

Minimizing the pain in local anesthesia injection – A review

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Abstract Local anesthesia is widely used in dermatological surgery. But a major concern with their use is the pain experienced by the patients at the time of injection. Various tips and tricks have been published in various studies to minimize this pain. The present review article is written to revisit those tips in the light of the recent literature.

Key words

Local injection, pain, buffer, pH, lignocaine, needle, distraction, spray.

Introduction

Local anesthetics are widely utilized in the practice of dermatological surgery for achieving cutaneous anesthesia with minimal side effects. However, pain or burning sensation at the time of injection is one of the major adverse issues related to this technique. Hence tips and tricks to minimize the local anesthetic injection pain have great potential to create ease and comfort for the physicians and the patients alike.¹ This article is aimed to review the various techniques of injection pain reduction, in the light of recent literature.

Materials and methods

A systematic review of English-language articles related to tips for minimization of pain in local anesthesia injection was performed after deriving references from sources including PubMed Central, Medline, Cochrane Database and HINARI. The search items/MeSH terms

included local anesthesia, methods, lignocaine, EMLA, buffering, ethyl chloride, pain measurement, vapocoolant spray and injection pain prevention/control. Articles published in last decade were preferred and a total of 23 references were used. Older references were cited only when no appropriate reference was available from the recent literature.

Techniques for injection pain control

1. Warming the anesthetic

Warming the local anaesthetic agent to body temperature or up to 40°C to 54.4°C (104°F–130°F) has been found to be a simple, practical and inexpensive option for reduction of pain due to local anaesthetic infiltration.² Sultan in 1997 after a review of a total of 758 papers published to study the impact of warming the local anesthetic, selected 11 studies that presented the best evidence, and concluded that warming significantly decreases the pain on injection.³ Hogan *et al.*⁴ in 2011 published the results of a systematic review and metaanalysis based on 18 studies with 831 patients. The study concluded that warming local anesthetics leads to less pain during injection and hence should be undertaken before administration. Allen *et al.*⁵ in

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2008, however, did not find any statistically significant reduction in pain experienced by patients undergoing a sub-Tenon's block for cataract surgery though Bell and Butt⁶ found warming local anesthesia to 37°C to significantly reduce pain during peribulbar infiltration.

2. Buffering the anesthetic

The most frequently used local anesthetic in dermatological practice is lidocaine (1% or 2%) combined with epinephrine 1:100,000. The pH of this product (pH 4.2) is, however, approximately 1000 times more acidic than subcutaneous tissue (pH 7.4) and this acidity contributes to uncomfortable stinging and burning with infiltration.⁷ Buffering with sodium bicarbonate (NaHCO₃) 8.4% in a 10:1 or 9:1 ratio (10 or 9 parts lidocaine-epinephrine 1% containing 5 microgram/ml to 1 part sodium bicarbonate containing 8.4g/l) more closely matches the neutral pH (around 7.4) in human tissues and decreases injection pain. Basic pH solutions convert lidocaine into its active, unionized form and hence, alkalinizing the anesthetic mixture also decreases the time of onset of its effects.⁸ Buffering the anesthetic decreases the usual shelf life; Momsen *et al.*⁹ established that the buffered lignocaine-epinephrine was stable for up to 24 hours after preparation. Hence, some studies have recommended the preparation of a freshly buffered mixture prior to injection.¹⁰ The antibacterial activity of lidocaine has however, not been found to get diminished by the bicarbonate buffer.¹¹ Ong *et al.*¹² however, suggested that increasing pH in buffered lignocaine is unable to fully explain the minimization of pain on injection, as clinical experiences have proven that procaine and chlorprocaine, although more acidic than lignocaine, are less painful on infiltration. Also, there is a suggestion of possible link in the

relationship between lipid solubility and painful infiltration; however, this suggestion needs to be analytically evaluated further.

3. Injection technique

Injection technique is an important factor in achieving nearly pain-free experience for patients and ensuring effective anesthesia in the field. Depending on the perception of the injection, the technique is a factor that would earn the physician either praise or blame from his patients.¹⁰

The superficial skin has the highest concentration of nerve endings, which branch repeatedly from larger nerve fibrils in the deeper dermis and subcutaneous fat. Any technique that reduces trauma to the nerve endings is bound to decrease pain and there are various maneuvers that have been described in literature to achieve this aim and these include:

a) Smaller-gauge needles

Using smaller-gauge (27-30 G) needle is highly recommended to reduce injection pain as it is less traumatic with lesser potential to hit the cutaneous nerve endings and hence higher potential of being pain free.^{10,13}

b) Limited use of the same needle

Use of the same needle multiple times dulls the needle tip and the dull needle tip induces increased trauma and hence more pain. It is recommended that the needle be changed often and ideally fresh needle be used if multiple injections are needed in the same lesion or when there are multiple injection sites. Similarly, different needles should be used for drawing up the anesthetic from the vial and for the actual injection procedure.¹⁰

