

Irreversible pulpitis and achieving profound anesthesia: Complexities and managements

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Abstract

Dental pain management is one of the most critical aspects of modern dentistry. Irreversible pulpitis and further root canal therapy might cause an intolerated pain to the patients. The improvements in anesthetic agents and techniques were one of the advantages of studying nerve biology and stimulation. This article tried to overview of the nerve activities in inflammatory environments or induced pain. Furthermore, the proper advises, and supplementary techniques were reviewed for better pain management of irreversible pulpitis.

Keywords: Anesthesia, nerve, pain, pulpitis

INTRODUCTION

Following the tissue injury due to trauma, contusion, chemical substances, heat trauma, microorganism invasion, and etc., multiple substances are released from the damaged tissue that cause secondary reactions of tissue which is called inflammation. The inflammation is characterized by some signs such as blood flow increase, capillary permeability enhancement, and diffusion of vascular fluid into intercellular spaces. Furthermore, granulocytes and monocytes immigrate to the tissue site. Multiple chemical mediators affect the regional nerves and cause changes in pain perception.[1]

The suitable treatment for pulpitis needs a definite diagnosis of pain etiology. The treatment for controlling the pain of periapical tissue sources differs from the treatment of the pain from pulp sources. It is possible that the pain becomes referral or originates from the other teeth. So, the first step to reaching a correct diagnosis is recognition of pain reason. Vitality tests and precise evaluation of tooth signs can be helpful in recognition of pain cause. The next step is to anesthetize the pain origin successfully. As anesthetizing the pain of pulpitis is somehow challenging the aim of this article is to overview the common techniques and approaches to provide a successful pain management of tooth with irreversible pulpitis.

MATERIALS AND METHODS

A data search was performed using PubMed's electronic database of dental reports, based on the following search terms in simple or multiple conjunctions: “Dental anesthesia,” “irreversible pulpitis,” “inflammation,” “nerves,” and “pain.” Some of the searched studies which had more relevance with the scope of this article were chosen. Consequently, case reports, studies with missing data, repeatedly published studies, and those in other languages than English were excluded. After screening both abstracts

and full texts, the information was gathered for summarizing.

RESULTS AND DISCUSSION

Etiology and biology

Commonly, the primary pain of pulpitis is caused by direct dentin destruction due to microbial invasion and alteration in osmotic pressure of dentinal tubules. Another reason, which is secondary to microbial effect, is hypersensitivity of the pulp nerve fibers due to inflammatory reactions. It seems that the C nerve fibers are more affected by inflammatory stimulators in the pulp.[1] In general, the A delta fibers respond to the stimulators related to the dentinal tubules whereas the C fibers mostly respond to inflammatory stimulators which are interpreted as long-standing and vague pain sensation. It is accepted that when the pulp nerve fibers are affected by chemical mediators, the action potential procedure would be facilitated or spontaneously started. Some of the inflammatory chemical mediators activate nerve fibers, and some of them strengthen the nerve fibers responses. So, when large numbers of chemical mediators exist, the nerve responds stronger. It is stated that some chemical mediators like nerve growth factor are effective in prolong pain.[2]

It seems that in the normal condition, the nerve fibers that transmit tooth pain impulses are not stimulated by ordinary stimulants such as cold and hot irritants. But in pathologic condition such as trauma and caries, nerve fibers are stimulated easily and produce pain impulses. Also, chemical and electrophysiological alteration in the innervation of the pulp causes hypersensitivity of peripheral and reflective neurons of central nervous system.[3]

An electrophysiological study demonstrated that the action potential velocity of the nerves is diminished in the inflammatory environment. Also, in that condition, greater numbers of nerve fibers undergo action potential with a certain stimuli.[4] In another study that evaluated nerve fibers morphology in an inflammatory environment, neurodegenerative, and myelin sheath destruction were observed at farther distances from inflammation. Also, new proteins were found in the exoplasm of the nerve fibers in the inflammatory condition that were not existed in sound nerve fibers. These changes were observed in all length of nervous fiber and farther areas.[5]

During impulse transmission, the receptors of the nerve fibers are important. Some of them, such as bradykinin and prostaglandin ones increase the activity of ion channels and some others, like morphin channels, decrease their activity and inhibit action potential. Briefly, the action potential procedure depends on the correspondence of these inhibitor and stimulator factors. In an especial condition such as increased pH, the provoked effects of inflammatory mediators are observed. In a clinical study on volunteer participants, inflammatory mediators were injected and consequently the pain was induced, whereas that induced pain was much more severe in an acidic environment.[6] It seems that the transmission system responds more severely in specific conditions like inflammation.

