TECHNICAL NOTE

Local Anaesthetics and Regional Nerve Blocks in ENT

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ABSTRACT

Background: Regional nerve blockade using local anaesthetics helps in achieving anaesthesia to a specific region. The application of nerve blocks enables a lot of cases without the need for general anaesthesia (GA) in ENT (Ear, Nose & Throat) practice, thus minimising the side effects associated with GA.

Objective: To give a brief overview of the pharmacology of local anaesthetics, the sites of regional blocks and the uses of local anaesthetics in ENT.

Methods: Literature search has been carried out using PubMed, Google Scholar, and Cochrane database

Results: Regional nerve blocks with various local anaesthetic agents usually achieves effective anesthesia with minimal complications.

Conclusion: Local anaesthetics and regional blocks play a crucial role in ENT, enabling the surgeon to undertake a wide range of procedures under local anaesthesia without the need for general anaesthesia.

Keywords: Local Anaesthetics, Regional nerve block, systemic complication of local anaesthetics.

INTRODUCTION

Local anaesthesia plays a crucial role in otolaryngology (ENT) for both minor and major procedures. Local anaesthetics usually blocks the sodium ion channels in nerves, preventing the conduction of nerve impulses. They block generation and conduction of nerve impulses. Regional nerve blockade using local anaesthetics is helps in attaining anaesthesia to a specific region of the body. They are usually useful in cases where local infiltration is not feasible or the use of which can result in tissue damage, it also provides better postoperative pain control.[1]

Since the surgeons are often the ones injecting local anaesthetics, it is important to know the pharmacology of various drugs commonly used.

Through this paper, we will also give a brief overview of various commonly used local anesthetic agents and also a brief overview of various regional blocks used commonly in ENT.

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METHODOLOGY

A literature search was conducted using keywords 'local anaesthetics', 'regional nerve blocks in ENT', 'regional anaesthesia' from PubMed, Google Scholar, and Cochrane Library databases. Articles published in English were included.

Mechanism of action:

Local anesthetics block neuronal pain transmission by reversibly binding to sodium channels, preventing depolarization and propagation of nerve impulses.[1] Nerves

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with fewer sodium channels and smaller diameters are more easily anesthetized, requiring lower volumes of anesthetic. Sensitivity to local anesthesia follows the order: autonomic fibers > sensory fibers (pain > pressure > proprioception) > motor fibers.[2]

Classification and type of local anaesthetics and its pharmacology:

Depending on their chemical components local anaesthetics are divided into esters or amides.[3] They can be rapid or intermediate in onset of action. The more potent an agent would be the more likely it is to be lipid soluble.[4] The increase in duration of action is directly proportional to the affinity of protein binding.[4] Many of the local anesthetics are weak bases as a result of which they remain partly in an ionized state at physiologic pH.[4] Lower the pKa, the more the unionised fraction is present for any given pH and therefore the faster the onset of action. Whenever, the ph of the solution comes down, the equilibrium will shift toward the ionized form and this will decrease the onset of action of the drug.[2] As a result of which to prolong the duration of action of local anaesthetic agents the absorption and metabolism can be delayed by the addition of vasoconstrictors.[2]

In the table given below, a brief about the description and properties of various local anaesthetic drugs in ENT is given.[2,5-8]

Table 1: Brief overview of pharmacology of intravenous local anaesthetic agents commonly used in ENT

Drug	Chemical composition	Onset of action	Half life	Duration (with addition of adrenaline)	Lipid solubility	pKa	Maximum dose (with adrenaline) (mg/kg)
Lignocaine	Amide	Rapid	120 min	120 min (240 min)	++	7.8	4.5 (7)
Bupivacaine	Amide	Intermediate	230 min	4h (8-12h)	++++	8.1	2 (3)
Ropivacaine	Amide	Intermediate	250 min	3h(6h)	++++	8.1	2 (3)

Brief overview of sensory innervation of most commonly used regional blocks in ENT:

Various types of local anaesthetic blocks are available. In this article we illustrated in brief about some of the most common blocks used in ENT.

