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Contraindications of Vasoconstrictors in Dentistry

R. BALAKRISHNAN* and VIJAY EBENEZER

Department of Oral & Maxillofacial Surgery, Sree Balaji Dental College and Hospital, Velachery Main Road, Narayanapuram, Chennai - 600 100, India.

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ABSTRACT

The association of a vasoconstrictor with a local anaesthetic solution is indicated because the vasoconstrictor decreases the intravascular passage of the injected solution and thus ensures an increase in duration and depth of the anaesthesia while reducing the systemic effects of the solution. Adrenaline is the main vasoconstrictor used today in local anaesthesia for dental treatments as it provides deeper anaesthesia, almost bloodless operative field and reduces the rate of absorption of local anaesthetic agents in the bloodstream by decreasing their plasma concentration. Vasoconstrictors can be used safely for most patients treated by dentists. But with the boon they also bring unknown medical complications which are more commonly not undergoing medical treatment like different cardiovascular diseases and other systemic diseases which if applied in those medically compromised patients can lead to life risk. In this review article various contraindications of vasoconstrictors to dentistry are being discussed.

Key words: Adrenaline, Vasoconstrictors, Systemic diseases, Contraindications, Life risk.

INTRODUCTION

Epinephrine is a natural hormone released from the adrenal medulla. The endogenous release of epinephrine and other catecholamines is reported to increase 20 to 40 times when persons are subjected to different kinds of stress. The functions of adrenaline are peripheral vasoconstriction, increased rate of sinus node, increased myocardial contractility, increased AV conduction, increased myocardial irritably, bronchodilatation ,vasodilatation of skeletal muscle. The reduction in systemic absorption is related to the local action of vasoconstrictors (adrenaline as a reference) by stimulating the á 1 receptors of the smooth muscle of the peripheral vessels. The consequence of this action is a reduction in tissue perfusion which results in local ischaemia of the tissues[1]. This ischaemia also relates to the vasa nervorum which supply the axons of sensitive nerve fibres concerned by the local anaesthesia; a significant reduction of the metabolism of the nerve cells arises and thus of the transmission of the nerve impulse which leads to a deepening of the anaesthesia and an increase in its duration. Like adrenaline, noradrenaline can also stimulate α 1 and α 2 receptors but it does not interact with β 2 receptors so the only direct effect of noradrenaline on vessels is to favour their constriction. Noradrenaline is thus approximately 4 times less vasoconstrictive locally than adrenaline. Moreover noradrenaline has a severe and paradoxical bradycardiac action as it is active on the cardiac β 1 receptors, an acceleration of the heart rate will be caused. In fact, noradrenaline could also cause a reflex stimulation of the aortic and carotid baro receptors in response to a rise in the diastolic and systolic pressures and lead to brutal bradycardia. Thus adrenaline is preferred more over noradrenaline as the preferred vasoconstrictor along with local anaesthetic solution. The most commonly used local anaesthetic for dental surgery is 2 per cent lignocaine with 1 in 80,000 adrenaline. The 1/200,000 or 1/100,000 solution gives a sufficient

duration of action for the majority of minor surgical procedures in dentistry(1) Adrenaline is added to the solution to improve its anaesthetic efficiency, principally duration and it also provides a near bleedless operative field and decreses the absortion rate of local anaesthetics by reducing the plasma concentration. The injection of an anaesthetic solution with or without vasoconstrictor must always be carried out slowly (1 ml/min)[1].

Contraindications

Addition of adrenaline to local anaesthetic solution is contraindicated for the following diseases like heart diseases, untreated or uncontrolled severe hypertension, uncontrolled hyperthyroidism, uncontrolled diabetes etc. The maximum doses are contained in 20 ml of local anaesthetic, epinephrine 1: 100,000 or levonordefrin 1:20,000; each ml of solution contains 0.01 mg and 0.05 mg of vasoconstrictor, respectively. Cardiac patients are at higher risk from the massive release of endogenous catecholamines associated with the mismanagement of pain control and anxiety than they are from the small quantities of vasoconstrictors usually used in dentistry.

Unstable angina

Unstable angina is characterized by recent worsening of symptoms and poor response to medical treatment. Angina de novo refers to all recent angina of 4 weeks' duration or less whereas crescendo angina is mainly characterized by an increase in frequency, duration, severity of symptoms, and a decreased response to medication. In normotensive healthy subjects injection of a moderate quantity of local anaesthetic with vasoconstrictor can lead to significant increase in cardiac stroke volume and oxygen consumption. An aspiration test should be done and the smallest effective dose should be administered for carrying out emergency dental procedures in these patients[1]. If emergency dental treatment is necessary, medical consultation is required and treatment should be aimed mainly at eliminating pain. Epinephrine dosages should be limited to one to two cartridges of 1:100,000 solution (0.018 to 0.036 mg of epinephrine)[2]. Similarly, in patients with stable angina, vasoconstrictors should be limited to one to two cartridges[2].