Clinical manifestations of these changes are known as allodynia and hyperalgesia. Which do not occur necessarily in a prolonged time and can occur within a few seconds in the special condition. In a study, hot pepper extract (capsaicin) injection resulted in allodynia and hyperalgesia in volunteers after a few seconds.[7] In another study with the aim of cavity preparation without anesthesia, the teeth were more sensitive to the electric pulp immediately after preparation.[8] Allodynia is called to decrease stimulation threshold of sensory nerves in which even nonpainful stimulators can induce pain. An example of allodynia is sunburn that the skin which is not normally tender to the touching becomes painful in contact with the clothes. This phenomenon could be seen in teeth as well in which mastication that does not cause pain in normal situation could become in teeth with pulpitis. The possible reason is reduced stimulation threshold in mechanical nociceptors of periodontal ligaments. Animal studies have been demonstrated that inflammation can affect pulp nerves to the extent that systolic blood pressure can induce pain impulse in the pulp with feel as pulsating pains of the tooth.[9]

Controlling pain in dental procedures

In root canal therapy, pain control is very consequential, and the most important way to prevent pain is

using local anesthetic drugs. These drugs have a peripheral effect and block the transmission of nerve impulses. The long-acting anesthetic drugs can provide pain control for 6 h or longer. Factors affect the anesthetic drug efficacy are the type of the applied drug, correct injection site, injection velocity, amount and dosage of the injected drug. The presence of inflammation at the injection site is another important factor which should not be overlooked. As mentioned previously, inflammatory mediators can induce provoked pain impulses. According to clinical experiences, the teeth with pulpitis involvement do not anesthetize completely. Success rate of inferior alveolar nerve block for teeth without any sign of inflammation is reported about 85–90%,[10,11] whereas, success rate for teeth with inflammation is reported <20% or very poor.[12,13] Accepted hypothesis about how local anesthetic drugs prevent action potential transmission declares that these drugs block voltage dependent gates in the length of nerve fibers and prevent action potential creation.[14] There are different types of voltage-dependent gates. One type of these gates, which is called tetrodotoxin-resistant, exists in the sensory nerve fiber which might increase in number in the inflammatory situation. Unlike other voltage- dependent gates, this gate is hardly blocked by lidocaine[15] which might explain why teeth with irreversible pulpitis do not anesthetize easily. Moreover, clinical observation supported the mentioned hypothesis in which the tested teeth with pulpitis were sensitive to the electric pulp test after local anesthesia administration and assurance of soft tissue numbness.[13] In animal studies, reduced tetrodotoxin-resistant gates were observed after prophylactic prescription of ibuprofen.[15] Clinical experiences on human being showed that prophylactic prescription of ibuprofen caused deeper anesthesia in teeth with irreversible pulpitis.[16,17,18]

Numbers of methods are introduced to overcome the anesthetic resistance of teeth with irreversible pulpitis. One of these methods is the secondary administration of anesthesia by the intra-osseous or ligamentary approach and using different anesthetic drugs.[19] Opioids are also used to locally control the pain of irreversible pulpitis. The presence of opioid receptors in the peripheral nerve fibers has been proved, and efficacy of opioids in local blockage of inflammatory mediators has been shown as well.[20] One randomized clinical study have shown the effectiveness of an intraligamentary injection of opioids on pain control of irreversible pulpitis.[21]

Other study evaluated the intra-osseous injection of anesthetic drugs to control the pain of irreversible pulpitis. Despite approved success rate of this method, it should be administered carefully because it is an invasive approach and might increase the heart rate due to the presence of adrenaline.

Another method which has been recently suggested is the prophylactic use of nonsteroid anti-inflammatory drugs (NSAIDs).[16] NSAIDs are effective in both acute and chronic inflammations. Their peripheral and central effect has been accepted. These drugs bond to plasma proteins and spread through inflammatory tissues like the pulp. Nevertheless, there are some studies in agreement[16,17,18] or disagreement[22] of using NSAIDs for better pain control in patients with irreversible pulpitis. Recently, a meta-analysis study suggested using them.[23]

CONCLUSION

Dental procedures, especially endodontic therapy are often of most patients' concerns. Pain management before, throughout and after a procedure is not only beneficial to a patient but results in patients' trust and cooperation. To achieve effective pain relief conventional methods of pain control, including a pharmacological plan and the use of anesthesia techniques, must be individually tried for each patient. Considering other supplementary anesthesia techniques, intra-osseus and ligamentary, is strongly recommended for patients with inadequate pain relief.

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Conflicts of interest

There are no conflicts of interest

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