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1

Regional techniques for head and neck surgical procedures



Matthew Novitch, MD, Resident Physicians ^a,
Farees S. Hyatali, MD ^b, George Jeha, Medical Student ^c,
Mark Motejunas, MD ^c, Lauren Bonneval, MD ^c,
Thakur Pankaj, MD ^b,
Elyse M. Cornett, PhD, Assistant Professor ^{b, *},
Mark R. Jones, MD, Resident Physicians ^d,
Rachel J. Kaye, BA, Medical School Student ^e,
Richard D. Urman, MD, Associate Professor ^f,
Alan D. Kaye, MD, PhD, Professor, Program Director &
Chairman ^c

^a University of Washington, 1959 NE Pacific St, Seattle, WA 98195, USA

^b Department of Anesthesiology, LSU Health Shreveport, 1501 Kings Highway, Shreveport, LA 71103, USA

^c Department of Anesthesiology, LSU Health Sciences Center, Room 656, 1542 Tulane Ave., New Orleans, LA 70112, USA

^d Department of Anesthesia, Critical Care and Pain Medicine, Harvard Medical School, Beth Israel Deaconess Medical Center, 330 Brookline Ave., Boston, MA 02115, USA

^e Medical University of South Carolina, Charleston, SC 29425, USA

^f Department of Anesthesiology, Perioperative and Pain Medicine, Harvard Medical School, Brigham and Women's Hospital, 75 Francis St, Boston, MA 02115, USA

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Regional anesthesia has evolved as an important tool for anesthesiologists and surgeons managing patients for surgery of the head and neck region. In recent years, ultrasound use has increased significantly, and newer nerve blocks have been established for surgeries of the head and regions. In this review, anatomy, indications, efficacy, and potential side effects of regional anesthesia for the head and neck region are presented. Evolving practice strongly suggests that regional nerve blocks for the head

* Corresponding author.

E-mail addresses: mnovitch@uw.edu (M. Novitch), fhayata@lsuhsc.edu (F.S. Hyatali), gjeha@lsuhsc.edu (G. Jeha), mmotej@lsuhsc.edu (M. Motejunas), lbonn4@lsuhsc.edu (L. Bonneval), pthaku@lsuhsc.edu (T. Pankaj), ecorne@lsuhsc.edu (E.M. Cornett), mjones13@bidmc.harvard.edu (M.R. Jones), rachelkaye17@hotmail.com (R.J. Kaye), rurman@bwh.harvard.edu (R.D. Urman), akaye@lsuhsc.edu (A.D. Kaye).

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and neck region are safe and effective. Future studies and education will likely evolve practice to make these regional techniques standards for future surgeries of the head and neck region.

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Introduction

Regional anesthesiology for the head and neck region is practical and effective because of an abundant nerve supply with reliable and consistent anatomical landmarks. Dental and oral-maxillofacial procedures currently account for the bulk of these procedures. However, in recent years, it has become more commonplace for otolaryngologic procedures. Regional anesthesia has been demonstrated to be useful as a primary anesthetic, such as a superficial cervical block for carotid endarterectomy, or as an adjuvant for postoperative pain relief. Additionally, regional blocks placed intraoperatively have been used effectively as the sole anesthetic for exploration and hemostasis in the rare and catastrophic event of postoperative bleeding.

Improvement of operative conditions for surgical colleagues is an additional benefit of regional blockade in this region. A combination of medications with epinephrine decreases bleeding and is additionally useful for surgical field exploration. There are a wide variety of blocks that can be done in this region, each with its own unique procedural indications and contraindications. Therefore, the present study describes the head and neck blocks typically used in practice and their indications, contraindications, efficacy, technique, and complications.

Frontal (V1), infraorbital (V2), and inferior alveolar (V3)

Anatomical considerations

The frontal nerve is the largest division of the ophthalmic nerve (V1). After entering the orbit through the superior orbital fissure, the nerve courses anteriorly between the orbit and the periosteum as the most superior structure within the orbit. The nerve then branches into the smaller supra-trochlear nerve medially and the larger supraorbital nerve laterally. The supraorbital nerve traverses the supraorbital foramen and provides sensation to the upper eyelid, conjunctiva of the eye, the frontal sinus, and the skin on the anterior scalp. The supratrochlear nerve exits the orbit anteriorly and provides sensation to the skin of the forehead, bridge of the nose, and upper eyelid.

