jcda.ca
ESSENTIAL DENTAL KNOWLEDGE

Management of the Hypertensive Dental Patient

Rickson Valtellini, BEng; **Aviv Ouanounou**, MSc, DDS, FICO

Cite this as: *J Can Dent Assoc* 2023;89:n2

ABSTRACT

Hypertension is a serious chronic illness that affects more than a third of the world's population. The high prevalence of hypertension coupled with its lack of initial clinical symptoms can make managing a hypertensive patient in a dental setting difficult. The dentist's role in managing hypertensive patients encompasses more than simple treatment modifications. Because of the frequency of dental checkups, dentists play an integral role in the detection of elevated blood pressure and appropriate subsequent referral. As such, it is imperative that dentists are aware of risk factors associated with hypertension to council patients early. In addition, antihypertensive medications pose a risk in dental treatment. Such drugs may produce various oral presentations and interact negatively with drugs commonly prescribed by the dentist. It is critical to recognize these changes and avoid possible interactions. Furthermore, dental treatment can often induce fear and anxiety resulting in an increase in blood pressure; this can further complicate management of patients with pre-existing hypertension. As research and recommendations are constantly changing, dentists must stay informed on how to appropriately administer care. This article is intended to provide the dental team with clear guidelines on the overall management of a hypertensive patient in a dental clinic.

Published: March 31, 2023

Hypertension affects more than a billion people and is the leading risk factor for morbidity and mortality around the globe.[1,2] The lethality of hypertension is attributed to the fact that it is the most common risk factor for cardiovascular disease, which claims roughly 18 million lives a year.[3,4] Despite global efforts to mitigate hypertension, the number of cases has been increasing steadily over the last 25 years.[5] In 2017, the threshold at which we classify hypertension was reduced to any reading over 130 mmHg systolic blood pressure (SBP) and 80 mmHg diastolic blood pressure (DBP).[6] This decision was made after studying the importance of early intervention as well as the fact that, with each increased increment of 20 mmHg in SBP, the risk of cardiovascular diseases doubles.[7–9] The association of hypertension with cardiovascular disease is not the only reason for the disease's high mortality rate. It is also a risk factor for chronic kidney disease, stroke, heart failure, diabetes, dementia and erectile dysfunction.[10,11]

The etiology of hypertension falls into 2 major categories: primary/essential and secondary.[12] For adults, close to 95% of hypertension can be attributed to primary causation, meaning there is no identifiable cause. Secondary hypertension, the remaining 5%, is the result of an underlying condition, such as obstructive sleep apnea, adrenal gland tumours, thyroid conditions, kidney disease and congenital blood vessel defects. Certain medications may also be linked to secondary hypertension: oral contraceptives, decongestants and over-the-counter analgesics.[11–14] The pathogenesis of hypertension involves intricate interactions between environmental, genetic and behavioural factors.[15] Risk factors notably include age, family history of cardiovascular disease, smoking, elevated and frequent alcohol consumption, cholesterol, sodium-rich diet and sedentary life style.[11,12,16,17] Pathophysiologic mechanisms that contribute to essential hypertension are salt/volume overload, activation of the renin-angiotensin-aldosterone system and the sympathetic nervous system.[4,12] The pharmacologic action of antihypertensive medications will target these specific systems. However, we also discuss the importance of non-pharmacological intervention as an adjunct to reducing blood pressure.

Hypertension often lacks symptoms, and, for many people, the most common interaction with a health professional is with their dentist. Therefore, dentists play an important role in early recognition, referring for diagnosis and providing council on prevention. The aim of this article is to go beyond simple screening for hypertension and to provide the dentist with a complete guide to managing the care of a hypertensive patient. Aspects of this include restrictions and warnings when certain procedures should be limited, common dentist-prescribed medications and their interaction with antihypertensive medications, oral presentations of hypertension, office blood pressure reading protocol and stress-limiting protocols.

Methods

We carried out a literature review to identify the management of hypertensive patients in a dental setting. Databases in the University of Toronto library system were searched to locate relevant peer-reviewed articles written in English and published in the past 5 years to ensure relevancy. Search words included "hypertensive patients," "management," "adverse effects," "pharmacology," "classification" and "dentistry." Dentistry textbooks were also obtained from the University of Toronto Library and reviewed for relevant information. A limitation was the fact that some guidelines are based on best practices from the literature and not derived from a randomized controlled study because of ethical constraints.

Classification

The classification of hypertension has changed many times throughout the years and differs globally. A 2017 update from the American College of Cardiology (ACC) and the American Heart Association (AHA) decreased the threshold at which we classify hypertension.[6,7] This change stems from the fact that recent data have shown that intense blood pressure control in the lower ranges results in reduced fatality rates from cardiovascular events.[18] Previously, prehypertension was described as SBP 120–139 mmHg or DBP 80–89 mmHg. The ACC/AHA has now separated hypertension into 2 categories: elevated (SBP 120–129 mmHg and DBP < 80 mmHg) and stage 1 (SBP 130–139 mmHg or DBP 80–90 mmHg). As a result, all other thresholds have also been lowered (**Table 1**).

It should also be noted that a single elevated blood pressure reading does not justify a specific classification. Classification should be based on an average of ≥ 2 readings on ≥ 2 occasions in a standardized environment using appropriate blood pressure technique. If SBP and DBP readings place the classification in different categories, the higher category should be chosen.[19] Furthermore, persistent elevated blood pressure in a clinical setting in a patient who has no previous elevated reading within a 24h period should be considered "white coat" hypertension. White coat hypertension can be confirmed with home blood pressure readings of ≤ 135/85 mmHg or 24h ambulatory readings ≤ 130/80 mmHg.[20,21]

From a treatment standpoint, classification is important as it serves as a factor when deciding when pharmacologic therapy should commence. However, the standard practice does not rely solely on blood pressure, but also includes a risk assessment for atherosclerotic cardiovascular disease, 10-year cardiovascular disease and general clinical judgement (**Figure 1**). If a patient falls within the normal or elevated blood pressure class, pharmacologic

treatment is not necessary. The administration of antihypertensives is deemed appropriate for stage 1 hypertensive patients if they also have an atherosclerotic cardiovascular disease or 10-year cardiovascular disease risk assessment ≥ 10%. The initiation of antihypertensive medication is acceptable for a stage 2 hypertensive patient without the need for risk assessment but assessment is still recommended.[6] In all classes, the therapeutic target is to lower blood pressure to ≤130/80 mmHg. In the case of seniors (over 65 years) with hypertension and other comorbidities, the appropriateness of pharmacologic action relies on other factors, such as clinical judgement, patient preference and a team-based approach. It is extremely important that, regardless of pharmacological treatment, all patients be educated on appropriate lifestyle modifications to reduce blood pressure, enhance antihypertensive therapy and decrease cardiovascular risk.[22]

The measurement and classification of hypertension are useful in a dental setting for several reasons. First, it is important to recognize hypertension early to offer intervention, counseling and referral to mitigate progression of the disease; lifestyle modifications play an important part in the control of hypertension, independent of pharmacologic treatment. Second, classification serves as an important indicator as to when certain dental procedures should be suspended. Third, measuring blood pressure at the beginning of appointments—and during—can reveal how dental treatment may affect blood pressure. Blood pressure may change with administration of local anesthetic, general anesthesia or even anxiety over the procedure. We discuss the nuances of these effects below.