Trigeminal nerve block:

The trigeminal nerve (cranial nerve V) and its 3 main branches is mainly responsible for the sensory innervation of the face: the ophthalmic nerve (V1) innervates the upper third of the face, the maxillary nerve (V2), which innervates the middle third of face, and the mandibular nerve (V3) innervates the lower third of face.[9,10]

Various sub-branches of V1 innervates the upper part of the face:

- **Ophthalmic:** forehead, supraorbital region and cutaneous nose
- **Supraorbital:** scalp (to lambdoid suture), forehead, upper eye lid,
- **Supratrochlear:** anterior scalp, midline forehead, glabella, upper eye lid, conjunctiva
- **Infratrochlear:** bridge of nose, medial aspect of eyelid below brow
- **Nasociliary:** frontal sinus, anterior and posterior ethmoid sinuses, sphenoid sinus, anterior nasal septum, lateral nasal wall, skin of nasal tip, cornea, iris, ciliary body
- **Anterior ethmoidal:** nasal dorsum, alae and vestibule.
- **Supraorbital/supratrochlear block:** The supraorbital nerve emerges from the skull through the supraorbital notch/foramen, which is typically situated along the midpupillary line. The supratrochlear nerve exits approximately 1.05 cm medial to the supraorbital nerve, with its point of emergence lying medial to the supraorbital foramen.[11]

Procedure:

The supraorbital notch is first identified by palpation along the midpupillary line. After locating the notch, the needle is advanced from lateral to medial, and 1–3 mL of local anaesthetic is deposited in the tissue plane beneath the muscle. Before administering the anaesthetic, gentle aspiration should be performed to ensure the needle is not within a blood vessel, and care should be taken to avoid entering the supraorbital foramen. To achieve a complete blockade of the supratrochlear nerve, the anaesthetic should be extended medially so that the nerve is adequately infiltrated.

Application of this regional block:

- Laceration repair in the upper face by decreasing the sensation in the upper face.
- Used as a supplementary anesthetic technique for surgical procedures involving the upper one-third of the face.
- Provides effective analgesia for the management of postoperative pain and chronic headaches.[12]
- **Anterior ethmoidal nerve block:** The anterior ethmoidal nerve leaves the cranial cavity through the anterior skull base and emerges at the transition between the bony and cartilaginous junction of the nose.

Procedure:

A 27-gauge needle is used to administer the local aneasthetic at the junction of the bony and cartilaginous junction of the nose, targeting the plane just beneath the superficial musculoaponeurotic system (SMAS). The injection site should be positioned approximately 5 mm lateral to the midline, and 1–2 mL of local anesthetic is usually sufficient. Alternatively, the nerve block may be performed through an intranasal approach, with the anesthetic deposited along the lateral nasal wall, just anterior to the root of the middle turbinate.

Application of this regional block:

- It is used for middle meatal antrostomy and frontal recess surgeries.

- External nasal neuralgia[13]
- Adjunct for nasal surgery

Various sub-branches of V2 innervates the middle part of the face:

- **Zygomaticofacial:** sensation over the cheek
- **Zygomaticotemporal:** skin over side of lateral forehead and temples
- **Infraorbital:** lower eyelid, lateral nares, upper lip
- **Nasopalatine:** anterior portion of hard palate behind incisors
- **Greater and lesser palatine:** hard and soft palate, lateral nasal wall
- **Superior alveolar:** maxillary teeth, nasal floor, gums
- **Sphenopalatine:** nose, buccal mucosa, palatal mucosa and paranasal sinuses
- **Zygomaticotemporal nerve block:** The zygomatico-temporal nerve emerges from the skull near the lateral orbital rim, with its exit point typically located at the level of the lateral canthus or up to 1 cm below this landmark.

Procedure:

An essential step in this injection is reaching the space located just behind the lateral orbital rim. Begin by identifying the zygomaticofrontal suture through palpation, then place the index finger of the non-dominant hand in the slight depression situated inferior and posterior to this landmark. A 27-gauge, 38-mm (1.5-inch) needle is introduced immediately posterior to the palpating finger and advanced anteriorly until the tip reaches the concave surface on the posterior aspect of the lateral orbital rim. Once the needle is correctly positioned, 1–3 mL of local anesthetic is slowly injected after appropriate aspiration.

Application of this regional block:

- Combined with a supraorbital nerve block to achieve complete anesthesia of the forehead.
- Provides local anesthesia for the repair of lacerations involving the central region of the face.
- **Infraorbital nerve block:** The infraorbital nerve emerges onto the face through the infraorbital foramen, which is typically located 0.5–1.0 cm inferior to the midpupillary line.

Procedure:

Two techniques can be used for this block: an intraoral and an external approach.