Recent myocardial infarction

The current recommendation for patient with a history of recent myocardial infarction is to postpone dental treatment for at least 3 to 6 months. Because of their chronotropic, inotropic, and arrhythmogenic properties, epinephrine and other vasoconstrictors are strictly contraindicated for patients recovering from myocardial infarction supported by the fact that after a myocardial infarction, higher risk of reinfarction is reported during surgery with the patient. In the postrecovery period local anesthetic with vasoconstrictor should be employed only in patients whose heart condition has been followed closely and judged stable by the treating cardiologist. In case of six months after the stroke, doses of epinephrine should be limited to less than 0.036 mg[2]. Intravenous sedation is used significantly more often for patients with hypertrophic cardiomyopathies[3].

Recent coronary artery bypass surgery

Both the injection of local anesthetic with vasoconstrictor and regular dental treatments could indeed be risky within 3 months after coronary artery bypass surgery. This corresponds to the delicate healing period during which significant ischemic alterations can take place.

Refractory arrhythmias

Ventricular tachycardia and ventricular fibrillation are among other dangerous types of arrhythmias associated with an increased risk of sudden death and thus represent one of the major contraindications to the use of vasoconstrictors in dentistry.

Untreated or uncontrolled severe hypertension

After many studies with varying number of subjects it has been found that that the blood pressure of the patients of the group without vasoconstrictor are significantly worse, in terms of control of the pain and stress, than those of the group with vasoconstrictor when the subjects were injected with local anaesthesia without and with vasoconstrictors respectively prior to tooth extraction[1].It is attributed to the bad anaesthesia obtained due to using local anesthesia without a vasoconstrictor which led to more stress during the extraction of teeth leading to increase in the endogenous catecholamines. Thus there is no contraindication to use of a LA associated with adrenaline when a prolonged and deep local anaesthesia is needed in hypertensive

subjects provided the hypertension is stabilized by an antihypertensive treatment.The maximum recommended dose is 0.04 mg in total which corresponds to 2 or 4 cartridges , 4ml of LA with 1/100000 adrenaline[2].Although vasoconstrictors may precipitate significant elevations in blood pressure, numerous studies have shown that the use of one to two cartridges of 2% lidocaine with 1:100,000 epinephrine (0.018 to 0.036 mg of epinephrine) is of little significance in most patients with hypertension[4]. Moreover, these patients should never undergo any dental treatment unless their condition has been assessed and adequately treated by a general physician.

Uncontrolled or untreated heart failure

Several studies have clearly shown that uncontrolled congestive heart failure carries a poor
prognosis and a high risk of sudden death resulting mainly from ventricular arrhythmias.

Digoxin, prescribed to increase the heart's contractile force, has a narrow therapeutic index and may precipitate a cardiac arrhythmia when used concurrently with vasoconstrictors. In patients taking nitroglycerin and other vasodilators, the diminished effects of vasoconstrictors can shorten the anaesthetic's duration of action[4].Therefore it is concluded that local anaesthesia with vasoconstrictor is contraindicated in these patients since they are at at high risk for morbid complications.

Uncontrolled Hyperthyroidism

Thyrotoxicosis is responsible for tachycardia, hypertension, and an increase in cardiac output. Studies have shown that hyper- and hypothyroid patients do not present major disorders when they are subjected to corrective treatment and put in the presence of catecholamines before the beginning of this treatment[1]. As part of a health care team, the dentist plays an important role in detecting thyroid abnormalities as well as modifications of dental care must be considered when treating patients who have thyroid disease[5]. Although the existing data remain equivocal, it is recommended that the use of vasoconstrictors in local anesthetics be avoided in untreated or poorly-controlled hyperthyroid patients[2].

Uncontrolled diabetes

The action of epinephrine directly opposes that of insulin. Its stimulates neoglucogenesis and hepatic glycogenolysis leading to hyperglycemia. Studies have shown that the amounts of epinephrine contained in one to three cartridges of local anesthetic (0.018 to 0.054 mg) may be enough to significantly increase the risk of a complications (ketoacidosis, hyperglycemia) in patients with unstable diabetes, and so should be avoided until their condition is brought under glycemic control and can be used safely for the majority of diabetic patients who are under control by diet or by hypoglycaemic[4] .The amount of local anesthetic with epinephrine 1:l00,000 should be the smallest doses compatible with profound anesthesia of sufficient duration and should be administered slowly after negative aspiration has been ensured[6].