Pharmacology of Antihypertensive Drugs

One of the most important aspects of management of the hypertensive patient in a dental setting is a complete medical history, and a significant aspect of the medical history is noting all medications the patient is taking. Antihypertensive medications have a variety of adverse effects that can manifest in the oral cavity.[23] Some of the more frequent ones include xerostomia, lichen planus type lesions, dysgeusia and gingival hyperplasia. Although direct adverse effects are of concern, dentists should also be aware of potential problematic interactions involving the use of vasoconstrictors, such as epinephrine and NSAIDS, as well as the induction of orthostatic hypotension.

A variety of medications are used by hypertensive patients to control their blood pressure (**Table 2**). The goal in multidrug therapy is to treat the hypertension through multiple mechanisms of action, which may lower the chances of adverse effects and drug resistance by reducing the relative amount of each drug that's taken. The main classes of medications include angiotensin-converting enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs) and thiazide diuretics.[22] ACE inhibitors combat hypertension by interfering with the renin-angiotensin-aldosterone system (RAAS). The RAAS is a complex of organs and enzymes that increase blood pressure through a variety of mechanisms, such as increasing blood volume and vasoconstriction. ACE inhibitors block the conversion of angiotensin 1 into angiotensin 2 thus halting the RAAS and decreasing blood pressure.[24] ARBs counteract the RAAS through a different mechanism of action. They block the active enzyme (angiotensin 2) from interacting with its receptor, thus preventing vasoconstriction, water retention and aldosterone production and, therefore, decreasing blood pressure.[24] CCBs lower blood pressure by acting at the level of the cardiac myocytes and smooth muscle cells in arteries. They block the influx of calcium into these cells allowing for vasodilation and a decrease in cardiac output.[24] Thiazide diuretics act at the level of the kidney by inhibiting the reabsorption of sodium and chlorine ions from the distal convoluted tubule by blocking thiazide-sensitive sodium–calcium symporter.[24] Blocking this transport allows for a decrease in blood volume and, subsequently, blood pressure.

Xerostomia

Commonly known as dry mouth, xerostomia is the most commonly reported adverse effect of antihypertensive medication.[23] Xerostomia tends to increase with the amount of anti-hypertensive drug taken; thus, the likelihood of developing adverse effects would also likely increase. Xerostomia is associated with the development of dental caries. Salivary flow plays a crucial role in the buffering effect needed to balance the demineralization/remineralization process taking place in the oral cavity. Without adequate salivary flow, the oral environment favours demineralization, leading to dental caries.[27] Other negative effects of xerostomia include increasing susceptibility to halitosis, oral/pharyngeal infections, gingivitis and bleeding/ulceration events.[28] Non-pharmacologic management may involve drinking more water and using oral lubricants, gums, pastes and sprays.[29] Changing the brand of antihypertensive medication or prescribing parasympathomimetic agents, such as pilocarpine, cevimeline, bethanechol chloride or anethole trithione, has also been shown to be an effective treatment option.[30,31]

Oral Lichenoid Reaction

The etiology of oral lichen planus (OLP) is not well understood; however, its histology and clinical presentation are identical to that of a oral lichenoid reaction (OLR).[32] OLR is a well observed adverse drug reaction to a variety of antihypertensive medications (**Table 2**).[33] It can present as bilateral white papules forming reticular or annular plaque-like patterns on the buccal mucosa, palate, gums and tongue. It may also present as erythematous erosive and ulcerative lesions.[34] OLR creates an unpleasant environment for patients causing a burning sensation, bleeding, pain and general discomfort associated with the patches.

A variety of management strategies exist for symptomatic OLR lesions, including non-pharmacologic approaches, such as limiting mechanical trauma that may be induced by an ill-fitting prosthesis. Pharmacologic treatment with topical corticosteroids, such as clobetasol, have also proven to be effective.[32] Although OLR can be a serious adverse effect, stopping or changing the offending antihypertensive often resolves the condition.[33]

Dysgeusia

Some degree of taste alteration has been reported in roughly 30% of patients prescribed antihypertensive and antihyperlipidemic drugs.[34] Although dysgeusia presents no immediate threat to oral health from a clinical standpoint, it can have implications for the psychological well-being of the patient. Dysgeusia may affect a patient's quality of life or influence his/her appetite and body weight, leading to more severe physiologic consequences.[35]

Management of dysgeusia may closely follow that for xerostomia as prolonged xerostomia can also lead to dysgeusia.[36] Therefore, use of the previously mentioned sialagogues is appropriate. However, dysgeusia may be independent of xerostomia and require alternative management. Although research is limited, alpha lipoic acid and zinc supplementation have been shown to improve taste perception.[37] In addition to pharmacologic treatment, lifestyle modifications may also alleviate antihypertensive-induced taste alteration, e.g., avoiding metallic silverware and bitter tasting foods, increasing the consumption of flavourful high-protein foods.[38]

Gingival Hyperplasia

Gingival hyperplasia—aka gingival overgrowth or gingival enlargement—is an often-observed adverse reaction to calcium channel blockers, affecting 20–75% of patients.[39] The effect varies with type of calcium channel blocker as well as the oral health status of the patient. It should also be noted that gingival overgrowth can be observed in about 50% of patients who take phenytoin (a class 1 anti-arrhythmic drug).[34] Although tissue overgrowth is benign, it can impact mastication, phonation and general esthetics and compromise quality of life.[40] Gingival overgrowth can also create an uncomfortable oral environment, as tissue can become inflamed with the accumulation of plaque under enlarged gums where it is not easily removed.[41]

Potential management of gingival hyperplasia can be mitigated by removing the pro-inflammatory agents, by increasing oral hygiene regimes and using chlorhexidine or folic acid rinses. This approach is usually intended for patients who are trying to prevent the disease before onset and less so for management.[33] A more appropriate non-surgical modality is subgingival scaling and root planing, supplemented with oral hygiene instruction and frequent recalls.[42] Surgical intervention via gingivectomy is the most effective treatment; however, as recurrence is common, this is recommended only for severe cases.[33,42] In addition to the aforementioned treatment modalities, substitution of the offending agent should be considered where medically appropriate.

