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[Intervention Review]

Injectable local anaesthetic agents for dental anaesthesia

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ABSTRACT

Background

Pain during dental treatment, which is a common fear of patients, can be controlled successfully by local anaesthetic. Several different local anaesthetic formulations and techniques are available to dentists.

Objectives

Our primary objectives were to compare the success of anaesthesia, the speed of onset and duration of anaesthesia, and systemic and local adverse effects amongst different local anaesthetic formulations for dental anaesthesia. We define success of anaesthesia as absence of pain during a dental procedure, or a negative response to electric pulp testing or other simulated scenario tests. We define dental anaesthesia as anaesthesia as anaesthesia given at the time of any dental intervention.

Our secondary objective was to report on patients' experience of the procedures carried out.

Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL; the Cochrane Library; 2018, Issue 1), MEDLINE (OVID SP), Embase, CINAHL PLUS, WEB OF SCIENCE, and other resources up to 31 January 2018. Other resources included trial registries, handsearched journals, conference proceedings, bibliographies/reference lists, and unpublished research.

Selection criteria

We included randomized controlled trials (RCTs) testing different formulations of local anaesthetic used for clinical procedures or simulated scenarios. Studies could apply a parallel or cross-over design.

Data collection and analysis

We used standard Cochrane methodological approaches for data collection and analysis.

Main results

We included 123 studies (19,223 participants) in the review. We pooled data from 68 studies (6615 participants) for meta-analysis, yielding 23 comparisons of local anaesthetic and 57 outcomes with 14 different formulations. Only 10 outcomes from eight comparisons involved clinical testing.



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We assessed the included studies as having low risk of bias in most domains. Seventy-three studies had at least one domain with unclear risk of bias. Fifteen studies had at least one domain with high risk of bias due to inadequate sequence generation, allocation concealment, masking of local anaesthetic cartridges for administrators or outcome assessors, or participant dropout or exclusion.

We reported results for the eight most important comparisons.

Success of anaesthesia

When the success of anaesthesia in posterior teeth with irreversible pulpitis requiring root canal treatment is tested, 4% articaine, 1:100,000 epinephrine, may be superior to 2% lidocaine, 1:100,000 epinephrine (31% with 2% lidocaine vs 49% with 4% articaine; risk ratio (RR) 1.60, 95% confidence interval (CI) 1.10 to 2.32; 4 parallel studies; 203 participants; low-quality evidence).

When the success of anaesthesia for teeth/dental tissues requiring surgical procedures and surgical procedures/periodontal treatment, respectively, was tested, 3% prilocaine, 0.03 IU felypressin (66% with 3% prilocaine vs 76% with 2% lidocaine; RR 0.86, 95% CI 0.79 to 0.95; 2 parallel studies; 907 participants; moderate-quality evidence), and 4% prilocaine plain (71% with 4% prilocaine vs 83% with 2% lidocaine; RR 0.86, 95% CI 0.75 to 0.99; 2 parallel studies; 228 participants; low-quality evidence) were inferior to 2% lidocaine, 1:100,000 epinephrine.

Comparative effects of 4% articaine, 1:100,000 epinephrine and 4% articaine, 1:200,000 epinephrine on success of anaesthesia for teeth/ dental tissues requiring surgical procedures are uncertain (RR 0.85, 95% CI 0.71 to 1.02; 3 parallel studies; 930 participants; very low-quality evidence).

Comparative effects of 0.5% bupivacaine, 1:200,000 epinephrine and both 4% articaine, 1:200,000 epinephrine (odds ratio (OR) 0.87, 95% CI 0.27 to 2.83; 2 cross-over studies; 37 participants; low-quality evidence) and 2% lidocaine, 1:100,000 epinephrine (OR 0.58, 95% CI 0.07 to 5.12; 2 cross-over studies; 31 participants; low-quality evidence) on success of anaesthesia for teeth requiring extraction are uncertain.

Comparative effects of 2% mepivacaine, 1:100,000 epinephrine and both 4% articaine, 1:100,000 epinephrine (OR 3.82, 95% CI 0.61 to 23.82; 1 parallel and 1 cross-over study; 110 participants; low-quality evidence) and 2% lidocaine, 1:100,000 epinephrine (RR 1.16, 95% CI 0.25 to 5.45; 2 parallel studies; 68 participants; low-quality evidence) on success of anaesthesia for teeth requiring extraction and teeth with irreversible pulpitis requiring endodontic access and instrumentation, respectively, are uncertain.

For remaining outcomes, assessing success of dental local anaesthesia via meta-analyses was not possible.

Onset and duration of anaesthesia

For comparisons assessing onset and duration, no clinical studies met our outcome definitions.

Adverse effects (continuous pain measured on 170-mm Heft-Parker visual analogue scale (VAS))

Differences in post-injection pain between 4% articaine, 1:100,000 epinephrine and 2% lidocaine, 1:100,000 epinephrine are small, as measured on a VAS (mean difference (MD) 4.74 mm, 95% CI -1.98 to 11.46 mm; 3 cross-over studies; 314 interventions; moderate-quality evidence). Lidocaine probably resulted in slightly less post-injection pain than articaine (MD 6.41 mm, 95% CI 1.01 to 11.80 mm; 3 cross-over studies; 309 interventions; moderate-quality evidence) on the same VAS.