Sulfite sensitivity

Many people are allergic to sulphites. Local anesthetics with vasoconstrictor provide a source of sulphite are used as preservatives in foods and beverages to prevent microbial spoilage or to inhibit undesirable organism reaction during fermentation, and therefore in any cases of proven allergy their administration becomes formally contraindicated[1].

Pheochromocytoma

Pheochromocytoma is a tumour of the adrenal medulla or paravertebral sympathetic ganglion which causes severe hypertension because of endogenous hypersecretion of adrenaline leading to severe risk of cardiovascular disorders. Local anaesthesia with vasoconstrictors are strictly contraindicated in the patients suffering from pheochromocytoma[1].

Triccyclic antidepressant (TCA)

The tricyclic antidepressants (TCAs) are drugs used in the treatment of major depression Tricyclic antidepressants (amitriptyline, doxepin, nortriptyline) elevate mood by preventing the reuptake of endogenous serotonin and norepinephrine in neuronal synapses. Addition of exogenous epinephrine in patients taking TCAs may result in abnormally high concentrations of catecholamines, thereby potentiating a hypertensive effect[7]. Among the vasoconstrictors noradrenaline is more prone to be blocked of the recapture[1]. The TCAs also

block the muscarinic and á adrenergic receptors therefore leading to myocardial depression which in turn modifies the cardiovascular response to the vasoconstrictors. Levonordefrin, a synthetic vasoconstrictor, has adrenergic effects that result mainly in the constriction of blood vessels. It therefore carries a higher risk than epinephrine of causing hypertension[2]. In patients taking TCAs, the use of levonordefrin-containing anesthetics (mepivicaine 3% with 1:20,000 levonordefrin) should be avoided[2].

Monoamine oxidase inhibitors

The monoamine oxidase inhibitors (MAOIs) are a group of psychotropic drugs primarily used in the treatment of major depression, certain phobic anxiety states and obsessive-compulsive disorders. Local anesthetics with vasoconstrictor should be used with utmost care for patients receiving MAOIs because the possibility of serious potentiation of exogenously administered catecholamines which could eventually lead to hypertensive crisis[7].

Phenothiazine compounds

The phenothiazines are a class of psychotropic drugs primarily employed in the treatment of serious psychotic disorders. Postural hypotension is the most common cardiovascular side effect reported with the phenothiazines. Although the epinephrine content of a single dental cartridge of local anesthetic is small, accidental intravascular injection could potentially worsen the hypotension frequently associated with the phenothiazines through an unbalanced stimulation of vascular P-receptors[7].

β blockers

It is mainly non cardio-selective β-blockers that competitively block the stimulation of the β 1 and β 2 receptors by endogenous as well as exogenous catecholamines which are the cause[4].It is mainly upon the β 2 receptors that the β-blockers act by transforming adrenaline into an exclusively á-adrenergic drug.The consequences are an increase in peripheral resistances and, directly in connection with the dose, an increase in blood pressure and a deceleration of the heart rate which can lead to major and well documented accidents. A clinically significant interaction between epinephrine or levonordefrin with nonselective beta-adrenergic blocking agents, although apparently rare in the dental setting, is potentially serious and can lead to significant hypertension with a concomitant reflex bradycardia[8]. This risk, however, is considered minimal if dosages are limited to amounts contained in one to two cartridges (0.04 milligrams of epinephrine) of local anaesthetic[2].

Cocaine

Recent use of cocaine increases the risk of a medical emergency during dental treatment, especially when epinephrine-containing local anaesthetics or retraction cords are used[9]. Cocaine is a sympathomimetic agent that stimulates norepinephrine release and inhibits its reuptake in adrenergic nerve terminals[6] predisposing abusers to arrhythmias, hypertension, and myocardial ischemia. Peak blood levels occur within 30 minutes, and the effects may linger for 4 to 6 hours. Due to the potential medical risks, any elective dental treatment should be postponed for at least 24 hours since the last cocaine use in order to allow elimination of the drug[7].

DISCUSSION

From the above mentioned facts and theory it is clear that local anaesthetics along with vasoconstrictors should be administered very carefully to medically compromised patients. For short-time dental treatments, epinephrine-reduced anaesthetics may offer shorter and more individual anaesthesia with reduced potential side effects[10]. The patients who are suffering from cardiac diseases or vascular diseases or other systemic diseases may have a life risk if the vasoconstrictors are used injudiciously. A thorough knowledge about the patients history, prior treatments being given to the patients and the medications which the patients are undergoing should be recorded. After judging all these details a proper plan should be made regarding the use of vasoconstrictors and then it should be meticulously carried out. A meta-analysis was done for one hundred and one studies reporting 1645 events regarding the adverse effects of local anaesthesia were included. Seven of these were deaths. Lidocaine (43.17%) and bupivacaine (16.32%) were the most often involved local anaesthetics. According to the meta-analysis, the risk of using LA alone was lower than when combined

with epinephrine. This study demonstrated that the adverse drug reactions of local anaesthetics could not be ignored, especially in oral and ophthalmologic treatments. Some adverse drug reactions could be avoided by properly evaluating the conditions of patients and correctly applying local anaesthetics[11]. A special care should be taken regarding the drug interactions of the vasoconstrictors with other drugs which the patient is already taking. Even patients who are under the effect of narcotics should be given an extra attention as injudicial use of vasoconstrictors may lead to immediate life risk situations and chair side deaths.