Indications and contraindications

Supraorbital and supratrochlear nerve blocks are indicated for procedures involving the ipsilateral forehead and scalp, including foreign body removal, pain relief, burns or abrasion debridement, and repair of lacerations. These nerve blocks may additionally be used in the management of pain caused by supraorbital or supratrochlear neuralgia, acute herpes zoster, or postherpetic neuralgia [1].

Technique

The supraorbital and supratrochlear nerve blocks are performed with the patient in the supine position. A 10 mL syringe is prepared with 3 mL of local anesthetic. Gentle pressure is applied to the upper eyelid using a gauze sponge before and after the injection to minimize post-injection bleeding. The overlying skin should be prepared with an antiseptic solution [1].

The following procedure is performed for supraorbital block: after identifying the supraorbital notch by palpation, a 25-gauge, 1½-inch needle is inserted at the orbital notch, directed medially by 15

degrees off the perpendicular, and advanced until it reaches the periosteum. Three milliliters of the anesthetic is delivered to achieve anesthesia. Care must be taken to avoid entering the supraorbital foramen [1,2].

The following procedure is performed for supratrochlear nerve block: after identifying the supra-orbital ridge by palpation, a 25-gauge, 1½-inch needle is inserted immediately lateral to the junction of the bridge of the nose and the supraorbital ridge and advanced medially. Three milliliters of the anesthetic is delivered to achieve anesthesia [1,2].

The trigeminal nerve is the fifth cranial nerve whose primary function is to transmit sensory information from the face to the brainstem. It is composed of three branches bilaterally. The first two branches are sensory conducting general somatic afferents and include the ophthalmic branch (V1) and the maxillary branch (V2) [3]. The mandibular branch (V3) is the final branch and provides mixed sensory and motor functions. V3 innervates the muscles of mastication, which include the masseter, the temporalis, and the medial and lateral pterygoids, as well as innervation to other small muscles of the head and neck region [3,4]. The point at which these branches originate is the trigeminal ganglion, also known as the semilunar or Gasserian ganglion. This ganglion lies in a cavity near the apex of the temporal bone in the middle cranial fossa [3,5]. The cavernous sinus is just medial to the ganglion, and the foramen ovale can be found slightly anterior and inferior [3].

It is of clinical importance to understand the anatomy when treating medical conditions such as trigeminal neuralgia. This chronic neuropathic pain condition typically presents in adults and is more common in women [6]. The classic presentation is the sudden onset of episodic sharp or stabbing like unilateral facial pain triggered by tactile stimulation of facial skin or simply by performing daily activities such as chewing or talking [4]. Diagnosis is based on clinical presentation and is one of the exclusion criteria. Initial treatment includes medications like carbamazepine or other anticonvulsants. However, according to Kendall et al., nearly 25% of patients diagnosed with trigeminal neuralgia fail traditional pharmacological therapies, and further medical management such as trigeminal nerve blocks must be considered [6].

A trigeminal nerve block begins with the patient in the supine position and with slight extension of their head [5]. Throughout the procedure, it is important to monitor the patient's blood pressure, EKG, and pulse oximetry continuously. To provide additional comfort measures for the patient, medications such as midazolam can be administered before the procedure [5]. Once the patient is in the proper position, their face is cleaned using the standard aseptic technique. After identifying the foramen ovale, as well as the external auditory canal and the clivus with the c-arm, a 22 or 25 gauge curved needle is inserted nearly 2–3 cm lateral to the angle of the patient's mouth [4,5]. Using image guidance, the needle is advanced toward the foramen ovale with the goal of approaching the anterior edge. Once you have reached the bone, the needle is redirected posteriorly to enter the foramen ovale. Using a lateral view, proper needle placement is confirmed and then fluoroscopic guidance is used until the needle is just below the clivus [5]. To ensure proper placement and rule out intravascular location, 0.2 mL increments of nonionic IV contrast is injected, followed by aspiration [5]. After the proper location has been confirmed, the medication is injected. Typical medications include local anesthetics such as 1% lidocaine. Owing to the nature of the small space, 1 mL of medication is adequate. To potentially prolong the duration of block, additional steroid medications such as triamcinolone, dexamethasone, or methylprednisolone can be used [5]. Various complications include hematomas, diplopia, hearing loss, intracranial hemorrhage, and CSF leakage due to inadequate needle visualization and placement when performing the procedure [5,7].

