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Recent Advances in Local Anesthesia: Review of Literature

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Abstract

Even if local anaesthetic remains the mainstay of pain management in dentistry, research will continue to hunt for innovative and more effective strategies to control the pain. The majority of research efforts are focused on developing anaesthetic medicines, delivery systems, and related approaches. Modern dentistry techniques enable dentists to provide better pain management with less painful injections and unfavourable side effects. The current review of the literature aims to compile persuasive evidence for dentists about the use of modern local anaesthetics, various techniques, and tactics to lessen pain while delivering anaesthesia and so enhance patient comfort.

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1. INTRODUCTION

Modern dentistry would not be conceivable without the use of local anaesthetic. The dentist has access to a range of instruments and methods to accomplish local anaesthesia. Despite this paradox, individuals experience the greatest amount of fear and agony during dental treatments since local anaesthetic reduces their pain perception. Safe and effective pain treatment is essential in today's dentistry practise.[1] Our current arsenal of tools for local anaesthetic solution administration to the maxilla and mandible is adequate for most clinical scenarios. Local anaesthetics are used for invasive dental operations such as surgical treatments, deep scaling and root planing, cavity preparation, and necessary pulp therapy. Almost all dental procedures—aside from examinations, scaling, oral prophylaxis, and fluoride application—use local anaesthetics, depending on the patient's pain threshold and degree of anxiety.[2] Nowadays, most common dental local anaesthetics can be used successfully for most routine operations. Nonetheless, one of the procedures that causes patients the greatest amount of anxiety is administering a local anaesthetic injection.[3]

Therefore, a variety of methods have been proposed to lessen the discomfort experienced during the administration of local anaesthetic agents. These methods include the use of various anaesthetic gels, distraction tactics, warming the anaesthetic agents, slowing down the injection rate, and buffering the local anaesthetic agents. The goal of the current evaluation of the literature's findings is to provide dentists with reliable information regarding the use of contemporary local anaesthetics, alternative methods, and strategies to reduce pain during anaesthesia administration and consequently improve patient comfort.[4,5]

2. RECENT ADVANCES IN LOCAL ANESTHETIC DRUGS

Articaine and centbucridine are two relatively recent medications that have shown to be as effective as or perhaps more effective than lignocaine.[6]

2.1. Articaine: It is a local anaesthetic that is a member of the Amide family. It has an ester group that is processed by tissues' esterases and a thiophene ring in place of a

benzene ring. Articaine has an exponential half-life and is eliminated over an extended period of time. Unidentified plasma esterases are mostly responsible for metabolism in the liver and plasma.[86]

2.1.1. Articaine VS Lignocaine: Articaine acts more quickly and for a longer period of time. It has a higher success rate. Articaine is 1.5 times more potent than other drugs and produces less systemic intoxication.[6]

2.1.2. Adverse effects of Articaine: Similar to prilocaine, articaine has the potential to produce neuropathies and methemoglobinemia. Articaine and prilocaine have increased paresthesia incidence, mainly with the lingual nerve, indicating that they have a more neurotoxic effect than lidocaine. It has been observed that taking articaine, particularly for infra-orbital nerve block, can cause eye problems. The enhanced drug diffusion across tissues, including bone, may be the cause of this.[6]

2.2. Centbucridine: It is a locally anaesthetic chemical that was developed in 1983 at the Centre for Drug Research in Lucknow, India. It is a derivative of quinolone and has a local anaesthetic effect. It has antihistaminic and vasoconstricting properties by nature. At a concentration of 0.5%, centbucridine can be used successfully for spinal anaesthesia, nerve blocks, and infiltration. Its anaesthetic power is 4-5 times more than that of 2% lignocaine. This special chemical has been widely utilised in ophthalmology and other medical disciplines, despite the inexplicable failure of physicians to capitalise on its advantages and confirm its use in the management of pain during dental procedures.8 According to Gune and Katre, cenbucridine is similar to lignocaine and can be used as an alternative in patients between the ages of 12 and 14 who exhibit hypersensitivity, as well as in cardiac and thyroid conditions where these vasoconstrictors are contraindicated.[7]

3. ALTERNATIVE DENTAL ANESTHESIA

Alternative methods are as follows:

3.1. Electric Dental Anesthesia: This non-pharmacological method is widely used to treat both acute and chronic pain. Transcutaneous electrical nerve stimulation (TENS) stimulates nerves, usually for therapeutic purposes, using an electrical current produced by a machine. The absence of syringes in the equipment encourages children to behave well and reduces their fear. Therefore, this approach can be advantageous for paediatric patients. Adult patients can also benefit equally from producing analgesia for a variety of conditions, such as rubber dam placement, cavity preparation, pulp capping, endodontic procedures, prosthetic tooth preparation, oral prophylaxis, extractions, and pain reduction during local anaesthetic injection.[1]

