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Management of hot tooth

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Abstract
To achieve a good pulpal anesthesia, is a landmark in Endodontic practice. However, things become difficult when patient experiences pain during the treatment even after local anesthesia is injected in the area, is termed as 'Hot Toot'. The article describes some treatment strategies that the dental practitioner can use when treating patients with "hot" tooth.

Keywords: hot tooth, hyperalgesia, anesthesia, formo-cresol

Introduction
Acheiving anesthesia for a tooth is always necessary to commence the endodontic treatment. One must know the proper anatomy and the procedure thoroughly to accomplish a proper anesthesia technique. Sometimes after giving a proper anesthesia also, patients respond negatively to the treatment because of pain. In Endodontics, this condition is often referred as "Hot Tooth. Treating such condition shall always become a trouble to the clinician. When a carious lesion approximates the pulp, inflammatory changes within the pulp progressively worsen. In this stage, there will be an acute exacerbation of chronic inflammation, with an influx of neutrophils and the release of inflammatory mediators (prostaglandins and interleukins) and proinflammatory neuropeptides (Substance P, Bradykinin, and Calcitonin gene related peptide) (1, 5, 10). All these mediators can stimulate the peripheral nociceptors within the pulp of affected tooth, thereby increases the pain production and neuronal excitability (6). This leads to moderate-severe pain (irreversible pulpitis) even after giving adequate anesthesia with traditional techniques. So in this stage endodontist must ensure extensive anesthetic efficiency for providing pain relief to the patient.

Factors in failure of the inferior alveolar nerve block
Accessory Innervation: Mylohyoid Nerve
The mylohyoid nerve is the accessory nerve most often cited as a cause of failure of mandibular anesthesia (1). A controlled clinical trial compared the IAN block alone to a combination of the IAN block and a mylohyoid nerve block using 2% lidocaine with 1:100,000 epinephrine, which was aided by the use of a peripheral nerve stimulator.66 The investigators found that the mylohyoid injection did not significantly enhance pulpal anesthesia of the IAN block, so the study does not support the hypothesis that the mylohyoid nerve is a major factor in failure of the IAN block.

Accuracy of Injection
It has been theorized that an inaccurate injection contributes to inadequate mandibular anesthesia. Studies using ultrasound and radiographs to accurately locate the inferior alveolar neurovascular bundle or mandibular foramen revealed accurate needle location did not guarantee successful pulpal anesthesia.

Needle Deflection
Needle deflection has also been theorized as a cause for failure with IANB. In asymptomatic subjects it was found that the orientation of needle level, for an IANB did not affect anesthetic success or failure.

Cross-Innervation
Cross-innervation from the contralateral inferior alveolar nerve has been implicated in failure to achieve anesthesia in anterior teeth after an IAN injection (1). Experimentally, cross-innervation occurs in incisors but plays a very small role in failure of an IAN block.

Case Study
Case 1
A female patient aged 50 years visited our clinic for pain in relation to right lower second premolar tooth. On radiographic examination, it was found that there is pulpal exposure and hence endodontic therapy initiated.

Inferioralvelor nerve block was given 2% xylocaine with 1:100,000 adrenaline. During endodontic therapy patient experienced extreme pain. And hence endodontic therapy could not be progressed. It was decided to give xylocaine intra-pulpally with extreme pressure (1, 2, 8). After 2 min to 3 min of wait it was found that patient did not experienced any sort of pain and hence endodontic therapy gained success.

Case 2

In another case of endodontic therapy in relation to right upper first molar tooth patient experienced pain while preforming procedure. Hence it was decided to give intra-ligamentary anesthesia (2, 5, 8). Anesthetic solution was deposited in mesial and distal sulcus with the bevel of the needle facing the corresponding tooth. Pulpal anesthesia was achieved and patient did not experience any pain.

Case 3

A 12 year old female patient visited our clinic for endodontic treatment of left lower first molar tooth. After xylocaine was injected patient experience highest degree of pain while performing the procedure. Small cotton dipped in formo cresol (excess is wiped out) was placed in the pulp chamber (1) and closed with ZOE cement. Patient was sent back and recalled after 2 days. In the next visit Inferior-alveolar nerve block was repeated, it was found that patient did not experienced any sort of pain and hence complete pulpal anesthesia was achieved.

Theories of hot tooth

Ion trapping theory

Ion trapping Low pH is responsible for ion trapping of local anesthetic. According to this hypothesis, low tissue pH shall be responsible for a greater proportion of the local anesthetic being trapped in the charged acid form of the molecule and thus unable to cross cell membrane.

