve block. (A) Anatomy of the occipital nerves; (B) the technique for the greater and lesser occipital nerve blocks.

new daily persistent headache, posttraumatic headache, post-dural puncture headache, trigeminal neuralgia (28-36).

Landmarks

A straight line connecting the occipital protuberance and the mastoid process forms the anatomic landmark of the GON (27).

Technique

Various techniques have been described in the literature for GON blocks. One of the most accepted methods of GON block involves an LA injection at a tender point, that

Table 2 Branches arising from the sphenopalatine ganglion (64)

Nerve branches	Anatomic distribution (sensory)
Orbital	Periosteum of orbit
Greater palatine/lesser palatine	hard and soft palates; palatine tonsil (mucosa)
Posterior lateral nasal; nasopalatine	Mucosa of:
	Posterior and inferior nasal cavity
	Posterior ethmoidal air cells
	Hard palate immediately posterior to maxillary incisors
Pharyngeal	Mucosa of nasopharynx, sphenoid sinus, and posterior ethmoidal air cells

is lateral to the occipital protuberance. The LON block is administered approximately 1.5 inches lateral to the palpated occipital artery (*Figure 1B*) (14,41-46).

It has been proven that use of ultrasound may help to inject the anesthetic block at a more targeted site between C1/C2, although, the benefit of this in comparison to a block given without any image guidance is yet to be proven (39,47,48).

Pharmacology

Much of the literature focuses on the use of either 1–2% lidocaine or 0.25% to 0.5% bupivacaine (23,46). Botulinum toxin-A (Botox) apparently gives longer pain relief than when the blocks are administered with LA alone (49,50). The proposed mechanisms of action of Botox bringing about sustained pain relief in GON blocks have included inhibition of substance P, CGRP, and glutamate (49,51-53).

Adverse effects

Presumably, the adverse/side effect of a GON block may stem from direct trauma to the local tissues/nerve, pharmacologic side effect of the agent, or injury to an adjacent blood vessel causing localized bleeding. It must be noted that most of these adverse effects are of a transient and mild nature. The rarely reported side effects include hematoma, pain at the site of injection, alopecia, and local injection site infection (54). The clinician should be aware of the possibility of more pronounced localized side effects with repeated injections, especially with steroids. Very rarely steroids can cause local tissue necrosis, wasting of muscle and a risk of rupture of the tendon (24,55). Bilateral blocks have shown to have higher incidence of side effects. There is a possibility of scalp tissue necrosis secondary to significant vasoconstriction associated with anesthetic solutions containing vasoconstrictors. This effect has been proposed to be the result of vasoconstriction of the occipital artery (28).

Third occipital nerve

The third occipital nerve (TON) originates from the dorsal ramus of the C3 nerve (25). The TON has an anatomic relationship with the C2-C3 facet joint. The TON is known to pierce the splenius capitis, trapezius, and semispinalis capitis muscles. This nerve also supplies sensory innervation to the C2/C3 facet joint (26). Some literature proposes the use of a TON block for accelerated decelerated injury (whiplash) associated pain (9,56,57). It is worth mentioning that C3 stimulation can also be used for management of occipital neuralgia (22,58-61). One of the more common uses of the TON block is for upper cervical pain and cervicogenic headache (62).

Sphenopalatine ganglion (SPG) block

Nerve anatomy and distribution

The SPG is located in the pterygopalatine fossa (PPF). It has autonomic, sensory and motor components (63). The Vidian nerve carries the sympathetic and parasympathetic nerve fibers to the SPG. Synapse of preganglionic parasympathetic neurons occurs within the SPG, and postganglionic parasympathetic fibers then reach the target organs (lacrimal gland, nasal glands, palatine glands, and pharyngeal glands) via the SPG, through the ophthalmic and maxillary divisions of the fifth nerve. Preganglionic sympathetic nerve fibers first synapse in the superior cervical ganglion, and the postganglionic sympathetic nerve fibers travel along with parasympathetic fibers and pass through the SPG (with no synapsing) (63). The sensory component of SPG is depicted in *Table 2*.