3.2. Cryoanesthesia: Using ice or refrigerant sprays, this technique cools a restricted area of the body to stop neurons from sending pain signals. Therefore, applying cold topically would activate myelinated A-fibers and trigger pain-inhibitory pain pathways. Neuropraxia is caused by chilling, which lowers the threshold of tissue nociceptors and the impulses sent by conduction nerves that transport pain. Hindocha et al. claim that injecting 5% lidocaine gel during needle insertion has the same effect as topically anestheticing the mouth mucosa with cold beforehand.[8] The effects of the topical anaesthetic last for a few minutes after application.19 According to Bose et al., precooling the soft tissue area before to standard dental procedures reduces children's sense of discomfort during infiltrations and prevents anaesthesia.[9]

4. RECENT ADVANCES IN LOCAL ANESTHESIA DELIVERY DEVICES

Some of the more contemporary local anaesthetic delivery devices meant to reduce needle anxiety make use of the gate control concept of pain management, which postulates that pain can be decreased by simultaneously activating nerve filaments through vibration.[10] Inui and colleagues, however, have demonstrated that tactile-induced pain inhibition can result in pain reduction mediated by non-noxious touch or vibration and happens without any input from the spinal level, including descending inhibitory actions on spinal neurons.[11]

4.1. VibraJect: The vibrating dental local anaesthetic attachment known as Vibraject was just introduced. It vibrates the needle at a high frequency that is strong enough for the patient to feel. Kakigi and Watanabe claim that interfering stimulation, like vibration, can lessen pain because of the gate-control theory.[14] According to Hutchins et al., the vibration might help reduce the discomfort associated with injections.[15]

4.2. Buzzy System: The gadget has two parts: body vibration and removable ice wings, and it is shaped like a bee. It operates in accordance with the gate control theory and the descending inhibitory controls. More specifically, the device's vibration will block the A-delta and C afferent pain-receptive fibres, which will lessen discomfort. Conversely, prolonged cold administration activates the C nociceptive fibres and inhibits the A-delta signals when it is given in close proximity to the nociception region. Suohu et al. state that children's pain and anxiety during the delivery of local anaesthetic next to the tooth—which is indicated for invasive dental procedures - can be decreased by the Buzzy® system, which externally applies cold and vibration.[12,13]

5. RECENT ADVANCES IN LOCAL ANESTHESIA DELIVERY TECHNIQUE

5.1. Intranasal Tetracaine/Oxymetazoline Spray: Tetracaine is a long-acting, water-soluble ester local anaesthetic with five to eight times the efficacy of cocaine when applied topically. One Plasma pseudocholinesterase metabolises it in plasma, and injection and topical administration are used at 0.15% and 2%, respectively, of its metabolised content.35 As a nasopharyngeal and nasal anaesthetic, it is used prior to surgical and exploratory procedures.[16] Hersh et al. evaluated the safety and efficacy of a 3% tetracaine/0.05% oxymetazoline (K305) intranasal spray as a maxillary dental anaesthetic in a 150-person double-masked randomised placebo-controlled study. After the first two 0.2 ml were sprayed into the ipsilateral nostril at a 4-minute interval, a third spray was also administered if needed. Pulpal anaesthesia demonstrated an overall success rate of 88% with a 95% confidence interval when used to execute restorative treatments on maxillary incisors, canines, and premolars.[17]

5.2. Periodontal ligament injection: When only one mandibular tooth needs to be anesthetized, intraligamentary injection (ILI), commonly referred to as the periodontal ligament injection, has proven to be highly successful.39 After the PDL injection gives the tooth pulpal analgesia, only localised soft tissue anaesthesia occurs. There is no extraoral or lingual numbness following a jaw injection, in contrast to a conventional inferior alveolar nerve block. The possibility of LA solution seeping into the patient's mouth and the difficulty of accurately determining the needle implantation position (inside or at the PDL entry) are among the constraints. Using a normal syringe, high pressure is needed to inject the LA into the thick oral tissues at the PDL injection site.[18,19]

5.3. QuickSleeper: Using this method, anaesthesia is injected at a constant pressure and speed to minimise the pain of the anaesthetic effect. It is made up of a handpiece and a control box. Signals are sent to the main control box via Bluetooth when the pedal is depressed. When the circuit is finished, the handpiece drills and injects an anaesthetic solution into the intra-bony region or cancellous bone to achieve the highest level of anaesthetic effectiveness.[20] Smal-Faugeron et al. claim that because QuickSleeper® technology reduces discomfort and anxiety, treating young patients and teenagers is made easier for dental practitioners.[21]

6. CONFERENCES

Local analgesia is a secure and reliable pain management technique. One of the fou-

ndational tenets of contemporary dentistry practise is its application. Traditional methods for administering local anaesthetic no longer seem to be as effective as the modern approaches. These more modern methods are being promoted for their benefits and have a broad range of potential applications in dentistry. Modern techniques for providing local anaesthetics efficiently and painlessly make the process more enjoyable for the dentist and the patient, which has a good impact on establishing a strong patient-dentist bond.

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