Hypertension and the Dental Patient

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Learning Objectives: After reading this article the individual will learn: (1) classification and mechanism of action of antihypertensive medications, and (2) management of the hypertensive patient in the dental setting.

About the Author

Dr. Hardeman is a board-certified oral and maxillofacial surgeon and has been practicing for 25-plus years. After spending 24 years in private practice in Orlando, Fla, he has transitioned into an academic position at the University of Florida College of Dentistry (UFCD). He currently holds the position of clinical assistant professor of oral and maxillofacial surgery and is director of the predoctoral program of oral and maxillofacial surgery at UFCD. He graduated from the University of Missouri-Kansas City School of Dentistry and the University of Illinois College of Medicine, and he completed a residency in oral and maxillofacial surgery at Carle Foundation Hospital and Clinics in Urbana, Ill. His clinical interests include dentoalveolar surgery, trauma, pathology, and implants, and he has extensive experience in the areas of hard- and soft-tissue grafting for preparation of the oral cavity for future implant placement. Further areas of interest include team organization and preparation for office-based emergencies, and he has created several Web-based programs to facilitate the training of dental teams for unexpected emergencies. He can be reached at jhardeman@dental.ufl.edu.

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Hypertension is by far the most common cardiovascular disease in the United States, and patients with this disease process are commonly seen in the dental office. How patients with hypertension are managed is largely dependent upon their primary care physician, but their management may have an effect on the dental care rendered to them. It is important as a dental professional to understand the classification of antihypertensive medications and the effects that they have upon the patient as a whole and on the oral cavity. Hypertension can be divided into 5 distinct categories based upon the readings of the systolic and diastolic pressures (Table).1

**CLASSIFICATION OF ANTIHYPERTENSIVE MEDICATIONS**

While it is difficult to list every medication used to treat hypertension, the classification of these drugs is more easily understood. According to the American Heart Association, there are 10 main classifications of antihypertensive medications. These include the following: diuretics, beta-blockers, angiotensin converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), calcium channel blockers (CCBs), alpha-blockers, alpha-2 receptor agonists, combined alpha- and beta-blockers, peripheral adrenergic inhibitors, and vasodilators.2 A more in depth look at these medications singularly will reveal their mechanisms of action and potential ramifications for the dental patient.

**Diuretics**

There are several subclassifications of the diuretics, which include thiazide diuretics, potassium-sparing diuretics, and loop diuretics. Thiazide diuretics (eg, hydrochlorothiazide) can be used alone, or they can be administered adjunctively with other antihypertensive agents. The thiazide diuretics inhibit reabsorption of sodium and chloride mostly in the distal tubules of the kidneys and cause them to be excreted in the urine. Long term use of these drugs may result in hyponatremia.3 These medications do not affect normal blood pressure.

The potassium-sparing diuretics (eg, triamterene) interfere with sodium reabsorption at the distal tubules (primarily in the collecting duct region of the nephron), decreasing potassium secretion. Potassium-sparing diuretics have a weak diuretic and antihypertensive effect when used alone.3

Loop diuretics (eg, Lasix [furosemide]) are commonly used to control volume retention and are more commonly prescribed for patients with decreased glomerular filtration rate or heart failure. These antihypertensive medications act on the ascending limb of the loop of Henle, inhibiting the reabsorption of sodium and chloride. They are highly protein-bound and therefore enter the urine primarily by tubular secretion in the proximal tubule, rather than by glomerular filtration.3
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Known potential side effects of the diuretics include hypokalemia, weakness, thirst, dehydration, and increased urination. Changes in blood sugar levels are also possible. Skin reactions, some severe, are possible with thiazide diuretics (such as hydrochlorothiazide). Some potassium-sparing diuretics, such as spironolactone, may cause breast enlargement in males.

**Beta-Blockers**

Beta-blockers reduce the heart rate, the heart's workload, and the heart's output of blood, which lowers blood pressure. Although not generally used as a first line of treatment for hypertension, beta-blockers are suitable alternatives when a compelling cardiac indication (eg, heart failure, myocardial infarction, diabetes) is present. Selective beta-blockers specifically block beta-1 receptors alone, although they can be nonselective at higher doses. These drugs block norepinephrine and epinephrine (adrenaline) from binding to beta receptors on nerves. Norepinephrine and epinephrine are produced by nerves throughout the body; they serve as neurotransmitters and also are released into the blood.