However ion trapping is for infiltration injections only, block injections are likely to involve acidotic tissues (1, 6).

Altered Membrane excitability of peripheral nociceptors

Nerves from inflamed tissue shows decreased excitability threshold and altered resting potential. Studies shows that lower excitability thresholds are responsible for transmission of impulses even with action of local anesthetia.

Tetrodoxin resistant channels

It is confirmed that, Tetrodoxin resistant channels (TTXr), a class of sodium channels resist the action of local anesthesia (1, 7). Increased expressions of sodium channels in pulp are responsible for anesthetic failures in hot tooth. TTXr channels are resistant to lidocaine, thereby causing incomplete anesthesia

The Central core theory

This theory states that the nerve that situated outside of the nerve bundle supply molar teeth while the nerve situated inside the nerve bundle supplies the anterior teeth. The anesthetic solution may not diffuse into the nerve trunk to reach all the nerves to produce an adequate block even if deposited at the correct site. This theory may only applicable for the higher failure rates in the anterior teeth with IANB and not for the posterior teeth.

Central sensitization

Central sensitization may contribute to local anesthetic failures. Increased Sensitization may amplify incoming signals from sensory nerves. In central sensitization, there is an increased response to peripheral stimuli and because of this, the IANB may permit for sufficient enough signaling to occur thereby leading to the perception of pain.

Psychological factors

Patient anxiety is one of the factors for local anesthetic failure. It is understood that apprehensive patients have a reduced pain threshold and more likely to complain pain during the time of endodontic treatment

Management strategies in patients with a hot tooth

If patient feels pain even after anesthesia. Following things can be done.

Supplement Injection

A. Intraligamentary (Periodontal ligament) Injection
B. Intraosseous Injection
C. Intrapulpal Anesthesia
D. Mandibular Buccal Infiltration Injection with Articaine
E. Preemptive Strategies to Improve Success of the IANB Injection

A. Intraligamentary (Periodontal ligament) Injection

Periodontal ligament injection is still one of the supplemental injections for reducing pain in endodontics. It has been reported that supplemental PDL injection shows 50-96% of cases with successful anesthesia for endodontic procedures [33-36]. But, most of the times, a re-injection is advisable for good result.

B. Intraosseous Injection

The use of the intraosseous (IO) injection allows the practitioner to deliver local anesthetic solutions directly into the cancellous bone surrounding the affected tooth (9). There are several IO systems available in the market, including the Stabident system. The Stabident system consists of a 27-gauge beveled wire that is driven by a slow-speed handpiece, which perforates the cortical bone. Anesthetic solution is then delivered into the cancellous bone with a 27-gauge ultrashort needle through the perforation using a standard anesthetic syringe.

C. Intrapulpal Anesthesia

In approximately 5% to 10% of mandibular teeth diagnosed with irreversible pulpitis, supplemental injections (PDL and IO) do not produce adequate anesthesia, even when repeated, to enter the pulp chamber painlessly (9, 10). This is a prime indication that an intra-pulpal injection may be necessary. The intrapulpal injection works well when it is given under back-pressure. Onset of anesthesia is immediate. Various techniques have been advocated in giving the injection; however, the key factor is giving the injection under strong back-pressure. Simply placing local anesthetic solution in the pulp chamber will not achieve adequate pulpal anesthesia.

A disadvantage of the intrapulpal injection is its short duration of action (approximately 15‑20 minutes).

Mandibular Buccal Infiltration Injection with Articaine

An infiltration of articaine after an IANB if the patient has pain after a clinically successful IANB (lip numbness), helped in providing profound pulpal anesthesia.

Preemptive Strategies to Improve Success of the IANB Injection

Recent clinical studies have looked at the use of oral medications like acetaminophen or its combination with ibuprofen before treatment of a patient with a tooth diagnosed with irreversible pulpitis improves the success rate of the IANB injection (10). It was also found that 40mg of methylprednisolone also played role in improving success rate of the IANB injection.

Anxiety is believed to play a role in lowering pain thresholds, and the use of a sedative agent to help increase the success of the IANB injection in patients diagnosed with irreversible pulpitis was studied by Lindemann and colleagues75 This group used sublingual triazolam and found that a dose of 0.25 mg given 30 minutes before treatment failed to improve the success rate of the IANB as compared with placebo. They concluded that, with conscious sedation, profound pulpal anesthesia was still required to eliminate pain during endodontic treatment of a hot tooth.

Conclusion

Earlier hot tooth management in endodontics was a challenging process, but with changing times, different supplement injection techniques has become a trend worldwide and is no longer any difficult. However, more studies should be done to counter hot tooth.

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