Sphenopalatine blocks

Anatomical discussion

Sphenopalatine ganglion (SPG), also known as pterygopalatine ganglion, is an extracranial parasympathetic ganglion suspended and innervated by the sensory fibers from the trigeminal nerve (V2) and located in the pterygopalatine fossa along medial wall, posterior to the middle turbinate. SPG is a

crossroad with complex trigemino-autonomic innervation, where it receives not only parasympathetic fibers but also sensory and sympathetic neural fibers confluence through SPG, which are then relayed through its branches to innervate the nasopharynx, nose, and palate. The SPG plays a vital role in numerous head and neck pain syndromes, and adequate regional block of the SPG can be achieved by intranasal, transoral, or lateral approach or the newer techniques listed below to achieve excellent anesthesia and analgesia. See [Table 1](#).

Sensory innervation

SPG receives sensory branches from the maxillary nerve. Two branches from the maxillary nerve traverse the SPG without synapsing and supply sensory innervation to the soft palate, uvula, and tonsils through the lesser palatine nerve. Sensory innervation to the hard palate, adjoining gingiva, and buccal mucosa is innervated by the greater palatine nerve [8].

Sympathetic innervation

SPG receives postganglionic secretomotor and vasoconstrictor fibers from the superior cervical ganglion (T1–T3) through the deep petrosal nerve, which then continues onward to form the nerve of the pterygoid canal (Vidian Nerve) [8]. Some of these sympathetic fibers also supply lacrimal gland in addition to innervation of the nasopharyngeal mucosa. Sympathetic fibers traverse the SPG ganglion without synapsing [8].

Parasympathetic innervation

Preganglionic parasympathetic fibers arise from the superior salivatory nucleus located in the pontine tegmentum through the intermediate nerve of the facial nerve (CNVII). After traversing through the geniculate ganglion, the nerve reaches SPG through the greater petrosal nerve (GPN) [8]. The GPN provides secretory innervation to mucosal membranes of the nose, soft palate, tonsil, lips nasopharynx, and lacrimal gland [8]. Parasympathetic fibers, unlike the sympathetic fibers, synapse in the SPG ganglion.

Techniques

SPG block can be accomplished using intranasal, transoral, and lateral infra-temporal approach. Neurolysis of SPG can also be accomplished with 6% phenol or 1 mL absolute alcohol and is primarily done only by the lateral infra-temporal approach [8,9]. In patients with chronic cluster headaches, radiofrequency ablation (RFA) of SPG has also shown effective results [10]. More recently, onabotulinumtoxin-A, in a dose of 25–50 units, has also been used under general anesthesia [11].

Alternatively, novel techniques of electromagnetic fields (EMF) and pulsed radiofrequency (PRF) radiation have been employed, creating a high electric field and disrupting A-delta and C-fiber transmission [8]. PRF uses a frequency range of 300–500 kHz with an alternating voltage of 45 V in 2 Hz cycles of 20 ms for approximately 8–9 min, and this may be a long-term symptom-free approach for the patient without side effects of neurolysis while preserving the integrity of local tissues. It is believed that pulsed delivery of electrical current in PRF also leads to the inhibition of excitatory transmission of A-delta and C fibers. RFA of SPG has also been used to achieve effective results.

Table 1

Branches and innervation of the sphenopalatine ganglion.

Branches of sphenopalatine ganglion	Innervation
Lacrimal branch	Secretomotor branch to the lacrimal gland
Posterior nasal nerves	Nasal mucosa, medial and inferior meatus, inferior turbinate, ethmoid cavity, superior aspect of the palate and nasal septum
Pharyngeal branch	Nasopharynx close to Eustachian tube, sphenoid sinus
Greater palatine nerve	Bony palate of the buccal cavity, upper central incisors, gum and adjoining mucosa, uvula, and tonsils
Lesser palatine nerve	Soft palate, uvula, and tonsils

Continuous RFA of SPG performed at 80 °C for 60–90 s leads to the generation of high-density electrical field altering the nociceptive pain signals [8,10]. Choice of anesthetics includes 2–4% lidocaine, 0.5% bupivacaine, and 4% cocaine.

