Anesthetic solution indication protocols for use in the endodontic clinic

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ABSTRACT

Introduction: The indication of anesthetic solutions in routine endodontic treatments must be based on knowledge of the possible effects that these substances can trigger in systemically compromised patients. **Aim:** The aim of the present study was to prioritize the indication and discuss the possible secondary or adverse effects likely to occur with the use of substances of which anesthetic solutions are composed, during the routine treatment of root canals.

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Introduction

Endodontic treatment performed without painful symptoms makes it possible to ensure the well-being and comfort of patients. Therefore, the use of an appropriate local anesthesia technique and the punctual choice of an anesthetic solution are crucial factors for good clinical performance.[1] However, there are several chemical compositions of these solutions and each of them can trigger secondary or side effects, particularly in systemically compromised patients.[2]

The main local anesthetics for dental use are the derivatives of: a) esters, mainly metabolized in plasma and have significant allergenic potential; or b) amides, mainly metabolized in the liver and have a lower allergenic potential. Due to several undesirable effects caused by ester derivatives, amide derivatives are at present most indicated for use during endodontic treatment.[2]

Although the amide derivatives belong to the same pharmacological group [as the ester derivatives], they have different hemodynamic manifestations, and demonstrate a different degree of systemic toxicity and local irritability between them. The most representative local anesthetics of this pharmacological group are lidocaine, mepivacaine, prilocaine, bupivacaine and articaine. Whereas anesthetic solutions are composed not only of the active principle, but also of vasoactive substances and their respective chemical preservatives.[1]

Vasoactive substances have the functions of minimizing the vasoactive effects caused by the anesthetic itself and potentiating the activity of blocking transmission of the nerve impulse. Sympathomimetic amines, adrenergic catecholamines (e.g., adrenaline or noradrenaline) or non-catecholamines (e.g., phenylephrine) and vasopressins (e.g., felypressin) are the most frequently used vasoactive substances in the composition of anesthetic solutions in Brazil.[2,3]

Additionally, sulfite chemical preservatives, especially sodium metabisulfite (preservative of adrenergic catecholamines) and paraben, may also be part of the chemical composition of anesthetic solutions. If, on the one hand, these substances provide greater chemical longevity of the anesthetic solution, in parallel they can cause undesirable reactions, especially of an allergic nature.[1]

Therefore, due to the association of different chemical substances to make up the anesthetic solution, there is great likelihood of the occurrence of highly complex local and/or systemic effects, and it is necessary for endodontists to be aware of these phenomena, to enable them to indicate these anesthetics in a precise and timely manner, without harming the patient in question.[1,2]

Therefore, the aim of this study was to list the clinical indications, point out possible local and/or systemic effects, and discuss the problem of using the main anesthetic solutions in systemically compromised patients.

General considerations

Indication and discussion of the selection of anesthetic solutions

Clinical situations of endodontic care provided for systemically compromised patients may require greater attention in the selection of the anesthetic solution, in order to avoid complications. As from this time onwards, we will describe the indications of anesthetic solutions in a clear and punctual way and discuss the parameters for rational choice in these clinical situations of providing care for patients undergoing endodontic treatment.

1. Pregnant women

1.1. Indication: 2% lidocaine (it is also possible to use mepivacaine) with epinephrine 1:100,000, using a maximum of two anesthetic vials per clinical treatment session.

1.2. Discussion: the incorporation of the vasoactive agent into the anesthetic tends to minimize the risk of systemic diffusion of the anesthetic solution, thus avoiding hemodynamic and/or pressure changes in the pregnant woman, which could have negative repercussions on the fetus. However, the option will always be to use epinephrine, at a concentration of 1:200,000 or 1:100:000. Norepinephrine and phenylephrine should be avoided, due to the risk of raising the patient's blood pressure, because these substances have greater action on alpha-receptors of the peripheral microcirculation.[1,4]

Prilocaine (Citanest, for example) should be avoided, due to the risk of causing methemoglobinemia, in which Methemoglobin forms when hemoglobin is oxidized to contain iron in the ferric iron [Fe3+], which is unable to bind and transport oxygen. Additionally, in Brazil, this anesthetic is associated with felypres-

sin, which is a vasopressin similar to oxytocin, with the potential to cause uterine contraction, although it is questionable whether this phenomenon could occur in the concentration of the drug used in dentistry. Articaine (Septanest, for example), although it is an amide derivative, it has low liposolubility, undergoes rapid biotransformation and is eliminated via the kidneys, emerging as a potential anesthetic for solving cases in which the use of lidocaine is contradindicated.[5-7]

2. Nursing Mothers

2.1. Indication: preferably 2% lidocaine with 1:100,000 epinephrine.

2.2. Discussion: amide-derived anesthetic solutions with epinephrine can be used, as they are practically destroyed and poorly absorbed in the gastric tract of the infant.[1,2]

3. Hypertension

3.1. Indication: in ASA II, stage 1 patients (pressure limits of 160/100 mmHg), 2% lidocaine with 1:100,000 epinephrine is recommended, limited to two vials of anesthetic per clinical treatment session. Indication: in ASA II, stage 2 patients (pressure limits between 160/100 mmHg), 3% prilocaine with 0.03 IU/mL felypressin is recommended, limited to two vials of anesthetic per clinical treatment session.