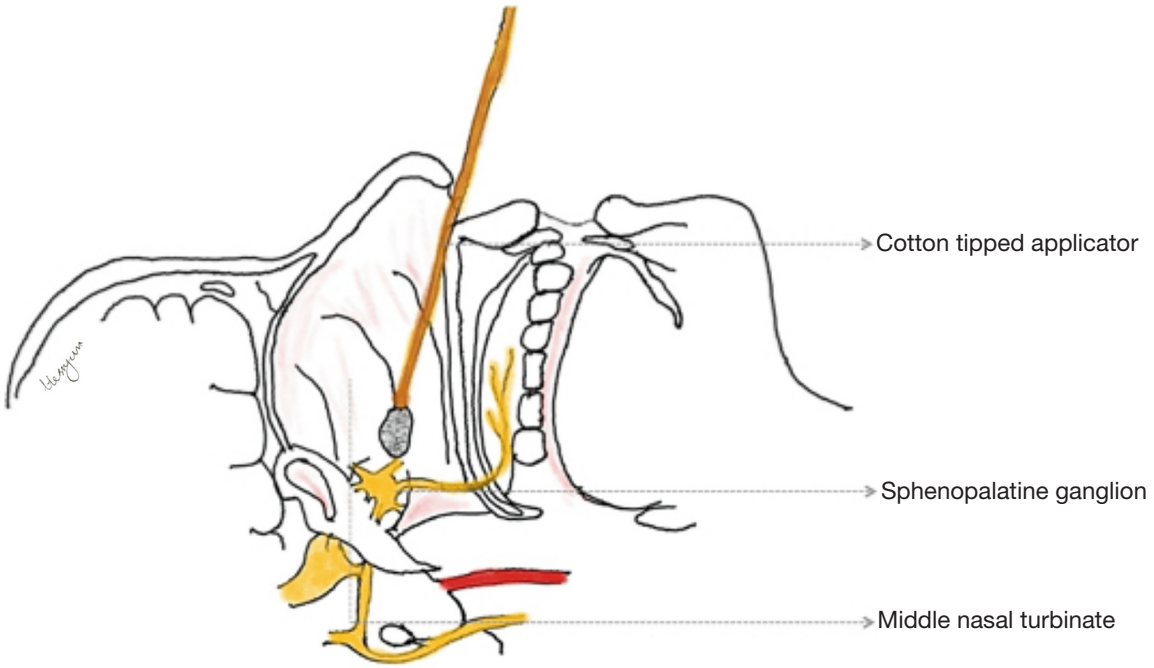

Figure 2 Transnasal approach for the sphenopalatine ganglion block.

Indications

Cluster headaches are proposed to have activation of the parasympathetic outflow from the superior salivary nucleus of the seventh nerve, mainly via the SPG (65). SPG blocks are effectively used for the management of cluster headaches and migraines (9,66-69). SPG blocks are also effectively used in post-dural puncture headache, post-traumatic headache, and post-herpetic neuralgia (68,70,71). SPG blocks used repetitively are indicated in cases of hemicrania continua in patients intolerant to indomethacin (68).

Landmarks

The PPF can be accessed via the sphenopalatine foramen, which is approachable at the level of nasal mucosa and behind the middle nasal concha (64). The other local landmarks related to the SPG are the middle nasal turbinate and the PPF (pyramidal space formed at the junction of maxilla, palatine and sphenoid bones) (72).

Technique

Initially described by Barré in 1982, the SPG block utilized varying concentrations of cocaine solutions in a trans nasal approach (73). The technique simply involves patients in a supine position, tilting their head upwards, and deposition of the drug in each nostril (74). A similar approach utilizing 4% xylocaine was employed by Kittrelle *et al.* in 1985 (75), and later reconfirmed by Berger *et al.* (76). Three traditional approaches are employed in the SPG block. These include the trans-nasal approach, transoral approach and lateral infra-zygomatic approach (77). A newer technique employing the supra-zygomatic approach is also used (78). The transoral approach is a direct approach for blocking palatine nerves by targeting the greater palatine foramen. The PPF can be approached by passing a 27-gauge curved dental needle through the greater palatine foramen medial to the maxillary wisdom tooth to reach the main trunk of V2 division of trigeminal nerve at the superior portion of the PPF (27,77,79). Topical application of LA solution on a cotton tipped applicator to the posterior wall of nasopharynx in the area of middle turbinate with the patient in supine/reclined position is the trans nasal approach for blocking the SPG (*Figure 2*) (66,73,79). The lateral infra-zygomatic approach to block the SPG is usually guided by fluoroscopy or computed tomography (27,79,80).

