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Research Article

Local Anesthetics in Dentistry – Newer Methods of Delivery

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ABSTRACT

Fear of pain is the most common reason for patients to defer dental treatment. Most dental procedures employ administration of local anaesthesia, but this fear of a "needle prick" and the pain associated with the same needs to be offset by the dental practitioner. Technological innovations have provided with methods of delivering local anaesthesia painlessly. This increases patient comfort, compliance and the trust they have in the dentist. This review discusses the newer methods of delivering painless local anaesthesia in the oral cavity.

Key words: local anaesthesia, pain, electronic dental anaesthesia, transdermal patch, DentiPatch, iontophoresis, computer controlled delivery, EMLA, Wand, intraosseous

INTRODUCTION

Local anaesthesia is the most commonly employed technique of achieving pain control in dentistry. Ex traction of teeth, root canal treatment, minor surgical procedures and periodontal procedures mandatorily meed administration of a local anaesthetic to minimize patient discomfort and be co-operative during treatment. Fear of pain is the main issue which causes patients to refuse dental treatment Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. The discomfort signals actual or potential injury to the body1.

With regard to local anaesthesia, the administration administration of the same is the single most important factor from the patient's perspective 2. For an injection to be painless, the solution may be subjected to warming or buffering to enhance the efficacy. However, research does not appear to be equivocal on the same. Local anaesthesia is normally administered via a syringe or a cartridge. Development of newer method of delivery can enhance pain relief with diminished pain from injection and lesser side effects. This is of exceptional importance in pediatric dentistry wherein children in their dental visit, in lieu of not experiencing pain during injections are motivated to come for regular dental check up. This review addresses the newer methods of delivering local anaesthetics in dentistry.

Newer Methods of Delivery In Modern Dentistry: The newer methods of delivery of LA that will be addressed in this review are:

a. Electronic Dental Anesthesia (EDA)
b. Intra-oral Lidocaine Patch (DentiPatch ®)
c. Jet Injection
d. Iontophoresis
e. Eutectic Mixture of Local Anesthetics (EMLA)
f. Computer Controlled Local Anesthetic Delivery Devices (CCLAD)
g. Intra-osseous Systems (IO Systems)

Electronic Dental Anesthesia (EDA): This technique involves the use of the principle of Transcutaneous Electrical Nerve Stimulation (TENS). TENS is a non-invasive, low-risk nerve stimulation to relieve the pain. By using electric current produced by a device to stimulate the nerves, it can be used a supplement to conventional local anesthesia 3,4

The limitations of this method includes increased salivary flow in oral cavity and the inability to use metal instruments freely. EDA is however contraindicated in heart diseases, neurological disorders, brain tumors, seizures, patients wearing pacemakers and cochlear implants .

Intra-oral Lidocaine Patch (DentiPatch ®): The DentiPatch® system is applied to the buccal mucosa and it releases Lidocaine to provide topical anaesthesia. By inhibiting the ionic fluxes required for the initiation and conduction of impulses, Lidocaine stabilizes the neuronal membrane, therefore effecting local anaesthetic action.

DentiPatch® contains 10-20% of Lidocaine and must be placed on the dried mucosa for a minimum of 15 minutes to achieve the required action. It is useful in reducing the pain associated with injections of local anaesthetic into the gingival for both maxilla and mandible 5.

Adverse effects include localized reactions like minimal to moderate redness was reported and central nervous system manifestations (excitatory and/or depressant). It is characterized by lightheaded, nervousness, apprehension, euphoria, confusion, dizziness, drowsiness, tinnitus, blurred or double vision, vomiting, sensations of heat, cold or numbness, twitching, tremors, convulsions, unconsciousness, respiratory depression and arrest; Cardiovascular system effects are usually depressant and characterized by bradycardia, hypotension, and cardiovascular collapse. Allergic reactions have also been

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also noted and are characterized by cutaneous lesions, urticaria, edema or anaphylactoid reactions. Allergic reactions as a result of sensitivity to lidocaine are extremely rare. It is also not recommended in pediatric patients because of the time taken for onset of anaesthesia 6,7

Jet Injection: A jet injector is a type of medical injecting syringe that uses a high-pressure narrow jet of the injection liquid instead of the use of a hypodermic syringe/needle from a reservoir. A small amount of local anesthetic is pushed as a jet into the submucosa. It is powered by compressed air or gas, either by a pressure hose from a large cylinder, a built-in gas cartridge or small cylinder. This takes place when the knob is pressed to release air pressure which produces a fine jet of solution which penetrates the mucosa through a small puncture wound to produce surface anesthesia 8

Iontophoresis: It is first introduced in 1993 as a suitable alternative for application of drug in achieving surface anesthesia. It is a painless modality of administrating anesthesia. It is a form of active transportation by extending its sensory component. It delivers the drug into the skin by using a constant low-voltage direct current, promoting ion transport through the skin. The positively charged lignocaine molecules are delivered when placed under a positive electrode for local anaesthesia 8

