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ADVANCES IN LOCAL ANAESTHESIA

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ABSTRACT

Local anesthetic solutions have been utilized in clinical dentistry to alleviate or eliminate pain associated with invasive procedures as early as the 19th century. Many patients are apprehensive about receiving local anaesthesia through syringe-needle injection. The main drawbacks associated with it are anxiety, fear of needle, long period of numbness of tissues such as tongue, lips, along with it being painful and uncomfortable to the patient, which cause a reduction in compliance with the SRP. So recently new novel anesthetic techniques have been developed which includes transmucosal patch, intrapocket anesthesia, intraligamentary, TENS and use of nanorobots to achieve successful topical anesthesia.

KEYWORDS: Local anaesthesia, AMSA, pain, Electroniic anaethesia.

INTRODUCTION

Effective and therapeutic removal of bacterial plaque by various treatment modalities such as non-surgical (scaling and root planning procedures) as well as surgical (open flap debridement procedures) requires the use of injected local anaesthesia to make the procedure comfortable for the patient. Many patients are apprehensive about receiving local anaesthesia through syringe-needle injection. The main drawbacks associated with it are anxiety, fear of needle, long period of numbness of tissues such as tongue, lips, along with it being painful and uncomfortable to the patient, which cause a reduction in compliance with the SRP.

So recently new novel anesthetic techniques have been developed which includes transmucosal patch, intrapocket anesthesia, intraligamentary, TENS and use of nanorobots to achieve successful topical anesthesia.

Advanced Local Anesthetic Techniques

1. Intrapocket Anesthesia (Non – Injectable Anesthetic Gel)

A new lidocaine/prilocaine intrapocket anesthetic gel (Oraqix®) has been developed. Oraqix® contains the active ingredients lidocaine and prilocaine base (25 mg/g of each substance), together with thermosetting agents. It is a low-viscosity fluid, whereas at body temperature it becomes an elastic gel. When applied to a periodontal pocket, it remains at the application site, thereby limiting the risk of its spreading to other areas. It is applied by inserting a 23-G blunt applicator to the bottom of the periodontal pockets before release of the substance. The pockets are filled until the gel became visible at the gingival margin.

Advantages

i. Gets occluded, where it is placed and remains in place at the site.
ii. Lidocaine and prilocaine exhibit a biphasic, dose-dependent, vascular response i.e. low concentrations they cause vasoconstriction, and at higher concentrations they cause vasodilation.[1]
iii. Easy to apply.
iv. Its taste does not affect the patients' willingness to have the gel at their next visit.

2. Electronic Anesthesia (TENS)

It is also known as transcutaneous electronic nerve stimulation (TENS). The fundamental to electronic anaesthesia is the gate-control theory of pain proposed by Melzack and Wall' in 1965.[2] The components of the system include a TENS control unit, which has dials to control amplitude, wave rate, and width; lead wires with green, black, and blue slide locks; electrode pads; and an injection-assist applicator, 9-V alkaline or nickel cadmium batteries. Prior to pad placement, the skin where the pads are to be placed must be cleaned with alcohol wipes and dried. Before the pads are placed on the patients, it must be ensured that the control unit is off.

For each procedure, there are specific sites for pad placement:

- For mandibular oral hygiene and periodontal procedures, the pads are placed bilaterally at the mental foramina while,
- For procedures in the maxilla, they are placed bilaterally at the apices of the premolars, just below the zygoma.

For the administration of a local anesthetic injection, both the wave rate and wave width are set to maximum (R= 140: W = 250), and the mode switch is set at C (continuous mode). The patient is instructed to turn the amplitude dial until he or she feels a significant sensation. This is maintained for 20 seconds to make sure that the patient is used to the sensation. The amplitude is then increased to the next level, and the cycle is repeated until fasciculation, or quivering, is noted near the pads.

Indications

1. Patients who are highly motivated, who strongly object to injections.
2. Deep scaling & root planing of sensitive roots.
3. Management of facial pain – myofacial pain, trigeminal neuralgia, TMJ pain.

Contraindications

1. Fearful to electricity,
2. Dislike tingling sensation,
3. Systemic conditions like CVD, pace makers, cerebrovascular d/s, seizures, Pregnancy,
4. Bleeding disorders,
5. Undiagnosed dental pain,
6. Skin lesions & facial abrasions.