3.2. Discussion: in ASA III patients (pressure levels above 180/110 mmHg), even in conditions of endodontic emergencies, the prescription of anesthetic solutions at the dental office level is contraindicated, and simultaneous medical outpatient care is recommended.[8]

Anesthetic solutions that contain vasoactive agents that act predominantly on alpha receptors (norepinephrine or phenylephrine) should not be used, due to the risk of undesirable effects on the renin-angiotensin-aldosterone system, which may cause a significant increase in blood pressure and its adverse systemic consequences[1,9]

The prescription of drugs that minimize the stress caused by endodontic pain contributes to increasing the effectiveness of anesthetic solutions. In cases of endodontic urgency in ASA II patients, especially in stage 2, the prior use of a pre-anesthetic anxiolytic medication is prudent, such as 10 mg promethazine (Fernergan®, for example) or 10 mg zolpidem (Stilnox ®, e.g.). In situations in which sedation is required for the outpatient care of ASA III patients, the prescription of 10 mg promethazine or 10 mg hydroxyzine (Hixizine®, for example) associated with 7.5 mg midazolam (Dormonid®, e.g.,) is recommendable.[2]

4. Ischemic Heart Diseases

4.1. Indication: in these situations, we have two parameters that must be respected: a) for stable patients, without symptoms of cardiac ischemia, who have been under control for longer than 30 days, 2% lidocaine with 1:200,000 epinephrine is recommended (Alphacaine®, for example.), respecting the prescription of two vials of anesthetic per clinical treatment session, with time intervals of 30 to 40 minutes; and b) for patients considered unstable, with a previous history of angina or recent myocardial infarction (30 days), it is recommended not to use anesthetic solutions with vasoactive agents, but, when unavoidable, 3% prilocaine with 0.03 UI/mL felypressin is recommended, at most two to three vials of anesthetic per clinical treatment session.

4.2. Discussion: in patients considered unstable, only the punctual elimination of pain by means of non-invasive procedures is recommended and postpone the endodontic treatment of the root canals. Whereas, if invasive intervention is necessary, it is recommended that it should be performed in an outpatient setting, with monitoring of vital signs and prior prescription of angina control medication, such as nitrate derivatives (nitroglycerin, or isosorbide, for example). It is important to avoid vasoactive substances such as sympathomimetic amines; Felypressin, which does not act on beta-adrenergic receptors, is always preferable.

5. Cardiac arrhythmia

5.1. Indication: if possible, use anesthetic solutions without vasoactive agents, preferably 3% mepivacaine. Whereas, if the use of vasoactive agents is necessary in low or medium risk patients and/or those under prescription with non-selective beta-blocker drugs (propranolol, for example), the use of 2% lidocaine with epinephrine 1:200,000 (preferably) is permissible, or 1,100:000, maximum two vials of anesthetic, at time intervals of 30 to 40 minutes. If

the patient is on a prescription with digoxin, the use of vasoactive agents it is not recommended, due to drug interaction that tends to cause cardiac arrhythmias.[11]

5.2. Discussion: the use of vasoactive substances (vasoconstrictors) in patients with cardiac arrhythmia is cause for concern, as it can trigger tachycardia and/or arrhythmia. Greater attention should be paid to patients with significant changes in the Q wave of the electrocardiogram. Complications tend to be less frequent when abnormalities occur in the ST-T waves, and low concentrations of vasoactive substances are acceptable in these cases.[12]

Due to the high toxicity of digoxin and the fact that it is still widely used in the medical field, endodontists must be careful to avoid the use of vasoactive agents, including felypressin (present in Citanest®, for example). In these cases, 3% lidocaine or mepivacaine without vasoactive is recommended, associated with the prior use of a benzodiazepine, such as 7.5 mg midazolam (Dormonid®, for example), and the prescription of one tablet the night before and another an hour before the procedure.[11]

6. Asthma

6.1. Indication: ideally, it is recommendable to use 3% lidocaine or mepivacaine without vasoactive. Lidocaine 2% with epinephrine 1:200,000 or 1:100,000 can be an alternative if the patient is not hypersensitive to sulfites (food preservatives, especially found in the processed types). In positive situations, 3% prilocaine with 0.03UI/mL felypressin can be indicated with caution.

