

REVIEW ARTICLE**Anesthetic Failure in Endodontics**Hossam Tewfik ¹**ABSTRACT**

One of the most important skills for dental practitioners to attain is the ability to provide safe and effective local anesthesia. However, failure in local anesthesia in dentistry is not uncommon. In endodontics, achieving adequate anesthesia in cases associated with acute painful pulpitis is considered a major clinical challenge. Successful Inferior Alveolar Nerve Block (IANB) numbs the soft tissues around the tooth to be treated, but it does not always anaesthetize the inflamed pulp. Lack of success in obtaining complete anesthesia can be due to patient-related factors or operator-related factors. The patient related factors can be further categorized into anatomical, pathological or psychological factors. Management of local anesthetic failure can be through repeating the primary injection in case of absence of positive signs of success. However, in presence of positive signs of successful primary injection, supplemental injections should be considered. There are several supplemental injection techniques available to help achieving proper anesthetic effect.

Keywords

Local anesthesia, inferior alveolar nerve block, irreversible pulpitis, supplemental injections.

STATEMENT OF THE PROBLEM

Failure in local anesthesia in dentistry is not uncommon with failure rates ranging from 15 to 30%.¹ In endodontics, achieving adequate anesthesia in cases associated with acute painful pulpitis is considered a major clinical challenge. Successful Inferior Alveolar Nerve Block (IANB) numbs the soft tissues around the tooth to be treated, but it does not always anaesthetize the inflamed

pulp.² Dentist treating a patient with painful irreversible pulpitis usually encounters the problem of ineffective pulpal anesthesia even after achieving positive signs of soft tissue numbness. Clinical studies involving patients with painful pulpitis failed to show any difference in success rate by using various types of anesthetic agents.³ Furthermore, studies involving various techniques of

1. Professor of Endodontics, Faculty of Oral and Dental Medicine, Misr International University

anesthesia administration such as Gow-Gates technique,⁴ Vazirani-Akinosi (closed mouth) technique were not found to be superior to conventional IANB technique.⁵ Therefore replacing conventional anesthetic injection techniques with others, will not improve success. Furthermore, increasing the volume or the concentration of the vasoconstrictor was not found to increase the incidence of successful pulpal anesthesia.²

In this review article, the causes for local anesthetic failure will be discussed. Furthermore, methods to manage these failures will be described.

CAUSES FOR FAILURE OF ANESTHESIA

Lack of success in obtaining complete anesthesia can be due to patient-related factors or operator-related factors.

PATIENT RELATED FACTORS

The patient related factors can be further categorized into anatomical, pathological or psychological factors.

Anatomical factors:

Anatomical variations:

An understanding of the variations in teeth innervation would help to improve the dentist ability to induce profound anesthesia.⁶ The foramina of importance in regional block anesthesia in dentistry do not have a

consistent location. Anatomic variations like Bifid inferior alveolar nerve and accessory mental foramen have been reported.⁷ These variations play a significant role in block injections in comparison to infiltration anesthesia. Furthermore, teeth may be innervated from more than one nerve trunk. Among these, the accessory supplies which innervate mandibular teeth can be derived from the mylohyoid nerve, the auriculotemporal nerve and the upper cervical nerves. In addition, the cross innervation in mandibular incisor region is not uncommon.⁸

Pathological Factors:

Effect of Inflammation

It is apparent to all practitioners that teeth with inflamed pulpal tissues are more difficult to anesthetize. This can be explained by the fact that substances released from inflamed tissue may alter the composition, distribution or activity of sodium channels expressed on nociceptors.⁹⁻¹¹ The effect of inflammation on these sodium channels may have profound implications in local anesthetic failures.

Central sensitization is the increased excitability of central neurons and is thought to be a major central mechanism of hyperalgesia.¹² Under conditions of central sensitization, there is an exaggerated CNS

response to even gentle peripheral stimulation.

Clinical studies have reported that patients with irreversible pulpitis had an 8-fold higher failure rate for local anesthetic injections in comparison to normal control patients.¹³⁻¹⁵

Patient anxiety may also contribute to local anesthetic failure. Clinicians understand that apprehensive patients have a reduced pain threshold and more likely to report an unpleasant dental experience.¹⁶ Therefore, patient anxiety should be considered when managing those endodontic cases.