Pharmacology

Most commonly used drugs for SPG block include 2% to 4% lidocaine, 0.5% bupivacaine, 4% cocaine, depot steroids or 6% phenol (79).

Adverse effects

The most common adverse effects of SPG block include epistaxis usually with trans-nasal and infra-zygomatic approach (81). Other adverse effects include hematoma due to accidental intravascular injection of maxillary artery or its branches which are in PPF, infection if there is a breach in oral or nasal mucosa during giving the SPG block (27). Transient hypoesthesia of the maxilla, palate or pharynx can occur as sensory supply to these areas are via the SPG block (82,83). Transient diplopia is common after SPG block due to spread of LA solution affecting abducent nerve in the inferior orbital fissure from the pterygopalatine fissure (84).

Stellate ganglion (SG) block

Nerve anatomy and distribution

The SG is formed by the fusion of inferior cervical ganglion and first thoracic sympathetic ganglion (85-89). The traditional description of the location of SG is the junction of C7 vertebrae and T1. The sympathetic supply to head, neck and upper extremity is via the sympathetic nerves that traverse through the SG (90,91). By blocking SG, sympathetic supply to the ipsilateral side of the upper quadrant of the body is inhibited. Location of SG is in front of the transverse process of C7 vertebra and behind the vertebral artery (*Figure 3A*) (64). Pre-ganglionic sympathetic nerve fibers traverse from spinal cord T2 or T3–T5 to SG. Sweat glands, blood vessels of the upper extremities, nerve branches to lung and heart, and nerve plexus surrounding vertebral artery receive postganglionic sympathetic nerve fibers from SG through spinal nerves C7, C8 and T1 (64,92). The blood supply to head, neck and upper limbs on the ipsilateral side is increased by blocking the SG (93-95). SG block reduces the response to nociception and also has sedative effects, thus resulting in antinociception (96,97).

Indications

The SG block has been used to manage complex regional pain syndrome (CRPS I & II) (90,98-100). Some articles mention the use of SG block for CRPS of the craniofacial region as well (101). It is also used for sympathetically maintained pain (98,102,103). It is effectively used to manage painful conditions like herpes zoster and post herpetic neuralgia (89,99,104-107). SG block is also useful in treating cases of refractory migraine and tension type headache (99,108). SG block is also effective in management of intractable atypical facial pain (90,93,109,110) and temporal arteritis (111,112). Recently, it has been used for therapeutic management of burning mouth syndrome (64,113).

Landmarks

The most common landmarks used while giving a SG nerve block are C6 vertebra, Chassaignac's tubercle on the transverse process of C6 vertebra, the cricoid cartilage and the carotid artery (114). For ultrasound guided technique the soft tissue landmarks used are carotid artery, internal jugular vein, thyroid gland, longus colli, longus capitis muscle, prevertebral fascia, and the root of C6 spinal nerve (114,115). The anatomic landmarks are summarized in *Table 3*.

Technique

There are three known methods of SG block. The conventional blind approach of administering SG nerve block is by identification and palpation of the Chassaignac's tubercle on the transverse process of C6, thereby preventing inadvertent intravascular injection. The injected solution spreads to the SG through the longus colli muscle (90,117). The level at which SG block is given to avoid inadvertent intravascular injection in the vertebral artery or lungs causing pneumothorax is C6 level (*Figure 3B*) (118,119). Various new techniques have been used to administer SG block such as ultrasound and fluoroscopic guided blocks (119-121). These techniques have made the conventional blind approach almost obsolete. The fluoroscopic guided SG block utilizes only bony landmarks like the transverse process of C6 vertebra. The anterior-posterior approach is the most commonly used approach in fluoroscopic guided technique, wherein the needle is advanced till the bone (tubercle of transverse process of C6) is reached and taken out a few millimeters before injecting (119,122). The ultrasonography (US) guided technique utilizes soft tissue landmarks in addition to bony landmarks for administration of SG block. Unlike fluoroscopic technique, bone is not contacted in ultrasound guided block. In US guided technique, the needle is placed in the fascial plane between the prevertebral fascia which covers the posterior fascial layer of the carotid sheath and the longus colli muscle (119,122).

