Pain management for children needing laceration repair

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Abstract

Question An 8-year-old child who lives in a small town has presented to my practice with a 3-inch laceration on the calf that has been assessed and needs repair with sutures. The family lives 4 hours from the nearest emergency department and I was planning to repair the wound in the office. What is the best way to manage pain in young patients needing sutures for laceration repair?

Answer Children are particularly susceptible to experiencing high levels of pain and anxiety during routine emergency procedures such as laceration repair. It is important to consider measures to reduce procedural pain. Using needle-free anesthesia, such as the lidocaine-adrenaline-tetracaine combination, might be effective to anesthetize the area. In instances where lidocaine-adrenaline-tetracaine is not sufficient, additional injected lidocaine or bupivacaine can be used. Buffering lidocaine with bicarbonate, warming the lidocaine ampule, and injecting the compound slowly at a perpendicular angle to the skin will reduce pain associated with the injection.

Lacerations are common presentations to physicians' offices, and approximately 8% of all pediatric and adult presentations to emergency departments (EDs) are owing to lacerations.[1] Children in urban centres presenting to their family physicians with lacerations will often be referred to the local ED for suturing. However, nearly 20% of Canada's population lives in rural areas with fewer than 1000 inhabitants and limited access to an ED,[2,3] and in these areas family physicians commonly respond to children's needs in their offices. Pain and anxiety play a considerable role in shaping the pediatric experience,[4] and general practitioners can reduce pain during laceration repair in the office by using a mix of topical and injectable anesthesia.[5]

Infiltrative anesthesia: lidocaine and bupivacaine

Infiltrative or injected anesthesia, such as 1% or 2% lidocaine, has been a commonly used method for pain management during laceration repair.[6] Lidocaine relieves pain by blocking the sodium channels in the local nerve fibres and has proven to be effective, particularly for deeper lacerations.[7] Adding adrenaline can be useful owing to its vasoconstrictive effect on the surrounding blood vessels, thus reducing potential toxicity of systemic distribution of anesthetic and reducing excessive bleeding at the site of injury.[8] For many years it has been recommended to avoid lidocaine with a vasoconstrictor on the digits, penis, nose, and ears owing to the tenuous end-artery blood supply to these areas[6]; however, more recently adrenaline has been shown to be safe to use in digits as long as surrounding vasculature is intact.[9]

Other compounds for anesthesia are also available, including bupivacaine, mepivacaine, procaine, and tetracaine.[6] Bupivacaine has a longer half-life and longer duration of anesthesia.[10] In a double-blind randomized controlled trial of 104 patients, pain was rated significantly higher 2 hours after wound repair in the lidocaine-treated group compared with the bupivacaine-treated group ($P<.001$).[11]

Infiltrative anesthesia is contraindicated in patients with an allergy to the product or local infection in the area of injection. Allergic reaction to lidocaine is usually a result of the methylparaben preservative used for storage, and a preservative-free lidocaine can be used.[6] However, given the reduced shelf-life of preservative-free lidocaine it might not be practical to store it in a remote family practice. Allergy to procaine or tetracaine does not preclude patients from using lidocaine and vice versa, as they have different chemical structures.[6]

Administering local anesthesia: pain-reduction techniques

Reducing pain from injectable anesthetics[12] can be done by injecting the compound slowly[13] and directing the needle in a perpendicular angle to the skin, which has been shown to reduce sensory nerve irritation.[14] Physicians can also attempt to move the needle through areas of the skin that have already been anesthetized,[14] or they can begin injection at the wound edges rather than through intact skin.[15]

Bicarbonate buffering is a useful technique for reducing pain during lidocaine injection because much of the pain associated with lidocaine injection is due to infiltration of the acidic compound.[16] The addition of bicarbonate brings lidocaine to a neutral pH level, similar to that of body tissue.[16] While buffering lidocaine reduces its shelf-life to 1 week,[17] it has been shown to reduce mean pain scores from 8.2 (out of 10) for plain lidocaine to 4.7 (out of 10) for buffered lidocaine ($P<.05$).[18]

Warming the lidocaine ampule before use was also shown to reduce pain in a meta-analysis of 18 studies including 831 adult patients.[19] Pooled analysis revealed a reduction of 11 mm in pain on a 0- to 100-mm pain scale (95% CI -7 to -14 mm). A subanalysis of 8 studies revealed warmed *and* buffered lidocaine was as effective as warm *or* buffered solutions for pain reduction.[19] Warming and buffering together had an additive effect on pain reduction among healthy volunteers.[20] These findings were not supported by a recent study in ED patients with wounds in which warmed, buffered, or warmed and buffered solutions did not significantly differ in reducing pain, suggesting no synergistic effect in a trauma setting.[21]