6.2. Discussion: Sulphites, especially sodium metabisulfite, are chemical preservatives, responsible for preserving some vasoactive substances, and may cause hypersensitivity reactions in asthmatic patients. Therefore, it is prudent to avoid the use of anesthetic solutions that contain adrenergic catecholamines (epinephrine and norepinephrine, for example).[13,14]

Whereas, the anesthetic solution with felypressin does not contain sulfites and may be an alternative when there is a need for longer-lasting anesthetic action, but it should not be used if there is a report of associated respiratory failure.[15,16]

7. Smokers

7.1. Indication: 2% lidocaine or 2% mepivacaine with 1:100,000 epinephrine, provided that the patient is not under treatment for the cessation of addiction, with the use of dopaminergic or noradrenergic drugs, such as buspirone, and/or monoamine oxidase (MAO) inhibitors). In these cases, 3% lidocaine without vasoactive is recommended.

7.2. Discussion: since buspirone and/or MAO inhibitors can potentiate the effects of adrenergic catecholamines, it is recommendable to avoid the use of anesthetic solutions in patients under prescription with these drugs.[17] Prilocaine should also be avoided, as it is partially biotransformed into orthotoluidine in the lungs, forming orthohemoglobulin, which tends to hinder gas exchange, a factor that favors metabolic acidosis.[15,16]

8. Hepatitis

8.1. Indication: patients who have recovered from viral hepatitis do not need special attention. However, if the patient has chronic active hepatitis, 2% lidocaine with 1:100,000 epinephrine (maximum two vials of anesthetic per clinical treatment session) or 4% articaine with 1:100,000 epinephrine is recommended.

8.2. Discussion: amide derivatives, such as lidocaine, are metabolized at hepatic level, but the use of two to three vials of anesthetic per clinical treatment session, with time intervals of 30 to 40 minutes, is considered relatively safe.[18] Another option is articaine which, despite being an amide derivative, it is partially metabolized in blood plasma by cholinesterases, requiring little liver activity.[19]

9. Alcoholism

9.1. Indication: 4% articaine with 1:100,000 epinephrine. Exceptionally, 2% lidocaine with epinephrine can be used in cases where liver functions and blood clotting are not significantly altered.

9.2. Discussion: as previously discussed, articaine requires less liver function, and is the anesthetic solution recommended in cases of liver cirrhosis and/or in situations of surgical interventions. Whereas, 2% lidocaine with epinephrine can be used if there is no significant liver damage, restricted to two vials of anesthetic per clinical treatment session.[20,21]

10. Chronic kidney failure

10.1. Indication: in patients only undergoing conservative treatment, 2% lidocaine with epinephrine 1:200,000 (preferably) or 1:100,000, restricted to two vials of anesthetic per clinical treatment session, can be used. In endodontic emergencies in patients undergoing hemodialysis treatment, use of the smallest possible quantity of 4% articaine with 1:100,000 epinephrine is recommended.

10.2. Discussion: the elimination of articaine is similar to that of ester derivatives of anesthetics, involving fewer effects and need for renal function.[22] However, some diabetic patients can have renal failure, and the prescription of epinephrine is contraindicated. In these cases, it is recommended to use 3% prilocaine with 0.03UI/mL felypressin.[23,24]

11. Diabetes

11.1. Indication: in diabetic patients with a well-controlled glycemic rate, preferably below 125 mg/dL, the prescription of 2% lidocaine with epinephrine 1:200,000 or 100,000 is recommended, limited to two vials of anesthetic per clinical treatment session. However, when the glycemic rate is found to be above 125 mg/dL and there is a need for intervention, due to an endodontic urgency, the prescription of 3% prilocaine with 0.03 IU/mL felypressin is the most rational indication.

11.2. Discussion: the adrenergic catecholamine-derived vasoactives exert practically no negative effects on the diabetic patient, provided that the glycemic rate is under control.[25,26] Epinephrine and felypressin, in the usual concentrations arranged in anesthetic vials, lead to practically no changes in glycemic levels.[25] Although some clinicians indicate the prescription of 4% articaine with 1:100,000 epinephrine for anesthesia in diabetic patients, there is insufficient data to prove its safety for this purpose, due to the presence of the thiophene ring in its chemical structure, which confers some degree of systemic toxicity.[27]

12. Adrenal insufficiency

12.1. Indication: 2% lidocaine with 1:100,000 epinephrine.

12.2. Discussion: patients who make chronic use of corticosteroids, or routinely suffer from adrenal hyperfunction are systemically compromised with other diseases, such as hypertension, hyperglycemia (diabetes), delayed tissue repair, osteoporosis and/or peptic ulcer[28]. In these situations, whenever possible, we should minimize the use of substances that interfere in the renin-angiotensin-aldosterone axis, and the use of 2% lidocaine with epinephrine 1:200,000, in the smallest possible quantity, is allowed.