Pharmacology

The various LA solutions used for administering SG nerve block are 5 mL of 0.5% bupivacaine (123), 0.5% mepivacaine in 5 mL (124), and 5 mL of 1.5% lidocaine (99).

Adverse effects

The most common adverse effects of SG nerve block include intravascular injection in the vertebral artery,

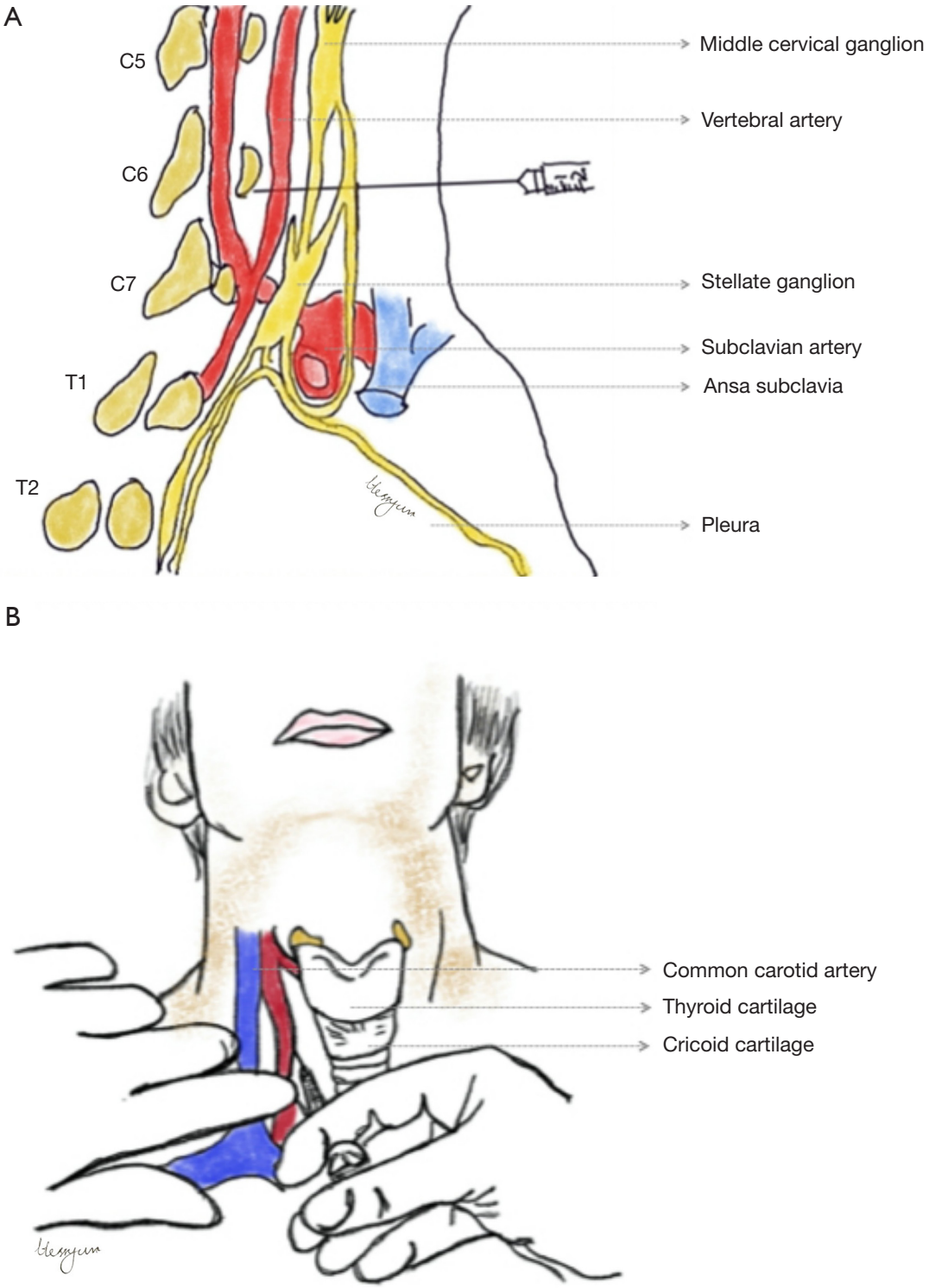

Figure 3 Stellate ganglion block. (A) Anatomy and needle position of the stellate ganglion block; (B) the stellate ganglion block technique.