It causes skin irritation at higher current densities or upon longer application. When direct current electric field is applied over longer durations, an electrochemical polarisation occurs in the skin which decreases the magnitude of current flow through the skin. Therefore affect the amount of drug ions driven across the skin. 9-11

Eutectic Mixture of Local Anesthetics (EMLA): It contains a mixture of lignocaine 2.5% and prilocaine 2.5%, which forms an oily phase and diffuses through the intact skin. In 1986, Clarke et al suggested the use of EMLA cream for anesthetizing the skin prior to needle insertion as this reduces the incidence of injection pain 12, 13

Lidocaine and prilocaine separately are solid bases but when mixed in equal quantities by weight, they form a eutectic mixture. It is formulated into preparations without the use of a non-aqueous solvent, thus allows higher concentrations of anaesthetic to be formulated into the preparation and maintained during application. It is working by blocking nerve signals to achieve local anaesthetic effect 12,13

Computer Controlled Local Anesthetic Delivery Devices (CCLAD): In the mid-1990s, computer technology is incorporated with the development of local anesthetic delivery systems to control the rate of flow of the anesthetic solution through the needle. In 1997, "Milestone Scientific" introduced the first CCLAD system, which was named "WAND", and then subsequent versions were termed as "WAND PLUS" and "COMPUDENT". In 2001, DENTSPLY International introduced the "Comfort Control Syringe (CCS)". Similar devices originating from other countries like France were Quick Sleeper, Sleeper One; Anaeject and Orastar from Japan 14

CCLAD system enabled an accurate manipulation of needle placement with fingertip accuracy and delivers the LA with a foot-activated control. The lightweight handpiece is held in a pen-like grasp, it provides the user with greater tactile sensation and control. The available flow rates of LA delivery are controlled by a computer and thus remain consistent from one injection to the next. The pain perception was reduced two- to threefold when compared to the standard manual syringe.

a) WAND 15-17: This system contains 3 components: Base unit, foot pedal and disposable handpiece assembly. Foot pedal controls the rate of injection and if aspiration feature is enabled, it prevents inadvertent intravascular injections 18-20. This is a commonly used system in dentistry. Rate of injection: i) Slow: 0.005ml/s – needle insertion, PDL injection, Palatal administration. ii) Fast: 0.03ml/s – buccal infiltrations, nerve block. iii) Turbo: 0.06ml/s
b) Single Tooth Anesthesia System (STA System) 21,22: Introduced by Milestone Scientific in 2007, the STA system incorporates dynamic pressure-sensing (DPS) technology that provides a constant monitoring of the exit pressure of the local anesthetic solution in real time during all phases of the drug's administration and also to identify the ideal needle placement for PDL injections. The DPS system alerts the user if leakage of LA occurs that can be caused by improper needle placement, insufficient hand pressure on the syringe, or internal leaking from the cartridge/ syringe. Pressure of the LA is strictly regulated by the STA system, therefore greater volume of LA can be administered with increased comfort and less tissue damage.

   Rate of Injection: i) STA mode: Single, slow rate of injection. ii) Normal mode: emulates the Compudent device. iii) Turbo mode: faster rate of injection – 0.06ml/s.
c) Comfort Control Syringe (CCS) 23,24: It consists of two components; base unit and syringe. Injection and aspiration can be controlled directly from the syringe. Rate of injection: Five different basic injection rate settings for specific applications: Block, Infiltration, PDL, IO and Palatal regions. Two stage delivery rates are used for every injection. LA solution is initially expressed at an extremely low rate, the rate slowly increases to the pre-programmed value for the selected injection technique after 10 seconds [23]

Intra-osseous Systems (IO Systems): It involves the placement of local anesthetic directly into the cancellous bone spaces adjacent to the tooth or teeth that require anesthesia. It offers rapid onset of pulpal anesthesia. [23] Commonly used devices in IO systems include Stabident, X – Tip and Intraflow.

Two methods can be used with these IO systems, which are two-step and one-step techniques. In two-step technique, a bur is first used to penetrate the bone using a slow speed handpiece, then local anesthetic is placed. In one-step technique

(IntraFlow™ Anesthesia Delivery System) uses a slow speed handpiece with a needle, known as perforator, and transfuser, resulting in penetration of the bone and

immediate flow of anesthetic in one shot. One-step technique uses a foot pedal to regulate the flow 25

CONCLUSIONS

Local anesthesia forms the backbone of pain control techniques, as well as to create pain-free dental practice in dentistry. Lately, many newer delivery methods have been discovered and introduced to enhance a better quality performance during dental treatment. To achieve the goal of absolute pain-free practice dentistry, more efforts are required to be put in to discover the best method. It is very important for all the dentists to adapt the newer methods of delivery of LA. It is necessary in the current evidence-based era of dental practice for dentists to constantly update, evaluate and incorporate newer drugs and methods into daily practice to provide our patients the best of care at all times, and also can reduce the public fear of seeking for dental treatment.

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