There are 3 types of beta receptors and they control several different functions based on their location in the body. Beta-1 receptors are located in the heart, and beta-2 receptors are located in the smooth muscular walls of the blood vessels. By blocking these receptors, blood pressure can be controlled by affecting the heart rate, contractility and tone of the vessels themselves. Examples of beta-blockers include atenolol, Inderal (propranolol), timolol, and carvedilol. Beta-3 receptors are located in adipose tissues. Their roles are still being discovered but have been shown to have some depressant activity in the ventricles of the human heart.

Dizziness, weakness, fatigue, and fainting are all possible side effects of the beta-blockers. Because they also affect the respiratory system, other side effects include shortness of breath, difficulty breathing, and chest pain. Beta-blockers should not be withdrawn suddenly, as that could result in a heart attack or sudden death.

**Angiotensin Converting Enzyme Inhibitors**

Medical management of the renin-angiotensin-aldosterone (RAA) system has proven to be an effective adjunct in the management of hypertension. ACE inhibitors appear to act primarily through suppression of the RAA system. ACE inhibitors prevent the conversion of angiotensin I to angiotensin II and block the major pathway of bradykinin degradation by inhibiting ACE. These medications are the treatment of choice in patients with hypertension, chronic kidney disease, and proteinuria. ACE inhibitors have also proven to reduce morbidity and mortality rates in patients with heart failure, recent myocardial infarctions, and patients with renal disease. Although these medications are used as single-agent therapy, they are often times used in combination with other antihypertensive medications such as thiazide diuretics because of their synergistic effects. Examples of ACE inhibitors include lisinopril, captopril, and enalapril.

The most common side effect from ACE inhibitors is a dry cough. This usually goes away with continued use of the drug, but could take weeks before it subsides. Because ACE inhibitors reduce blood pressure, hypotension could result, which in turn could lead to headache, dizziness, fainting, and reduced kidney function.

**Angiotensin II Receptor Blockers**

ARBs are used to treat patients with hypertension who are found to be unable to tolerate ACE inhibitors. The effect on the RAA system is essentially the same. ARBs competitively block...
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binding of angiotensin II to angiotensin I receptors, thereby reducing effects of angiotensin II: vasconstriction, sodium retention, and aldosterone release. They can be used in combination therapy if proven to be less effective when used singularly. Popular examples of ARBs include Diovan (valsartan) and Cozaar (losartan potassium).

Potential harmful effects of the ARBs in patients with hypertension, type 2 diabetes, and renal impairment include the elevated risk of cardiovascular and renal events. Studies have shown that there is an increased risk of nonfatal stroke, renal complications, hypokalemia, and hypotension when used in combination therapy. Dizziness is also common, along with fatigue. Upper respiratory tract infections have also been reported, as well as gastrointestinal issues like upset stomach and diarrhea.

**Calcium Channel Blockers**

CCBs can be divided into 2 basic subgroups: those that have their effect on the vascular smooth muscle and those that also affect the calcium channels of the sinoatrial node and the atrioventricular node. They are chemically known as the dihydropyridines and non-dihydropyridines. These drugs prevent calcium from entering the smooth muscle cells of the heart and arteries by blocking the channels. Normally when calcium enters these cells, it causes a stronger, more forceful contraction. However, when these medications take their effect, the level of calcium coming into the heart and vascular cells is decreased and as such the heart’s contraction is not as forceful and the vessels are allowed to relax and dilate.

Dihydropyridines, such as amlodipine and nifedipine, bind to L-type calcium channels of the vessels, creating vasodilation and thus a decrease in blood pressure. Amlodipine is a peripheral arterial vasodilator that acts directly on vascular smooth muscle to cause a reduction in peripheral vascular resistance and reduction in blood pressure. This subclass of medications is effective as single agent therapy in black patients and elderly patients.

Non-dihydropyridines, such as verapamil and diltiazem, bind to L-type calcium channels in the sinoatrial and atrioventricular nodes of the heart as well as have a direct effect on the myocardium and the vasculature. These agents may constitute a more effective class of medication for black patients.

As many as one third of patients taking CCBs may experience side effects such as swelling of the ankles and other extremities, flushing, and dizziness. Other common side effects include heartburn and nausea. Gingival hyperplasia has also been recognized as a specific dental side effect with nifedipine.

