LOCAL ANESTHESIA TECHNIQUES IN DENTISTRY AND ORAL SURGERY

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Abstract:
When used in dentistry, local anesthesia involves the injection of an anesthetic solution adjacent to the nerves that provide sensation to a region of the oral cavity where treatment will be delivered. The anesthetic solution temporarily prevents the propagation of nociceptive nerve impulses, thus allowing for the pain-free delivery of dental treatment. This activity reviews the indications, contraindications, anatomical considerations, equipment, techniques, and complications of local anesthesia in dentistry and highlights the dental team's role in the safe and efficient delivery of local anesthesia.

Objectives:
- Identify the indications and contraindications of local anesthesia in dentistry.
- Review the anatomical course of the nerves supplying the oral cavity.
- Explain the different local anesthesia techniques utilized in dentistry.
- Outline the potential complications of using local anesthesia in dentistry.

Introduction

Pain is an unpleasant sensory and psychological experience resulting from actual or potential tissue damage and is commonly associated with dental treatment. Local anesthesia is a safe and effective way of managing pain. Anesthetic agents work by reversibly binding to sodium channels, preventing the entry of sodium into the cells and thereby inhibiting the propagation of nerve impulses. Consequently, nociceptive impulses associated with painful stimuli do not reach the brain, and the patient does not perceive pain.

The maxillary and mandibular branches of the trigeminal nerve provide sensory innervation to the soft and hard tissues of the oral cavity. The anesthetic solution must be injected adjacent to the nerve supplying the area where dental treatment will be performed. A thorough understanding of these trigeminal nerve branches and associated anatomical landmarks is essential

Anatomy and Physiology

Infraorbital Nerve

The infraorbital nerve originates from the maxillary division of the trigeminal nerve as it enters the inferior orbital fissure after passing through the pterygopalatine fossa. The nerve travels along the infraorbital groove and infraorbital canal in the orbital floor before entering the face via the infraorbital foramen. The infraorbital nerve delivers sensation to the maxillary teeth via the superior alveolar nerve branches prior to entering the infraorbital foramen. It divides into palpebral, nasal, and superior labial terminal branches on the face. These terminal branches provide sensation to the skin of the lower eyelid, nose, cheek, and upper lip.

Superior Alveolar Nerves

The posterior superior alveolar (PSA) nerve emerges before the maxillary nerve enters the infraorbital groove, and it descends along the maxillary tuberosity, where it innervates the gingiva and buccal mucosa of this region. It then enters the posterior alveolar canal and provides sensory fibers to the maxillary sinus mucosa, the maxilla, maxillary molar teeth, and periodontium.

Palatine Nerves

The palatine nerves originate from the pterygopalatine ganglion, which is supplied by the maxillary division of the trigeminal nerve.The greater palatine nerve runs through the greater palatine canal and enters the greater palatine foramen, usually located medial to the third maxillary molars, to innervate the hard palate and palatal gingiva. The lesser palatine nerve descends through the lesser palatine foramen, which is posteromedial to the greater palatine foramen, to innervate the soft palate, uvula, and tonsils. The nasopalatine nerve enters the sphenopalatine foramen, running along the nasal cavity and innervating the nasal septum. The nerve then emerges through the incisive foramen of the hard palate to innervate the anterior hard palate and anterior palatal gingiva. The nasopalatine nerve also provides sensory fibers to the maxillary incisors in some patients

Inferior Alveolar Nerve (IAN)

The IAN stems from the posterior trunk of the mandibular division of the trigeminal nerve. It runs deep to the lateral pterygoid muscle and gives off a mylohyoid nerve branch before descending into the pterygomandibular space and entering the mandibular foramen. The IAN runs along the mandibular canal below the teeth apices, giving dental branches innervating the teeth via their apical foramina and interdental branches to innervate the periodontium. At the mental foramen, located below the premolar apices, the IAN divides into incisive and mental nerves. The incisive nerve continues within the bone via the incisive canal to supply the teeth and buccal gingiva of the first premolar, canine, and incisors. The incisive nerve sometimes extends beyond the midline to provide additional sensation to the contralateral anterior teeth. The mental nerve exits via the mental foramen to supply the lower labial mucosa and the skin of the lower lip and chin. The mylohyoid nerve originates from the IAN approximately 13.4 to 14.7 mm above the mandibular foramen. It pierces the sphenomandibular ligament and runs along the mylohyoid groove of the lingual surface of the mandible. It provides motor supply to the mylohyoid and anterior belly of digastric muscles.[