Orthostatic Hypotension

Orthostatic hypotension is the sustained reduction of SBP by at least 20 mmHg or of DBP by at least 10 mmHg within 3 minutes of standing or head-up tilt to at least 60° on a tilt table.[43] A patient taking antihypertensive medication may often experience light-headedness or syncope on standing after prolonged dental procedures in the supine position. The failure of the autonomic nervous system to adequately perfuse cerebral arteries creates a brief moment when the patient could trip, fall and harm themselves. Orthostatic hypotension can be managed simply by allowing the patient to sit upright for a few minutes followed by assistance on standing.[44] This allows for adequate cerebral profusion to occur, mitigating the risk of syncope.

NSAIDS

Non-steroidal anti-inflammatory drugs (NSAIDs) are often prescribed in a dental setting for their analgesic and anti-inflammatory properties.[22] Furthermore, NSAIDs make up 5–10% of all prescriptions across all health care professions.[45] The use of NSAIDs, while helpful in mitigating pain, can attenuate the effects of antihypertensive medications for prolonged periods.[46] The average rise in blood pressure with chronic NSAID use is 5 mmHg, which over a long enough time can increase a patient's risk of other cardiovascular disease, including heart failure.[45]

The management of this potentially detrimental reaction is to limit the duration of treatment with NSAIDs to 5 days, as the use of NSAIDs for a few days shows almost no clinical relevance.[22,47] In addition to limiting duration, other analgesics, such as paracetamol, may be prescribed to avoid this effect.[20]

Vasoconstrictors

The use of vasoconstrictors, such as epinephrine, in local anesthesia is paramount in performing successful clinical dentistry. The added vasoconstrictor aids in providing profound anesthesia to the focus area by mitigating systemic uptake, thus extending duration of action and providing local hemostasis. In addition, the dulling of sensory nerve fibres can alleviate stress experienced by the patient which would increase blood pressure from the release of catecholamines.[48] However, the administration of vasoconstrictors into the circulation system can also cause an increase in blood pressure; therefore, special consideration must be given to the hypertensive patient.

Much research has been done on this topic and it concludes that administration of local anesthetic containing vasoconstrictors shows

little clinical relevance if done within accepted guidelines [49–51] In fact, the appropriate administration of local anesthetic containing a vasoconstrictor far outweighs the risk by limiting stress-induced increases in blood pressure resulting from dental pain and anxiety. The effects of vasoconstrictors on systemic blood pressure is dose dependant.[52] Therefore, procedures of long duration to multiple quadrants using epinephrine should be completed independently, while maintaining diligent supervision of blood pressure. The use of 1 to 2 cartridges of local anesthetic with 1:80 000, 1:100 000 or 1:200 000 of epinephrine in patients with controlled hypertension and/or coronary disease is generally considered safe.[26,53–55] In general, keeping the dose of vasoconstrictor below 0.04 mg per appointment is a safe practice for patients with hypertension.[56] Although this rule generally applies to patients with uncontrolled hypertension and/or cardiovascular disease, the state of a patient's control is variable and the best practice may be to limit epinephrine in all cases and focus on the establishment of profound anesthesia with plain anesthetics.[21] Consequently, the amount of epinephrine in the local anesthetic should be 1:100 000 or 1:200 000 to limit its delivery.[22] Also, aspiration before injection to mitigate system load is of vital importance. It should also be noted that the use of even 1 cm of retraction cord impregnated with epinephrine can administer a dose equivalent to about 11 cartridges (2% lidocaine, 1:100 000 epinephrine) of local anesthetic and, therefore, should be absolutely contraindicated for the hypertensive patient.[20,22,57]

Patient Management

The management of hypertensive patients requires a delicate combination of accurate record keeping, detailed knowledge and extensive preparation. The first step to patient management is identification and classification. A complete medical history encompassing all prior aliments with up-to-date drug history is required to become familiar with any relevant adverse drug reactions or common dental interactions (**Table 2**). In addition, blood pressure should be measured before any treatment and documented for both new and returning patients. Intermittent blood pressure measurement over the duration of the appointment is advisable for diagnosed hypertensive patients as blood pressure can change dramatically during treatment.[58] Such measures are especially indicated for more complicated dental procedures that are stress inducing, such as long-duration restorative procedures, oral/periodontal treatments and the placement of dental implants. Although fluctuations in blood pressure pose a relatively low risk to non-hypertensive individuals, acute elevation of blood pressure in known hypertensive patients could lead to detrimental outcomes, such as stroke or myocardial infarct.[4,58] Measurement of blood pressure not only provides an indicator for dental treatment but it also creates an opportunity to make the patient aware of the possibility of undiagnosed hypertension. Early diagnosis is vital, as uncontrolled hypertension is a major predictor of mortality, morbidity, stroke and decline in cognitive function.[59]

Protocol for Office Blood Pressure Measurement

Because of the importance of blood pressure measurement in a dental setting, accuracy is essential. The most common equipment used for this purpose is a standard or electronic sphygmomanometer. The device should be calibrated before each use and maintained and used according to the manufacturer's guidelines. The patient should be seated with his/her feet on the floor for 5 minutes in a non-stressful environment. An appropriate size cuff is one in which the cuff bladder encompasses at least 80% of the circumference of the patient's arm. The arm on which the cuff is to be placed should be positioned and supported at the level of the heart. Using a stethoscope, SBP is recorded when the first of 2 or more sounds is heard, and DBP is recorded at the disappearance of sounds. Whether using a manual or electronic sphygmomanometer, measurements should be taken twice and documented for consistency.[7,60,61] If readings are drastically different, allow the patient to rest and proceed with taking a third reading.

Suspension of Treatment

The question as to what level treatment should be suspended is difficult to answer. There are no specific circumstances for which we can be absolutely certain dental treatment will not negatively impact a hypertensive patient. However, extensive evidence-based guidelines show that hypertensive patients with preoperative SBP < 180 mmHg and DBP < 110 mmHg and no pre-existing cardiac conditions are at extremely low risk for complications during the course of their dental treatment and, therefore, treatment does not have to be suspended.[6,62–64] Above this threshold, a variety of risk assessment measures coupled with clinical judgement can be employed to decide whether suspension of treatment is necessary.