Needle-free local anesthesia

Topical anesthetics have been shown to be highly effective in reducing pain associated with suturing.[4] Topical anesthetics are of special benefit in children with contraindication to injectable anesthesia, difficulty tolerating injections, and needle phobia.[12]

A tetracaine-adrenaline-cocaine combination was the first topical anesthetic gel produced in 1980,[22] but it fell out of favour after a number of cocaine toxicity–related fatalities were reported.[23-25] Furthermore, cocaine-free products offer the same level of pain relief.[12] In 1996, the use of topical anesthesia (cocaine-adrenaline mix) showed no difference in pain relief compared with plain 1% lidocaine in children.[26] More recently, a randomized controlled trial of 110 patients found topical lidocaine hydrochloride putty to be equally effective as injected lidocaine with a mean difference in pain of 0 (95% CI -1 to 0).[27]

Lidocaine-adrenaline-tetracaine gel. The lidocaine-adrenaline-tetracaine (LAT) combination is a topical gel containing 4% lidocaine, 1:2000 adrenaline, and 0.5% tetracaine.[28] While lidocaine provides effective pain relief and "numbs" the effective area through sodium channel blockade, adrenaline works to induce vasoconstriction and leave the affected area dry, which can be beneficial if a tissue adhesive solution is being used instead of sutures.[5] Lidocaine-adrenaline-tetracaine has been shown to improve patient outcomes for a number of painful pediatric procedures (including intravenous cannulation[29] and lumbar puncture[30]) and reduce the need for injected anesthesia.[31] The use of LAT gel for pain minimization has become standard practice for large-scale EDs[4] and is far less expensive than its predecessor, the tetracaine-adrenaline-cocaine combination.[32] In a double-blind placebo-controlled trial,[31] LAT was shown to statistically significantly reduce pain associated with lidocaine injection before suturing. It was also shown to be effective when used alone for laceration repair (ie, without adjunctive infiltrative anesthetic). In a study of 60 adult patients, 30 were treated without LAT and all required additional infiltrative anesthetic, whereas less than half of the 30 patients who received LAT before treatment required additional injected lidocaine.[33]

The use of LAT has been mainly introduced into large-scale EDs and relies heavily on nurses' ability to identify wounds that might need some form of primary closure and apply LAT early on at triage, such that the anesthetic has time to take effect while the patient waits to see the doctor.[31] Sherman and colleagues identified a low uptake of topical anesthesia use in a large tertiary pediatric ED where only 57% of patients received LAT gel before painful procedures.[4] Furthermore, it has been postulated that LAT might have reduced usefulness in a primary care setting where the length of time it takes to numb the surrounding area (up to 1 hour) is longer than the length of time patients would wait to see their doctors.[31] Despite potential drawbacks, LAT use should be strongly considered in laceration repair procedures in the family practice setting.[4,31,33]

Amethocaine and tetracaine gels. The 4% amethocaine and the 4% tetracaine gels are frequently used for painful pediatric procedures like intravenous cannulation.[34] However, neither are approved for use on broken skin and there is a relative lack of research regarding their effectiveness during laceration repair.

Lidocaine-prilocaine combination. The 2.5% lidocaine and 2.5% prilocaine combination—in gel, cream, or patch form—is currently not approved for use on mucous membranes or broken skin, reducing its usefulness in laceration repair with sutures. Past research has shown the lidocaine-prilocaine combination to be effective on broken skin and mucous membranes[31,32] and it has been used successfully off label for laceration repair in children[35]; however, it should not be a first-line topical anesthetic, particularly given the availability of LAT. In a head-to-head comparison of LAT versus the lidocaine-prilocaine combination used on open wounds in patients aged 1 to 59 (median age of 8.5 years) there were no clinically significant differences in pain and acceptability found between treatments. Also, LAT is less expensive than the lidocaine-prilocaine combination is.[32]

Conclusion

When repairing lacerations in children it is important to use all available techniques to manage pain. It is important for physicians to focus on injection-associated pain of local anesthetics. Pain management should be top priority in managing children with minor trauma. In instances where infiltrative anesthetic is needed, 1% buffered or warmed lidocaine can be used. Evidence-based pain-reduction techniques, such as slow infiltration into wound edges, should also be used.

Competing interests
None declared

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