13. Hyperthyroidism

13.1. Indication: avoid anesthetic solutions with sympathomimetic amines (epinephrine, norepinephrine and phenylephrine, for example).

13.2. Discussion: Thyroid hormone increases oxygen consumption and degradation of the LDL cholesterol fraction, in addition to promoting greater cardiac contraction and altering sinoatrial depolarization and polarization. The simultaneous prescription of vasoactives, derived from sympathomimetic amines, especially adrenergic catecholamines, can potentiate the effects of thyroid hormones, especially T_3.[29]

14. AIDS (HIV infection)

14.1. Indication: there is no restriction on the indication of anesthetic solutions.

14.2. Discussion: irrespective of the antiviral medication used, no significant effects of anesthetic solutions in infected patients have been observed.[30]

15. Allergic to sulfur (thiophene ring)

15.1. Indication: avoid articaine.

15.2. Discussion: Patients who demonstrate allergic sensitivity to compounds containing sulfur in their chemical formula, such as sulfa drugs, are potentially sensitive to the thiophene ring present in articaine. In these situations, other amine derivatives are recommended, such as 2% lidocaine with epinephrine 1:100,000.[31]

16. Rheumatic diseases

16.1. Indication: there is no restriction on the indication of anesthetic solutions, except if there is adrenal insufficiency. In this case, follow the recommendations as described above.

16.2. Discussion: follow the same recommendations described for patients with adrenal insufficiency.[28]

17. Drug and Amphetamine Abuse

17.1. Indication: after patients have used hallucinogenic drugs, it is recommendable to wait for 24 hours before performing dental treatment. If endodontic emergency care is needed, it is recommended to avoid epinephrine and opt for 3% prilocaine with 0.03 IU/mL felypressin.

17.2. Discussion: the prescription of epinephrine in patients who have recently used cocaine and/or methamphetamine can cause cardiac arrhythmia, hypertensive crisis and/or myocardial infarction.[32]

18. Psychiatric Disorders

18.1. Indication: avoid anesthetic solutions that contain epinephrine or norepinephrine. It is recommendable to use 3% prilocaine with 0.03 UI/mL felypressin.

18.2. Discussion: In patients undergoing treatments with antidepressant drugs that inhibit monoamino-oxidase (MAO inhibitors) the biotransformation of sympathomimetic amines may be reduced and may lead to causing cardiac arrhythmia and/or hypertensive crises.[33]

19. Anemia

19.1. Indication: avoid 3% prilocaine with 0.03 UI/mL felypressin. For routine procedures, it is recommendable to avoid epinephrine, but if invasive intervention is needed, 2% lidocaine with 1:200,000 epinephrine is recommended.

19.2. Discussion: prilocaine should be avoided due to the risk of orthotoluidine being incorporated into the hemoglobin molecule.[31,34]

20. Neurological disorders

20.1. Indication: 2% lidocaine with 1:100,000 epinephrine (maximum two vials of anesthetic per clinical treatment session) or 3% prilocaine with 0.03 IU/mL felypressin is recommended.

20.2. Discussion: in patients who routinely use anticonvulsant agents, such as phenytoin and carbamazepine, their effects may be potentiated.[31,35]

21. Allergic to sulphites

21.1. Indication: 3% prilocaine with 0.03 UI/mL felypressin.

21.2. Discussion: as previously discussed in the item indicating anesthetic solutions for asthmatics, sodium metabisulfite is a potentially allergenic preservative of adrenergic catecholamines. Whereas sulphites are also preservatives in some types of foods, which can cause hypersensitivity cross-reactions.[12,36]

22. Allergic to paraben

22.1. Indication: consult the chemical composition of the anesthetic solution.

22.2. Discussion: paraben can be used in some chemical compositions of anesthetic solutions as a preservative of the active ingredient; however, it is potentially capable of causing hypersensitivity reactions.[1,36-38]

Conclusion

The selection and prescription of anesthetic solutions must be based on the clinical condition and any medications, which may lead to synergistic or antagonistic effects, presented by the patient who needs endodontic intervention.

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