SBP in the range 160–180 mmHg and DBP 100–110 mmHg should be a potential red flag for severe asymptomatic hypertension. Hypertensive urgency, defined as SBP and/or DBP above 160 and 100 mmHg, respectively, with no associated end organ damage,[65] may be experienced for a variety of reasons ranging from white-coat hypertension to noncompliance with an antihypertensive drug regime.[65] Management of hypertensive urgency is multifaceted and requires adequate referral.

Blood pressure varies considerably throughout the day; ambulatory measurements can show variations of 60–100 mmHg for SBP and 50–70 mmHg for DBP over 24h.[64,66] Blood pressure changes with normal physiological processes, such as routine activity, sleep, excitement or stress and even talking. This, in conjunction with white coat hypertension, can create an environment where blood pressure readings may exceed 180/110 mmHg.

Appropriate risk assessment tools such as that created by the American Society of Anesthesiologists (ASA), the use of metabolic equivalents (METs)[22] or even a recent risk stratification questionnaire adapted by

Yarows et al.[64] from the new hypertension guidelines may be useful (**Tables 3A, 3B** and **3C**). The ASA is a standardized classification system used to assess the fitness of patients before surgery. METs are used to quantify an individual's ability to perform physical activities. The Yarows et al. study created a useful short questionnaire to assess hypertension based on ACC/AHA guidelines.[64]

Based on these classification systems, if a patient has an ASA classification of 3–4 or a MET capacity of 4, precautions should be taken during dental procedures, such as breaking up long appointments into several shorter ones as well as taking frequent blood pressure measurements during procedures.[21] With respect to the risk questionnaire (**Table 3C**), a patient who answers no to a prompt from category A and B would trigger an immediate discussion with the primary care physician to discuss risk versus benefits of the dental procedure.[63,64]

Dental Anxiety

Various dental procedures can undoubtably cause an increase in blood pressure because of dental anxiety before and stress during the procedure. Stress can result in endogenous epinephrine release. If substantial pain is experienced, catecholamine release can spike to 40 times the normal baseline level.[26] In some studies, increases in blood pressure resulting from stress and pain have been so large that local anesthetic with or without the use epinephrine had no effect on blood pressure during extractions.[51] Therefore, it is prudent for the dental team to create an anxiety-free environment, not only for hypertensive patients, but also for all patients. Management of stress could involve morning visits as well as the administration of an anxiolytic the night before the treatment and 1–2h before the appointment (depending on the dose and brand).[47] The use of nitrous oxide may also be indicated to reduce stress during treatment. The use of music during treatment has also been shown to reduce stress.[69,70]

Intraoperative Bleeding

Hypertensive patients are susceptible to excessive intra-operative bleeding, which can limit visibility during dental procedures. Also, because of various comorbidities associated with hypertension, many patients are also prescribed anticoagulants, such as aspirin and warfarin. These further exacerbate intraoperative bleeding and may also impair adequate impression taking.

It is recommended that patients remain on anticoagulant medication during the course of their dental treatment depending on the degree of invasiveness.[26] Restorative work does not indicate cessation of anticoagulants or antihypertensives.[71] However, more extensive oral and maxillofacial surgery extending beyond the dentoalveolar scope require case-by-case discussion.[72,73] In restorative work where bleeding may impede adequate impression taking, various hemostatic agents may be used to improve visibility. Such agents include chitosan-based products, bone wax, fibrin sealants, acid, oxidized cellulose, aluminium chloride, ferric sulfate, aluminium potassium sulfate, zinc chloride, trichloroacetic acid and tannic acid, used in addition to cordless retraction techniques.[21,74] It is important to be mindful of the chemistry of these agents to limit the use of unnecessary epinephrine. A good practice with patients with hypertension and oral bleeding is to perform 1 extraction and assess coagulation before moving forward.

Table 1: Updated classification of hypertension.

Systolic pressure, mmHg	And/or	Diastolic pressure, mmHg	JNC, 7th report[7]	2017 ADD/AHA[6]
< 120	and	< 80	Normal blood pressure	Normal blood pressure
120–129	and	< 80	Prehypertension	Elevated blood pressure
130–139	or	80–89	Prehypertension	Stage 1 hypertension
140–159	or	90–99	Stage 1 hypertension	Stage 2 hypertension
≥ 160	or	≥ 100	Stage 2 hypertension	Stage 2 hypertension

Note: ADD = American Dental Association, AHA = American Heart Association, JNC = Joint National Committee.

Table 2: Antihypertensive medications and their dental implications.[20–23,25,26]

Medication, generic (trade) name	Adverse effects	Potential treatment interactions
Primary agents		
Angiotensin-converting enzyme inhibitors		
Benazepril (Lotensin), captopril (Capoten), enalapril (Vasotec), fosinopril (Monopril), lisinopril (Prinivil, Zestril), moexipril (Univasc), perindopril (Aceon), quinapril (Accupril), ramipril (Altace)	Xerostomia, dysgeusia, ageusia, lichenoid reactions, rash, dry cough, angioedema, burning mouth, gingival bleeding, neutropenia	NSAIDs/orthostatic hypotension
Angiotensin receptor blockers		
Candesartan (Atacand), eprosartan vasoconstrictor (Teveten), irbesartan (Cozaar), Olmesartan (Benicar), telmisartan (Micardis), valsartan (Diovan)	Xerostomia, dysgeusia, angioedema, sinusitis, cough	Systemic antifungals, sedatives/ orthostatic hypotension
Calcium channel blockers		
Nondihydropyridines: diltiazem (Cardizem), verapamil (Calan) Dihydropyridines: amlodipine (Norvasc), felodipine (Plendil), isradipine (DynaCirc), nicardipine (Cardene), nifedipine (Procardia), nisoldipine (Sular)	Xerostomia, gingival hyperplasia, dysgeusia, erythema multiform	Macrolide antibiotics, NSAIDS
Thiazide diuretics		
Chlorothiazide (Diuril), chlorthalidone, hydrochlorothiazide (HydroDIURIL, Microzide), indapamide (Lozol), metolazone (Mykrox, Zaroxolyn), polythiazide (Renese)	Xerostomia, lichenoid reactions	NSAIDS, epinephrine/orthostatic hypotension
Secondary agents		
Beta blockers		
Cardioselective — acebutolol (Sectral), atenolol (Tenormin), betaxolol (Kerlone), bisoprolol (Zebeta), metoprolol (Lopressor)	Xerostomia	
Noncardioselective — carteolol (Cartrol), nadolol (Corgard), penbutolol (Levatol), pindolol (Visken), propranolol (Inderal), timolol (Blocadren)	Xerostomia, dysgeusia, lichenoid reactions	NSAIDs, epinephrine
Alpha 1 blockers		
Doxazosin (Catapres), prazosin (Minipress), terazosin (Hytrin)	Xerostomia, Dysgeusia	NSAIDS/orthostatic hypotension
Combined alpha/beta blockers		
Carvedilol (Coreg), labetalol (Normodyne, Trandate)	Dysgeusia	NSAIDS/orthostatic hypotension
Central-acting agents		
Clonidine (Catapres), guanfacine (Tenex), methyldopa (Aldomet), reserpine	Xerostomia, dysgeusia, lichenoid reactions (specific to methyldopa), sedation, parotid pain	Orthostatic hypotension
Direct-acting vasodilators		
Hydralazine (Apresoline), minoxidil (Loniten)	Lupus-like oral and skin lesions, lymphadenopathy, gingival bleeding, infections, facial flushing	NSAIDS/orthostatic hypotension

Note: NSAIDS = non-steroidal anti-inflammatory drugs.