For the intraoral approach, the operator palpates the inferior orbital rim with one hand while gently retracting the cheek to expose the gingivobuccal sulcus in the premolar region. A 27-gauge needle is then introduced through the buccal mucosa and advanced toward the infraorbital foramen, stopping approximately 0.5–1 cm below the inferior orbital rim along the midpupillary line. Once the needle tip is in the appropriate position, 3–5 mL of local anesthetic is injected after careful aspiration. Particular attention should be paid to preventing inadvertent injection into the orbital cavity.

In the external technique, the infraorbital foramen is located just beneath the infraorbital rim along the mid-pupillary line. A 27-gauge needle is passed through the skin toward the rim and advanced beneath the muscle before injecting. Aspiration is essential prior to injection due to the proximity of the facial artery.

Application of this regional block:

- To numb the sensation over the mid portion of face, cheeks, upper lips, and lower eyelid.
- Used in Nasolabial cyst excision
- Adjunct to surgery in setting of IV sedation
- Possible pain reduction following cleft lip repair[14]
- **Greater palatine block:**

Procedure:

The greater palatine foramen is typically situated near the posterior border of the hard palate, opposite the maxillary second molar, and just anterior to its posterior margin. It is generally positioned midway between the alveolar margin and the midline of the hard palate. The foramen opens into a funnel-shaped canal that courses superiorly at an angle of approximately 45° relative to the plane of the hard palate.In order to perform an effective infiltration of the pterygopalatine fossa, the needle should be bent at 25 mm from the tip at an angle of 45 degrees.[16] This will result in the tip of the needle just penetrating the pterygopalatine fossa without putting any of the contents of the fossa at risk.[15]

Application of this regional block:

- Can reduce pain during nasal surgeries
- It anesthetises the lateral nasal wall so useful in surgery involving the maxillary sinus
- **Sphenopalatine Block:**

Procedure:

A transnasal sphenopalatine ganglion block is performed by introducing a 23-gauge spinal needle into the nasal cavity and directing it superiorly and laterally. The needle is inserted submucosally at a point approximately 5 mm inferior to the posterior end of the middle turbinate and advanced toward the sphenopalatine foramen. This foramen is located at the posterior aspect of the middle meatus, slightly posterior and superior to the attachment of the horizontal basal lamella of the middle turbinate. Once the needle reaches the target area, the local anesthetic is administered.[16]

Application of this regional block:

- Useful in acute migraine[12]
- Vasomotor rhinitis
- Sluders neuralgia
- Endoscopic sinus surgeries to achieve hemostasis and decrease pain.

Various sensory sub branches of V3 innervates the lower third of the face:

- **Auriculotemporal:** external ear and the temporal region of the scalp.
- **Buccal:** cheek, buccal mucosa, and gingival tissues.
- **Inferior alveolar:** sensory innervation of the mandibular teeth.
- **Lingual:** anterior two-thirds of tongue
- **Mental:** cutaneous chin, lower lip, and side of mandible.
- **Auriculotemporal nerve block:**

Procedure:

Palpate the superficial temporal artery which lies just anterior to the tragus. Insert the needle slightly in the subcutaneous plane, aspirate to avoid intravascular imjection. Inject 1-2 ml of local anaesthetic.

Application of this regional block:

- It helps in anesthetising the anterior auricle, temporal scalp and TMJ region
- **Mental Nerve Block:** The mental nerve emerges through the mental foramen, which is typically located between the first and second mandibular premolars, approximately 1 cm inferior to the gingival margin. The mental foramen generally aligns with the midpupillary line and lies in the same vertical plane as the infraorbital foramen and the supraorbital notch.

Procedure:

This block is performed via an intraoral approach. The lower lip on the affected side is retracted to stretch the mucosa over the gingivobuccal sulcus and the first and second mandibular premolars serve as the primary anatomical landmarks. A 27-gauge needle is inserted approximately 1 cm below the gingival margin at an angle of about 45° and advanced carefully until bony contact is achieved. The needle is then withdrawn slightly, and 2–3 mL of local anesthetic is administered.

Application of this regional block:

- Anaesthetic effect on the lower lip and chin
- Helpful in lower lip surgical procedures
- Helpful in treating trigeminal neuralgia which are localised to the lower lip[17]

Regional Blocks to the Auricle:

The auricle is innervated by:

- **Auriculotemporal nerve (branch of V3):** Provides sensory innervation to the superior aspect of the auricle and the temporal region.
- **Facial nerve:** Supplies sensory fibers to portions of the external auditory canal, the tympanic membrane, and the conchal bowl.
- **Greater auricular nerve (C2–C3):** Innervates the inferior and posterior portions of the auricle, the mastoid region, and the parotid gland.
- **Lesser occipital nerve (C2):** Provides sensation to the posteromedial surface of the auricle and the adjacent posterior neck.