Intranasal SPG block

The intranasal approach remains the preferred method, considering its natural procedural dexterity and lesser complications. This technique, which previously utilized cocaine as the local anesthetic of choice, involves soaking a long cotton-tipped applicator in 2% or 4% lidocaine or 0.5% bupivacaine. Oxymetazoline 0.05% can be used as a nasal decongestant in each nasal passage before the procedure to facilitate the probe through the nares. With the patient lying supine and the patient's head in the sniffing position, the applicator is then gently passed parallel to the middle turbinate unilaterally, or bilaterally if needed [8]. While applying gentle pressure, the applicator is left in for approximately 10 min after the applicator's end abuts the posterior nasopharyngeal wall [8]. Anesthesia/analgesia achieved can be confirmed after the patient's confirmation of complete resolution of pain, following which the applicator can be removed. The endoscopic intranasal approach can also be used. Under direct visual guidance with a rigid sinuscope, a local anesthetic can be delivered to anesthetize the nasopharyngeal mucosa. Alternatively, an epidural catheter can be used to deliver a controlled amount of topical anesthetic as it passes and anesthetizes mucosa from the turbinates to the nasopharynx [12]. Specially designed catheters for administering an SPG block are now commercially available, namely, Sphenocath®, Allevio®, and Tx360®. SPG block using Tx360® can be administered to the patient in an upright and seated position. A repeat block may be needed depending on the pathology, but a prolonged relief can be achieved with the RFA, EMF, or PRF technique as mentioned above.

Transoral SPG block (greater palatine nerve block)

This technique has been used for the diverse pathology of the apical maxillary regions and commonly employed by the dentists to deliver anesthetics for tooth extractions through pterygomaxillary fissure [8]. Although this technique delivers direct anesthetics for the desired block, it is technically difficult, more painful to the patient and with unpredictable results. This technique involves passing a curved dental needle through the greater palatine foramen, which is located at the posterior end of the hard palate approximately 1 cm medial to the junction of maxillary second and third molars (see Fig. 1).

Lateral infra-temporal approach

Lateral infra-temporal approach to block SPG involves navigating the approach infra-temporally to pterygopalatine fossa, with the needle directed to the region through the pterygomaxillary fissure. This can successfully be performed under fluoroscopic guidance with direct catheter placement laterally through the pterygomaxillary fissure [8]. CT-guided needle placement by the transfacial approach through the pterygomaxillary fissure to deliver anesthetics around the foramen rotundum for SPG and



Fig. 1. Image showing intra oral location of greater palatine block and anatomical landmark for needle insertion 1 cm medial to the junction of second and third molars for transoral SPG block (image courtesy of NYSORA).

maxillary nerve block has also been used – primarily for persistent idiopathic facial pain (PIFP), also known as atypical facial pain. As stated above, neurolysis of SPG is done only by the lateral infra-temporal approach using either 6% phenol or 1 mL absolute alcohol [8,9]. The lateral infra-temporal approach can also be used with real-time ultrasound, with the transducer placed at 45° inclination. The needle can then be advanced using out-of-plane approach. Maxillary vessels can be identified lying inferiorly before instilling a local anesthetic in the pterygopalatine fossa, see Fig. 2.

Indications

Indications for this block include sphenopalatine ganglion neuralgia (Sluder's neuralgia) [8]; persistent idiopathic facial pain (PIFP), also known as atypical facial pain [8]; primary headaches (cluster headache and migraine headache) [9,13]; trigeminal neuralgia; trigeminal autonomic cephalgia (TACs) [9]; paroxysmal hemicrania; short-lasting unilateral neuralgiform headache with conjunctival injections and tearing (SUNCT); temporomandibular joint disorder; pain due to head and neck cancer; post-dural puncture headaches [9,14]; postoperative after endoscopic sinus surgery [15]; postoperative after nasal septoplasty [16]; head and neck advanced malignancies [8]; and suppressing premature ventricular contractions (PVC) [17]. This block has also been used for chronic tearing; chronic vasomotor rhinitis; herpes keratitis; post-traumatic pseudo cerebral rhinorrhea; hyperhidrosis; myofascial pain of the head, neck, and shoulder origin (fibromyalgia); complex regional pain syndrome; and management of postoperative pain in patients undergoing an endoscopic sinus surgery [8].

Potential complications

Potential complications with the aforementioned approaches are described below.