CONCLUSION

Majority of vasoconstrictors are being used in local anaesthetic solution are to reduce the stress by prolonging the effect of anaesthesia and to achieve a bloodless surgical procedure so that the minor surgical procedures will be carried out without any complications in a short duration of time period. But patients suffering from uncontrolled systemic diseases might have a life risk situation if these vasoconstrictors are used improperly. In spite of records of safety set by using these drugs, there is evidence to adverse reactions ranging from 2.5%-11% and even death may take place[12]. As a dentist it is ones responsibility to have a thorough knowledge about the systemic diseases and the indication and contraindication of using vasoconstrictors in these cases as mentioned in this article. Over the past few decades new generation of medicines have evolved with the advancement of science and technology all of which is practically impossible to be accounted in one article. The agents currently available in dentistry are extremely safe and fulfill most of the characteristics of an ideal local anaesthetic. These local anesthetic agents can be administered with minimal tissue irritation and with little likelihood of inducing allergic reactions[(13)]. A variety of agents are available that provide rapid onset and adequate duration of surgical anaesthesia. One should also have a proper knowledge of the advanced medicines and their uses and their interactions with vasoconstrictors before administering the local anaesthetics with vasoconstrictors to patients.

REFERENCES

1. Carlos Madrid , Rapporteur Bruno Courtois, MarcVironneau. Recommendations to use vasoconstrictors in dentistry and Oral surgery, *medicine buccale chirurgie buccale,* **9**: 3-21 (2003).
2. Budenz AW. Local anesthetics and medically complex patients. *J Calif Dent Assoc* **28**(8): 611-9 (2000).
3. Shibuya M, Kamekura N, Kimura Y, Fujisawa T, Fukushima K.Clinical study of anesthetic management during dental treatment of 25 patients with cardiomyopathy.*Spec Care Dentist*. **23**(6): 216-22 (2003).
4. Lieutenant Commander Demetrio Domingo, DC, USN, and Captain Thomas Canaan, DC, USN. Local anesthetics (Part III): use in medically complex patients, *Clinical Update,* **24**(11): 22-24 (2002).
5. Pinto A, Glick M.Management of patients with thyroid disease: oral health considerations.*J Am Dent Assoc.* **133**(7): 849-58 (2002).
6. Rknald Phrusse,Jean-Paul Goulet, DOS, MSD,Jean-Yves Turcotte,Contraindications to vasoconstrictors in dentistry: Part I Cardiovascular diseases,*Oral Surg Oral Med Oral Pathol* ;**74**: 679-86 (1992).
7. Lieutenant Commander Demetrio Domingo, DC, USN, and Captain Thomas Canaan, DC, USN. Local anesthetics (Part II): use in medically complex patients, Clinical Update, **24**(10): 20-21 (2002).
8. Elliot V. Hersh, Helen Giannakopoulos. Beta-adrenergic Blocking Agents and Dental Vasoconstrictors,*Update of Dental Local Anesthesia*, **54**(4): 687-696 (2010).
9. Brand HS, Gonggrijp S, Blanksma CJ Cocaine and oral health. *Br Dent J.,* **204**(7): 365-9 (2008).
10. Daubländer M, Kämmerer PW, Willershausen B, Leckel M, Lauer HC, Buff S, RöslB ,Clinical use of an epinephrine-reduced (1/400,000) articaine solution in short-time dental routine treatments—a multicenter study. *Clin Oral Investig.* **16**(4): 1289-95 (2012).

11. Maitland RI.Debatable evidence for the adverse drug reactions to local anaesthetics. *Evid Based Dent.*, **14**(2): 51 (2013).
12. Kaufman E, Garfunkel A, Findler M, Elad S, Zusman SP, Malamed SF, Galili D. Emergencies evolving from local anesthesia. Refuat Hapeh Vehashinayim. **19**(1):13-8,98 (2002).
13. Paul A. Moore, Elliot V. Hersh .Local Anesthetics: Pharmacology and Toxicity Update of Dental Local Anesthesia, **54**(4): 587-599 (2010).