Procedure for regional block of auricle for ear surgeries:

Use 26/27G needle insert subcutaneously at bony-cartilaginous junction and inject ~0.5–1 mL in all the four quadrant of the EAC. If postauricular approach is planned, an additional 3-5 ml is infiltrated in the postauricular region.

Regional blocks in the neck:

The sensory innervation to the neck are:

- **Greater occipital (from C2):** posterior neck
- **Superior laryngeal (branch of vagus):** sensation of larynx above vocal cords and supraglottic mucosa
- **Supraclavicular (from C3–C4):** anterolateral shoulder and clavicle
- **Transverse cervical (from C2–C3):** along the sterno-cleidomastoid muscle
- **Superior Laryngeal Nerve Block:**

The vagus nerve gives rise to several cervical branches, including the superior laryngeal nerve and the recurrent (inferior) laryngeal nerve. The superior laryngeal nerve subsequently bifurcates into internal and external branches, each serving distinct sensory and motor functions. The internal branch, also known as the internal laryngeal nerve, passes through the thyrohyoid membrane to enter the larynx and provides sensory innervation to the supraglottic region.

Procedure:

There are multiple methods for performing a superior laryngeal nerve block, and the use of ultrasound can improve accuracy by helping identify key landmarks such as the hyoid bone and thyroid cartilage, particularly in patients with challenging neck anatomy. The procedure may be carried out with the patient either lying supine or seated upright. During the procedure, the clinician stabilizes the larynx with one hand and gently shifts the hyoid bone toward the side where the injection will be administered. The interval between the hyoid bone and the thyroid cartilage corresponds to the thyrohyoid membrane, which serves as the entry point. Surface landmarks such as the greater horn of the hyoid and the superior tubercle of the thyroid cartilage helps in approximating the site of the internal branch of the superior laryngeal nerve. The carotid artery lies posteriorly and should be considered to avoid vascular injury. The needle may be advanced from anterior to posterior, which can enhance spread of the injectate, although a posterior approach may provide additional safety by keeping the carotid artery behind the needle path. A fine needle (around 27-gauge) is used to deliver approximately 1–2 mL of the solution.

Application of this regional block:

- Managing neurogenic cough[18]
- Helpful during awake fiberoptic intubation and laryngeal procedures

- **Glossopharyngeal Nerve Block:**

The glossopharyngeal nerve arises from the medulla and leaves through the jugular foramen. After exiting, it travels downward within the parapharyngeal space, lying medial and posterior to the styloid process, in close relation to the vagus nerve. Beyond its exit from the skull base, the nerve gives off several branches that contribute to its sensory, motor, and autonomic functions. From a sensory perspective, the glossopharyngeal nerve carries general somatic sensation from the pharyngeal walls, the posterior 1/3rd of tongue, the lingual surface of the epiglottis, as well as parts of the external ear and tympanic membrane.

Procedure:

Both external and intraoral techniques are described for performing a glossopharyngeal nerve block.

The external approach can be carried out using different methods, with ultrasound guidance commonly employed to visualize important structures, particularly major vessels in the neck. Due to the close proximity of the internal jugular vein and carotid artery, this technique carries significant risk. Potential complications include hemorrhage and inadvertent spread of anesthetic to the vagus nerve, which may result in hoarseness; if both sides are affected, it can rarely lead to bilateral vocal cord paralysis.

Intraoral techniques are generally aimed at anesthetizing the distal branches of the glossopharyngeal nerve rather than the main trunk. A combination of local anesthetic with or without corticosteroid is often used to enhance symptom relief.

Two commonly used intraoral methods include:

- **Anterior tonsillar pillar approach:** Gently retract the tongue to expose the anterior pillar. The palatoglossal fold is identified. A fine needle (often spinal needle) is inserted approximately 0.5 cm deep, and about 1–2 mL of anesthetic solution is injected.
- **Posterior tonsillar pillar approach:** Gently retract the tongue to expose the posterior pillar near the base of the tongue. It is technically more challenging, as it requires greater tongue retraction and frequently provokes a gag reflex.