OPERATOR DEPENDENT CAUSES

Poor Technique

As far as conventional methods of local anesthesia are concerned poor technique usually relates to mandibular anesthesia, specifically inferior alveolar nerve block injections. The common causes of failure are touching bone too soon on the anterior ascending ramus or injecting inferior to the mandibular foramen.

HOW TO IMPROVE THE ANESTHESIA

A- Supplemental Anesthesia

There are several supplemental injection techniques available to help the dentist. It

should be kept in mind that these supplemental techniques are best used after attaining a clinically successful primary injection

Types of Supplementary injections:

1- Intraligamentary Injection

This technique is achieved by inserting the needle through the gingival sulcus on the mesial aspect of the tooth and approximately 0.2 ml of anesthetic solution is deposited. The solution penetrates the cancellous bone, spreading along the outer surface of the alveolar plate and outer the periosteum.

Walton and Abbot¹⁷ reported initial and reinjection success rates of 71% and 92% respectively of periodontal ligament supplemental injections in achieving anesthesia for endodontic procedures in mandibular molars.

2- Intraosseous Injection

Intraosseous injection (IO) directly delivers anesthetic solution into the cancellous bone surrounding the affected tooth. Various systems such as Stabident system, X-tip system and Intra- Flow hand-piece use different technique to deposit anesthetic agent to the targeted tooth. Nusstein and Reader¹⁵ found that a supplemental mandibular intraosseous injection using 1.8 ml of 2% lidocaine with 1:100,000 epinephrine had a 91% success

rate in achieving complete pulpal anesthesia.

3- Mandibular Buccal Infiltration

Hasse et al¹⁸ reported success rate of 88% when mandibular buccal infiltration supplementary injection of 4% articaine with 1:100,000 epinephrine was administered to enhance the success of IANB. However, when the buccal infiltration injection was used as a supplement to the IANB in patients diagnosed with irreversible pulpitis, the success rate was only 58%¹⁹ which is much less than that attained with the intraosseous and intra-ligamentary injections.

4- Intrapulpal Injection

Intrapulpal injection was found to be very effective when administered under strong pressure. Onset of intrapulpal anesthesia is immediate but duration of action is found to be 15 to 20 minutes only. However, it must be noted that intrapulpal injection should be the clinician last resort because it is a rather painful injection.

5- Intraseptal injection

This technique is useful in obtaining soft tissue and osseous anesthesia for surgical flap procedures. The needle is inserted at 90 degrees angle into the interdental papillae next to the tooth to be treated and 0.2 ml of anesthetic solution is injected.

B- Premedication

1- Non-steroidal anti-inflammatory

drugs:

Recent studies have shown favorable results regarding the use of oral medication prior to local anesthesia in patients suffering of irreversible pulpitis. Ianiro and Jeansonne²⁰ administered acetoaminophen or ibuprofen in combination with acetoaminophen orally and compared them with placebo in patients with acute irreversible pulpitis scheduled for root canal therapy and reported 71 to 76% success in comparison to only 46% with placebo.

2. Anti-anxiety drugs:

First, the clinician should establish a positive and confident relationship and avoid exposing the patient to obvious fear-producing stimuli. Second, pharmacologic agents can be administered to control patient anxiety.²¹ Punnia-Moorthy²² showed that oral triazolam 0.25mg was equally effective in comparison to intravenous diazepam in reducing anxiety in patients undergoing oral surgery.

REFERENCES

- 1) Vinckier, F. What is the cause of failure of local anesthesia? *Revue Belge de medicine Dentaire* 2002, 55:41-50.
- 2) Vreeland DL, Reader A, Beck M, et al. An evaluation of volumes and concentrations of lidocaine in human inferior alveolar nerve block. *J Endod* 1989;15(1):6-12.