Table 3 Anatomic relations of the stellate ganglion (64,116)

Relation	Structures
Anterior	Vertebral artery and subclavian artery, common carotid artery, internal jugular vein and vagus nerve
Posterior	Transverse process of C7
Anterolateral	Phrenic nerve
Anteromedial	Trachea, thyroid, esophagus, recurrent laryngeal nerve
Anteroinferior	Apex of lung

carotid artery, internal jugular vein, and inferior thyroid artery. This is more common with the conventional blind technique and fluoroscopic guided SG block (125). Pneumothorax, esophageal and tracheal puncture can occur with fluoroscopic technique (125). The direct visualization of vascular and soft tissue structures such as vertebral, inferior thyroidal, cervical, and carotid arteries, thyroid gland, esophagus, and nerve roots with ultrasound guided SG block makes this procedure relatively safe and minimizes complications seen with other techniques (122,126). Other adverse effects include transient Horner's syndrome (127,128), hematoma, airway obstruction (129), injury to recurrent laryngeal nerve, vagus nerve and brachial plexus roots (114). Severe hypertension, transient cough, dyspnea, persistent ptosis, hemi diaphragmatic paralysis/phrenic nerve injury, dural puncture, pneumothorax, hematoma and infection (125,128-131).

Supraorbital and supratrochlear nerve blocks (STNs)

Nerve anatomy and distribution

Supraorbital and supratrochlear nerves are the branches of the ophthalmic division (V1) of the trigeminal nerve supplying the orbit and upper eyelids, amongst other structures (9,132-136). They pass through the orbit above the supraorbital ridge providing easy access to neural blockade (9). The supraorbital nerve exits the supraorbital margin through a notch (135,136). The supratrochlear nerve travels along the medial roof of the orbit, between the trochlear and supraorbital foramina exiting through the frontal notch supplying the deep tissues of the forehead (134).

Indications

Supraorbital nerve blocks (SONs) and STNs are indicated in the management of chronic headaches (137). These blocks are also used to effectively manage refractory frontal headaches (138) Other indications for these blocks are the abortive therapy of acute migraine and for management of status migrainosus (139,140). STN block is also used for various autoimmune and inflammatory conditions that involve the trochlear nerve such as cranial neuritis, multiple sclerosis and Tolosa-Hunt syndrome (141). SON block is used to manage swimmers headaches (141). SON and STN blocks are indicated in management of cluster headaches (11). Other indications for SON and STN blocks that appear in the literature are supraorbital and supratrochlear entrapment neuropathies; the diagnosis and management of facial pain; palliative therapy for malignancy; and for pain from herpes zoster and facial bone fractures (27).

Landmarks

The landmarks for SON and STN blocks are supraorbital notch, bony orbit, and the corrugator muscle (11,142-144).

Technique

SON

After identification of supraorbital notch, a 25-gauge needle is inserted at the target area and is advanced towards the midline approximately 15 degrees away from the supraorbital foramen till it touches the periosteum (*Figure 4*) (9,142,144-147).

STN

Once the medial canthus of the eye is identified, an imaginary line is drawn superiorly from the eyebrow to the medial canthus of the eye inferiorly beneath the eyebrow. A 25-gauge needle is inserted midway on this line and advanced till it reaches the orbital bone and 3cc of anesthetic is deposited after aspiration (*Figure 4*) (9,144,147,148).

Pharmacology

The most commonly used anesthetic for SON and STN are 0.5% or 1% lidocaine and 0.5% bupivacaine (149-152).