Table 3: Guidelines for assessing patients with blood pressure over 180/120 mmHg.[21,22,64,67,68]

A: ASA classification

ASA 1	Normal healthy patient
ASA 2	Patient with mild systemic disease
ASA 3	Patient with severe systemic disease
ASA 4	Patient with severe systemic disease that is a constant threat to life
ASA 5	Moribund patient, who is not expected to survive without the operation
ASA 6	A declared brain-dead patient whose organs are being removed for donor purposes
E	The addition of "E" denotes emergency surgery: an emergency is defined as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part

B: Estimated energy required for various activities

1 MET	Self-care Eating, dressing, or using the toilet Walking indoors and around the house Walking 1–2 blocks on level ground at 3–5 km/h
4 METs	Light housework (e.g., dusting, washing dishes) Climbing a flight of stairs or walking up a hill Walking on level ground at 6 km/h Running a short distance Heavy housework (e.g., scrubbing floors, moving heavy furniture)
> 10 METs	Moderate recreational activities (e.g., golf, dancing, doubles tennis, throwing a baseball or football) Strenuous sports (e.g., swimming, singles tennis, football, basketball, skiing)

C: Adapted risk stratification questionnaire based on recent ACC/AHA guidelines

Group A

- Is the patient taking antihypertensive medication, and did he/she take it this day?
- Does the patient have a health care provider managing his/her hypertension and has he/she been seen in the past 6 months?
- Does the patient appear anxious, acknowledge anxiety about the procedure or have a heart rate > 100 beats/minute?

Group B

- Did the patient take public transportation, drive or walk in for the procedure?
- Does the patient take care of his/her own house or apartment?
- Does the patient state that he/she can walk up a flight of stairs?

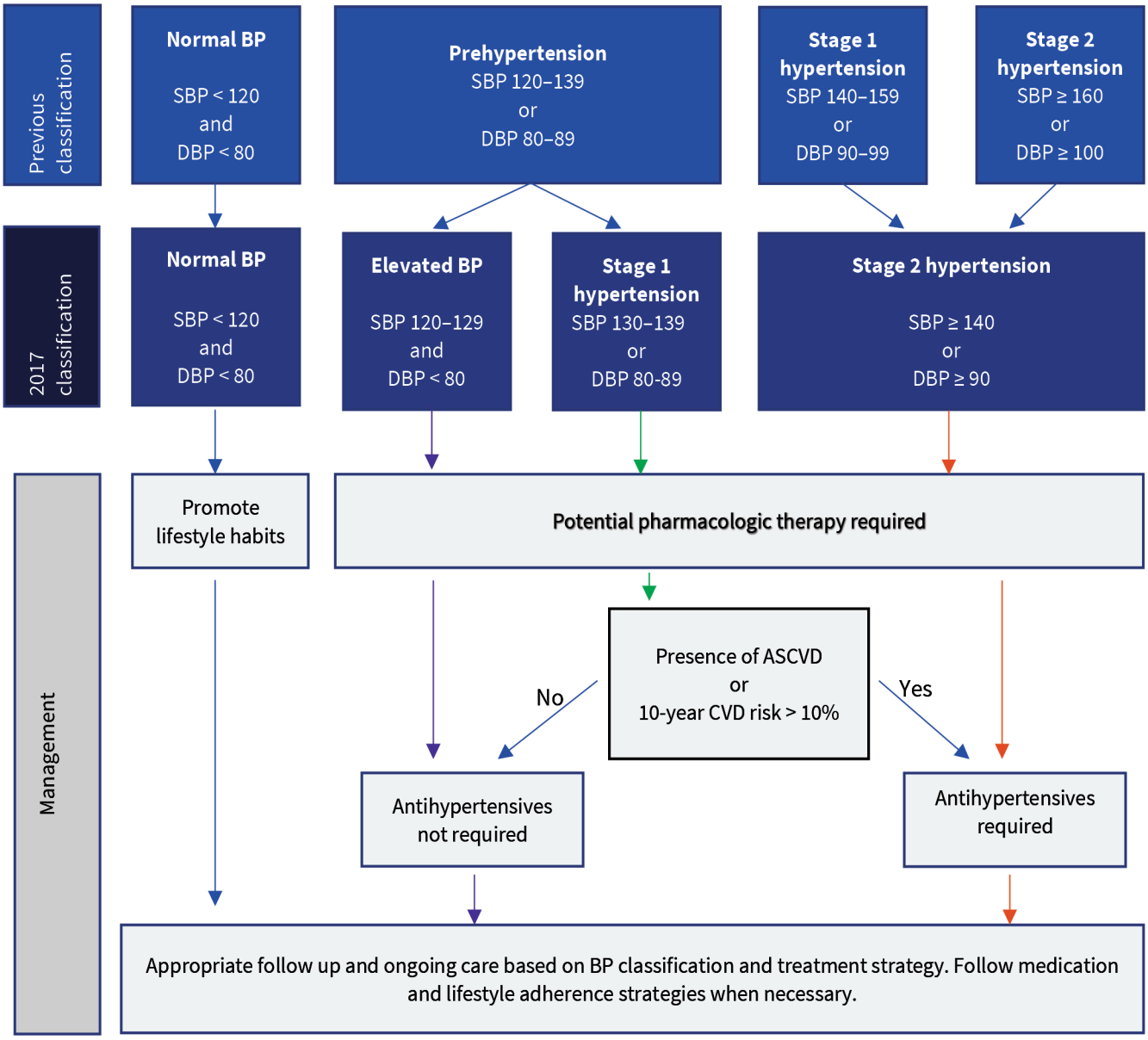
Note: ACC = American College of Cardiology, AHA = American Heart Association, ASA = American Society of Anesthesiologists, MET = metabolic equivalent.

Table 4: Summary of dental management and modifications for the hypertensive patient.