Equipment

- Personal protective equipment
- Dental syringe
- A 25, 27, or 30 gauge, short or long dental needle, depending on the anesthetic technique
- Local anesthetic solution
- Topical anesthesia can be considered

Local Anesthetic Agents

Local anesthetics are divided into two classes: amides and esters. Amide anesthetics are common in dentistry, including lidocaine, prilocaine, mepivacaine, and bupivacaine. Articaine is an amide anesthetic with an ester linkage. Ester anesthetics are less frequently utilized in dentistry, but drugs such as benzocaine may be used for topical anesthesia

Technique or Treatment

Infiltration Anesthesia

Buccal Infiltration

The needle is inserted 2 or 3 mm into the buccal sulcus adjacent to the tooth to be treated. The solution diffuses across the periosteum and alveolar bone to anesthetize the nerves supplying sensation to the tooth, periodontium, and buccal gingiva. Infiltration anesthesia is commonly reserved for the maxilla because the maxilla's porous structure allows the anesthetic solution to easily penetrate the bone.

However, the introduction of articaine has facilitated mandibular buccal infiltrations. Articaine has a high lipid solubility and can be used for buccal infiltrations in the posterior mandible as an alternative to or to supplement an IANB. Success rates of 84 to 94% have been reported for the ability of articaine buccal infiltrations to anesthetize the mandibular molars.

Palatal Infiltration

A palatal infiltration can be administered to anesthetize the nasopalatine or greater palatine nerve endings, thus providing anesthesia to the palatal gingiva. This injection is often described as painful due to the separation of the tightly-bound mucoperiosteum from the underlying hard palate bone. Methods to reduce discomfort may include topical anesthesia, cooling, applying pressure with a mirror handle, or slightly retracting the needle before injection.[

Inferior Alveolar Nerve Block (IANB)

The IANB anesthetizes the ipsilateral mandibular teeth, periosteum, lower lip, chin, and the buccal soft tissues from the premolars to the midline. The lingual nerve is generally anesthetized simultaneously, providing anesthesia to the ipsilateral lingual soft tissues, tongue, and floor of the mouth. For this technique, it is essential that the patient fully opens their mouth; otherwise, the IAN relaxes away from the lingula tip, and anesthesia may not be achieved. The dental syringe is positioned above the contralateral premolars. A long needle is inserted 1 to 1.5 cm superior to the mandibular occlusal plane into the pterygotemporal depression to reach the pterygomandibular space. The pterygotemporal depression is located between the pterygomandibular raphe and the coronoid notch of the mandibular ramus. The coronoid notch is the most concave point on the anterior ramus, and it can be palpated with the non-dominant hand before the injection. The needle is inserted 20 to 25 mm until the bone of the crista endocoronoidea is contacted.The needle is then withdrawn 1 to 2 mm, aspiration is performed to prevent intravascular injection, and 1.5 ml of anesthetic solution is delivered. The needle is then withdrawn halfway, and the remaining solution is given to anesthetize the lingual nerve. Nonetheless, an IANB usually anesthetizes the lingual nerve even if this last step is omitted. Anesthesia onset is generally three to five minutes.[

Mental and Incisive Blocks

Although the mental and incisive nerves are anesthetized by an IANB, mental and incisive blocks are useful when bilateral anesthesia is desired on or anterior to the mandibular premolars. A short needle is inserted in the buccal sulcus next to the mental foramen, usually located between the premolar apices. The needle is inserted 5 to 6 mm with the bevel facing the bone, and the anesthetic solution is administered following aspiration. Gentle pressure and massaging at the injection site for two minutes allow the anesthetic solution to enter the mental foramen to anesthetize the incisive nerve. The mental and incisive blocks provide anesthesia to the premolar, canine, incisor teeth and their periodontium, buccal soft tissues, the lower lip, and the chin. However, anesthesia of the lingual tissues is not provided.