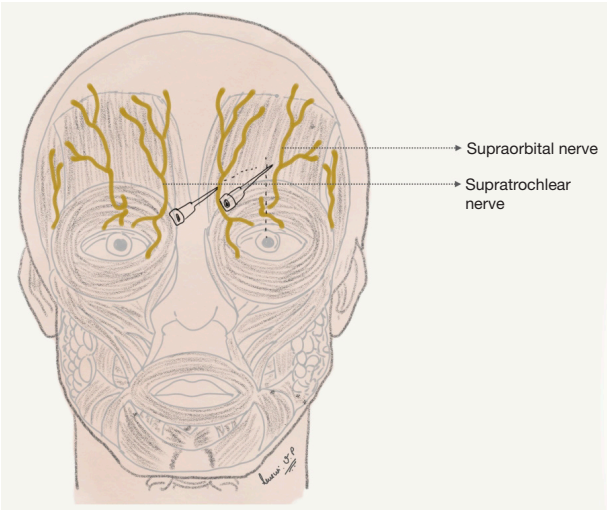

Figure 4 The technique for supraorbital and supratrochlear nerve block.

Adverse effects

The most common adverse effects/complications after SON and STN block are hematoma and ecchymosis post injection due to close proximity to vascular structures (141,149).

Facet joint injections

Nerve anatomy and distribution

Facet joint injections are an integral part of medical management of headaches. Facet joint is a synovial joint (cervico zygapophyseal) with a fibrous capsule. The main components of the joint are articular processes of the cervical vertebrae and inferior articular processes of the adjacent vertebrae (153,154). The medial branches of the C4-C8 dorsal rami supply the facet joints (155). A branch of C3 dorsal rami that lies in close proximity of the vertebra, known as the TON supplies the C3-C4 zygapophyseal joint (156). Anesthetic blockade of the TON is utilized in alleviating the pain arising from the C2-C3 joint (27).

Indications

Pain arising from facet joints, neck pain, acceleration-deceleration injury, post-surgical neck pain, pain from cervical degenerative joint disease, cervicogenic headache, other cervical disorders (27,157-160). Some physicians consider the cervical medial branch block as the standard for the diagnosis of facet joint pain (161,162).

Landmarks and technique

Most of the literature consistently talks about the need for fluoroscopy due to the sensitive nature of the structures adjacent to the area of injection. The most commonly used technique for administering facet joint injections is a lateral approach. The patient is made to lie down laterally with a head rest so that lateral flexion of neck is avoided. After identification of facet joint, a 22-to-25-gauge spinal needle is introduced posteriorly, taking care not to advance the needle in the intervertebral foramina and spinal canal. The injectate consists of a combination of LA and steroids. A total of 1 to 1.5 mL of this combination is injected at the target area (163). This procedure is performed under fluoroscopic guidance (157,158,163,164).

Pharmacology

The agents commonly used while administering facet joint injection are a combination of LA and steroids. Either 1% lidocaine or 0.5% bupivacaine is used as an LA. Steroids such as 40% triamcinolone, methylprednisolone, dexamethasone and betamethasone are also used (157,158,165).

Adverse effects

The adverse effects of administering facet joint injections are bleeding, hematoma, intravascular injection in the vertebral artery, dural puncture, meningitis, epidural abscess, vasovagal syncope, pneumothorax, damage to phrenic nerve resulting in palsy, infections such as septic arthritis and psoas abscess (157-159,164,166-168). Other side effects which are transient are swelling and pain at the site of injection (158).

General complications as well as complications pertaining to specific blocks have been summarized in *Table 4*.

Conclusion and clinical pearls

Nerve blocks appear in the literature as an accepted technique aiding in the diagnosis, prognosis determination, pain relief and management of headache disorders. The nerve blocks provide considerable improvement in the quality of life of patients affected by headaches. These blocks can greatly enhance accurate diagnosis, thereby potentially preventing difficulties in diagnosis and enabling the clinician in succinct pain management. There is a need for further retrospective and prospective studies exploring