Pharmacology	**Anticoagulants:** Restorative work does not justify cessation of anticoagulants. Dentoalveolar surgery may require the addition of other local hemostatic measures, but cessation still not required.
	Vasoconstrictors: General rule of thumb is to limit epinephrine use to <0.04 mg (approx. 2 carpules of 2% lidocaine 1:100 000 epinephrine). However, emphasis should be on achieving profound anesthesia to mitigate endogenous catecholamine release and avoid intravascular injections.
	NSAIDs: Prescription of NSAIDs should be used only for short-term analgesia (no more that 5 days)
	Oral adverse effects: A variety of antihypertensive medications, alone or in combination with common dental medications, can result is an assortment of oral adverse effects (**Table 2**). • Xerostomia: Drink more water. Use oral lubricants, gums, pastes and gels. Administer sialagogues. • Dysgeusia: Eat protein-rich flavourful foods. Administer sialagogues. • OLP: Fix ill-fitting prosthesis, use topical corticosteroids. • Gingival hyperplasia: Increase oral hygiene, use chlorhexidine rinses, scaling and root planing and gingivectomy. All of these oral adverse affects may also be mitigated by changing the offending antihypertensive medication.
Blood pressure measurement	**Technique:** Patient seated upright for 5 minutes in non-stressful environment with cuff positioned at the level of the heart and cuff bladder encompassing at least 80% circumference of the arm.
	Initial: All new patients, previously elevated BP patients and previously classified hypertensive patients should have BP taken before treatment.
	During procedures: BP monitoring recommended for longer unavoidable procedures where fluctuations may occur to assess whether treatment should be arrested.
	Frequency: Beginning of every appointment.
Cessation of care	Preoperative BP readings below 180 SBP and 110 DBP indicate little risk of complications during procedures. Measurements above this require further judgement (**Table 3**).
Chair position	Avoid sudden changes in chair position to prevent orthostatic hypotension associated with antihypertensive medications. Allow the patient to slowly exit the chair, possibly with assistance.
Anxiety/fear	Mitigate catecholamine release by creating stress-free environment. Use of nitroxide during dental treatment and anxiolytics before treatment may aid in this.
Education	Recognize early signs and readings of hypertension and provide lifestyle modification advice to prevent further exacerbation of condition in combination with referral to family physician.

Note: BP = blood pressure, DBP = diastolic blood pressure, NSAIDs = non-steroidal anti-inflammatory drugs, OLP = oral lichen planus, SBP = systolic blood pressure.

Figure 1: Updated classification and management of high blood pressure (BP) in adults.[6]



Note: ASCVD = atherosclerotic cardiovascular disease, CVD = cardiovascular disease, DBP = diastolic blood pressure (mmHg), SBP = systolic blood pressure (mmHg).

Summary

The prevalence of hypertension worldwide, in combination with its lack of clinical symptoms and strong association with other cardiovascular disease, makes it imperative for dental professionals to consider the management of a hypertensive patient. Research and recommendations are constantly changing; therefore, dentists must stay informed about appropriate care. A dental setting provides a unique opportunity to monitor previously undiagnosed patients at regular intervals during routine dental visits. For a diagnosed hypertensive patient, extra precautions must be taken to ensure his/her safety during treatment. An appropriate medical history with a complete drug list can provide relevant information with respect to potential oral adverse effects. Commonly used medications and techniques in dentistry may also affect the hypertensive patient; therefore, options should be well understood. Management of the hypertensive patient also involves knowledge of appropriate techniques for measuring blood pressure, knowing when to cancel treatment, as well as controlling stress and bleeding in a dental setting. Most important, if at any point during evaluation of a hypertensive patient questions arise, consultation with other medical and dental professionals is recommended, as patient health is principal.

The Authors

Mr. Valtellini
is a dental student at the faculty of dentistry, University of Toronto, Toronto, Ontario.

Dr. Ouanounou
is an associate professor, department of clinical sciences (pharmacology & preventive dentistry), faculty of dentistry, University of Toronto.

Corresponding author: Dr. Aviv Ouanounou, Dept. of Clinical Sciences, Pharmacology, Faculty of Dentistry, University of Toronto, 124 Edward St., Room 370, Toronto ON M5G 1G6. Email: **aviv.ouanounou@dentistry.utoronto.ca**

The authors have no declared financial interests.

This article has been peer reviewed.

References

1. Hypertension. Geneva: World Health Organization; 2021. Available: **https://www.who.int/news-room/fact-sheets/detail/hypertension** (accessed 2021 Feb. 20).

2. GBD 2016 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. ***Lancet.* 2017;390(10100):1345-422**.

3. Cardiovascular diseases. Geneva: World Health Organization; 2021. Available: **https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)**(accessed 2021 Feb. 20).

4. Rabi DM, McBrien KA, Sapir-Pichhadze R, Nakhla M, Ahmed SB, Dumanski SM, et al. Hypertension Canada's 2020 comprehensive guidelines for the prevention, diagnosis, risk assessment, and treatment of hypertension in adults and children. ***Can J Cardiol.* 2020;36(5):596-624**.

5. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, Marczak L, et al. Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990–2015. ***JAMA.* 2017;317(2):165-82**.

6. Carey RM, Whelton PK, 2017 ACC/AHA Hypertension Guideline Writing Committee. Prevention, detection, evaluation, and management of high blood pressure in adults: synopsis of the 2017 American College of Cardiology/American Heart Association hypertension guideline. ***Ann Intern Med.* 2018;168(5):351-8**.

7. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. ***JAMA.* 2003;289(19):2560-72**.

8. Lenfant C, Chobanian AV, Jones DW, Roccella EJ, Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Seventh report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7): resetting the hypertension sails. ***Hypertension.* 2003;41(6):1178-9**.

9. Miller CS, Glick M, Rhodus NL. 2017 hypertension guidelines: new opportunities and challenges. ***J Am Dent Assoc.* 2018;149(4):229-31**.

10. Kokubo Y, Iwashima Y. Higher blood pressure as a risk factor for diseases other than stroke and ischemic heart disease. ***Hypertension.* 2015;66(2):254-9**.

11. Fuchs FD, Whelton PK. High blood pressure and cardiovascular disease. ***Hypertension.* 2020;75(2):285-92**.

12. Byrd JB, Brook RD. Arm position during ambulatory blood pressure monitoring: a review of the evidence and clinical guidelines. ***J Clin Hypertens (Greenwich).* 2014;16(3):225-30**.

13. Akpunonu BE, Mulrow PJ, Hoffman EA. Secondary hypertension: evaluation and treatment. ***Dis Mon.* 1996;42(10):609-722**.