c) Perpendicular injection technique

By injecting the needle tangentially, disruption of a relatively larger number of nerve endings occurs, as the needle tracks through more superficial skin resulting in pain. By injecting perpendicularly (at 90 degrees), the needle plunges through the shortest route, thereby damaging less of nerve endings.^{9,10}

d) Slow injection

Injection of small volumes gradually and progressively allows the cutaneous nerve endings to accommodate for the distortion caused by anesthetic infiltration and thereby, substantially minimizing the pain.⁹⁻¹⁴

d) Pulse injection

Pulsed delivery of injections is potentially less painful than injecting an anesthetic in a continuous fashion as it allows the nerve endings to accommodate for distortion. It has been recommended in literature that 0.1 cc of anesthetic be injected followed by a 3-second pause, repeating this step a few times till the desired volumes are administered.⁸

e) Initial deeper level of deposition

Anesthetic should initially be deposited into the subcutaneous fat and the injection should be continued as the needle is withdrawn. Injection directly into the dense dermis causes hydrodissection leading to pain, while deeper placement is comparatively less painful due to decreased concentration of nerve endings and higher malleability of subcutaneous fat due to lesser tissue density than the dermis.¹⁴

f) "Hole in One" reinsertion

When larger surface areas are to be anesthetized, the needle may have to be re-inserted multiple

times. The patient should ideally have minimal feeling of only the first prick that blanches a particular area of skin indicating that the area is infiltrated with anesthesia and numb. All the subsequent pricks must be strategically placed within 1 cm of that visibly blanched area of skin and advanced slowly with continuous pressure on the plunger; needle tip advancement past the leading edge of the blanched area and into un-infiltrated skin with intact sensation should be avoided.¹⁵ This technique has not only been found to be efficacious in minimizing injection pain but is also easy to learn and master.

4. Distraction

Distracting the patient when injecting local anesthetics is one of modalities for pain reduction. The technique may involve engaging the patient in simple conversation (talkesthesia) with the patient over common topics like weather, clothing, sports etc. having the patient to look away or and even suggesting that the procedure is supposed to cause minimal discomfort.¹⁰

Physical distraction techniques are mentioned in literature and include stretching and scratching the skin, pinching, local vibration, and pressure. The physical methods counter-irritate and are based on the "Gate Control" theory that suggests that noxious sensation carried on unmyelinated C fibers can be masked by simultaneous activation of nerve fibers that conduct non-noxious stimuli.¹⁴

For pediatric age group patients, distraction is achieved with range of products, ranging from sweets, stickers or toys to sophisticated methods such as virtual reality glasses worn during the procedure.¹⁶

5. Combination anesthetic technique

Topical anesthetic application, such as EMLA (Eutectic mixture of local anesthetics: lidocaine 2.5%-prilocaine 2.5%) cream applied 60 to 120 minutes prior to intralesional anesthetic injection has been found in multiple studies to attenuate injection pain.¹⁷

Similarly, LET solution (lidocaine, epinephrine, tetracaine) application 30 minutes before wound/laceration closure, prior to actual lidocaine infiltration has been found to decrease the pain.¹⁸ The disadvantage with these techniques is the extra time required for EMLA or LET to show the effect.

6. Cooling of skin

Cooling the surface numbs the cutaneous nerve endings, thus minimizing pain. Cooling can be achieved by placing ice cubes packed in aluminum foil or latex gloves,¹⁹ over the skin for more than 20 seconds or by spray of ethyl chloride vapocoolant spray with an immediate onset of action.²⁰ Ice cubes are readily available in most clinics and ethyl chloride has been found to be equally effective as EMLA cream.

7. Focal ultrasound

Skarbek-Borowska *et al.*²¹ presented the results of focal pretreatment of skin in children with low-frequency ultrasound followed by a 5-minute application of a 4% lidocaine topical anesthetic, and found the technique to significantly decrease the pain of intravenous (IV) catheter placement. Assessment tools utilized in this study were Visual Analogue Scale (VAS) scores measuring children's pain and parents' perception of the child's pain.

8. Needle free pre-treatment

Jet injection devices are recent innovations that deliver a mist of lidocaine solution without

epinephrine via high pressure produced by either a carbon-dioxide-filled cartridge, nitrogen-filled cartridge or a spring.^{21,22} The needle-free powder lidocaine delivery system has also been introduced in recent years, and has been found to be well-tolerated, and produced significant analgesia within 1 to 3 minutes.

Conclusion

There is wide array of techniques for minimizing the injection pain. The techniques may be used in combinations as per the availability and thereby, alleviating the fears and anxiety of the patients and making their experiences more comfortable.

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