Table 4 Complications of cranio-facial nerve blocks

General complications	Drug related complications	Block specific complications		
		Blocks	Local complications	Systemic complications
(I) Bleeding, haematoma, hemorrhage, swelling, dyspnea, paresthesia, hyperesthesia, dysesthesia, mechanical trauma to lip due to paresthesia, nerve injury, facial paralysis, ocular complications like paralysis of extraocular muscles, diplopia, ptosis, miosis, enophthalmos, permanent loss of vision, Horner like syndrome (II) Allergic reactions, methemoglobinemia, seizures, prodromal symptoms like tinnitus, auditory disturbances, confusion, dysphoria, dysarthria, circumoral numbness, metallic taste in mouth, agitation, loss of consciousness. Cardiovascular symptoms like bradycardia, tachycardia, hypotension, hypertension, asystole, ventricular fibrillations (169-174)	(I) Local—depends on multiple variables including, but not limited to, mode of administration, volume used, patient factors, and specific formulation of the drug. Most common are neurotoxicity, myotoxicity (articaine and bupivacaine), tissue irritation (redness, edema, urticaria), burning, color changes (steroids and botulinum toxin) (II) Systemic—lidocaine has a biphasic action, being an anticonvulsant at lower concentrations, and causing tonic-clonic seizures at higher concentrations. Hypersensitivity reactions with botulinum toxin	Occipital	Perioral numbness, tinnitus, agitation, metallic taste, coma (175)	Central nervous system: Seizure Cardiovascular system: hyper- or hypotension, tachy or bradycardia, ventricular arrhythmia, cardiac arrest, myotoxicity, atrophy, alopecia, hyperpigmentation, folliculitis (175)
		Sphenopalatine ganglion	Hematoma, epistaxis, intravascular injection, temporary hypoesthesia or dysesthesia in the palate, maxilla, or posterior pharynx (27)	Post-dural puncture headache, permanent paraparesis, cauda equina syndrome, meningitis, and epidural infection (176) Reflex bradycardia, infection, dryness of the eye, temporary diplopia (27)
		Stellate	Hematoma, bleeding, swelling, intravascular injection in vertebral artery, carotid artery and internal jugular vein, dural puncture, esophageal and tracheal puncture (125,128-131)	Severe hypertension, allergic reaction, transient cough, hoarseness, dysphagia, dyspnea and respiratory depression, visual hallucinations, ptosis, bloodshot conjunctiva, seizures, light-headedness, migraine headaches, transient global amnesia, reading difficulty, brachial plexus block, subdural block/intraspinal blockade, transient locked-in syndrome, bilateral sympathetic blockade, decreased contralateral blood flow, contralateral and bilateral Horner's syndrome, myoclonus arm numbness, lower limb edema, internal jugular vein thrombosis, hemi diaphragmatic paralysis (125)
		Supraorbital & Supratrochlear	Bleeding, intravascular injection, hematoma (177)	Light-headedness, vasovagal syncope, allergy to local anesthetic or corticosteroid, teratogenicity, alopecia, dermal atrophy (177)
		Facet joint injection	Swelling and pain at the site of injection (158)	Paresthesia, numbness, paralysis, vertebral artery damage during cervical entry, neuritic pain, paraspinal abscess, leakage of anesthetic into the spinal canal causing motor and sensory blockade, phrenic palsy from overflow of LA during injection at C3-C6 levels, chemical meningitis, epidural abscess, pneumothorax, transient ataxia and unsteadiness due to partial blockade of upper cervical proprioceptive afferents and the righting reflex from the TON block during cervical injections. Significant vascular and neurological injuries (extremely rare in image-guided injections) (81,158)

LA, local anesthetic; TON, third occipital nerve.

the efficacies of various types of nerve blocks as compared to other conventional modalities in the management of headache disorders.

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Footnote

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Supplementary

Table S1 Detailed search strategy of PubMed

Search strategy	((((((((((((occipital nerve block*) OR (C2 nerve block*)) OR (C3 nerve block*)) OR (sphenopalatine ganglion block*)) OR (pterygopalatine ganglion block*)) OR (stellate ganglion block*)) OR (supraorbital nerve block)) OR (supratrochlear nerve block*)) OR (facet joint injection*)) OR (third occipital nerve block)) AND (english[Language]))) AND (("1992/01/01"[Date - Publication] : "2022"[Date - Publication]))) AND (headache)

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