For remaining comparisons assessing local and systemic adverse effects, meta-analyses were not possible. Other adverse effects were rare and minor.

Patients' experience

Patients' experience of procedures was not assessed owing to lack of data.

Authors' conclusions

For success (absence of pain), low-quality evidence suggests that 4% articaine, 1:100,000 epinephrine was superior to 2% lidocaine, 1:100,000 epinephrine for root treating of posterior teeth with irreversible pulpitis, and 2% lidocaine, 1:100,000 epinephrine was superior to 4% prilocaine plain when surgical procedures/periodontal treatment was provided. Moderate-quality evidence shows that 2% lidocaine, 1:100,000 epinephrine was superior to 3% prilocaine, 0.03 IU felypressin when surgical procedures were performed.

Adverse events were rare. Moderate-quality evidence shows no difference in pain on injection when 4% articaine, 1:100,000 epinephrine and 2% lidocaine, 1:100,000 epinephrine were compared, although lidocaine resulted in slightly less pain following injection.

Many outcomes tested our primary objectives in simulated scenarios, although clinical alternatives may not be possible.

Further studies are needed to increase the strength of the evidence. These studies should be clearly reported, have low risk of bias with adequate sample size, and provide data in a format that will allow meta-analysis. Once assessed, results of the 34 'Studies awaiting classification (full text unavailable)' may alter the conclusions of the review.

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PLAIN LANGUAGE SUMMARY

Injectable local anaesthetic agents for preventing pain in participants requiring dental treatment

Review question

This review assessed the evidence for providing successful local anaesthesia that prevents pain during a dental procedure. Included studies compared injections of local anaesthetic to help people requiring dental treatment and to prevent painful sensations tested in an experimental way (such as using cold, a sharp probe, or an electric stimulus).

Background

An injection of local anaesthetic prevents a person from feeling pain. It is given in one specific area rather than in the whole body. Although pain during dental treatment can be successfully managed, it is a common fear of patients.

Several different local anaesthetics are available to dentists, as well as a variety of ways to deliver them, to prevent pain. Factors that appear to influence success include increased difficulty in anaesthetizing teeth in the presence of inflammation, variable susceptibility of different teeth to local anaesthesia, different operative procedures performed on the tooth (for example, it appears easier to achieve successful anaesthesia for dental extractions than for root canal treatment), and various techniques and solutions used to give the local anaesthetic.

We investigated whether injection of one local anaesthetic solution was more effective than another for preventing pain during dental treatment or during an experimental study, and whether this effect occurred quickly or lasted a sufficient length of time, if any unwanted effects occurred, and people's experience of the dental procedures. Local adverse events might include pain during or after injection, or long-lasting anaesthesia. Systemic effects due to the local anaesthetic solution can include allergic reactions and changes in heart rate and blood pressure.

Study characteristics

Two reviewers searched the literature to identify studies that compared different local anaesthetic solutions injected into people undergoing dental treatment or volunteers who had the same outcomes measured in experimental ways. Within every trial, each person was randomly assigned to receive one of the local anaesthetics under study. The search was up-to-date as of 31 January 2018.

We found 123 trials with 19,223 male and female participants. These trials investigated pain experienced during dental treatment including surgery, extraction, periodontal (gum) treatment, tooth preparation, root canal treatment, anaesthesia of nerves within teeth (pulps) tested using an electric pulp tester or cold stimulant, and anaesthesia of soft tissues measured following pricking of gums or self-reported by the participant. We pooled data from 68 studies (6615 participants). This resulted in eight outcomes when seven different local anaesthetic solutions were tested during dental treatment, two outcomes assessing pain during and after injection of local anaesthetic, and 47 outcomes tested with a pulp tester or by pricking of gums or self-reported by participants.

Key results

The review suggests that of the 14 types of local anaesthetic tested, evidence to support the use of one over another is limited to the outcome of success (absence of pain), from three comparisons of local anaesthetic. Findings show that 4% articaine, 1:100,000 epinephrine was superior to 2% lidocaine, 1:100,000 epinephrine in posterior teeth with inflamed pulps requiring root canal treatment. No difference between these solutions was seen when pain on injection was assessed, and although lidocaine resulted in less post-injection pain, the difference was minimal. Researchers found that 2% lidocaine, 1:100,000 epinephrine was superior to 3% prilocaine, 0.03 IU felypressin and 4% prilocaine plain for surgical procedures and surgical procedures/periodontal treatment, respectively. Speeds of onset were within clinically acceptable times, and durations were variable, making them suitable for different applications. Both of these latter outcomes were tested in experimental ways that may not reflect clinical findings. Unwanted effects were rare. Patients' experience of the procedures was not assessed owing to lack of data.

Quality of the evidence

From comparisons of local anaesthetics in this review, all appeared effective and safe with little difference between them. Available evidence ranged from moderate to very low in quality. Some studies fell short, in terms of quality, owing to small numbers of participants, unclear reporting of study methods, and reporting of data in a format that was not easy to combine with other data. Further research is required to clarify the effectiveness and safety of one local anaesthetic over another.