Advantages

1. Noninvasive,
2. Safe,
3. Wall accepted by patients,
4. Equipment is easy to operate,
5. Technique is easy to mastered,
6. No risk of allergy,
7. Patient leaves dental office without residual numbness, slurred speech,

Disadvantages

1. Medical contraindications are still to be strictly observed,
2. Involuntary twitching of the lip and eyelid muscles,
3. Sensation of electricity, which may be unpleasant to some patients.

Causes of failure

1. Poor case selection.
2. Lack of communication with the patient and/or poor patient management.
3. Improper electrode (pad) placement and/or improper equipment setup.
4. Dirty, oily skin or skin covered with makeup may decrease the effectiveness of EA.

   Dental electronic anesthesia, although still in its infancy, promises to be an increasingly effective adjunct for the management of dental pain. The technique is noninvasive, safe, and generally well accepted by patients.

3. Intra-Ligamentory Anaesthesia

In the early 1900s, Guido, Fischer, and Cassamani were the first to describe the intraligamentary or periodontal ligament (PDL) local anaesthetic injection technique (1933).[3,4]

Solution injected via the periodontal ligament reaches the pulpal nerve supply by entering the cancellous bone through natural perforations in the socket wall. Direct administration of a small dose of an analgesic into the periodontal ligament produces elevation of the sensitivity threshold of the periodontium as well as the dental pulp for 10 to 20 min.[5]

Technique: The needle is inserted at 30° to the long axis of the tooth at the mesio-buccal aspect of the root(s). The needle is forced to maximum penetration until it is wedged between the tooth and the crestal bone (Dreyer 1983).[6] Once the needle is correctly positioned, the solution is injected under back-pressure. The amount of solution injected into the periodontal ligament is little.[7]

Advantages

1. Smaller dose of LA is needed as compared to conventional infiltration and nerve-block anaesthesia (approximately 0.2 mL per root).
2. There is limited spread of anaesthesia in the adjoining soft tissues like lips and cheeks.
3. This technique is advisable in patients with bleeding disorders like haemophelia.

Disadvantages

1. Intraligamentary injection may produce a bacteremia (Roberts, 1997).[8]
2. Intraligmentary anaesthesia may cause damage to the periodontal tissues. The tissue may show disruption of collagen, lesions over the root surface and alveolar bone. This may be followed by necrosis of the tissues (Brannstrom, 1982).[9]
3. It may damage the unerrupted teeth.
4. Damage to the equipment during deposition of the anaesthetic solution due to excessive pressure upto 5 MPa can occur (Walmsley, 1989).[10]

Traditional techniques and technologies used in routine intraligamentary injections are hampered by the blind nature of injection, the extreme pressures generated in local tissue during the procedure, and the relatively small volume of anesthetic that can be reliably delivered. These factors have resulted in a reduced duration of anesthesia, increased pain, and the associated tissue damage previously noted.

4. Computer-Controlled Local Anesthetic Delivery Systems

In 1997, a new concept of drug delivery was introduced to the dental profession: computer-controlled local anesthetic delivery systems (CCLADS) (Hochman, 1997).[11] The original CCLADS product was called The Wand and has since been renamed The Wand/Compudent System.

This delivery system consists of a computer-controlled drive unit and a separate single-use disposable handpiece/needle assembly. Several other CCLADS followed, including Comfort Control Syringe, Quick Sleeper, and Ana eject.

In 1998, a fundamental change was introduced to drug delivery systems with the development of dynamic pressure sensing (DPS) technology, which enabled fluid pressure and flow rate at the needle tip to be precisely controlled and monitored during all phases of the injection process (Friedman, 1998).[12] Applying this new concept to dental injections enables the clinician to perform an easier, faster, and more reliable dental injection technique.

In 2006, a device STA-System: Single tooth anesthesia-system was developed that incorporated DPS technology (Hochman, 2006).[13] The STA-intraligamentary injection requires the needle tip to be physically guided into the PDL. Once the needle tip is located in the optimal location, the system provides confirmation (in the form of audible tones, visual display, and spoken alerts) that the needle tip has arrived and has not moved outside the targeted tissue during administration. The recommended dosage of anesthetic solution ranges from 0.9 mL (for single-rooted teeth) to < 1.8 mL (for multi-rooted teeth).

In addition to location confirmation, the system provides pressure sensing feedback to inform the clinician that no blockage of the needle from obstruction or tissue clogging has occurred. Dynamic pressure sensing also alerts the user if leakage occurs, which can be a result of poor needle placement, insufficient hand pressure on the handpiece or internal leakage of the cartridge or tubing.