For the intranasal approach, complications include local trauma causing epistaxis, lightheadedness, posterior pharyngeal numbness, unpleasant and bitter taste, and septum perforation. For the transoral SPG block (greater palatine nerve block), complications can include hemorrhage, infections, intra-orbital hematoma, infra-orbital nerve injury, and needle damage to the local tissue. For the lateral infra-temporal approach, complications include infections, more profound tissue damage, and hemorrhage.

Neurolysis with phenol can cause paresthesia and, if used irresponsibly, can also lead to scarring [9]. Complications from more invasive techniques include block failure, orbital injury, transient diplopia, facial hematoma, blindness, stroke, seizure, bradycardia, and hemodynamic instability. A thorough knowledge of head and neck anatomy can potentially avoid these complications when performed by an

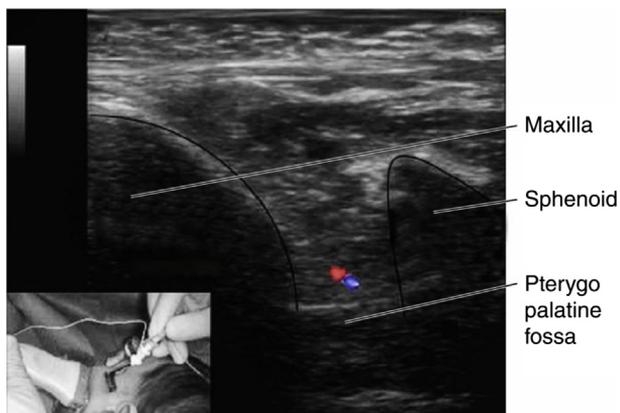


Fig. 2. Image showing a transducer placed inclined infra-temporally. Maxillary artery and vein can be identified inferiorly (image courtesy of NYSORA).

experienced operator. The rare episode of bradycardia can result after RFA stimulation of SPG referred to as the Konen reflex, which spontaneously resolves on cessation of the procedure [8].

Contraindications

Contraindications include local injection site or systemic infections, uncontrolled coagulopathy and bleeding disorder, anesthetic allergies, uncooperative patients (pediatric and combative patients), and abnormal facial anatomy (facial dysmorphism).

Superficial cervical block

The sensory branches of the nerve roots C2–C4 are the target of the cervical plexus block. It is an advanced block with risk of potential serious complication such as intrathecal injection or injection into a vertebral artery, and for this reason, most providers perform only the superficial technique, which involves insertion of the anesthetic superficially to the deep cervical fascia and even lower prevertebral fascia. The cervical plexus lies posterior to the SCM and immediately superficial to the prevertebral fascia, and block of the sensory nerve roots results in anesthesia of the skin of the anterolateral neck, anterior and posterior auricular areas, and the skin overlying the clavicle on the chest wall.

Considering the technique, the patient should lift their head off the bed for palpation of the posterior border of the SCM. The cervical plexus is located within the tissue space between the cervical fascia and the posterior sheath of the SCM, which creates the aim for 5–10 mL of the local anesthetic to be delivered immediately deep into the SCM and superficial investing layer of deep cervical fascia. As the plexus is made up of purely sensory nerves, high concentrations of the local anesthetic are not required; therefore, ropivacaine 0.25–0.5%, bupivacaine 0.25%, or lidocaine 1% is adequate.

Recurrent laryngeal and superior laryngeal blocks

Both recurrent laryngeal and superior laryngeal nerve blocks are popular in modern anesthetic practice. There are a wide variety of uses for these procedures with specific indications. The recurrent laryngeal nerve (RLN) is formed from the vagal nerve (CNX) and provides sensory innervation to the airway distal to the vocal cords. In addition, the RLN provides the majority of motor innervation to the intrinsic respiratory muscles with the exception of the cricothyroid muscle, which is innervated by the external branch of the superior laryngeal nerve (SLN). Direct blockade of the RLN is not performed, as bilateral blockade can lead to airway obstruction.

Technique

The transtracheal approach is the primary approach to performing the RLN block. First, the cricothyroid membrane is identified below the thyroid cartilage. The skin above the cricothyroid membrane is thoroughly sterilized by chlorhexidine glucuronide. A 25-gauge needle is then used to inject the local anesthesia into the skin above where the block is to be performed. A 20–25-gauge needle is placed with a syringe containing the local anesthetic into the cricothyroid membrane with continuous aspiration until bubbles are present in the syringe. This indicates that the needle is present within the trachea; any further advancement could penetrate the posterior laryngeal wall. The patient is then asked to inhale while injecting the local anesthetic during inhalation. This allows the anesthetic to spread to the carina and distal airways. One significant effect of local anesthesia injection during inhalation is coughing resulting from the injection. This allows the more proximal airways to be anesthetized up to the vocal cords.