Application of this regional block:

- Helps in treating glossopharyngeal neuralgia[19]
- Reduce posttonsillectomy pain[20]
- Adjunct during awake airway procedures
- Eagle's syndrome[21]

Complications associated with local anaesthesia:

- **Local anesthetic toxicity:** It is essential to determine the maximum safe dose of local anesthetics before administration. Careful calculation helps reduce the risk of overdose. Common local anesthetics and their recommended maximum doses are typically summarized in reference table. If an excessive dose is administered, the resulting features are similar to those seen in systemic local anesthetic toxicity, which will be dealt separately in detail.
- **Intravascular injection:** Even with small doses, accidental intravascular injection of local anesthetics can rapidly cause systemic toxicity; therefore, the needle position must be checked by aspirating before injection. If blood is aspirated, the needle should be repositioned, and in anatomically difficult areas or near major vessels, ultrasound guidance can help ensure correct placement.
- **Allergic reactions:** True allergic reactions to local anesthetics are uncommon, particularly with amide agents; suspected reactions should raise a suspicion of overdose or inadvertent intravascular injection,[22] while ester anesthetics are more likely to cause allergy due to their PABA structure, with higher risk in patients sensitive to PABA or with atypical pseudocholinesterase activity (notably with tetracaine).

  Reactions may also be due to preservatives such as methylparaben or sodium bisulfite, or even latex exposure during administration;[22] most true allergies are type IV hypersensitivity, and patch testing can help confirm the diagnosis in suspected cases.
- **Broken needle:** It occurs rarely, to avoid such an incidence use longer needles.
- **Nerve injury:** Injection near a nerve carries a risk of injury due to needle trauma, epineural bleeding, or local anesthetic toxicity. This may result in persistent numbness, burning sensations, or motor weakness.
- **Systemic Toxicity:** Incidence of systemic toxicity occurring due to local anesthetics is estimated about 2.5/ 10,000.[23] The Central nervous system and the cardiac system are typically affected. The risk factors for systemic toxicity are rapid absorption, large doses and intravenous injection. Speed of injection is inversely related to toxicity.[3]

  If systemic toxicity occurs patient has to be admitted to monitor and resuscitate the patient. Monitoring should last until patient stabilises and the drug is completely metabolised.

  Central nervous system toxicity usually appears before cardiac effects, as it occurs at lower doses. Local anesthetics suppress inhibitory cortical pathways, leading to relative excitation and early symptoms such as dizziness, poor concentration, confusion, tinnitus, and numbness around the mouth; severe cases may lead to seizures and respiratory arrest.

In patients already receiving CNS depressants, the initial excitatory phase may be absent, with direct progression to seizures and respiratory depression. Management involves airway support, oxygen administration, and control of seizures using agents such as benzodiazepines, barbiturates, or propofol.[3]

Cardiac toxicity from local anesthetics occurs due to blockade of sodium channels, which interferes with myocardial conduction and contractility, leading to arrhythmias and reduced cardiac output. Mild exposure may initially increase heart rate and blood pressure, but progressive toxicity causes vasodilation, hypotension, and can culminate in cardiac arrest.[23]

Management includes supportive care with vasopressors (e.g., vasopressin) for hypotension, antiarrhythmics such as amiodarone, and intravenous lipid emulsion therapy to reduce circulating drug levels; epinephrine should be used cautiously, and in severe cases cardiopulmonary bypass may be required.[23]

DISCUSSION

A wide range of local anesthetic agents are available, and the choice depends on the intended purpose of the block as well as patient-specific factors and comorbidities. The techniques discussed are commonly used for minor procedures, or endoscopic nasal sinus surgeries, but some also have applications in chronic conditions like neurogenic cough, migraine, and trigeminal neuralgia. Adequate visualisation in endoscopic sinus surgeries is crucial to avoid complications, infiltration of local aneasthetic agents helps in minimising the bleeding and pain thus leading to better outcome of surgery.[24,25]

Local anesthetics may also serve as adjuncts during surgical procedures, either alongside intravenous medications or to facilitate techniques such as fiberoptic intubation. Although these agents are generally safe, clinicians must remain aware of potential complications and identify patients who may be at increased risk with certain drugs.

GAP in literature:

- There is still lack of large RCTs on local anesthetics and regional blocks used in ENT
- There is limited ENT-specific guidelines
- USG guided regional blocks in face are still less explored.

CONCLUSION

Local anesthetics are indispensable in ENT practice. Local anesthetic blocks in endoscopic nasal surgery offer multiple benefits, including better control of intraoperative and postoperative pain and improved hemostasis, resulting in a clearer surgical field. They also enhance patient satisfaction by avoiding the risks associated with general anesthesia, while contributing to shorter hospital stays and overall improved quality of care. Advances in regional anesthesia techniques have improved patient outcomes, although further research is required to standardize protocols.

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