**Alpha Receptor Blockers**

The blood vessels contain 2 types of receptors in their muscular walls: adrenergic and cholinergic. Sympathetic nerves that release norepinephrine can stimulate both the alpha-1 and alpha-2 receptors, causing vasoconstriction. For the sake of complete understanding, norepinephrine also binds weakly to post-junctional beta-2 adrenoceptors, which causes vasodilation, but the effect of the alpha vasoconstriction is usually more prominent.

Alpha-blockers selectively block presynaptic alpha-1 adrenergic receptors. They dilate arterioles and veins, thus lowering blood pressure. These drugs are generally not recommended as initial monotherapy and can be combined with any of the other antihypertensives in other drug classes. Examples of alpha-blockers include Minipress (prazosin hydrochloride) and Cardura (doxazosin).

Common side effects seen in this drug class include dizziness, headache, and drowsiness, in addition to orthostatic and first-dose hypotension. Additionally, the alpha-blockers can result in tachycardia, nausea, and weakness.

**Alpha-2 Receptor Agonists**

These drugs reduce blood pressure by decreasing the activity of the sympathetic (adrenaline-producing) portion of the involuntary nervous system. Alpha-2 receptor agonists act centrally to stimulate presynaptic alpha-2 adrenergic receptors in the brain stem, which reduces sympathetic nervous activity. This decrease in sympathetic activity creates less norepinephrine release at the level of the vascular smooth muscles and, as a result, there is less vasoconstriction. Examples of these medications include methyldopa and clonidine. Postural hypotension as well as rebound hypertension can be seen with these medications.

Up to 40% of patients taking clonidine will experience dry mouth, and about a third will have drowsiness, headache, and sleepiness. Other common side effects include constipation, dizziness, and local skin reactions. Reserpine use is linked with possible side effects including nightmares, stuffy nose, depression, and an inability to fall asleep. Diarrhea and heartburn are also possible.

**Combined Alpha- and Beta-Blockers**

Stimulation of alpha-1 and beta receptors leads to vasodilation and decreased total peripheral resistance. Drugs such as labetalol and carvedilol cause a decrease in blood pressure without a substantial decrease in resting heart rate, cardiac output, or stroke volume. Combined alpha- and beta-blockers are used as an intravenous drip for those patients experiencing a hypertensive crisis. They may be also prescribed for outpatient control of high blood pressure, especially in patients who are at risk for heart failure. Like other antihypertensive medications, orthostatic (postural hypotension) can be seen, especially in the older population.
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**Peripheral Adrenergic Inhibitors**

These medications reduce blood pressure by blocking neurotransmitters in the brain. Reserpine is a peripherally acting adrenergic agent and reduces blood pressure by depleting sympathetic biogenic amines. The result is a loss of sympathetic function at the level of the blood vessels and blocks the smooth muscles from getting the "message" to constrict. These drugs are rarely used unless other medications don't help and are used as adjunctive therapy with other antihypertensive agents in more severe forms of hypertension.2,3

Reserpine use—as stated earlier—is linked with possible side effects including nightmares, stuffy nose, an inability to fall asleep, diarrhea, and heartburn. Reserpine, with its subsequent decrease in peripheral vascular resistance and a lowering of blood pressure, is often associated with bradycardia, orthostatic hypotension, and depression.3,4

**Vasodilators**

Vasodilators, such as hydralazine and minoxidil, lower blood pressure by exerting a peripheral vasodilation effect through a direct relaxation of vascular smooth muscle. Side effects of these medications include headaches, swelling around the eyes, heart palpitations or aches and pains in the joints. Minoxidil in particular may cause fluid retention (marked weight gain) or excessive hair growth.5

**MANAGING THE HYPERTENSIVE DENTAL PATIENT**

Because hypertension is such a common medical condition, it is frequently seen in the dental office. It is extremely important to understand how this condition affects the dental patient and how dental treatment affects the hypertensive patient. Therefore, management of these patients is paramount for the dental practitioner. When receiving notice on the medical history form, certain questions should be asked when encountering patients with a history of hypertension. These include:

- What medication(s) are these patients taking?
- When do they take their medication?
- Have they been compliant with taking their medication?
- Have they taken it today?