- 3) Claffey E, Reader A, Nusstein J, et al. Anaesthetic efficacy of articaine for inferior alveolar nerve blocks in patients with irreversible pulpitis. *J Endod* 2004; 30(8):568-71.
- 4) Gow-Gates GA. Mandibular conduction anaesthesia: a new technique using extraoral landmarks. *Oral Surg Oral Med Oral Pathol* 1973;36(3):321-28.
- 5) Sisk A. Evaluation of the Akinosi mandibular block technique in oral surgery. *J Oral Maxillofac Surg* 1986;44(2):113-15.
- 6) Blanton, P. Jeske, A. The key to profound local anesthesia. *Neuroanatomy. J Am dent Assoc* 2003, 134:753-760.
- 7) Araceli Boronat López 1, Miguel Peñarrocha Diago Failure locoregional anesthesia in dental practice. Review of the literature. *Oral Patol Oral Cir Bucal* 2006;11:E510-13.
- 8) Rood JP, Some anatomical and physiological causes of failure to achieve mandibular analgesia. *Br J oral surg.* 1977, 15:75-82.
- 9) Coward K, Plumpton C, Facer P, Birch R, Carlstedt T, Tate S, Bountra C, Anand P. Immunolocalization of SNS/PN3 and NaN/SNS2 sodium channels in human pain states. *Pain* 2000; 85(1-2): 41-50
- 10) Gold M, Reichling D, Shuster M, Levine JD. Hyperalgesic agents increase a tetrodotoxin-resistant Na¹ current in nociceptors, *Proc Nat Acad Sci* 1996; 93:1108.
- 11) Novakovic S, Tzoumaka E, McGiven J, Haragauchi M, Sangameswaran L, Gogas K, Eglen R, Hunter J. Distribution of the tetrodotoxin-resistant sodium channel PN3 in rat sensory nerves in normal and neuropathic conditions. *J Neurosci* 1998;18:2174-87.
- 12) Hargreaves KM. Pain mechanisms of the pulpodentin complex. In: Hargreaves, KM, Goodis H, eds. *Seltzer and Bender's Dental Pulp*. Chicago: Quintessence Publications 2002.
- 13) Hargreaves KM. Neurochemical Factors in Injury and Inflammation in Orofacial Tissues. In: Lavigne G, Lund J, Sessle B, Dubner R. eds. *Orofacial Pain: Basic Sciences to Clinical Management*. Chicago: Quintessence Publications 2001.
- 14) Cohen HP, Cha BY, Spangber LS. Endodontic anesthesia in mandibular molars: a clinical study. *J Endod* 1993; 19(7): 370-73
- 15) Nusstein J, Reader A, Nist R, Beck M, Meyers WJ. Anesthetic efficacy of the supplemental intraosseous injection of 2% lidocaine with 1: 100,000 epinephrine

- in irreversible pulpitis. *J Endo* 1998;24(7):487–91.
- 16) Wong M Jacobsen P. Reasons for local anesthesia failures. *J Am dent Assoc.* 1992, 12:69-73.
- 17) Walton R, Abbott B. Periodontal ligament injection: a clinical evaluation. *J Am Dent Assoc* 1981;103(4):571-75.
- 18) Hasse A, Reader A, Nusstein J, et al. Comparing anaesthetic efficacy of articaine versus lidocaine as a supplemental buccal infiltration of the mandibular first molar after an inferior alveolar nerve block. *J Am Dent Assoc* 2008;139(9):1228-35.
- 19) Matthews R, Drum M, Reader A, et al. Articaine for supplemental buccal mandibular infiltration anaesthesia in patients with irreversible pulpitis when the inferior alveolar nerve block fails. *J Endod* 2009;35(3):343-46.
- 20) Ianiro S, Jeansonne B, McNeal S, et al. The effect of preoperative acetaminophen or a combination of acetaminophen and ibuprofen on the success of inferior alveolar nerve block for teeth with irreversible pulpitis. *J Endod* 2007;33(1):11-14.
- 21) Kenneth M. Hargreaves Karl Keiser. Local anesthetic failure in endodontics. *Endodontic Topics* 2002, 1:26-33.
- 22) Punnia-Moorthy A. Buffering capacity of normal and inflamed tissues following the injection of local anaesthetic solutions. *Br J Anaesth* 1988;6:154–5