Indications

The majority of RLN blocks are performed for awake oral and nasal fiberoptic intubation, which allows the clinician to place the endotracheal tube (ETT) past the vocal cords without the patient coughing or bucking on the ETT.

Potential contraindications

The main contraindications include coagulopathy, hematoma, infection at the site to be injected, patient refusal, and large goiter.

Medication choice

Most clinicians tend to prefer a lower concentration of a local anesthetic that has a lower potential for the central nervous system and/or cardiotoxicity and a lower risk of local anesthetic toxicity (LAST). LAST is a major concern, as the trachea is vascular, and there is a chance that local anesthesia can be absorbed intravascularly, possibly leading to LAST. Generally, lidocaine 2–4% has a low toxicity to the central nervous system and cardiovascular system (CVS) and is inexpensive, with a fast onset, usually lasting up to 1–2 h. Care must be ensured that doses greater than 4 mg/kg are avoided as well as lower doses in patients with hepatic dysfunction.

Potential complications

Local anesthetic toxicity, tracheal perforation, esophageal perforation, and intravascular injection are the major concerns with this procedure.

Superior laryngeal nerve blocks

The superior laryngeal nerve (SLN) is also formed from the vagus nerve (CNX). There are two branches, namely, the internal branch, which provides sensory innervation to the distal oropharynx up to the vocal cords, is located inferior to the greater cornu of the hyoid bone, and pierces the thyrohyoid membrane continuing into the piriform recess, and the external branch, which provides innervation to the cricothyroid muscle, a tensor of the vocal cords, and does not penetrate the thyrohyoid membrane but instead travels deep into the sternothyroid muscle.

Technique

There are two main approaches to the SLN block, namely, the internal and the external approach.

External approach

The patient is placed in the supine position with the neck extended. The hyoid bone is first identified and palpated superior to the thyroid cartilage, and the greater cornu is identified. The skin is then thoroughly cleaned, and the injection of the skin with the local anesthetic is performed. A 25-gauge needle is then used to pierce the skin and contact the superior cornu of the hyoid bone. The needle is then moved away from the bone inferiorly, which will block both external and internal SLN. Injection of 2 mL of the local anesthetic is then given slowly, with aspiration before injection, as the carotid artery is located lateral to the hyoid bone, observing for any blood aspirated or signs of local anesthetic toxicity.

The internal approach involves the placement of local anesthetic-soaked pledgets placed in the piriform sinus for 5–10 min to allow the onset of the local anesthetic action.

Indications

This block is generally used for awake oral and nasal fiberoptic intubation, which allows the clinician to place the endotracheal tube (ETT) past the vocal cords without the patient coughing or bucking on the ETT.

Contraindications

The main contraindications include coagulopathy, hematoma, infection at the site to be injected, patient refusal, and goiter. For the external approach, altered anatomy is a contraindication, and an internal approach should be utilized.

Medication choice

Similar to RLN blocks, the majority of clinicians tend to prefer a quick-onset local anesthetic, which has lower cardiotoxicity and a lower risk of local anesthetic toxicity (LAST), such as lidocaine 2–4% [18]. LAST is a significant concern, as the trachea is very vascular, and there is a chance that local anesthesia can be absorbed intravascularly, possibly leading to LAST.

Potential complications

The internal carotid artery is located lateral to the hyoid bone, and if the needle is placed laterally, accidental injection of local anesthesia may occur, leading to direct exposure of the cerebrum to the local anesthesia, leading to seizures and obtundation. LAST is a significant concern, as the trachea is very vascular, and there is a chance that the local anesthesia can be absorbed intravascularly, possibly leading to LAST. Further, high injection pressure and large volumes can fracture the hyoid bone, and it is recommended that no more than 2 mL of the local anesthesia be injected.

Conclusion

Although the present review is not a complete list of the regional techniques that can be performed in this anatomical region, these common procedures in a day-to-day setting have been discussed and identified as feasible, safe, and able to be consistently repeated in practice. Anatomic and ultrasound-based regional techniques are only improving and clear communication and planning with the otolaryngologists is vital to improve acceptance of these newer techniques. Additionally, it is likely that patient outcomes and comfort postoperatively will improve with the utilization of these newer regional techniques of the head and neck region.