Understanding what medications the patient is taking is an important point because it gives the practitioner an idea as to how well the hypertension is controlled. Patients who take more medications to control their hypertension generally indicate a more recalcitrant condition. Compliance with medications is necessary. Without compliance, control of medical conditions is virtually impossible. The time of day that a patient takes the medication may play a role in appointment times. For example, if the patient takes his or her medication in the morning, it may be later in the day when the medication is in full effect, and so appointments later in the day may be more appropriate for adequate control of the hypertension prior to dental treatment. Certainly, the final question of whether or not the patient has taken the medication on the day of the dental appointment is important because it sets the tone for normal blood pressure readings at the appointment.

Local anesthetics used in dentistry generally have epinephrine as an additive, which helps improve the depth and duration of the anesthesia, as well as reduce bleeding in the operative field. The benefits of this vasoconstrictor are well documented. However, despite these benefits, the clinical impact on the cardiovascular system by the injection of exogenous epinephrine in hypertensive patients is a controversial subject in dentistry.8 Pain control is essential for patients undergoing general dentistry. This is especially true in patients with cardiac disease. Pain alone can result in a significant release of endogenous epinephrine.9 Malamed et al recommend a maximum dose of 40 μg epinephrine per dental appointment in this patient population.10 While there is no evidence to support this dose, limiting the amount of administered epinephrine to 40 μg can minimize the potentially deleterious effect of epinephrine. This amount is contained in 2 cartridges of 1:100,000 or 4 cartridges of 1:200,000. Although the half-life of epinephrine is very short, exceeding 40 μg epinephrine per appointment cannot be recommended unless the patient’s cardiac status is monitored continuously during the procedure.9,11

**CONCLUSION**

Hypertension is a common medical problem in the United States; thus many dental patients will be affected by this condition. Understanding the class of antihypertensives and their mechanism of actions will help the practitioner in fully understanding the disease process. The type and combination of high blood pressure medications, patient compliance, and monitoring of the condition as well as the surveillance of vital signs during the dental appointment are all important issues to be addressed when working with dental patients who are affected by this disease process.✔

**References**


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POST EXAMINATION QUESTIONS

1. Diuretics include the following subclassification(s):
   a. Thiazide diuretics.
   b. Potassium-sparing diuretics.
   c. Loop diuretics.
   d. All of the above.

2. Beta-blockers reduce the heart rate, the heart’s workload, and the heart’s output. They are not generally used as a first line of treatment for hypertension.
   a. The first statement is true, the second is false.
   b. The first statement is false, the second is true.
   c. Both statements are true.
   d. Both statements are false.

3. Lisinopril, captopril, and enalapril are examples of:
   a. Beta-blockers.
   b. Angiotensin converting enzyme (ACE) inhibitors.
   c. Diuretics.
   d. Calcium channel blockers (CCBs).

4. The following type of medication is used to treat patients with hypertension who cannot tolerate ACE inhibitors:
   a. CCBs.
   b. Alpha receptor blockers.
   c. Angiotensin II receptor blockers.
   d. Diuretics.

5. The following classification of antihypertensive medications is divided into 2 basic subgroups: dihydropyridines and non-dihydropyridines.
   a. ACE inhibitors.
   b. CCBs.
   c. Alpha-2 receptor agonists.

6. Alpha receptor blockers selectively block postsynaptic alpha-1 adrenergic receptors. They dilate arterioles and veins to lower blood pressure.
   a. The first statement is true, the second is false.
   b. The first statement is false, the second is true.
   c. Both statements are true.
   d. Both statements are false.

7. Up to 40% of patients taking clonidine will experience dry mouth and about a third will have drowsiness, headache, and sleepiness.
   a. True.
   b. False.
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8. The following is used as an intravenous drip for patients experiencing a hypertensive crisis.
   a. Alpha-2 receptor agonists.
   c. Peripheral adrenergic inhibitors.
   d. Vasodilators.

9. Which drug is a peripherally acting adrenergic agent that reduces blood pressure by depleting sympathetic biogenic amines?
   a. Reserpine.
   b. Minipress.
   c. Methyldopa.
   d. Triamterene.

10. For patients with cardiac disease, the maximum recommended dose of epinephrine per dental appointment is:
    a. 20 µg.
    b. 40 µg.
    c. 60 µg.
    d. 80 µg.
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