14. Poulter NR, Prabhakaran D, Caulfield M. Hypertension. ***Lancet.* 2015;386(9995):801-12**.

15. Bolívar JJ. Essential hypertension: an approach to its etiology and neurogenic pathophysiology. ***Int J Hypertens.* 2013;2013:547809**.

16. Know your risk for high blood pressure. Atlanta: Centers for Disease Control and Prevention; 2020. Available: **https://www.cdc.gov/bloodpressure/risk_factors.htm** (accessed 2021 Feb. 20).

17. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al. Heart disease and stroke statistics — 2019 update: a report from the American Heart Association. ***Circulation.* 2019;139(10):e56-528**.

18. SPRINT Research Group, Wright Jr JT, Williamson JD, Whelton PK, Snyder JK, Sink KM, et al. A randomized trial of intensive versus standard blood-pressure control. ***N Engl J Med.* 2015;373(22):2103-16**.

19. Casey DE, Thomas RJ, Bhalla V, Commodore-Mensah Y, Heidenreich PA, Kolte D, et al. 2019 AHA/ACC clinical performance and quality measures for adults with high blood pressure: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. ***Circ Cardiovasc Qual Outcomes.* 2019;12(11):e000057**.

20. Popescu SM, Scrieciu M, Mercuţ V, Ţuculina M, Dascălu I. Hypertensive patients and their management in dentistry. *ISRN Hypertens*. 2013;2013:1-8. **https://doi.org/10.5402/2013/410740**

21. Southerland JH, Gill DG, Gangula PR, Halpern LR, Cardona CY, Mouton CP. Dental management in patients with hypertension: challenges and solutions. ***Clin Cosmet Investig Dent.* 2016;8:111-20**.

22. Little JW, Miller CS, Rhodus NL. *Little and Falace's dental management of the medically compromised patient*. 9th ed. Amsterdam: Elsevier; 2018.

23. Habbab KM, Moles DR, Porter SR. Potential oral manifestations of cardiovascular drugs. ***Oral Dis.* 2010;16(8):769-73**.

24. Ram CVS. Antihypertensive drugs: an overview. ***Am J Cardiovasc Drugs.*** **2002;2(2):77-89**.

25. Hardeman JH. Hypertension and the dental patient. ***Dent Today.*** **2017;36(1):126-8**.

26. Bavitz JB. Dental management of patients with hypertension. ***Dent Clin North Am.*** **2006;50(4):547-62, vi**.

27. Gupta N, Pal M, Rawat S, Grewal MS, Garg H, Chauhan D, et al. Radiation-induced dental caries, prevention and treatment — a systematic review. ***Natl J Maxillofac Surg.*** **2015;6(2):160-6**.

28. Gil-Montoya JA, Silvestre FJ, Barrios R, Silvestre-Rangil J. Treatment of xerostomia and hyposalivation in the elderly: a systematic review. ***Med Oral Patol Oral Cir Bucal.*** **2016;21(3):e355-66**.

29. Han P, Suarez-Durall P, Mulligan R. Dry mouth: a critical topic for older adult patients. ***J Prosthodont Res.*** **2015;59(1):6-19**.

30. Ouanounou A. Xerostomia in the geriatric patient: causes, oral manifestations, and treatment. ***Compend Contin Educ Dent.*** **2016;37(5):306-311;quiz312**.

31. Ouanounou A, Ng K, Chaban P. Adverse drug reactions in dentistry. ***Int Dent J.*** **2020;70(2):79-84**.

32. Alrashdan MS, Cirillo N, McCullough M. Oral lichen planus: a literature review and update. ***Arch Dermatol Res.*** **2016;308(8):539-51**.

33. Hogan J, Radhakrishnan J. The assessment and importance of hypertension in the dental setting. ***Dent Clin North Am.*** **2012;56(4):731-45**.

34. Balakumar P, Kavitha M, Nanditha S. Cardiovascular drugs-induced oral toxicities: a murky area to be revisited and illuminated. ***Pharmacol Res.*** **2015;102:81-9**.

35. Nagraj SK, Naresh S, Srinivas K, George PR, Shrestha A, Levenson D, et al. Interventions for the management of taste disturbances. ***Cochrane Database Syst Rev.*** **2014;(11):CD010470**.

36. Giudice M. Taste disturbances linked to drug use: change in drug therapy may resolve symptoms. *Can Pharm J / Rev Pharm Can*. 2006;139(2):70-3. **https://doi.org/10.1177/171516350613900208**

37. Bloise R, Davis MP. Dysgeusia #304. ***J Palliat Med.*** **2016;19(4):462-3**.

38. Hong JH, Omur-Ozbek P, Stanek BT, Dietrich AM, Duncan SE, Lee YW, et al. Taste and odor abnormalities in cancer patients. ***J Support Oncol.*** **2009;7(2):58-65**.

39. Gopal S, Joseph R, Santhosh VC, Kumar VVH, Joseph S, Shete AR. Prevalence of gingival overgrowth induced by antihypertensive drugs: a hospital-based study. ***J Indian Soc Periodontol.*** **2015;19(3):308-11**.

40. Hatahira H, Abe J, Hane Y, Matsui T, Sasaoka S, Motooka Y, et al. Drug-induced gingival hyperplasia: a retrospective study using spontaneous reporting system databases. ***J Pharm Health Care Sci.*** **2017;3(1):19**.

41. Murakami S, Mealey BL, Mariotti A, Chapple ILC. Dental plaque–induced gingival conditions. ***J Clin Periodontol.*** **2018;45(Suppl 20):S17-27**.

42. Mawardi H, Alsubhi A, Salem N, Alhadlaq E, Dakhil S, Zahran M, et al. Management of medication-induced gingival hyperplasia: a systematic review. ***Oral Surg Oral Med Oral Pathol Oral Radiol.*** **2021;131(1):62-72**.

43. Magkas N, Tsioufis C, Thomopoulos C, Dilaveris P, Georgiopoulos G, Sanidas E, et al. Orthostatic hypotension: from pathophysiology to clinical applications and therapeutic considerations. ***J Clin Hypertens (Greenwich).*** **2019;21(5):546-54**.

44. Ali A, Ali NS, Waqas N, Bhan C, Iftikhar W, Sapna F, et al. Management of orthostatic hypotension: a literature review. ***Cureus.*** **2018;10(8):e3166**.

45. Wongrakpanich S, Wongrakpanich A, Melhado K, Rangaswami J. A comprehensive review of non-steroidal anti-inflammatory drug use in the elderly. ***Aging Dis.*** **2018;9(1):143-50**.