Practice points

- Regional anesthesia has been demonstrated to be useful as a primary anesthetic, such as a superficial cervical block for carotid endarterectomy, or as an adjuvant for postoperative pain relief.
- Dental and oral-maxillofacial procedures currently account for the bulk of these procedures.

Research agenda

- In recent years, ultrasound use has increased significantly, and newer nerve blocks have been established for surgeries of the head and neck region.
- Future studies and education will likely evolve practice to make these regional techniques standards for future surgeries of the head and neck region.

References

- *[1] Napier A, Taylor A. Supraorbital nerve block. StatPearls Publishing; 2019.
- *[2] Waldman S. Atlas of interventional pain management. 4th ed. US Elsevier Health Bookshop, Elsevier; 2015, ISBN 9780323244282.
- *[3] Price S, Daly DT. Neuroanatomy, nucleus trigeminal. 2019.
- [4] Allam AE-S, Khalil AAF, Eltawab BA, et al. Ultrasound-guided intervention for treatment of trigeminal neuralgia: an updated review of anatomy and techniques. *Pain Res Manag* 2018;2018:5480728.
- *[5] Manchikanti L, Kaye AD, Falco FJE, et al. Essentials of interventional techniques in managing chronic pain. 2018.
- [6] Kendall, MC, et al. Prospective case series ultrasound-guided trigeminal nerve block via the pterygopalatine fossa: an effective treatment for trigeminal neuralgia and atypical facial pain.
- *[7] Takechi K, Konishi A, Kikuchi K, et al. Real-time ultrasound-guided infraorbital nerve block to treat trigeminal neuralgia using a high concentration of tetracaine dissolved in bupivacaine. *Scand J Pain* Jan. 2015;6(1):51–4.
- *[8] Piagkou M, Demesticha T, Troupis T, et al. The pterygopalatine ganglion and its role in various pain syndromes: from anatomy to clinical practice. *Pain Pract Jun.* 2012;12(5):399–412.
- *[9] Robbins MS, Robertson CE, Kaplan E, et al. The sphenopalatine ganglion: anatomy, pathophysiology, and therapeutic targeting in headache. *Headache J Head Face Pain Feb.* 2016;56(2):240–58.
- [10] Loomba V, Upadhyay A, Kaveeshvar H. Radiofrequency ablation of the sphenopalatine ganglion using cone beam computed tomography for intractable cluster headache. *Pain Physician* 19(7)E1093–E1096.
- [11] Bratbak DF, Nordgård S, Stovner LJ, et al. Pilot study of sphenopalatine injection of onabotulinumtoxin A for the treatment of intractable chronic cluster headache. *Cephalalgia* May 2016;36(6):503–9.
- [12] Yang IY, Oraee S. A novel approach to transnasal sphenopalatine ganglion injection. *Pain Physician* Apr. 2006;9(2):131–4.
- [13] Rosso C, Felisati G, Bulfamante A, et al. “Cluster headache: crosspoint between otologists and neurologists—treatment of the sphenopalatine ganglion and systematic review. *Neurol Sci* Mar. 2019;40(1):137–46.
- *[14] Singla D, Mangla M. Sphenopalatine ganglion block: a newer modality for management of postdural puncture headache. *J Anaesthesiol Clin Pharmacol* 2018;34(4):567–8.
- [15] Rezaeian A, Hashemi SM, Dokhanchi ZS. Effect of sphenopalatine ganglion block with bupivacaine on postoperative pain in patients undergoing endoscopic sinus surgery. *Allergy Rhinol Jan.* 2019;10. 215265671882128.
- *[16] Fujiwara T, Kuriyama A, Kato Y, et al. Perioperative local anaesthesia for reducing pain following septal surgery. *Cochrane Database Syst Rev* Aug. 2018;8:CD012047.
- [17] Katsaras DN, Arvaniti CK, Flevari PG, et al. Sphenopalatine ganglion block: an external gate to modulate cardiac autonomic tone and suppress premature ventricular beats? *Ann Transl Med* Dec. 2018;6(23):457.
- *[18] Pani N, Kumar Rath S. Regional & topical anaesthesia of upper airways. *Indian J Anaesth* Dec. 2009;53(6):641–8.