Buccal Nerve Block

The buccal nerve block is administered when anesthesia of the buccal mucosa or the buccal gingiva of the mandibular molars is required. The needle is advanced 1 to 3 mm into the buccal vestibule distal to the second or third molar until the bone is contacted. The point of insertion is medial to the coronoid notch. A small amount of anesthetic solution, usually 0.25 ml, tends to suffice

Intraligamentary Anesthesia

A conventional dental syringe with a short needle or a specialized intraligamental syringe can be used. The needle is inserted into the gingival sulcus at 30 degrees to the tooth's long axis to reach the periodontal ligament (PDL) space, and it is advanced as far apically as possible. The injection is given slowly mesially and then repeated distally.The anesthetic solution diffuses from the PDL to the adjacent cancellous bone under the high pressure of the injection. Anesthesia onset is rapid, usually within 30 seconds. However, the duration of anesthesia is short, generally lasting 10 to 45 minutes.Reported complications for intraligamentary injections include cartridge fracture due to high pressure; damage to unerupted teeth; damage to the PDL; tooth extrusion; discomfort; and bacteriemia with a potential risk of endocarditis for high-risk patients. The risks of cartridge fracture and discomfort can be mitigated by injecting slowly. Generally, 0.2 ml of the solution is administered over 20 seconds. The intraligamentary technique is commonly utilized following a failed IANB and appears to be more successful for exodontia than endodontic treatment Intraligamentary injection should be avoided in the infected or inflamed periodontium. It should also be avoided in primary teeth as enamel

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hypomineralisation or hypoplasia of the developing permanent teeth has been described.

Intraosseous Anesthesia

Specialized intraosseous injection devices are used to drill a small hole through the cortical plate to reach the cancellous bone, and the anesthetic solution is injected slowly through this hole. A small amount of anesthesia is given via local infiltration to the adjacent gingiva prior to perforation to reduce discomfort.The perforation is made through the attached gingiva at a point 2 mm apical to the junction of two imaginary lines. These lines run horizontally across the buccal gingival margins and vertically to bisect the interdental papilla distal to the tooth to be anesthetized.Anesthesia onset is rapid, often immediate, and anesthesia usually lasts 15 to 60 minutes, depending on the use of a vasoconstrictor. Intraosseous injection should be avoided near the mental foramen and at sites of periapical infection or periodontal disease.

Intrapulpal Anesthesia

A short needle is inserted into the pulp chamber or root canal to a point where there is a tight fit, and 0.2 to 0.3 ml of anesthetic solution is delivered under pressure. Anesthesia is achieved due to the pressure rather than the anesthetic solution, and similar results have been observed when using saline solution instead of an anesthetic agent. Injecting all canals in multirooted teeth has been recommended. In addition, an alternative technique described is allowing the pulp chamber to bathe in the anesthetic solution for 30 seconds

Clinical Significance

Profound anesthesia is a prerequisite for most dental treatments as it allows the patient to be comfortable and the clinician to deliver treatment. Furthermore, given that dental anxiety frequently stems from painful experiences, effective pain management through local anesthesia can be key in preventing and mitigating dental anxiety. The selection of local anesthetic agents and delivery techniques can influence the efficacy of anesthesia. Subsequently, dental practitioners must have a robust knowledge of the local anesthetic agents and techniques utilized in dentistry, including their indications and contraindications.Although local anesthesia is rarely associated with serious adverse effects, clinicians must additionally understand the potential complications to ensure patient safety. This must also extend to understanding how best to manage or prevent these complications.Furthermore, understanding the nerve supply to the dentition and surrounding tissues is essential to ensure that the anesthetic solution is deposited near the nerves supplying the area of interest. In addition, an awareness of possible anatomical variations allows the clinician to understand why anesthesia might fail and what methods can be utilized to overcome failure.Failure to achieve anesthesia can delay treatment and cause the patient to lose confidence in the clinician and dentistry. Clinicians must understand why anesthesia can fail and be able to utilize alternative techniques where conventional methods have failed.

Enhancing Healthcare Team Outcomes

All members of the dental team have a responsibility to ensure patient safety. The operator and dental assistant should ensure that the anesthetic solution has not expired and the maximum dose is not exceeded.The dental team members must be aware of the risk of toxicity and understand how to prevent, identify, and manage toxicity. All team members must also be able to recognize and address any medical emergencies that may occur during or after the administration of local anesthesia. Dental assistants can also play a key role in patient care, for example, by providing reassurance to anxious patients. All team members must work together to deliver patient-centered care to ensure good patient outcomes

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