46. Muzyka BC, Glick M. The hypertensive dental patient. ***J Am Dent Assoc.*** **1997;128(8):1109-20**.

47. Singh S, Gupta K, Garg KN, Fuloria NK, Fuloria S, Jain T. Dental management of the cardiovascular compromised patient: a clinical approach. *J Young Pharm*. 2017;9(4):453-6. **https://doi.org/10.5530/jyp.2017.9.89**

48. Jung YH, Jang JH, Lee D, Choi Y, Choi SH, Kang DH. Relationships between catecholamine levels and stress or intelligence. ***Neurochem Res.*** **2019;44(5):1192-1200**.

49. Cioffi GA, Chernow B, Glahn RP, Terezhalmy GT, Lake CR. The hemodynamic and plasma catecholamine responses to routine restorative dental care. ***J Am Dent Assoc.*** **1985;111(1):67-70**.

50. Bader JD, Bonito AJ, Shugars DA. 48. Cardiovascular effects of epinephrine in hypertensive dental patients: summary. 2002 Mar. In: *AHRQ evidence report summaries*. Rockville, Md.: Agency for Healthcare Research and Quality (US); 1998-2005. Available: **https://www.ncbi.nlm.nih.gov/books/NBK11858/** (accessed 2021 Feb. 22).

51. Silvestre FJ, Verdú MJ, Sanchís JM, Grau D, Peñarrocha M. Effects of vasoconstrictors in dentistry upon systolic and diastolic arterial pressure. ***Med Oral.*** **2001;6(1):57-63**.

52. Taylor A, McLeod G. Basic pharmacology of local anaesthetics. ***BJA Educ.*** **2020;20(2):34-41**.

53. Balakrishnan R, Ebenezer V. Contraindications of vasoconstrictors in dentistry. *Biomed Pharmacol J*. 2015;6(2). Available: **http://biomedpharmajournal.org/?p=2785** (accessed 2021 Feb. 22).

54. Holm SW, Cunningham Jr LL, Bensadoun E, Madsen MJ. Hypertension: classification, pathophysiology, and management during outpatient sedation and local anesthesia. ***J Oral Maxillofac Surg.*** **2006;64(1):111-21**.

55. Seminario-Amez M, González-Navarro B, Ayuso-Montero R, Jané-Salas E, López-López J. Use of local anesthetics with a vasoconstrictor agent during dental treatment in hypertensive and coronary disease patients. A systematic review. ***J Evid Based Dent Pract.*** **2021;21(2):101569**.

56. Davis B. What dose of epinephrine contained in local anesthesia can be safely administered to a patient with underlying cardiac disease during a dental procedure? *J Can Dent Assoc*. 2010;76:a36. Available: **https://jcda.ca/article/a36** (accessed 2021 Feb. 22).

57. Decloux D, Ouanounou A. Local anaesthesia in dentistry: a review. ***Int Dent J.*** **2020.71(2):87-95**.

58. Olmo González B, González-Martín MA, Olmo-Villaseca JM, Mañes-Medina A, Ribera-Uribe M. The impact of dental treatments on blood pressure variations. *Cumhur Dent J*. 2019;22(1):74-82. **https://doi.org/10.7126/cumudj.475503**

59. Elias MF, Goodell AL. The need for accurate data on blood pressure measurement in the dental office. ***Am J Hypertens.*** **2020;33(4):297-300**.

60. Handler J. The importance of accurate blood pressure measurement. ***Perm J.*** **2009;13(3):51-4**.

61. Ogedegbe G, Pickering T. Principles and techniques of blood pressure measurement. ***Cardiol Clin.*** **2010;28(4):571-86**.

62. Fleisher LA, Beckman JA, Brown KA, Calkins H, Chaikof E, Fleischmann KE et al. ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing committee to revise the 2002 guidelines on perioperative cardiovascular evaluation for noncardiac surgery). ***Circulation.*** **2007;116(17):e418-99**.

63. Fleisher LA, Fleischmann KE, Auerbach AD, Barnason SA, Beckman JA, Bozkurt B, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. ***J Am Coll Cardiol.*** **2014;64(22):e77-137**.

64. Yarows SA, Vornovitsky O, Eber RM, Bisognano JD, Basile J. Canceling dental procedures due to elevated blood pressure: is it appropriate? ***J Am Dent Assoc.*** **2020;151(4):239-44**.

65. Varon J, Elliot WJ. Management of severe asymptomatic hypertension (hypertensive urgencies) in adults. Waltham, Mass.: UpToDate; 2021. Available: **https://www.uptodate.com/contents/management-of-severe-asymptomatic-hypertension-hypertensive-urgencies-in-adults**

66. Nwankwo T, Coleman King SM, Ostchega Y, Zhang G, Loustalot F, Gillespie C, et al. Comparison of 3 devices for 24-hour ambulatory blood pressure monitoring in a nonclinical environment through a randomized trial. ***Am J Hypertens.*** **2020;33(11):1021-9**.

67. Barnes JN, Joyner MJ. Physical activity and cardiovascular risk: 10 metabolic equivalents or bust. ***Mayo Clin Proc.*** **2013;88(12):1353-5**.

68. Doyle DJ, Hendrix JM, Garmon EH. American Society of Anesthesiologists classification. Treasure Island, Fla.: StatPearls Publishing; 2020. Available: **http://www.ncbi.nlm.nih.gov/books/NBK441940/** (accessed 2021 Feb. 22).

69. Moola S, Pearson A, Hagger C. Effectiveness of music interventions on dental anxiety in paediatric and adult patients: a systematic review. ***JBI Libr Syst Rev.*** **2011;9(18):588-630**.

70. Maulina T, Djustiana N, Shahib MN. The effect of music intervention on dental anxiety during dental extraction procedure. ***Open Dent J.*** **2017;11:565-72**.

71. Chassot PG, Marcucci C, Delabays A, Spahn DR. Perioperative antiplatelet therapy. ***Am Fam Physician.*** **2010;82(12):1484-9**.

72. Zellin G, Rasmusson L, Pålsson J, Kahnberg KE. Evaluation of hemorrhage depressors on blood loss during orthognathic surgery: a retrospective study. ***J Oral Maxillofac Surg.*** **2004;62(6):662-6**

73. Brady J, Morrison A. Managing the minor oral surgery patient on novel oral anticoagulants. Etobicoke, Ont.: Oral Health Group, Newcom Media; 2016. Available: **https://www.oralhealthgroup.com/features/managing-minor-oral-surgery-patient-novel-oral-anticoagulants/** (accessed 2021 Feb. 20).

74. Tarighi P, Khoroushi M. A review on common chemical hemostatic agents in restorative dentistry. **Dent Res J. 2014;11(4):423-8**.