The STA-System is comprised of a lightweight, portable drive unit and a separate single-use disposable handpiece assembly attachment (STA-Wand). The drive unit is powered by a standard AC electrical connection. The handpiece consists of a handle, microbore tubing, and an anesthetic cartridge holder that accepts any standard dental anesthetic cartridge and any standard medical needle.

The injection is typically performed using 30-gauge or 27-gauge half-inch-lock needle. All injection rates are controlled by the clinician using a foot-control connected to the drive unit. As the needle is introduced through the tissue, the system provides continuous audible and visual feedback to the clinician. The 'orange light' indicates minimal pressure, the 'yellow light' indicates mild to moderate pressure, and the 'green light' indicates moderate pressure-indicative of the PDL tissue.

Thus, the STA-intraligamentary injection provides a unique, single-tooth injection technique that provides a level of safety, comfort, and predictability. The system provides the clinician with multiple benefits that cannot be achieved using the standard dental syringe, the pistol-grip high-pressure syringe.

5. Anterior Middle Superior Alveolar Nerve Block Technique (AMSA)

Maxillary mucogingival surgery and effective therapeutic periodontal scaling and root planing procedures frequently require the use of local anesthetic to maintain patient comfort while permitting adequate instrumentation. The maxillary arch typically requires up to five injections to obtain anesthesia of the hard and soft tissues. Posterior superior alveolar, middle superior alveolar and anterior superior alveolar block injections are used to anesthetize buccal tissues, whereas greater palatine and nasopalatine blocks are used for palatal anesthesia. Although this series of injections effectively anesthetizes maxillary tissues, it may also inadvertently affect facial structures, such as the upper lip, lateral aspect of the nose, and lower eyelid.

To minimize these sequelae and reduce the number of total injections, a relatively new injection technique, the Anterior Middle Superior Alveolar (AMSA) injection technique has been designed (Friedman and Hochman, 1997).[14] Although for this, computer-controlled anesthetic delivery systems have been recommended to achieve consistent anesthetic delivery rate. The anterior middle superior alveolar (AMSA) injection is reported to effectively anesthetize maxillary teeth and associated gingival tissues extending from the buccal root of the first molar mesially to the central incisor with a single injection.

The AMSA injection site is located on the hard palate at the intersection of a vertical line bisecting the premolars and a horizontal line halfway between the midpalatine raphe and the crest of the free gingival margin. To avoid patient discomfort due to the tightly bound nature of the palatal tissue, the anesthetic agent should be injected into the site at a methodic rate of 0.5 ml per minute.[15] After slow deposition of the anesthetic agent, the bound nature of the palatal tissue promotes diffusion of the anesthetic agent through the palatal bone via numerous nutrient canals. A successful AMSA injection typically blanches the palatal tissue in a unilateral fashion that does not cross the midline. Following diffusion of the anesthetic agent, anesthesia of structures typically innervated by the greater palatine nerve, nasopalatine nerve, anterior superior alveolar nerve, and middle superior alveolar nerve is achieved.

6. Use of Nanotechnology (Nanorobots)

To induce local anesthesia in the era of nanodentistry, a colloidal suspension containing `millions of active analgesic micron-size dental nanorobots will be instilled on the patient's gingivae which can crawl through the mucosa, lamina propria or the 1- to 3 µm-thick layer of loose tissue at the cement-dentinal junction. Dentinal tubule diameter increases nearer the pulp which facilitates nanorobot movements. Assuming a total path length of about 10 mm from the tooth surface to the pulp and a modest travel speed of 100 µm/s, nanorobots can complete the journey into the pulp chamber in approximately 100 seconds. Once installed in the pulp and having established control over nerve-impulse traffic. The analgesic dental nanorobots may be commanded by the dentist to shut down all sensitivity in any tooth that requires treatment. When the dentist presses the icon for the desired tooth on the hand-held controller display, the selected tooth immediately numbs (or later, on command, awakens). After the oral procedures are completed, the dentist orders the nanorobots (via the same acoustic data links) to restore all sensation, to relinquish control of nerve traffic and to egress from the tooth via similar pathways used or ingress; following this, they are aspirated.

Advantages

1. greater patient comfort and reduced anxiety,
2. no needles,
3. greater selectivity and controllability of the analgesic effect,
4. fast and completely reversible action, and
5. Avoidance of most side effects and complications.

CONCLUSION

Dentistry is fortunate in that it possesses an abundance of excellent agents for the relief of perioperative and postoperative pain associated with the delivery of dental care.

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